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July 1 to December 31, 1920

EXPLANATORY NOTE

Illustrated articles are marked with an asterisk (*), book notices with a dagger (†), and new shop equipment as described in the departments "Shop Equipment News" and "Condensed Clipping Index of Equipment" with a double dagger (‡). Book reviews are listed under the heading "New Publications." Cross references to a particular initial word may apply also to its derivatives. The cross references condense the matter and assist the reader, but are not to be regarded as complete or conclusive. So, if there were a reference from "Milling" to "Jigs and Fixtures," and if the searcher failed to find the required article under the latter topic, he should look through the "Milling" entries, or others that the subject might suggest, as he would have done had there been no cross reference. The plural of any given item may not necessarily follow the singular immediately, as the items are listed in alphabetical order. All articles written by any given author are listed directly under his name in the special author's index which starts on page 19. Articles that are not credited to any auhor may be found under the heading "No author credited," listed under "N" in the Author's Index.

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1863 Some 1920
Examples of

Early Machine Design

by

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Associate Editor American Machinist

IN these days of high-speed and high-powered machine tools the average mechanical man, particularly if he be a designer of machine tools, is apt to look upon the accomplishments of his remote predecessors with a degree of commiseration that is more or less tinged, though no doubt subconsciously, with contempt. When he compares the chaste lines, the massive and rigid construction, the powerful drive of the modern lathe, shaper, planer, or milling machine with its sometimes weak-kneed and spindle-legged prototype of fifty years ago, with its panels and columns adorned with ornate scrolls and intricate designs in bas-relief, it gives him a gratifying sense of superiority in having made more of his opportunities than did the old-time designer and builder.

In the mad rush for production and still more production which has characterized nearly all manufacturing industries during the last quarter century, may we not in our demands for power, strength and speed, have overlooked some of the possibilities of the machinery of an earlier day.

He sometimes overlooks the fact that modern machine design is not based alone upon scientific knowledge and theory, but that it is to no small degree the slow progress of evolution, building upon the groundwork of previous experience, modifying already established ideas to meet changing conditions, profiting by demonstrated weaknesses of the earlier machines, adding to their strength by redistribution of material, and eliminating such features as have been proved to be unnecessary.

The present-day designer begins where his immediate predecessor leaves off. He has concrete examples of design from which to draw inspiration. He already knows some of the things he must avoid as well as the lines that he can safely follow. His work is to some extent the unconscious embodiment of the practices and principles of yesteryear, modified by the knowledge gained from more recent experience and experiment. A successful machine designer once said to the writer: "Anybody can improve; it takes a man with brains to create."

The designer of 75 or 100 years ago was a creator. He had little precedent and practically no source of inspiration but nature and his own brain. It is therefore not surprising that when he reached the limit of his imagination he should turn to nature for assistance.



FIG. 1. PLANER BUILT BY PUTNAM MACHINE COMPANY HAS BEEN IN SERVICE MORE THAN FIFTY YEARS

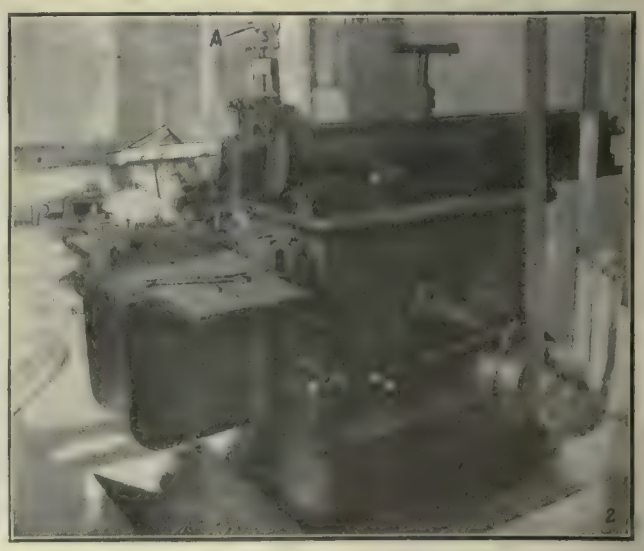


FIG. 2. SHAPER BUILT IN THE SHOPS IN 1879

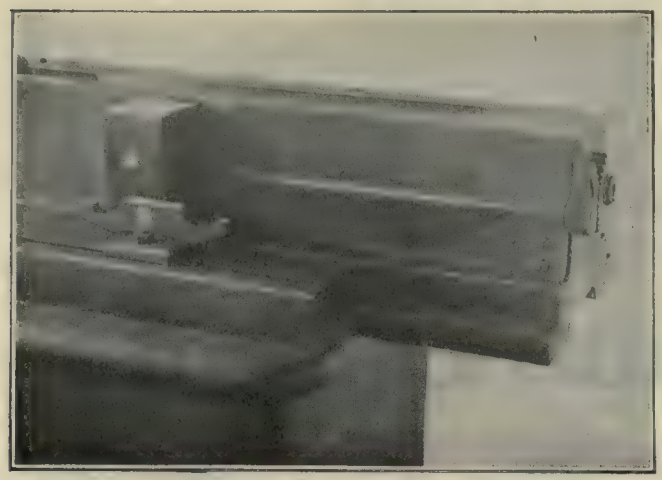


FIG. 3. DETAILS OF FEED WORKS

This may explain why the column of an old time drilling machine looks like the trunk of a tree, or the legs of a planer resemble the legs of a horse. It might help, too, to explain why otherwise bare surfaces of iron should be adorned with sun flowers, fig leaves, and other things foreign to a machine shop.

Nature has a way of combining beauty with utility and it is but natural that the pioneer in machine design should try to follow her lead. It is also but human that he should overlook the element of congruity in nature, which oversight is perhaps the basis of one of the most valid of the criticisms directed against old machinery. Clusters of leaves and bunches of fruit are very beautiful—on a grape vine; they are also necessary to the life of the vine. They are not a necessary adjunct of a machine for planing iron, and being out of place are not beautiful.

Whatever was in the average old-time designer's mind when he was laying out the elaborate panels, curves and curlicues with which he sought to adorn his product, his main idea was utility, and though his attempt to add to its attractiveness must have added a considerable sum to the cost of manufacture, the superfluous "gingerbread work" did not detract to any extent from the productive capacity of his machines, which was usually in keeping with the knowledge and practice of mechanics of that day.

That the old school of machine design did not fall so far short of present-day ideals is evidenced by the fact that many such machines, built fifty, sixty, or even more years ago are still doing valiant service in competition with up-to-the-minute machines of their own class.

The photographs accompanying this article were made in a large New England manufacturing plant, where many of these old machines are upholding their particular link in the chain of production, sandwiched in between massive machines that embody the latest ideas in machine-tool construction.

It would be fatuous to say that a machine tool built before the civil war could remove as much metal per unit of time as one built last year—it could not; its capacity in that respect would appear very limited by comparison. But removing metal is far from being the sole duty of a machine tool. The work has to be held during the process of removal, and the amount of material to be removed is seldom determined by the capacity of the machine to remove it.

The special line of machinery built by the above mentioned establishment has as some of its component parts long slender castings of gray iron and equally long, and even more slender, pieces of steel. The problem is not to remove a large quantity of metal, but to remove what is necessary and do it as quickly as possible, without permanently distorting the work.

The company in question had its origin in a country blacksmith shop in the decade of 1840-50 and by growth and absorption of other companies and individuals engaged in the same line of work the plant now covers many acres and has well over a thousand employees.

Some of the old machinery now running was first installed by the parent company and has been in continuous service for over sixty years; other machines came to it through its acquisition of other businesses and their age can only be guessed at.

The planer shown in Fig. 1 was built by the Putnam Machine Co., of Fitchburg, Mass., and is one of the machines acquired by its present owner upon the absorption of a smaller company in 1870. This is a good serviceable tool and is constructed along lines that are still considered good design. Its housings are hardly deep enough to insure rigidity when planing a piece of work the height of which represents the limit of the machines capacity, but there isn't the slightest chance of such a piece coming to it while on its present job. The height of its cross-rail has probably not been altered in years, and with it in the position shown in the picture the machine is sufficiently rigid.

The deep carving on the side of the housing, the device on the tie bar, and the paneling of the box bed no doubt furnished many hours of congenial occupation

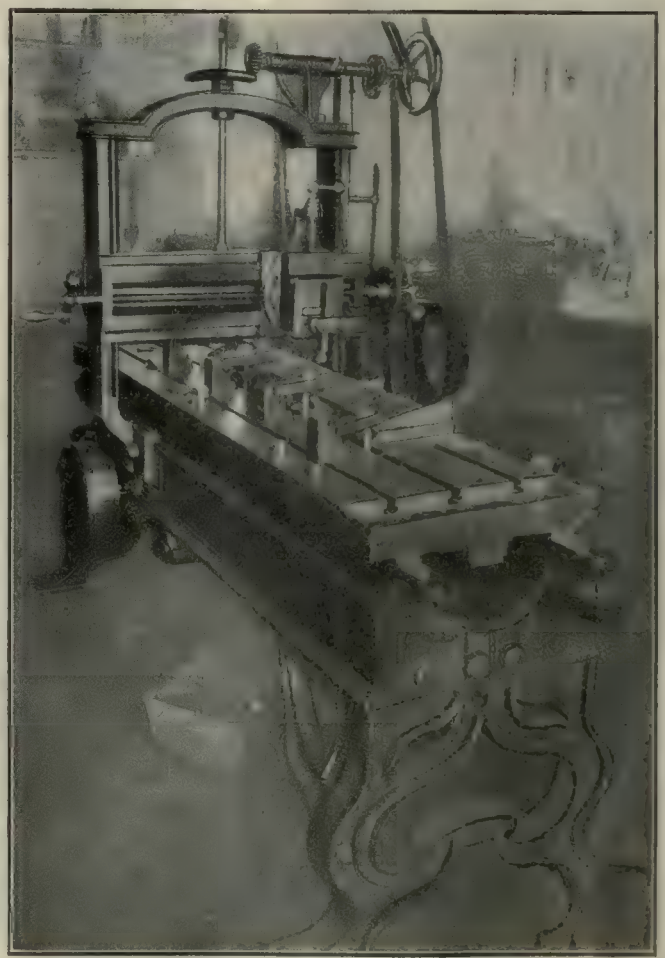


FIG. 4. UNIQUE VERTICAL FEED ON PLANER

to a pattern maker who was also an artist, but must have caused the foundryman some consternation when he was confronted with the problem of molding the pieces.

The reader will note that the designer had the "long bed" idea, but that he adopted what would seem a questionable method of securing it. However, the vicissitudes of upwards of fifty years have left the extension brackets (cast in one piece with the bed) intact, and the fact that the machine still planes flat on pieces several feet long indicates that the foundryman knew his business and the builder recognized the necessity of "seasoning" his castings.

To those of the readers who are familiar with Pratt & Whitney construction, the similarity of the feed movement in this and other planing machines will be apparent. The reason for this is not that all the older machine builders designed this movement simultaneously, but that years ago a master mechanic in this shop, himself a product of the Pratt & Whitney factory, rebuilt all these old planers, adding such features as seemed to him advisable.

Besides rebuilding old machines the master mechanic mentioned above built some new ones, embodying therein ideas and features of design which he had absorbed during his apprenticeship days. Thus in Fig. 2 may be seen a shaper which any old-time mechanic and many later ones would unhesitatingly indentify at first glance as a Pratt & Whitney machine. It was, however, built in the shop where it now stands, many miles from Hartford, and has never been elsewhere. It was built in 1879 and was one of a lot of three still in active service.

On close observation it will be noted that the machine is heavier than the Pratt & Whitney shaper, though this difference is less apparent in the picture than in the actual machine. In all its movements it is a close copy, with the exception of the vertical feed, which differs from any the writer ever saw.



FIG. 5. PLANER BUILT PRIOR TO 1870 BY NEW HAVEN MANUFACTURING CO.



FIG. 6. PLANER BUILT PRIOR TO 1870

This movement is shown in greater detail in Fig. 3. A square box-like projection from the side of the ram at *A* houses a short rack which has a vertical movement, and a pinion, which is mounted on the end of a short shaft running parallel to the ram. At the rear of the ram this shaft is geared, through the medium of a pair of gear sectors, to a shaft which extends longitudinally through the ram and ends in a small bevel gear just under the vertical slide.

This shaft is the center upon which the head swivels for the planing of angles other than 90 deg., and the bevel gears operate a spindle or shaft which is enclosed within the hollow vertical-feed screw, giving a forward and back movement to a ratchet wheel (*A*, Fig. 2) just above the crank handle that turns the screw. This part of the movement is the same as that applied by Pratt & Whitney to their planers.

The short rack above referred to at the side of the ram has a stud and roller at its lower end projecting outwardly to contact with the stationary cam *B*, Fig. 3, so that at each stroke of the ram the feed movement is given a reciprocating movement that is transmitted through the mechanism above described to the ratchet wheel at the top of the vertical-feed screw.

A pawl attached to the crank handle may be thrown into engagement in either direction with the ratchet wheel, thus providing for either up or down feed.

The cam *B* is adjustable so that by placing it at one end or the other of the stroke for which the machine is set, the feeding movement may be made to take place at the most favorable point and at whatever degree of amplitude is desired.

A planing machine whose simplicity of outline would seem to imply a later origin is shown in Fig. 4. It was built in Nashua, N. H., by Gage, Warner & Whitney, and is a part of the machinery acquired by the present owners in taking over the business and equipment of a smaller concern in 1872. It was by no means a new machine at that time, and it has had many vicissitudes. Originally placed in service in Woodstock, Vt., it was

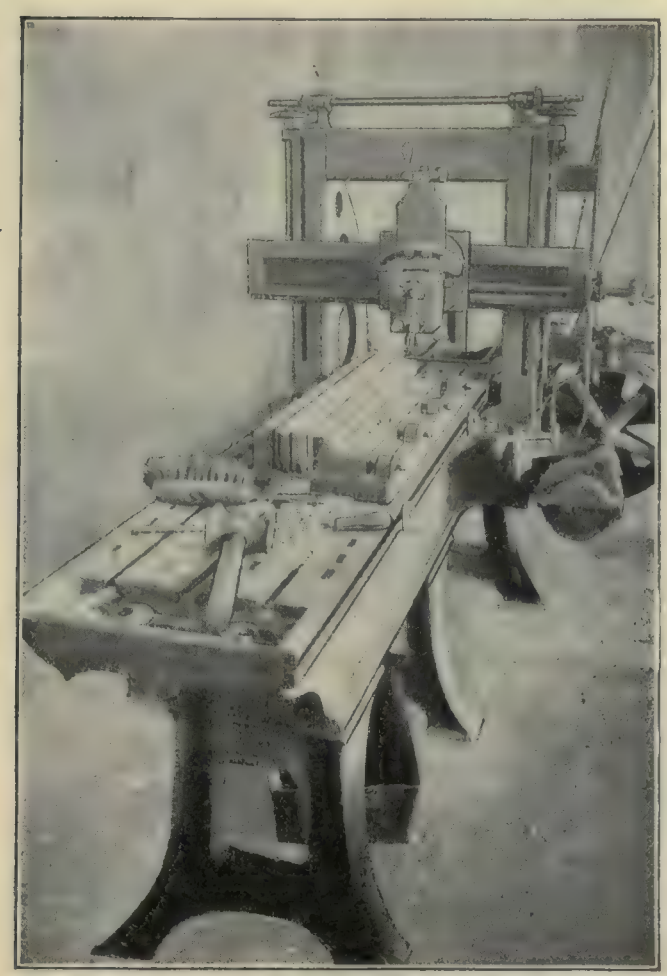


FIG. 7. A WILLIAM SELLERS PLANER OF AN EARLY DAY

later shipped to Smithville, N. J., and after a stay of some years was shipped, in the year mentioned above, to its present location.

On its trip from New Jersey to Connecticut it was a part of a consignment of machinery aboard a small schooner which met with disaster, and for a period of several months the planer, with other machines, lay at the bottom of Long Island Sound while the owners considered whether or not it was worth salvaging.

With the exception of the vertical feed, the machine might almost be considered of modern design. The cross-rail is gibbed to the face of the housings, riding upon deep V-shaped ways similar to the shears of a lathe. The V's are made exceptionally deep in proportion to their width to forestall any tendency of the rail to tilt to one side by reason of meeting with greater resistance at one end than the other.

Power is applied through the single elevating screw in the middle of the tie bar, the nut of which is rotated through the medium of bevel gears actuated by the ratchet and pawl movement or by means of the hand wheel. The nut passes clear through the tie bar and has a thrust-collar on the under side so that the movement of the cross-rail is positive in either direction. The tool slide has the usual hand operated vertical movement.

In Figs. 5 and 6 may be seen a planer built by the New Haven Manufacturing Co. that has been in continuous service for more than sixty years. Though there is considerable gingerbread work in evidence, the machine does not differ fundamentally in design from the product of 1919.

Another one is shown in Fig. 7 built in 1864 by William Sellers. It was originally a screw planer; a nut on the underside of the platen encircling a coarse lead screw that ran the whole length of the bed. This form of drive was smooth and powerful, and possessed the advantage that a careless operative could not run the platen out of mesh with the bull gear, but he could, and sometimes did, jam the nut against the bearings at the end of the bed, from which predicament it would require as much assistance to remove it as would be needed to replace a runaway platen.

This machine was given a thorough overhauling some years ago during which it was changed from a screw to a rack driven planer, the drive being through a skew gear mounted upon an angular shaft and occupying about the same position as the bull wheel of the ordinary drive. The machine has given continuous and satisfactory service, both before and after the change.

In the same shop are several examples of early milling machines that have survived the competition of newer machines, and for the same reasons; the amount of material to be removed is so slight and the piece produced so slender that the light machinery of a bygone day can do the work as well and as rapidly as the nature of the piece will allow.

The milling machine shown in Fig. 8 was built by Ezra Gould some years before the Civil War. The platen of this machine moves only in a direction at right angles to the spindle, and the vertical adjustment is secured by raising or lowering the head. There is no provision for adjustment transversely.

The head is practically in one piece, including the over arm, and is provided with a supporting brace tying the outer end to the bed. A large gear on the spindle is driven by a pinion mounted on a swinging sector, the pinion being a part of the driving pulley. Any change in the vertical adjustment thus affects the belt tension, which must be compensated for by moving the sector.

A similar sector on the opposite side of the main gear

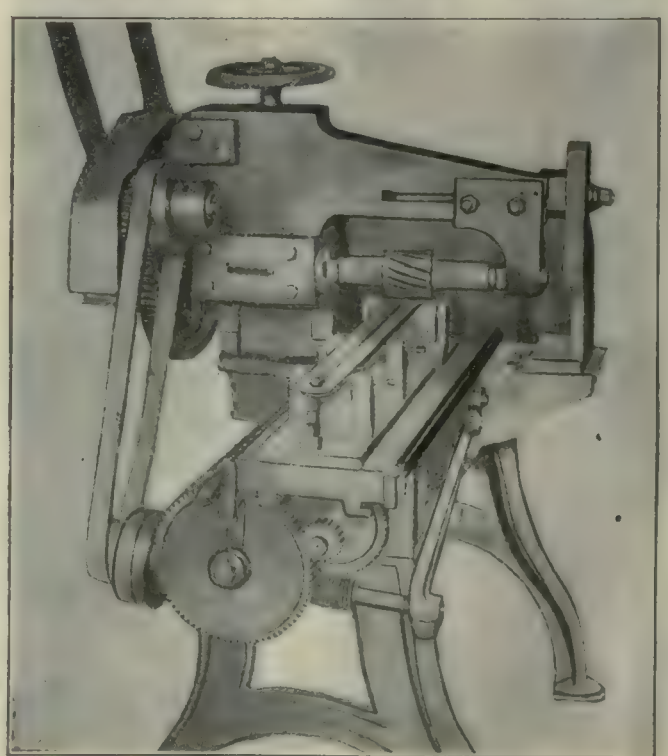


FIG. 8. A PROGENITOR OF MILLING MACHINES



FIG. 9. A STEP IN THE EVOLUTION OF THE MILLING MACHINE



FIG. 10. REAR VIEW OF MACHINE SHOWN IN PREVIOUS FIGURE

carries a pinion and small cone pulley for the feed belt, and this must also be readjusted every time there is any appreciable vertical movement.

Power feed is applied through the medium of a worm-wheel on the traverse screw into which meshes a worm that is keyed to a short shaft supported in a swiveling bearing. The free end of this shaft is held with the worm in mesh by a latch that can be tripped by an adjustable dog on the platen. This movement is the same in principle as that applied to the Lincoln type of machine, and also to the power feed of certain engine lathes of an earlier period.

A machine of this construction would obviously not be appreciated by toolmakers who must have every movement under instant control, but once set for a certain cut the machine is rigid and reliable. With a high-speed steel cutter it can remove what metal is necessary on this particular job as rapidly as the nature of the work will stand and is therefore able to compete with modern milling machines because of its being kept continuously at work on the one piece of work to which it is assigned.

Figs. 9 and 10 show, respectively, front and rear

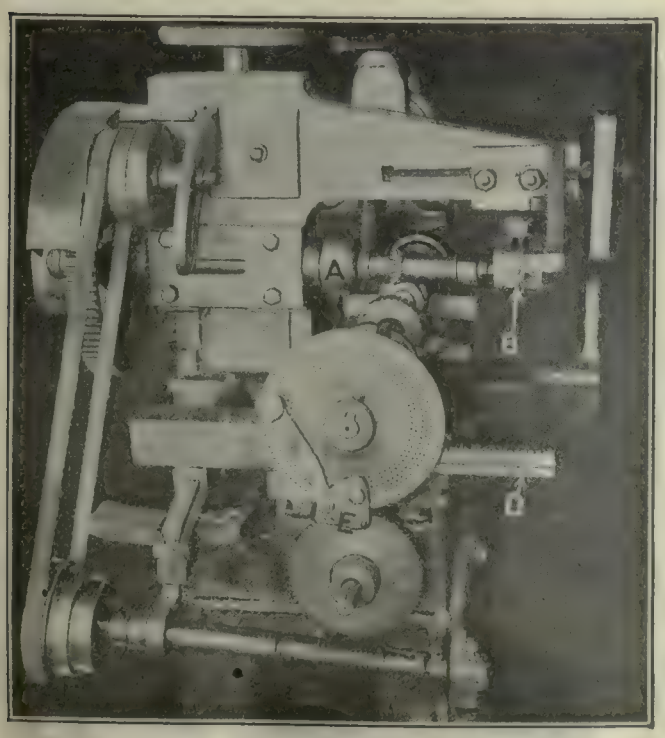


FIG. 11. ONE OF THE FIRST OF "UNIVERSAL" MILLING MACHINES

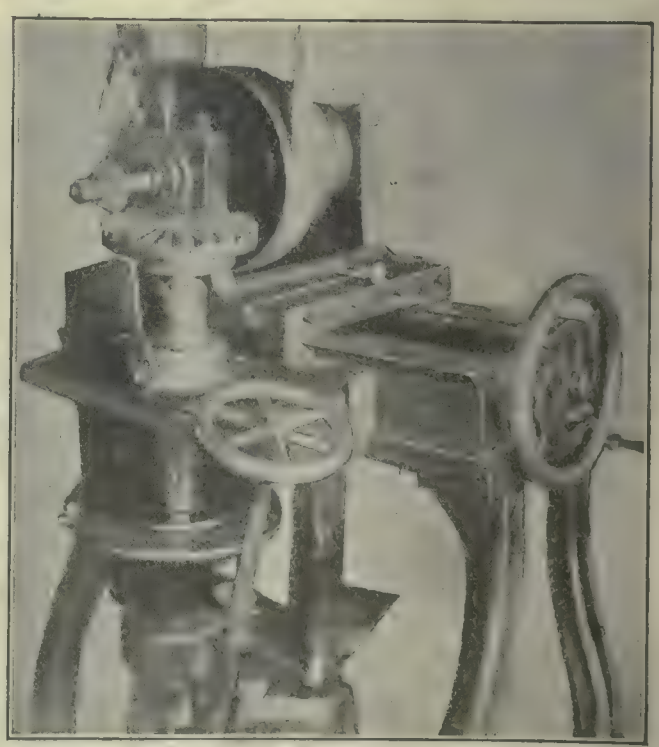


FIG. 12. OLD MILLING MACHINE ADAPTED TO SPECIAL PURPOSE

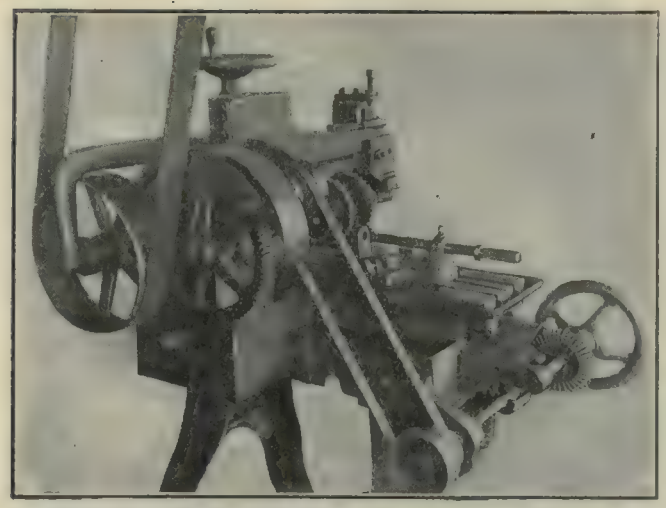


FIG. 13. FURTHER DEVELOPMENT OF THE MILLING MACHINE

views of a modification of this machine. The original machine was similar to the one shown in Fig. 8, the additions being made in the shops of its present owner. It was in service in 1867, which is the limit of the memory of the oldest employee, and was not a new machine then.

The table of this machine has a rack-and-pinion-operated traverse and the entire head is adjustable crosswise, sliding upon shears similar to those of a lathe. This adjustment is made by a screw, turned by a small handwheel located just back of the larger one seen in the picture.

What might be termed the main bearings of this machine carry the shaft upon which are the driving and feed cones. This shaft has no vertical movement and thus the belt tension is not affected by adjustment. The cutter spindle is mounted in a swinging frame of which the overarm is a part, and this frame swivels about the driving shaft, being turned by a wormwheel and worm moved by the small crank handle *A*, Fig. 10.

Substantial clamping bolts are provided at each of the bearings upon which the frame swivels to lock the latter in position after adjustment is made, but these bearings have not only to resist the thrust of the cutters, but of the driving gears as well, and it would seem that the machine was extremely susceptible to accidental change of adjustment under a cut. That it is not so in fact is evident from its survival of over fifty years' service. Another machine of similar origin, shown in Fig. 11, has been adapted to work that is the usual prerogative of the "universal" milling machine. The factory uses in its regular output large numbers of helical-fluted milling cutters, and the special job of this machine is the cutting and re-cutting of these flutes. The table of this machine does not swivel and therefore other means must be provided to bring the line of action of the cutter into coincidence with the helix angle of the work. This is done by connecting the cutter arbor to the machine spindle through the medium of a universal joint *A*, and supporting the outer end of the arbor in a bearing *B* that is horizontally adjustable in a direction at right angles to the center line of the spindle.

This bearing is held to the bracket on the overarm by a single stud passing through a slot, so that adjustment is made by loosening a single nut and sliding the bearing along until, in the judgment of the operator, the cutter is in correct position. This requires skill and experience on the part of the operator, as there are no graduation marks to assist the setting, but as the work is really toolmaking and the machine run by apprentices under the eye of an experienced toolmaker, this lack does not constitute a serious drawback.

The blank is rotated during the cutting by means of an adjustable slide bar *C*, similar to the taper bar of a lathe; the slide being connected to the rack *D* which meshes with a gear loosely mounted on the main spindle of the index head. To this gear is attached the sector *E* carrying the index pin, so that as the table advances the whole mechanism is turned to correspond to the required helix angle. Indexing is accomplished by withdrawing the pin (in whatever position it happens to be) and turning the index plate past the number of holes that gives the required division.

Setting the taper bar, in conjunction with setting the bearing *B*, a necessary part of resetting the machine for a new helix angle, requires the services of the toolmaker, but once set the machine is as capable of turning out its product as well and as rapidly as a modern universal milling machine.

The machine shown in Fig. 12 is a different design but is contemporaneous with Fig. 11. The head of this machine moves along the shears on top of the bed in a direction at right angles to the center line of the spindle, while the latter is adjustable lengthwise by a screw, the handwheel of which may be seen at the rear of the head.

The vertical indexing spindle was added in this fac-

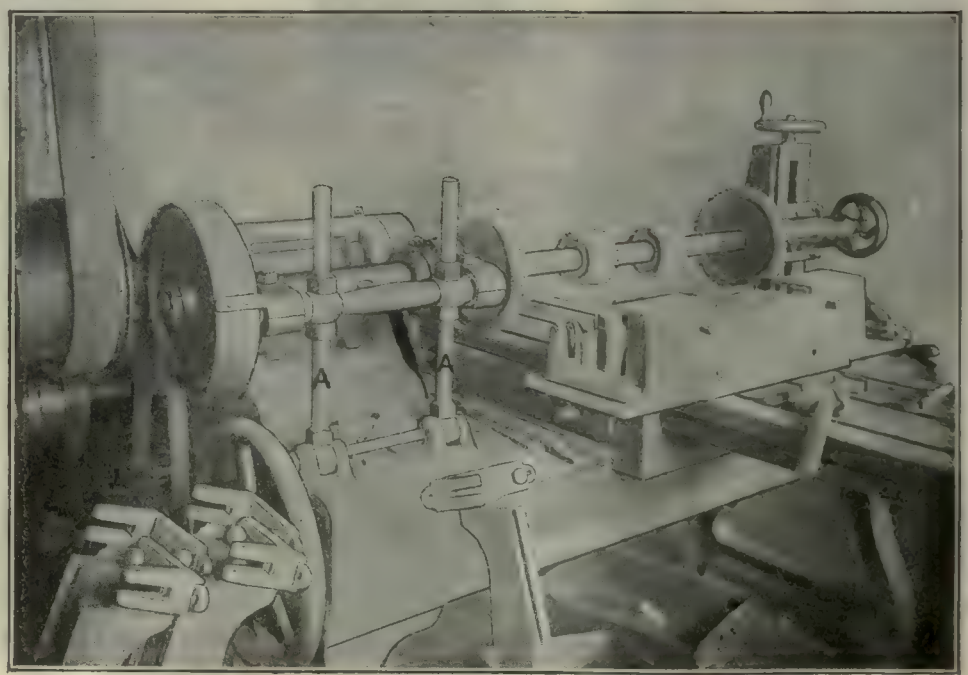


FIG. 14. BUILT IN 1867. A CONTEMPORARY OF THE "LINCOLN" MILLER

tory when the machine was adapted exclusively to the cutting of large face mills, one of which is shown in place. The index plate may be seen below the upper main bearing, and though the locking pin does not show to advantage, its manner of operation is clear. The handwheel on the upper end of the angular shaft gives a convenient means of turning the spindle when indexing, connection being made through a pair of angular gears at the lower ends of the respective shafts. The wrench seen below and in front of the work operates a clamping ring contained within the upper bearing, rendering the work rigid while under cut.

Another milling machine is shown in Fig. 13, built by Gould and Eberhardt at a somewhat later date, and beginning to show the characteristics of the modern milling machine. Its principal interest lies in the fact that it represents an early stage in the evolution of machine design. This machine, like the others, maintains its place as a link in the productive chain because of its having been adapted to one special job and kept continuously at work on that job, of which it is as capable as a more modern machine.

In Fig. 14 may be seen a milling machine built in 1867 or before, to make practically the same cuts on the same parts as it is making today. It has many features in common with the well-known "Lincoln" type of machine but was probably developed independently of the latter. Its cutter spindle is carried in a swinging sector after the manner of the machine shown in Figs. 8 and 10, but when it is adjusted it is held firmly in position by locknuts on the bolts *A* which are swivelled at their lower ends to adapt them to the swinging movement of the head. The outboard bearing is adjustable in two directions for the same purpose. Except that the table traverse is much longer, the details of its movement are much the same as in the Lincoln.

A special Lincoln milling machine built by Pratt & Whitney for the job with which the picture shows it occupied is shown in Fig. 15. This is a comparatively youthful machine, dating only from 1888.

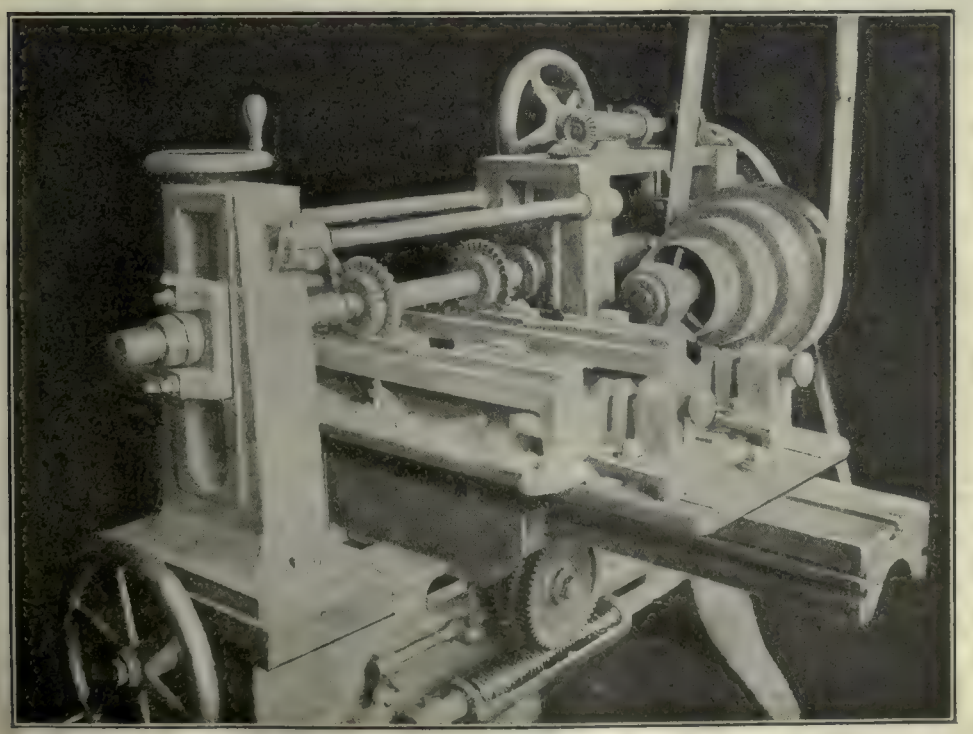


FIG. 15. A SPECIAL "LINCOLN" MILLING MACHINE BUILT IN 1888

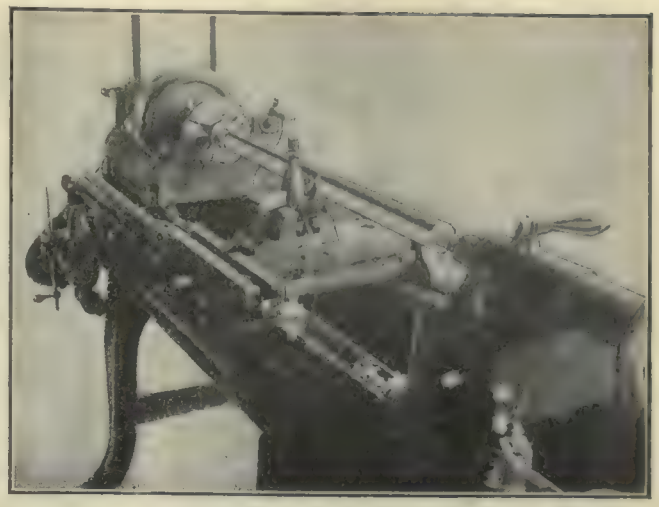


FIG. 16. A PATRIARCH. THIS LATHE HAS ALMOST OUTLIVED ITS USEFULNESS

Probably the oldest machine in the shop that is in regular service is the lathe shown in Fig. 16. There are in the employ of the company several men who have been contiuously with it for fifty years, and this lathe was the "old lathe" to these men when they were boys, fifty years ago.

Many of the old-time mechanics are familiar with this tool. It has a short shaft running across the bed under the headstock, and from a sprocket on this shaft, inside the box bed, a chain runs to an idler at the other end of the bed.

On the outer end of the cross shaft is a handwheel, or rather what once was a handwheel, for it long ago lost its wooden rim, and just inside it a worm wheel by means of which the power feed is obtained. The carriage is attached to the upper side of the chain.

There is of course a great deal of slack or lost motion resulting from this form of feed, especially when feeding the carriage to the right or toward the tailstock. As long as the resistance of the cut is constant it works very well, but if the tool strikes a hole or a soft spot, the carriage is likely to jump forward a half inch or so, causing extreme annoyance to the operator, to say nothing of what happens to the work. For turning shafts of homogeneous material and symmetrical shape the lathe is serviceable, but for working on castings or rough forgings it leaves much to be desired. It holds its place on the floor among modern tools more from sentimental than practical reasons. In Fig. 17 may be seen a tool that was regularly used sixty years ago for cutting splines or keyways in small gears. It was incidentally the only drilling machine in the shop at that time. For cutting a keyway the tool was fixed in the spindle, being held by a setscrew in the same manner that the straight-shanked

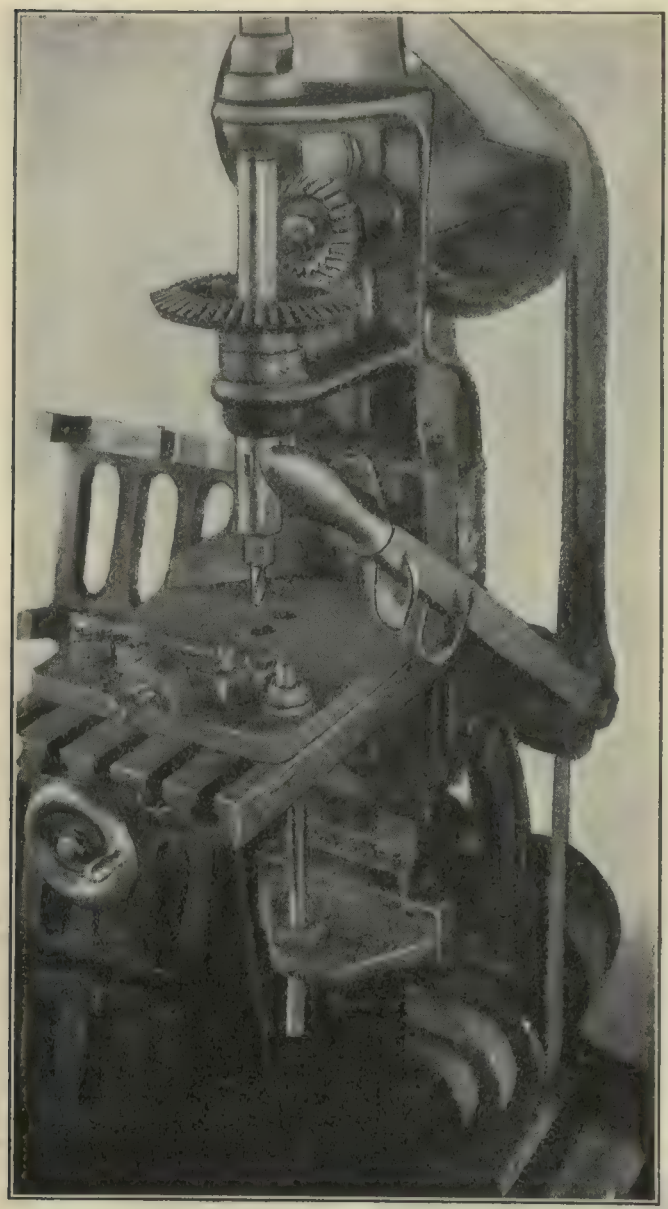


FIG. 17. A "KEY-SEATER" OF 1863, NOW RETIRED

drills of that period were held, the spindle fixed so that it could not revolve, and the table moved up and down by means of the lever while the work was held in the vise and fed forward to the cut by the small handwheel in front.

While it does not seem possible that this device could compete with modern machines built for the purpose, I am assured by the older workmen that given a small quantity of gears in which to cut keyways the job can be finished in less time than will be required to set up and complete the job with the big, modern key-seating machine that has displaced it.

That the company operating these old machines are considerate of their men as well as their machinery is evidenced by the number of employees that have been continuously in their service for fifty years. There are five men at least who hold this distinctive and honorable record, though not all of them were available for photographing at the time of the writer's visit, some having been retired on pension. Of the six men whose portraits appear in the head piece of this article, one entered the employ of the parent company in 1863, one in 1867, two in 1870, one in 1874, and one in 1878.

That the conservation of men and machinery is not philanthropy, but business, is evidenced by the fact that this plant where both are employed is a live, up-to-the-minute concern, and a leader in its line. There are in its workshops many machines embodying the latest mechanical ideas, while the engineers are constantly adding machinery specially designed to meet their requirements.

Questions of Shop Ethics

By F. W. Munson

In writing under the title "Rules of Etiquette for Foremen" on page 437 of the *American Machinist*, Mr. Charles D. Folsom brings up some important questions, not the least of which is the one relative to raising the wages of individuals.

If the foreman grants a raise to Bill and does not give one to Sam, Sam is mad and perhaps quits his job; while if Sam gets the raise to keep him quiet, there is a dozen or so of others who are dissatisfied with their jobs and ready to quit. As to expecting one or two individuals to get a raise and keep quiet about it, such things seldom happen, for as a rule, when a workman gets a raise he delights in telling his fellows about it and telling them what poor fish they are not to get one too.

As to giving advance notice of a lay-off, I believe this is customary with most firms when business conditions are such that a lay-off can be foreseen. Advance pay is another thing, for a lay-off usually indicates the necessity for curtailing expenses, and the payroll being the largest item of expense, not many firms would consider it wise to make further inroads upon their resources.

During the past years, few employees gave their employers any advance notice of their intention to quit. The right to leave their jobs without notice has been one of the many privileges of which the employees have taken full advantage.

In regard to the data furnished by applicants for jobs to substantiate their claims, I do not take much stock in it. During the war period, there has been developed many single-purpose men, some of whom have acquired a considerable degree of proficiency upon—let us say—shell-lathes, and perhaps made big wages as operators of such lathes, but as all-round mechanics they are not there; yet rarely is their vision such that they can see why wide experience is more valuable than single-purpose efficiency.

I think that whenever it is practicable to do so, the "show-me-what-you-can-do" idea should be put into practice before setting a value on the applicant's ability. This is the one certain way of recognizing and appraising experience.

In our shop we aim to follow this method. We explain to a new man our organization, our product, what our trade name stands for, and all the advantages that will be his if he will join us. We introduce him to all with whom he will come in immediate contact, and our employment superintendent keeps in touch with him for the first few weeks to see how he is getting on. If he is a reliable man and wants steady work he will stick; if he is a floater, two or three weeks will show him up and he floats off to another job—usually without notice.

These few remarks represent the opinion of one foreman: Let's hear from some more.

Standardization and the Safety Movement

By CHAS. E. OAKES and J. A. DICKINSON

No other field in American industry offers greater possibilities for intelligent standardization work than that of safety codes for use by various states, municipalities and insurance companies. Of the value of standardization there is ample evidence.

THE standardization program adopted by the War Department made possible the enormous output of munitions during the war. The choice of standard side-arms, capable of using a universal cartridge, strikingly illustrates the beneficial effects of standardization. At the time America entered the war there were two types of pistols in use in the army—the Colt 0.45 Automatic and the regulation 0.45 revolver, generally referred to as a "six-shooter," each requiring a special cartridge. This latter type was manufactured in two models, the 0.45-caliber Smith & Wesson and the Colt 0.45. By providing a clip which would hold the rimless automatic cartridge in the ordinary revolver it was possible to use one type of cartridge in the three guns. Germany with all her vaunted efficiency had no less than twenty-two different makes and calibers of revolvers and automatics in use by her army, the calibers ranging from 0.22 to 0.56. The result was that an extremely large stock of various-sized cartridges had to be kept on hand; otherwise a large proportion of their side-arms would have been useless.

The War Department also standardized heavier guns, shells, fuses and detonators as well as hundreds of the articles used by the American forces. In the case of dry batteries the War Department selected, as a result of a series of tests by the U. S. Bureau of Standards, seven types from the hundreds of sizes and shapes on the market, and standardized them for use abroad. In practically every field of manufacturing endeavor this standardization work was carried on, chiefly through the medium of the War Industries Board.

Peace-Time Value of Standardization

Prior to the World War the automobile manufacturers, through the Society of Automotive Engineers, had done some very remarkable standardization work, and it is largely through their efforts that America leads the world in the production of low- and medium-priced cars. In the electrical field the larger manufacturers have standardized certain definite types of machines, and by producing such standardized types in large quantities they have been able to reduce materially the price of electrical machinery without any reduction in the quality. Nearly every branch of industry today has a manufacturers' association and almost invariably these associations are working toward a uniform product, standardized to meet the needs of the market.

At the present time there is a woeful lack of uniformity in the safety rules and regulations in general use. This very lack of uniformity is doing much to hinder the ultimate safeguarding of industrial plants. Where the requirements of the city, the state and the insurance companies differ widely and each interest is seeking to enforce its own particular set of standards, it is to be expected that the manufacturer will hesitate to carry out an extensive and comprehensive plan of safeguarding when he has no assurance that such safeguarding will ultimately meet the demands of all of the authorities concerned.

Lack of Uniformity a Drawback

This lack of uniformity is a great drawback in the purchasing of some kinds of machinery in large quantities. Let us take a hypothetical case. A manufacturer with branch factories in twenty different states finds that on account of the growth of his plants it will be necessary to install additional elevators in a number of them. If he were able to place an order for all the elevators needed, all to be of one type, differing perhaps in platform size and capacity, but with standard safety devices, hoistway inclosure, cables, sheaves, etc., in all probability he would be able to purchase them at a considerable reduction. While present conditions hold, however, an elevator that will pass the requirements in one state will in all probability not be satisfactory in another, and the requirements of each code must be carefully studied in order to meet the requirements of the particular locality in which each elevator is to be installed.

As an example of the great value of a national code, the A. S. M. E. Boiler Code might be cited. It is being rapidly adopted by various states and cities and a boiler built according to the A. S. M. E. specifications is standard anywhere in the country. Many of the boiler manufacturers who at the time of the writing of the code opposed certain more or less stringent clauses, are now glad to advertise that their boilers meet the A. S. M. E. specifications. Similar improvement in types of apparatus and methods of construction have resulted from a widespread use of the National Electrical Safety Code and the National Electrical Code published by the Fire Underwriters.

The Logical Place to Install Safety Devices

The logical place to install safety devices on a machine is in the factory where it is built. Many manufacturers, notably in machine and wood-working lines, have done excellent work toward guarding gears and cutters, but until there is a uniform set of standards there is little hope of this work being carried much further, as the details of the requirements in the various states still differ widely. If a series of national codes were to be adopted the manufacturer of machinery could build a machine which would meet the requirements of any state in the union, and in all probability would be glad to build and advertise such "national standard machines" just as the boiler manufacturers are advertising the "A. S. M. E. Standard" boilers.

One step in the right direction has already been made by the various casualty insurance companies in the formation of compensation service bureaus and rat-

ing boards. By adopting a uniform rating schedule and allowing premium credits for installation of safeguards, such bodies have done much to promote the adoption and use of safety devices throughout the country. Many manufacturers, unfortunately, can be appealed to only on the "dollars and cents" basis. Such standards as have been drawn up by the rating boards and bureaus have quite naturally been drawn up primarily with a view to hazards as viewed from an insurance standpoint. Unfortunately, there has been no concerted effort made to standardize the various state laws and bring them and the insurance requirements into harmony. When this most desirable move has been made the effect will undoubtedly be noticeable immediately, and not only will there be a large increase in the amount of guarding done in various plants, but there will doubtless follow a marked increase in the amount of guarding done by the manufacturers of machines. Furthermore, if all the various organizations concerned can be led to take part in drawing up uniform specifications, their participation in the work will undoubtedly stir up and foster a much greater interest in safety work throughout the country than there has been heretofore.

Relation of Standardization to Conditions of Employment

Entirely aside from the humanitarian aspect of a move to secure national safety standards, with the resulting increased installations of guards, the fact that the nation at large is alive to industrial hazards and is making a strong concerted effort to better conditions through standardization, should go far to aid in the bettering of relations between employer and employee. The careful study which has been given to the problems of methods of employment of labor, welfare of workers, rehabilitation of crippled workmen, etc., by some large industrial concerns has materially assisted in developing a friendly feeling on the part of their employees, and an evident effort to provide all practicable safeguards for workmen should likewise help in creating good feeling. The fact that representatives of the various labor organizations are not only consulted but are actually assisting in the formulation of safety standards should have considerable effect in advancing better understanding between employee and employer and should go far to convince workmen that, from the standpoint of the industrial worker, conditions are being improved with respect to safety.

Fundamental Principles as Bases for Codes

In order that a national safety code may be generally adopted it is necessary that it be prepared by a carefully chosen committee of trained men representing all important interests. Upon such a committee manufacturers, state authorities, municipal authorities, insurance companies and labor interests should each be given equitable representation. The committee should submit the tentative drafts of such a code to as many interests as possible, due consideration being given to their criticisms and suggestions. The working together of such a committee would probably be of considerable benefit to the interests represented aside from the code drawn up by them.

Unlike the standards of length, weight and measure which are fixed and unchangeable, a safety code, which is really a standard of practice, must be a live, and to a certain extent, a flexible instrument. It must not hamper or hinder the development of new or improved processes, nor should the provisions of such a code interfere with the production of work on machines which they cover. It will be necessary to take into account the fact that not all the manufacturing plants of any one industry are confined to a single community Frequently, there are local conditions in one plant that will not be found in a plant a few hundred miles away which is making an identical product. The processes in both plants may be satisfactory from the standpoint of safety and yet differ considerably in detail and method of application. It is apparent, therefore, that while the standard must be fundamental and explicit, at the same time it must possess a flexibility that will meet the varying needs of widely divergent plants operating under an extremely wide range of local conditions.

The vast majority of operations now carried on in our manufacturing establishments utilizes machines of special design or process which are peculiar to the industry. Radical re-designs made from the viewpoint of safety may increase the cost of operation or the initial cost of the machine to such an extent as to be prohibitive. The increased cost of operation may be evidenced in a decreased production or the necessity of additional attendants. Unless the hazard is so great that an immediate and radical change in design is necessary a large expenditure to obtain the greatest degree of safety may not be warranted. A standard should not place too great a burden on the industry either in the cost of operation or in the first cost of a machine.

It is needless to say that the worker should be relieved of undue fatigue, and the evolution of industry has operated in this direction. It is a noteworthy fact that new types of machines in all lines of industry have been more efficient and at the same time usually offer less hazard and are less fatiguing to the worker than machines of older types. A uniform standard safety code will open the way for still better and safer machines. Then and only then can the real educational work of accident prevention be fully carried out.

With a well-guarded plant the owner can say: "We've done our part. Guards will prevent only a certain percentage of accidents; the elimination of the rest is up to you." The hearty co-operation of the workmen can be obtained and a worthwhile concerted effort inaugurated toward making the plant safe in its fullest and truest sense.

In view of the conditions which have been outlined, is it not high time that at least a beginning be made on the formulation of safety codes suitable for use in all parts of the country? And is there a better procedure possible than to have this work done under the auspices of such a representative committee as has been suggested above? Naturally, men from different sections of the country and in different relations to the industries will have different opinions regarding the general requirements which should be established; but no better way of disseminating the valuable results of experience or of combatting ideas of doubtful value can be found than to bring the advocates and opponents of each requirement face to face for discussion. By such full consideration with all interests represented it should be practicable to produce codes which would be acceptable both to insurance and to State and city regulatory authorities, and which would gain the great advantages of uniformity of practice without blocking development and improvement in any industry.



FROM time to time attention is called to educational moving pictures which have been prepared by different firms for the benefit of their employees, or for sales purposes. The majority of these are of local interest only and, serving a limited purpose, are of no general value; but there are subjects in the machining field which can be, and should be, so covered that the benefits of a film presentation will be general.

A short time ago the writer was privileged to witness the presentation of a moving picture film of mechanical interest before an audience of shop-men, everyone of whom appeared thoroughly interested and without doubt derived considerable benefit therefrom. The name of the film story was "The Use and Abuse of the Twist Drill," which picture has been produced by the Cleveland Twist Drill Co., Cleveland, Ohio. It was originally only two reels in length, but its success has encouraged the producer to add first a third and later a fourth reel.

By J. V. HUNTER,
Western Editor, *American Machinist*

This article tells of a moving picture which has been put out by a large twist-drill producer in order to inform the users of its products as to the correct methods of handling them. The chief points brought out in the moving picture are shown by the accompanying series of cuts, which should prove of value for reference purposes.

Although this work has been produced without advertising features, it is furnished free of charge to those who will have it shown in their shops for the benefit of their workmen, the only stipulation being that, for the sake of safety, a licensed cinema operator be employed. Some mention has been made of the film in the columns of the various technical journals during the past few months, but it does not seem that every one has the proper conception of its purpose; and perhaps it may be said that it has not been press-agented in the manner that it deserves, although it seems to be well dated-up and to be playing to full houses.

The Instruction of Mechanics

There are probably few shops in the metal-working field where the twist drill does not constitute an important part of the tool equipment. The maintenance of an adequate stock of high-speed twist drills is today a considerable item of expense, and yet it will probably be found in most shops that the greater portion of the life of the drill is destroyed by unintelligent use by the mechanic or by wasteful grinding away in sharpening. The stoppage of such sources of loss can be effected only by intelligent instruction in the use and care of the tool.

How many shop managers can say with knowledge that their foremen are giving adequate instruction of this character to each of the workmen under their supervision? Usually the foreman today is so loaded with troubles relating to production that he thinks only experienced mechanics should be furnished for his service, and he is losing the role of instructor, which he was once supposed to occupy. No mechanic trained in the old school of apprenticeship can say that he learned all there is to know about a twist drill in one day, nor even in the many days that he had occasion to use a drill. Most of his information was acquired by experience; and even when that meant a spoiled hole and a ruined piece of work or a broken drill, the "bawling out" which he received from the foreman rarely served to give him the information necessary to avoid a repetition of the same trouble at a later date. It has been for some time one of the main principles upon which modern educational methods are founded, that the human mind can be more rapidly instructed through actual examples shown to the eye than it can absorb the same knowledge through precepts either spoken or read. Most men in executive work in the shops have learned this same principle by actual experience, and have found that directions given by spoken word to the workman regarding the form or condition of work to be done on any mechanical device is far better understood if supplemented by even the rudest form of pencil sketch, thus constituting a form of visual instruction.

We have lately learned that the same methods of schooling should be applied to make proper mechanics that are used in training scholars in the public schools. This has brought about the establishment of training schools in some of the larger industrial plants where, with the proper methods of "forced feeding" of mechanical training, fairly good mechanics can be produced in a few weeks.

It is a forward step in this educational development to teach a mechanic the proper handling of a twist drill by a moving picture. To learn these points by the regular slow shop methods of experience is a very expensive one for the employer. Many dollars may be quickly lost through a little ignorance which leads to the breakage of a few large high-speed drills; and when this is multiplied by the many different ways in which drill troubles can occur, and multiplied again by the number of green hands which are being broken into the work each day, the advantage of using this educational opportunity should be quickly seen.

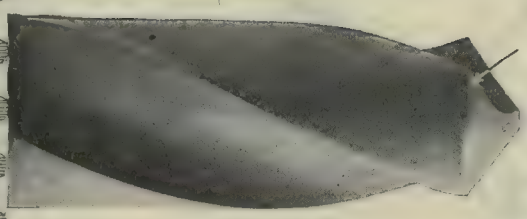


Fig. 1. Insufficient lip clearance has caused the drill to "drag at the heel"

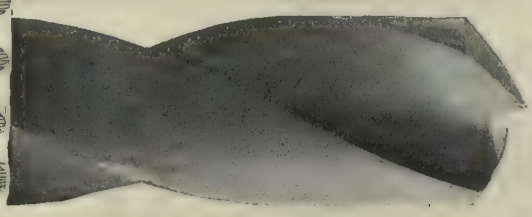


Fig. 2. Lack of lip clearance near the center caused the point to crack and chip out

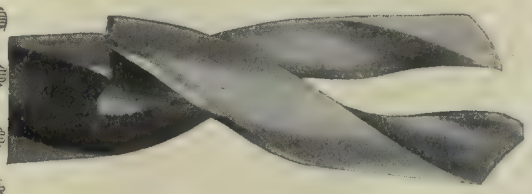


Fig. 3. Running a drill at high speed without sufficient lip clearance at the point caused the drill to split

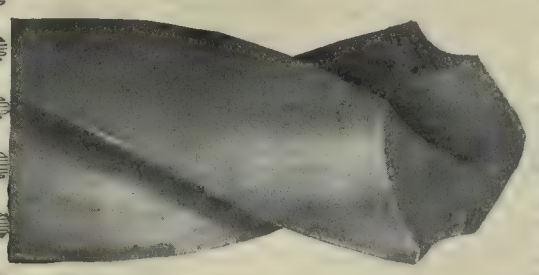


Fig. 4. Too much lip clearance left the cutting edge so thin that it burned away on the outer corners

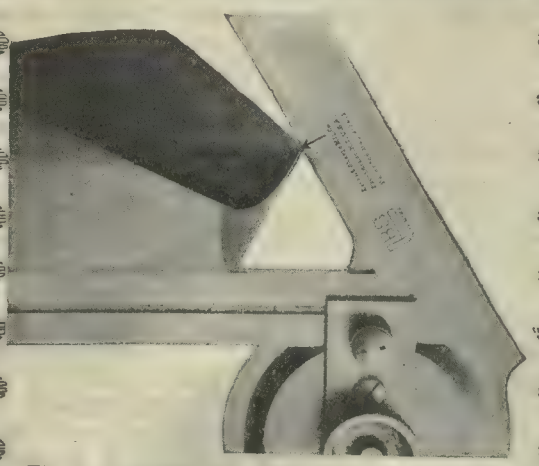


Fig. 5. Grinding with more angle on one cutting edge than the other causes it to drill too large a hole

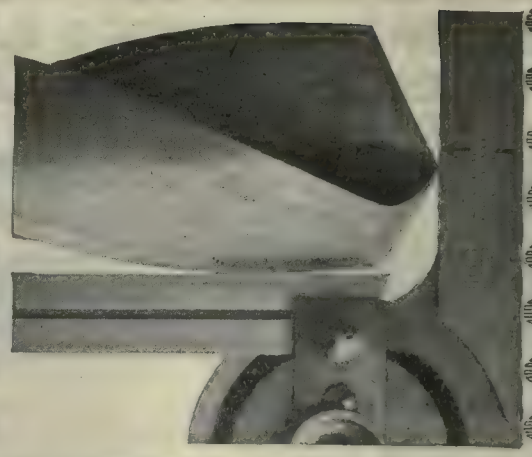


Fig. 6. Equal angles on the cutting edge, but point is off center, also making it drill an over-size hole



Fig. 7. Lower portion shows hole made by a correctly-ground drill

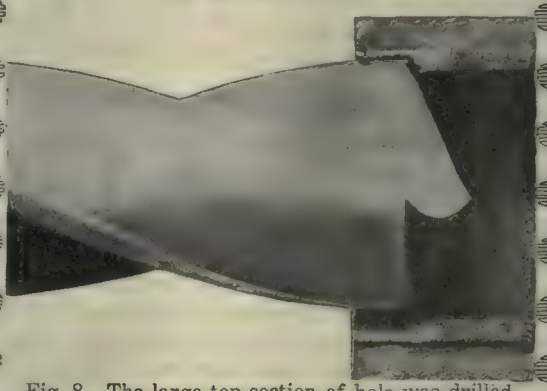


Fig. 8. The large top section of hole was drilled with an incorrectly-ground drill of same size as used for lower portion



Fig. 9. Incorrect grinding can double the trouble by throwing point out of center and making cutting angles unequal

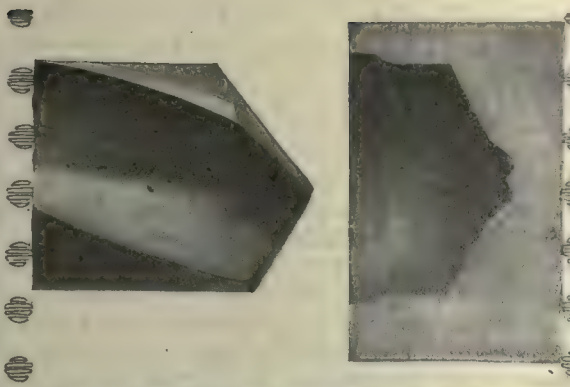


Fig. 10. A wabbly hole produced by the drill shown in No. 9. The long lip is cutting a larger hole

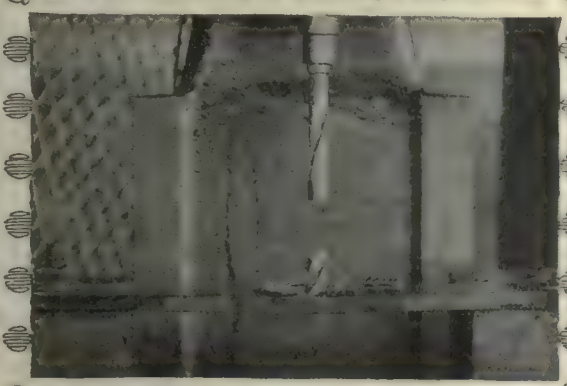


Fig. 11. Drilling without properly supporting work. This binds and breaks drill

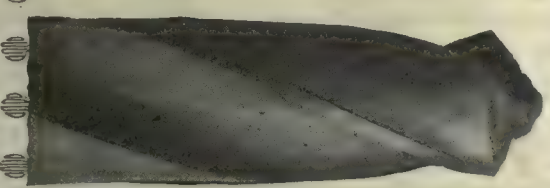


Fig. 12. Drilling with too much feed and insufficient speed chips the cutting edges



Fig. 13. Too much speed causes the outer corners of cutting edges to wear away more rapidly than any other portions

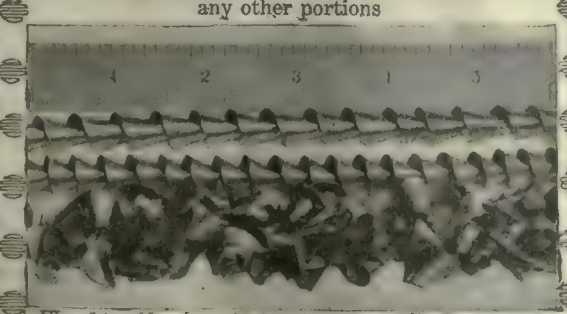


Fig. 14. Hard spots in the material often cause character of chips to change and for these conditions the feed and speed should be changed



Fig. 15. A drill properly ground produces uniform chips

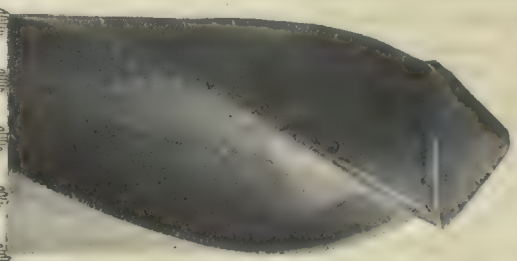


Fig. 16. Blunt point, due to pounding with hard hammer, causes drill to require greater pressure while drilling

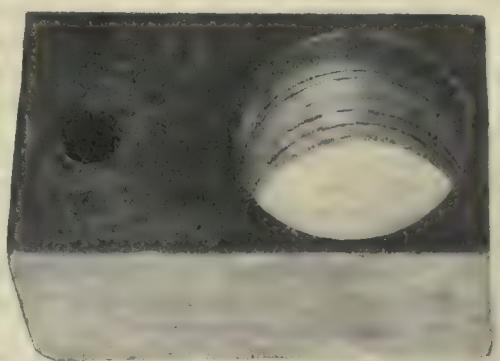


Fig. 17. Rough holes are caused by dull drills. Sharpening drills will often save a reaming operation

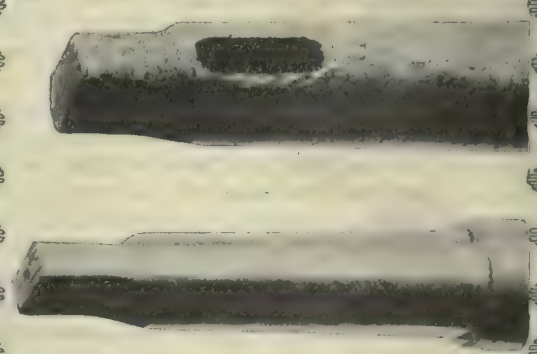


Fig. 18. Poor sockets are caused by abuse and use of improper drift pins. These cause drill breakage and inaccurate holes

The Ship of State*

By ELBERT H. GARY
President, American Iron and Steel Institute

IN THIS presence it may be asserted, without thought of contradiction, our country is the best of all.

"As frequently stated, notwithstanding the United States has only 6 per cent of the world's population and 7 per cent of the world's land, yet we produce:

20 per cent of the world's supply of gold.
25 per cent of the world's supply of wheat.
40 per cent of the world's supply of iron and steel.
40 per cent of the world's supply of lead.
40 per cent of the world's supply of silver.
50 per cent of the world's supply of zinc.
52 per cent of the world's supply of coal.
60 per cent of the world's supply of aluminum.
60 per cent of the world's supply of copper.
60 per cent of the world's supply of cotton.
66 per cent of the world's supply of oil.
75 per cent of the world's supply of corn.
85 per cent of the world's supply of automobiles.

"Better still, we have constitutional freedom; protection of life, liberty and property. If, in any respect, these principles are violated, it is by individuals and not by sanction of fundamental laws. As one becomes familiar with the Constitution and with all departments created by it, one is convinced that the scheme and philosophy of the framers was to guarantee equal protection and opportunity to all the people. With the preservation and functioning of the Government in accordance with the letter and spirit of the Constitution there is offered peace and protection; with disregard or violation of any material part of it there is, *pro tanto*, suffering, distress and ruin.

"Possessed of these natural resources and opportunities a moral, intelligent and industrious people have reached the first place in worthy achievement. Hence, persons from every part of the world have come to the United States to better their condition by participating in the blessings which are here provided. For no other reason, except an intention to wantonly attack, destroy and forcibly appropriate, would foreigners settle in our midst.

"The great majority of immigrants have come with pure motives. They have been welcomed by their predecessors and eagerly and gladly have become a part of the mass of loyal and deserving citizens. We have approximately one hundred and ten millions of inhabitants, and, as a whole, they rank high in the world's throngs of human beings.

"However, we need not close our eyes and ears to the utterances of learned men in editorials, lectures, public addresses and private speech, to the effect that even our Government itself is threatened at the present time; that for some months there has been and still is being carried on propaganda, instigated and controlled by vicious men, mostly foreigners, which tends to create a feeling of unrest, dissatisfaction and antagonisms. Appeal is made to the cupidity, the selfishness and the baser instincts of men. Promises not possible of fulfillment are made; sometimes threats and intimidations are indulged in.

"Human nature, weak and greedy, is easily affected. The minds of considerable numbers, due to war conditions, resulting in privation, suffering and misery in some cases and temporary possession of unusual funds in others, are abnormal, and false and wicked doctrines are apt to find lodgment. Advantage has been taken of these natural tendencies by unprincipled men, some of them really enemies of the United States, others merely demagogues, all actuated by the desire to promote personal gain. Numbers of men who are loyal Americans, some giving evil advice and others lending receptive ears, will hereafter entertain feelings of regret and shame for their part in the public discussions of today.

"The present so-called labor strikes, involving riot and injury to property and person, are instigated as a part of the campaign to disturb and demoralize the social and economic conditions of the country. In other lands very serious results have been accomplished by the same means which have been employed here.

"Is the disease of unjustified unrest and revolt now discernible progressive? Will large numbers of our population be influenced? Is the Ship of State in danger? Is she headed for the rocks? Is there a possibility of increasing storms to a degree which would drive her to destruction?

"The answers depend upon the conduct and efforts of the sailors themselves, and they include all classes of people. The word 'class' is not used in an invidious sense. There are no classes in the United States such as have existed in other countries. Formerly, in certain parts of the world, classes were actually formed and sustained by the rich or powerful, who were supposed to belong to the 'upper class.' They became distinct and commanding. They secured and continued to hold additional privileges and benefits to which they were not justly entitled, and which made them proud and overbearing. They were doomed to eventual failure and final destruction, except so far as they might be deserving on the merits. In America those who now seek to establish classes and to secure discriminating favors for themselves are not prominent because of wealth; they are composed of a comparatively small minority of the population who have adopted the word 'labor,' which signifies honorable activity, with the concealed design of forming a 'class' which they hope will finally attract a majority of the people, and thus enable them to obtain one legislative act after another until the Constitution shall be undermined and the whole structure destroyed.

"These men have already secured certain legislation which is wrongfully discriminating. Some of them know what the final consequence of their designs must be; that all would be lost in the ruins; but immediate personal gain is to them sufficient justification.

"The safe, efficacious and natural remedy for the perils which have been hinted at is to be found only in unity of purpose and effort on the part of the whole crew on board our Ship of State, which includes everyone who is blessed with the privileges of citizenship in the United States; an undivided loyalty to the principles of our Constitution and all the laws which are

*Address delivered at annual meeting, Hotel Commodore, New York City, May 28, 1920.

passed in conformity to it. This will eliminate from the social structure the vicious elements. Sad to say, there is not at present, nor has been in the past, perfect harmony of action between the masses of the people.

"Without dispute, any person has his or her place, rights and privileges. This includes those which are personal, private and exclusive. No one may properly impinge upon the rights of another. Everyone must be protected to the full limit of the laws which are intended for the benefit of all, with the understanding that private interests are subordinated to the public welfare; but in the exercise of individual rights, in the protection of individual property and interests, it is the obligation, as it should be the pleasure, of everyone to act without animosity toward the Constitution, the laws, and the general public, and without improper and unnecessary friction.

"In a discussion of this kind there should be a frank admission that no one is without fault; that every variety of human nature may justly be censured. And for purposes of illustration, we may refer to groups of persons and interests. We could not accurately speak of them as classes; but these groups might be, and heretofore have been, mentioned as the capitalistic group (including their representatives), the labor group, and the general public. Slight effort at analysis will demonstrate how far short of accuracy these descriptions are.

"Who compose the first? Those who have accumulated property; if so, how much?

"Who make up the second? Those who work with their hands; if so, with the shovel, the lever of a machine or the pen?

"Who constitute the third? Those who neither possess pecuniary resources nor perform any labor? If so, there is none to be considered in this connection, for the group would be small in numbers and subjects of charity or public control. Obviously, the public is made up of the entire population.

"And yet, we can comprehend to some extent what is in the minds of some of the writers and speakers who undertake to make these classifications to which I have alluded.

Employers

"I will, for present purposes, place the members of this large audience in the first group. Most of you are possessed of accumulated savings and occupy important positions, although you started from the lowest rung of the ladder of success, and because of merit and hard work have reached your present station in life. You have, in management, in greater or less degree, marked responsibilities in regard to each and all of the groups described. You could not shirk or minimize them if you desired to do so. As a business citizen you must account to others for your stewardship. What you say, what you do, will have an important influence in national, even international, affairs. It will be good or bad. You must consistently observe the principles of the Constitution, the provisions of the laws of the land, the rights and interests of your neighbors, including your employees, customers, competitors and the general public. You must be unselfish, reasonable, fair, sincere and honest. You should, without interruption, give evidence of a disposition to conciliate and co-operate. Regardless of the past, even though you may believe you have been unjustly treated or censured, you should and will make and keep resolutions for the future which you know are proper. All this, of course, applies with full force to your President.

"If we adhere firmly to these principles, if we are steadfast and true; and then courageously, though modestly, proclaim our rights and insist upon proper consideration in return it will be accorded. We have heretofore been somewhat backward in this respect.

Employees

"Employees generally are included in the second group. With all others they have full and equal rights and responsibilities. They must and will realize that their advancement and contentment depend upon the progress and prosperity of the employers; that, except for the willing and free investment of capital up to the requirements of business demands, together with full co-operative assistance on the part of the best talent, enterprise and initiative would languish and disappear and that indifference and idleness would be substituted.

"Agitators who are trying to create trouble between employees and their employers as a rule are insincere and selfish. Generally, they, themselves, have performed no hard labor, nor had experience which qualifies them to lead or instruct. They strive for personal popularity and gain. Their business is better, their compensation increased, when others are in trouble. Assuming to be sympathetic and superior in intelligence, they mislead and often misrepresent. They promise reforms, but their methods lead to trouble and loss to others. In this list are included a few writers, lecturers, public speakers and self-appointed labor leaders, so called.

"The great masses of employees, if left to decide for themselves, are loyal to the country, to the public interest and to their employers; and to the extent of this loyalty they will be rewarded up to the full measure of their deserts. This they will have the right to demand; and it will be readily and cheerfully accorded. They also should, and they will, continuously exercise a disposition to conciliate and co-operate. As applied to all groups, faithful performance, and this only, will insure highest pecuniary results and most liberal treatment.

"We sometimes hear a man claim that the world, or the nation or the public owes him a living. This is foolish and preposterous. There is due every citizen of this country no more and no less than the same opportunity to procure a living that is accorded any other. This is the full measure of fairness and justice. The state cannot furnish to the individual natural ability or disposition. The honest man who reads, studies, thinks, works, economizes, saves, persists and uses his best judgment will succeed in this country. If he is neglectful, indolent, profligate and dishonest, he will fail. A large majority of the men of the United States who have become prominent in statesmanship, finance, professional or business life, started from an humble beginning; and, by their own endeavor, have advanced. Ordinarily, the men who complain because of their poverty or position in life have only themselves to blame. There are exceptions, such as those who are naturally or otherwise disabled at birth or later, and they are entitled to and do receive public assistance; but, as a rule, those who do not prosper are indifferent to worthy accomplishment, or partly so. In every department of life in this country, in the mill, the shop, the store, the bank, the office, the profession, the schools,

one may, so far as opportunity is concerned, start at the bottom, and, by his own energy and faithfulness, progress even to the top. We who are present on this occasion know, by experience, this is true. Any concern, any organization, any government which seeks to promote, demote, or retain a man in position contrary to his just deserts, combats the public interest, the life and growth of the nation; and more than this, is perpetrating an incalculable injury to the man himself.

The Public

"In the classification suggested, the public comprehends every citizen except the individual who is discussing the subject. Speaking of men we can define interest only as either public or private. Depending upon the question under consideration, we may embrace in the word 'public' a community, a village, city, county, commonwealth or nation; but the question comes back to either public or private interest.

"As each individual in the groups heretofore mentioned is obligated to conduct himself or herself in such manner as to promote and not impair the public welfare, so the public is likewise responsible to the individual. In public discussions, and occasionally in newspaper editorials, it is frequently assumed that there is no corresponding and reciprocal duty on the part of the general public whom, at the particular time, the speaker or writer attempts to represent. Unjust attacks or criticisms against individual interests, sometimes promiscuous, in other instances by name, are made from a biased standpoint or upon distortion of the facts. The exact truth is not infrequently ignored or overlooked. Many able discourses in the press, in the Congress of the United States, by public officials, even from the pulpit, are based on a misstatement of the facts. Those possessed of least ability from experience or otherwise are most pronounced in abuse or misrepresentation. It sometimes seems apparent that persons indulging in harsh criticisms purposely avoid ascertaining the truth which is easily obtainable. A proposed assertion that might seem to be effective in popularizing the speaker or influencing the poorly advised, would be withheld if previous inquiry were made as to the truth.

"The speakers or writers who are recklessly unjust are rare exceptions. But for this reason, if for no other, they perhaps receive more extended notice. And they are a part of the general public and from that viewpoint claim to prepare and deliver their dissertations.

"The volunteer guardians of the public welfare and of private individuals and interests are numerous and audacious. They wrap about themselves the cloak of self-righteousness and proclaim from the housetops. The public has a duty to perform in exposing and controverting hypocrisy and sham on the part of the reckless and irresponsible. In its own interest it is bound to protect private property, private business and capital, and of course, most of all, them that are least capable of caring for themselves.

"Every individual should under all circumstances receive from all others honest and fair consideration. There should not be, there must not be, any discrimination against or in favor of any particular group of persons if this country is to retain the position among the nations to which it is justly entitled.

"The general public, whether it is represented by governmental heads, by Congress or otherwise, should cooperate with and assist private enterprise. Every department of government has responsibilities and opportunities of magnitude at this particular period in our history, remembering that general prosperity is the first essential.

"They can do much toward the preservation or destruction of the Ship of State. They can by precept and example contribute in rehabilitating and re-establishing the affairs of this country. For constructive statesmanship, which will add to stability and progress in the moral, economic, social and political life of the nation, they will be entitled to the commendation of all mankind; while by a narrow-minded, partisan, fault-finding, destructive policy, they will create discord, distress and demoralization. The majority of the people of this country are tired of petty animosities, of unreasonable rewards or punishments, of undue restrictions or liberality concerning public or private undertakings. They are disgusted with muckracking, which usually is conducted for the glorification of the inquisitor and at a large expense to the public. This is especially true of the present, when sentiment is inflamed and when the burdens of taxation are almost intolerable.

"A word concerning the next President—the Captain of the Ship of State. There must be selected one who is able, wise and well-informed, of unquestioned honesty, morally and intellectually, eminently fair and impartial, frank and sincere, broad-minded, deeply sympathetic, courageous, sturdy and well balanced; and above everything else, loyal to the Constitution and the laws of the land.

"Other problems of magnitude, national and international, engage our attention at the present time, but those of highest importance relate to the life and safety of our Ship of State.

Conclusion

"We have reason to expect, and I firmly believe, that now and henceforth, more than ever before in our history, a spirit of unity will pervade and control the minds of all the citizens from the President down; that each one will recognize a personal responsibility to his country and to all its inhabitants; that strictest economy in expenditures and management, lowest costs, and proper compensation for faithful performance will be the universal sentiment; and that order, stability, advancement and prosperity will surely follow."

Use of Cross-Section Paper in Making Charts

By Johnson Barr

In making up charts on tracing cloth which has been previously ruled up into proper columns, it was formerly our custom to rule guide lines in pencil to keep the figures in alignment.

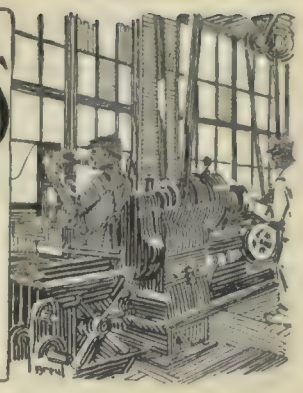
This proved to be a slow and tedious job—especially in making up large charts—and in order to overcome this we hit on the scheme of first ruling up the chart in its proper columns, and then laying it down on a sheet of cross-section paper. The lines on this paper showed through the tracing cloth and it was an easy matter to follow them in adding the figures.

This stunt may be old to some but was new to us, and did away very effectively with the old tiresome ruling of pencil guide lines, so I am passing it along to you for what it is worth.



MODERN PRODUCTION METHODS

By
W. P. Basset
of
Miller, Franklin, Basset & Co.



IN the first article of this series it was stated that there were two main phases to planning production; the preliminary building of a smooth road to facilitate the later movement of work; and the day by day planning by means of which the individual parts of an order are made to move regularly down this road.

We have completed the discussion of the preliminary work and are now ready to see how a specific order is handled in the office and shop. We have seen in the foregoing articles:

1. How purchasing is handled.
2. How stock is kept and controlled.
3. How the product is engineered.
4. How tools are provided and kept.
5. How the shop is put into balance.

VII. The Central Control of Production

In order to manufacture machines economically the various parts should reach the assembly floor at the proper time and to this end it is necessary that they be at all times controlled, from the purchase and delivery of the raw material, to the time they reach the assembly floor. This means planning—not letting "George do it"—or the assembly department will get excuses instead of finished parts.

(Part VI was published in our June 17 issue.)

The movement of work in an unplanned shop has always reminded me of a disorderly mob, lunging first one way and then another way, without precision or apparent aim. The purpose of planning is, of course, to get the work to move smoothly and regularly in a definite direction and at an eccelerated speed. Hence the first step is to organize the mob of parts into an army, comprising units of a definite size. That is, we divide all work up into lots and combine the lots into series. The effect is comparable to that of organizing a mob of uncontrolled Bolsheviki into companies and regiments of soldiers, which can be made subject to control.

The size of a lot must be settled for each part. The general rule is to make the lot of such size that it can go through the average operation in not more than one day. This must be tempered by the size and weight of the part, for the lot should travel as one piece and it should take a great emergency to warrant splitting it.

So that each lot may easily be moved as a unit, it is well to design the trucks so that each will hold one complete lot. In the plant of the Warner Gear Co., for instance, it was possible to design three styles of trucks which handle 90 per cent of the parts. All three types are of wood, mounted on casters and so constructed that for long moves they may be picked up and carried by an electric lift truck. Each has a receptacle for the traveller form.

The dimensions of all three trucks are the same—26 x 36 in. and 44 in. high. In one truck a series of holes is provided to hold such parts as shafts with gears attached; another is provided with pegs upon which gears with holes can be hung; another consists only of shelves to hold such pieces as straight shafts, levers and so on.

To see how the work is scheduled and controlled from the central planning office, let us follow the course of an order from the time the sales department gets it. We have seen in article IV how the engineering department notifies the production department on Fig. 15, the parts list, what parts must be made for any assembly.

This form with the sales order, which gives the delivery specifications, serves as the basis for planning the work by the central planning department.

Our example is taken from a highly complete planning system in a shop which has, under normal circumstances, the advantage of knowing what to make and deliveries specified for at least three months in advance of delivery. When delivery cannot be ascertained from customers' specifications, it becomes a function of the general manager and sales manager to release for manufacture a sufficient quantity of product to keep the shop up to any capacity which has been previously decided upon.

The planning department then goes ahead as if this release were a real sales order. The planning department now posts the story as shown by the sales order onto the "order and shipment record," Fig. 30, this record being headed with the name of the customer and the name of the model which he is purchasing. This form is self-explanatory, it is simply a bird's-eye-view of the obligations to the customer and how well these obligations are being met.

We are now ready to post—guided, of course, by the bill of material—to the "production stock and demand record," which was shown as Fig. 12 in article III. This form is truly the "production man's bible." We mentioned this form rather casually when discussing stock keeping. A careful study of it will now be well worth the reader's time.

This record provides a sheet for each part. It is a comprehensive picture of the condition at any time of each item of raw material needed, for it shows not only what is needed, but how fast the stock comes in and

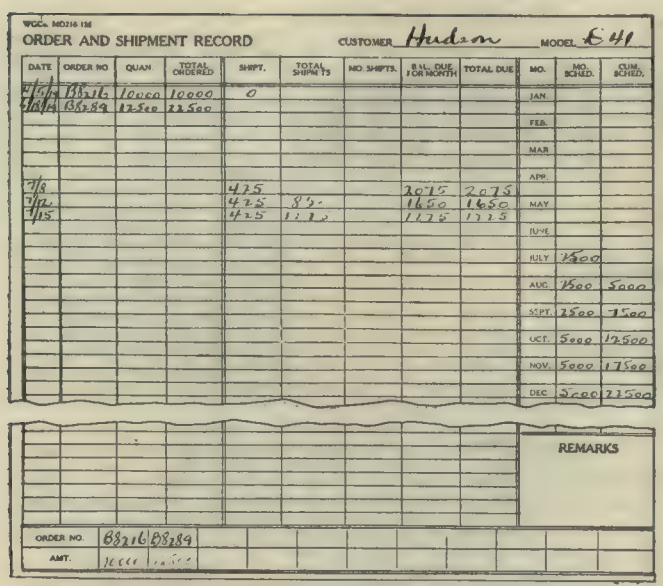


FIG. 30. ORDER AND SHIPMENT RECORD

exactly how much stock is in the plant at any time, after considering receipts, shipments, reclaimed spoilage and all.

One of the chief difficulties in planning production comes from lack of knowledge concerning the disposition of rejected pieces, that is, pieces which may either have to be scrapped, or which may be reclaimed by re-operation. This may cause over-production, over-purchasing and trouble in assembling, due to pieces delayed in passing through the plant.

As the production department posts on this record the delivery specifications, it notes on the parts list, Fig. 15 (part IV) against each part, the standing of the stock available for that order. One copy of the parts list goes to the purchasing department, which contracts for the required material, the delivery dates to be specified later.

Let us assume that an order for, say, 10,000 transmissions comes in April and that the first delivery date is in July. We have seen that certain parts of the assembly will have to be put into manufacture at an earlier date than others.

Why not start all the parts on the same day? Because that would tie up needlessly a large amount of capital in work in process and finished stores. To avoid this we must determine the date on which we should start to manufacture the various parts to insure their simultaneous arrival on the assembly floor. This is one of the most important parts of planning. Otherwise production must be started from assembly floor shortages—which is like locking the stable door after the horse has been stolen. Unless the need for each part at a certain time is foreseen, the production man's time each day is occupied in straightening out the trouble he got into yesterday. It is not only easier, but cheaper and better all around to look ahead and avoid production troubles before they come.

If this order was the only order in the plant, scheduling it would not be so complicated. But as a rule it is necessary to sandwich an order in between several other orders from other customers for the same and different models, which are already in the shop.

Now, no manufacturer likes to receive his shipments all on the first day, nor yet all on the last day of the month.

The automobile manufacturer especially prefers to have his transmissions, say, come to him a few at a time, scattered evenly throughout the month. To oblige the customer, the production of transmissions must be so planned that at certain intervals there will appear in finished stock enough parts to enable the assembly room to maintain an even production, thus making it possible to ship each customer at frequent intervals, a carefully graded proportion of his order.

To do this, the planning department groups all of the sales orders for that particular model that are due for delivery in a given month, and divides the total so that a certain quantity will come through, say, every five days. Thus, if all told, 2,500 transmissions must be shipped during the month, it is necessary to make 500 of them every five working days.

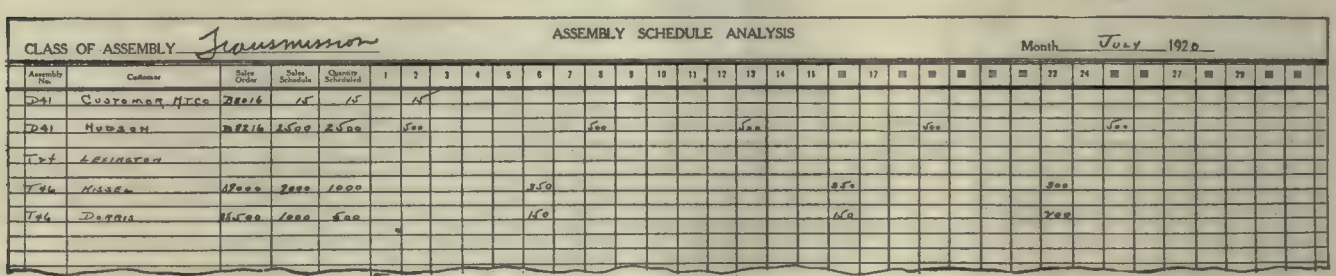


FIG. 31. ASSEMBLY-SCHEDULE ANALYSIS

A better idea of this can be obtained by looking at the "assembly schedule analysis," Fig. 31, which shows the quantity to start, including a reasonable allowance for spoilage. At the right of this sheet are columns indicating the dates of delivery to the finished stores. The different models are so grouped that total may be easily obtained. Since we are concerned now solely with manufacturing we do not care to which particular customer any given model is going. All we need to know is the total number to be built and the dates on which a given quantity will be required.

Having decided to make a total of 2,500 transmission of a given model, 500 of which are destined for our assumed sales order, let dates be assigned on which delivery is to be made to finished stock as follows: July 2, 8, 13, 19 and 25.

This covers the transmission as a whole. However, the transmission is not one single part, but an assembly

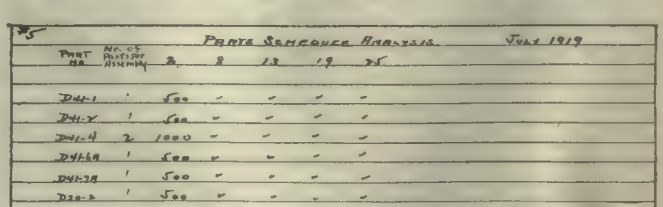


FIG. 32. PARTS-SCHEDULE ANALYSIS

of many parts. It is therefore necessary to analyze the assembly into its component parts and get a record of the number of parts which must be delivered to finished stock on certain dates in order to live up to the assembly schedule. That is done on Fig. 32 the "parts schedule analysis." This sheet carries the following: In the first or left hand column, the assembly number, in the next column, the part number, and in the next, the number of pieces per assembly. The dates heading the columns at the right correspond to the dates on the assembly schedule analysis on which the transmission as a whole is desired. This indicates the finishing dates of the various parts necessary for the complete assembly. The number due on any date is known as a series. That gives, for instance, five series for completion during July, and the planning department is responsible for seeing that these five series come through in July.

From these finishing points, the planning department must look backward and determine the starting dates for each part. This is done by means of a graphic schedule control chart, Fig. 33, which is the master record to the entire planning of production system.

It is in graphic form so that the works manager can, day by day, check the entire work of the manufacturing departments and quickly see that their obligations are being met. It is futile to find fault after the delivery date is passed.

Such a chart can be made up in many ways and of many materials. My experience makes me favor preparing it on a thin vellum cross-section paper from which blueprints can be made, for the reason that in this way a master graph can be made from which as many copies can be produced as there are series.

There is one schedule-control graph for each series; it is therefore possible to have as many as ten or more schedule-control graphs on a given model. The blueprinted graphs are mounted upon display racks, which are made of some material into which a pin can be easily stuck and are so hung that they can be opened like the leaves of a book. All the graphs for one model are kept together with the series number and date due at assembly on the edge of the board.

At the right-hand edge of the sheet, is a vertical line which represents the date on which the parts are to reach the finished stores. Each division represents an hour, then since this plant has the 10-hour day, 10 divisions cover one day.

The heavy, horizontal black lines are drawn to separate the part numbers which, together with the number of pieces in a lot, are indicated in the right-hand column.

At the top of this sheet is shown part D 41-1 and 2, the latter being a sub-assembly. Part D 41-1 travels as a separate part until it has been through 10 operations where it meets part D 41-2 at its sixth operation. The two are then assembled and travel together through nine operations.

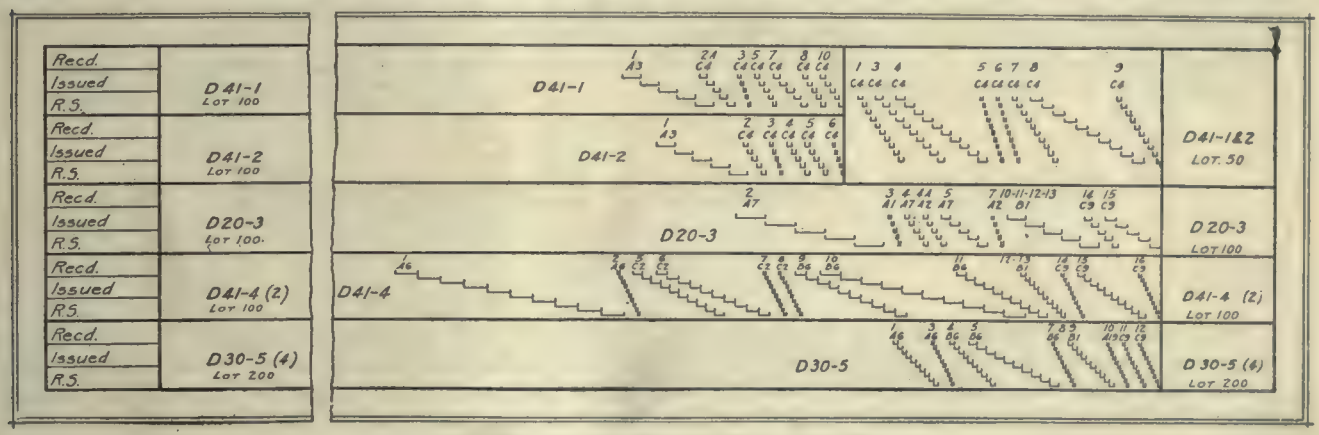


FIG. 33. SCHEDULE-CONTROL CHART
(The original of this chart was made on cross-section paper)

To make the graph for this part, the planning man turns to his production routing sheet which is shown as Fig. 34. The ninth operation on the sub-assembly, "drill idler," takes 0.5 hours for 10 pieces. A lot of 50 pieces therefore takes 2.5 hours for operation No. 9. There are 500 pieces or 10 lots to a series which means that 25 hours are needed to complete a series. The man who makes up the graph therefore lays off 25 divisions to the left of the finish line which he divides into 10 segments of 2½ divisions each to indicate the 10 lots. Since these lots follow each other without a break there is no gap needed between lots. Bear in mind that though lots physically travel separately they do not require separate set ups.

But obviously this part cannot start on operation No. 9 the instant it completes operation No. 8. A certain gap must be allowed for trucking and sometimes for inspection. This gap between operations depends largely upon whether the planning is to limited production or to capacity. If to production, the gap should be made the irreducible minimum; if to capacity, it should be as large as the treasurer of the company will allow, basing his limit on the allowable amount of money which may be tied up in goods in process account. For it is quite obvious that the longer the gap the more work there will be between operations and therefore, the greater will be the shock absorber to take up the jolts

Production Routing Sheet

Part Name "Transmission Case Recovers" Material 1-041-1 : 1-041-2 Part No. D41-1&2 Date 4/20/19

Special Tools	Oper. No.	Operation Name	Dept. Old	Dept. New	Machine No.	Price Set up	Price Piece	Set up Tags	Time Per 10
	1	Turn Flange		CV	204-206-227			0.2	0.4
	3	Face Flange		C4	204-206-227			0.2	0.6
	4	Drill Oil Holes		C4	68-77-21-10			0.1	0.2
	5	Drill Dust Holes		C4	76-79			0.1	0.2
	6	Chain " "		C4	68-77-21-10			0.1	0.2
	7	Grind Flange		C4	602-610-620			0.3	0.4
	8	Face Idler		C4	221-214			0.4	1.0
	9	Drill Idler		C4	68-77-21-10			0.2	0.5
	10	Stock		C4					

FIG. 34. PRODUCTION ROUTING-SHEET

caused by machine breakdowns, unexpected shortage of labor and other emergencies. On an average, we allow at least six hours between the finishing of a lot on one operation, and the starting of the same lot on the following operation.

Now the eighth operation on part D 41-1 and 2 is longer than the ninth. If we started the ninth operation on the first lot six hours after the eighth operation on that lot was finished, the ninth operation would shortly be out of work. So we lay out the schedule so that the ninth operation on the last lot will start six hours after the eighth operation has been completed on all the lots and work back.

The seventh operation is, however, a shorter one than the eighth so the six hours' gap comes after the seventh operation has been completed on the first lot. This is all plain from the graph. In the same way we lay out, working backward, the time needed to perform all operations on a part until finally we determine the exact time the first operation must be started on each part to get all parts done at the same time. The figures C4 above each operation show the department which performs the operation. The numbers 1 to 9 etc. are the operation numbers.

By fastening to the top of the graph a strip showing dates based on 10 divisions to the day, we determine the exact time and date for starting each operation.

Near the left-hand edge of the sheet, a line of arbitrary length is drawn for each part and is divided into spaces, indicative of the number of lots to be run on that part. This last phase of the schedule control indicates the standing of the rough stock on each of the various parts shown. Sometimes it is desirable to make up departmental control-graphs from the master, for the booth men in the various departments. This is seldom necessary however, especially if the machine schedule described later is used.

The schedule control should not be looked upon as something hard and fixed, but rather as a flexible guide for production. It is an ideal from which we may stray, now and then, but which so often as we *do* stray, brings us back to the straight path immediately. Farther on in this article it will be shown how production is followed and kept in balance by use of the schedule control. I want, now, to impress the fact that the schedule-control graph indicates the last possible dates on which the parts may be started and brought through economically. I assume of course that the shop is in balance and that the machine tools are all loaded.

(Part VII will be concluded next week.)

Modern Aviation Engines—III*

By K. H. CONDIT
Managing Editor, *American Machinist*

IN THIS installment we are showing representative motors from two air services which were not only on opposite sides but were also radically different in principle. The Germans concentrated almost their entire efforts on the engines shown, with the result that these two became exceedingly reliable but did not progress nearly so fast as the engines used by the Allies. On the other hand, the British had at one time more than 40 different types of engines in use in their land and sea forces. The difficulty in maintaining these widely varying units may be imagined. Mechanics had to be trained to know all sorts of engines, and the amount of spares required was stupendous. This experience of the Royal Air Force, coupled with the similar experience of their transportation service with a variety of motor trucks, was one of the principle reasons for our development of the standardized Liberty aircraft engine and the several standardized models of motor trucks. The saving in spare parts alone runs into millions.

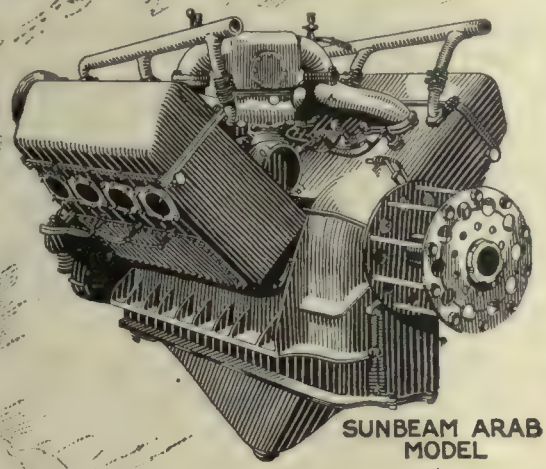
With so many British engines it is difficult to choose only two to represent the field but the recent transatlantic flights of the Vickers-Vimy biplane and the R-34 rigid dirigible airship have offered an easy solution. The heavier-than-air machine was driven by two Rolls-Royce Eagle VIII's while the lighter-than-air craft mounted five Sunbeam Arabs.

The Rolls-Royce aircraft engines earned for themselves a reputation for reliability that ranked with that of the automobiles built by the same company. They were used to the limit of the factory capacity which could be increased but slowly because of the nature of the product. The very fineness of the workmanship necessary in their construction made them unsuited to large-scale production and they were consequently rejected by our aviation authorities in favor of the untried but all-American Liberty. Several of our automobile factories made parts for the British concern, however, and aided materially in boosting production. This engine became the mainstay of the British day and night bombing squadrons, after its trial in the Handley-Page bomber which flew from London to Constantinople, bombed a Turkish battleship, and returned. This, of course, was not a continuous flight but it proved the feasibility of long-distance bombing which was later entrusted to the Independent Air Force. The supply of engines was not sufficient to meet the needs and in the fall of 1918 squadrons were fitted out with DH 9a and DH 10 machines with Liberty motors.

The actual destruction caused by this organization may not have come up to public expectations but their policy of striking at various German bases and manufacturing plants kept a large fleet of defending combat planes out of the front-line fighting, for the Germans never knew where the next blow was coming and had to keep a widely spread aërial defense constantly on the alert. The moral effect on the factory workers is another element that must not be lost sight of. No man can do his best work when he has in his mind the constant fear of explosive or gas bombs dropping into his shop.

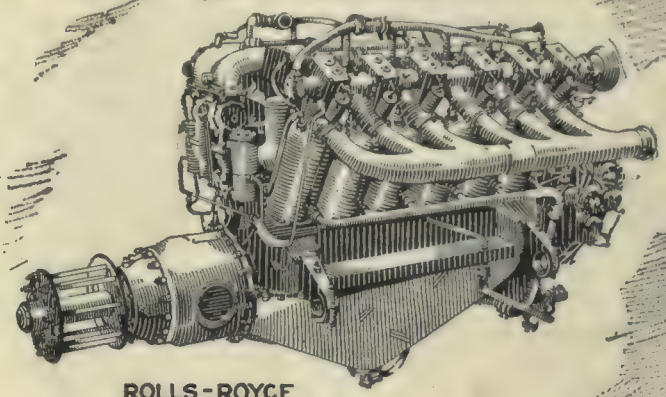
Both the British engines make use of reduction gearing for propeller drive. This, of course, permits the engine to be run at a higher and more efficient speed and at the same time increases propeller efficiency by keeping propeller speed down. An element of uncertainty is introduced in the gearing itself which experience shows has made the engine less reliable. Spur gears are used in the Sunbeam while the Rolls-Royce has an epicyclic or planetary system which turns the propeller in the same direction as the crankshaft.

*Part II was published in our March 4 issue.



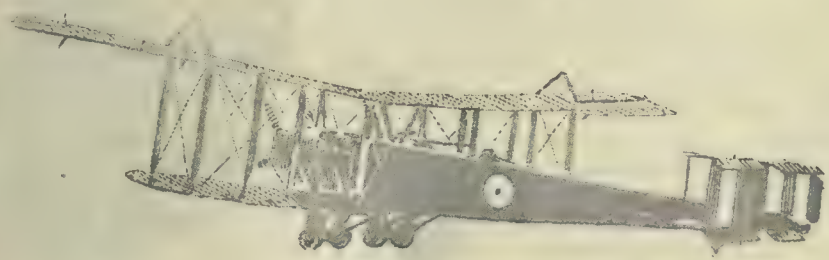
SUNBEAM ARAB MODEL

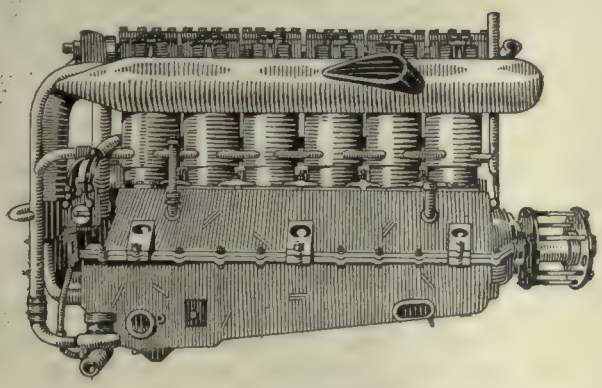
Eight cylinders; bore, 4.72 in. (120 mm.); stroke 5.12 in. (130 mm.); compression ratio 5.3 to 1; rated hp., 200 at 2000 r.p.m; magneto ignition; dry weight per hp., 6.4 lb.; fuel consumption 0.5 lb. per b. hp.-hr.



ROLLS-ROYCE MODEL "EAGLE 8"

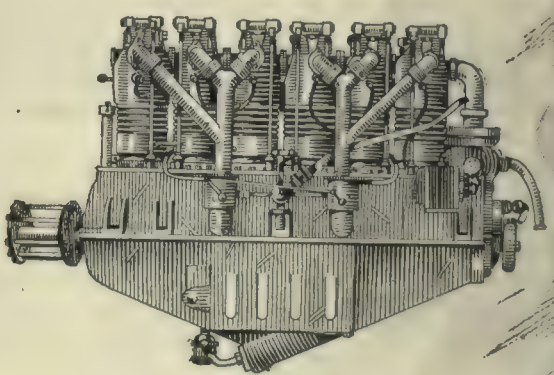
Twelve cylinders; bore, 4.5 in. (114.3 mm.); stroke 6.5 in. (165.1 mm); compression ratio 5.3 to 1; rated hp., 360 at 1900 r.p.m; magneto ignition; dry weight per hp., 2.66 lb; fuel consumption, 0.5 lb. per b. hp.-hr.





MERCEDES

Six cylinders; bore, 6.3 in. (160 mm); stroke 7.09 in. (180 mm); compression ratio 4.94 to 1; rated hp., 260 at 1400 r.p.m; magneto ignition; dry weight per hp., 3.71 lb.



BENZ

Six cylinders; bore, 5.71 in. (145 mm); stroke, 7.48 in. (190 mm); compression ratio 4.93 to 1; rated hp., 230 at 1400 r.p.m; magneto ignition; dry weight per hp., 3.68 lb.; fuel consumption 0.653 lb. per b. hp.-hr.

By - S.Z. Reiter

The Rolls cylinders are individual forgings with welded steel jackets, those of the Sunbeam being more like the Hispaño type except that the aluminum water jackets have plates held by capscrews instead of the intricate single casting. The Rolls engines look complicated because the "gadgets" are all on the outside and most of their design features are the result of years of experience in automobile engineering. The Sunbeam, on the other hand, is pretty well closed in and embodies such advanced ideas as multiple valves, each cylinder having one inlet and two exhausts. The performance of the Sunbeam engines on the transatlantic flight of the R-34 speaks volumes for their efficiency.

The problems of the German air service were much simplified by the early adoption of the Mercedes and Benz engines as standard. With engines of known weight, power and performance, their designers had only to build planes around them. Their scope was limited, of course, but where production meant control of the air they had an advantage. Apparently, they never had much success with the bigger V-type engines, for very few were used, although several models were tried. They also had a copy of the French monosoupape Gnome for their small scouts, but this engine did not have sufficient power for the heavier single-seaters of the latter part of the war.

In performance, the Benz and Mercedes engines did not differ materially, but in detail they were not much alike except in general type characteristics. Both motors were built with two inlet and two exhaust valves per cylinder, but where the Mercedes had an overhead camshaft like the ones used on the Liberty, Rolls-Royce and Renault, the Benz was fitted with camshaft in the crank case and long push-rods which operated double rockers. Both had individual cylinders with welded steel jackets and ventilated crank cases which demanded dry-pump oiling systems with double pumps and outside tanks. The carburetor air-intake pipes were installed in the crank case in each case to warm the air for the explosive mixture. This arrangement also helped to cool the hot crank case.

The Benz piston had a thin head supported by a light steel cone which connected it to the piston pin, thus taking the explosion pressure direct to the upper end of the connecting-rod. The Mercedes piston had a cast-steel head which carried the piston-pin bosses and was screwed and welded to the cast-iron skirt.

The Mercedes carburetor was placed rather low and the long intake pipe was wrapped with asbestos packing to keep the heat absorbed from the crank case.

Either of these engines was used in multiple in the big German bombing planes which aroused the wrath and condemnation of the civilized world by their attacks on Allied hospitals. This work was of a piece with the submarine warfare on hospital ships and was just as futile in attaining the desired result.

Far from terrorizing, it infuriated the Allied people and led to reprisals which never would have been thought of otherwise.

An American firm got a nice order for threaded pipe from Australia. It made application to Washington for permit to ship, but the permit was refused. Because we were at war? Because we needed the pipe for home consumption? No. It was refused because "the application for permit did not state whether the pipe-thread was to be of linen, silk or cotton."—From *Drill Chips*.

Why the Blueprint?

By Harry Senior

The above question raised by Frank Richards on page 871 of the *American Machinist* is timely and to the point.

The usual roll of blueprints is an unmitigated nuisance. Every mechanic who has had to use them knows how they have to be spread out (on his neighbor's bench, for if he spreads them on his own bench there would be no room to work) and the corners weighted with sundry hammers, surface gages, squares, boxes of steel figures, drill blocks, etc., until the place looks like a pawn-broker's window in a machine-shop district.

Then, when things are nicely arranged, neighbor comes back to his bench with his hands full of junk and wants to know "what the ——— ——— ———!! any way?

There is but one kind of blueprint that is worse than a rolled blueprint and that is a folded one. It



accumulates grease and dirt at all the creases; important dimensions become obliterated; it tears along some of the folds, and, just about the time a fellow gets used to it, it separates into several minor and perfectly useless prints and the round has to be started over again.

Blueprints shellacked to a piece of heavy binder's board are perhaps the most convenient for everybody concerned, and even in this form they are unwieldy; a man cannot carry more than two at a time without a truck.

I think the post card size suggested by Mr. Richards for photographically reproduced drawings is too small. Eight by ten inches would be better for the shop, and unless a lot of prints from the same drawing are needed, the zinc plate is not necessary; direct prints on silver paper would serve the purpose.

Now don't commence to howl about the cost of silver paper. How many silver prints can be made for the price of a tracing? More than you will need probably, for the nicely mounted silver print will be taken care of, its glossy surface will repel dirt, and it will last a long time. Besides—blueprint paper is not given away now-a-days.

There is one difficulty in the way of using the photographic process to which Mr. Richards did not call attention. A drawing is seldom finished. No matter how carefully thought out was the engineer's design, there will be additions and alterations from time to time,

and the combination of pencil-drawing and tracing lends itself readily to such treatment while the nicely finished original drawing does not.

However, as Mr. Richards says, the blueprint will never be discarded, and the point at which to choose between full-sized blueprints and reduced-scale photo prints would be easily decided. Perhaps it would be well to make a tracing and work from blueprints for a time until it was apparent that no more changes were to be made immediately, and then photograph.

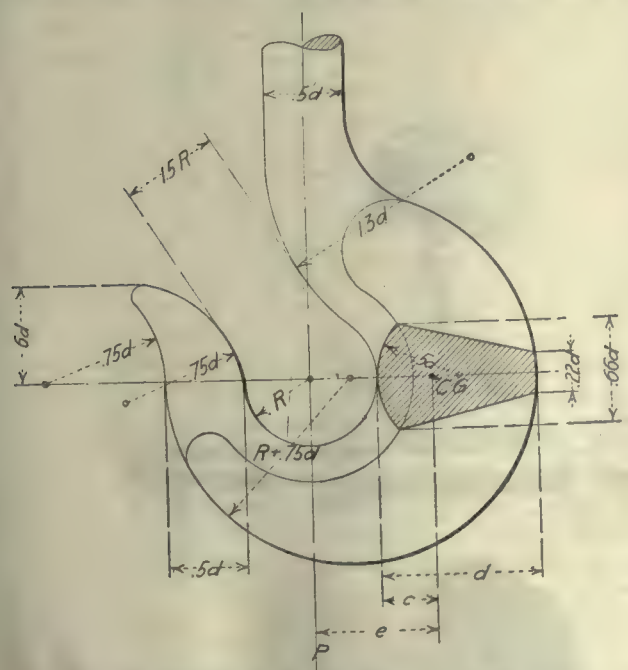
The only difference between a drawing for a full-sized tracing and a drawing for the reduced photo print aside from inking and cleaning would be that the figures and notes should be made larger in proportion, but this would not detract in the least from the value of the average blueprint.

A Useful Formula in the Design of Crane Hooks

By Willard A. Thomas

The writer has made an examination of the various methods used in the design of crane hooks. From a strictly theoretical standpoint the formulas following the well-known theory of curved beams are sufficient to cover the proper design of crane hooks generally. Again, from a practical standpoint there is much available data which has evolved from actual tests under working conditions. As a result of these tests and studies of the theory, empirical formulas for the proportions of crane hooks have been presented, as well as tabulated proportions which have proved useful. A disadvantage that sometimes occurs in the use of tables lies in the fact that the exact requirements are not always found to be within the limits of the tables, or else that the designer must use his judgment in the selection of the nearest values of the requirements to those tabluated. The use of available formulas, however, results in more time being required to get the results.

The empirical formulas for the proportions of crane hooks as given by good authorities are not materially different one from the other, insofar as the result is concerned. In most of these formulas all of the necessary dimensions can be determined providing three requirements be established. These three are: The load to be carried, the allowable unit stress for the material of which the hook is to be made, and the radius of the inside of the hook. The first two of these requirements are always fixed for each particular case, but the third requirement which may be called the inside radius of the hook must often be proportioned by the designer. This is often the first and only obstacle to be passed in making the completed design.



DIMENSIONS OF STANDARD HOOK

For the designer who prefers to rely upon the empirical formulas in the design of crane hooks the following formula for obtaining the third requirement—the inside radius of the hook—directly from the load, is presented as a short-cut through the obstacle, or as a check.

Let P equal the load to be carried by the hook, in pounds.

Then the inside radius of the hook may be made:

$$R = \sqrt{\frac{P}{4{,}000}} + \sqrt{\frac{500}{P}} \text{ inches.}$$

Using this formula and bringing the value obtained for R to the nearest eighth inch will give a value closely approximating the practice of Pawling & Harnischfeger.

This value of R may be at once substituted in the following formula (recommended in Kent's Pocketbook for Mechanical Engineers) for the proportions shown in the figure, together with the values already assigned to the first two requirements mentioned, and the equation solved for d:

$$S = \frac{P\,(7.44d + 12.39R)}{d^3}$$

Where S is the allowable unit stress for the given material, in pounds per square inch.

Proportions for the complete design of the hook may then be obtained by using these values of R and d in the figure as shown.

It may be well to note that this last equation which has been solved for d, has been prepared from values assumed and substituted in the general formula for eccentric loads.

The formula for eccentric loads may be made to apply to hooks of any desired cross-section by writing it in the following form:

$$S = \frac{P}{A}\left(1 + \frac{ce}{r^2}\right)$$

Where S = unit stress, pounds per square inch at the inner edge of the bend;
P = load in pounds;
A = the area of the cross-section, in square inches;
c = distance of center of gravity of section to inner edge of bend, in inches;
e = distance from line of action of load from center of gravity of section, or eccentricity of load, inches;
r = radius of gyration of the section of the hook.

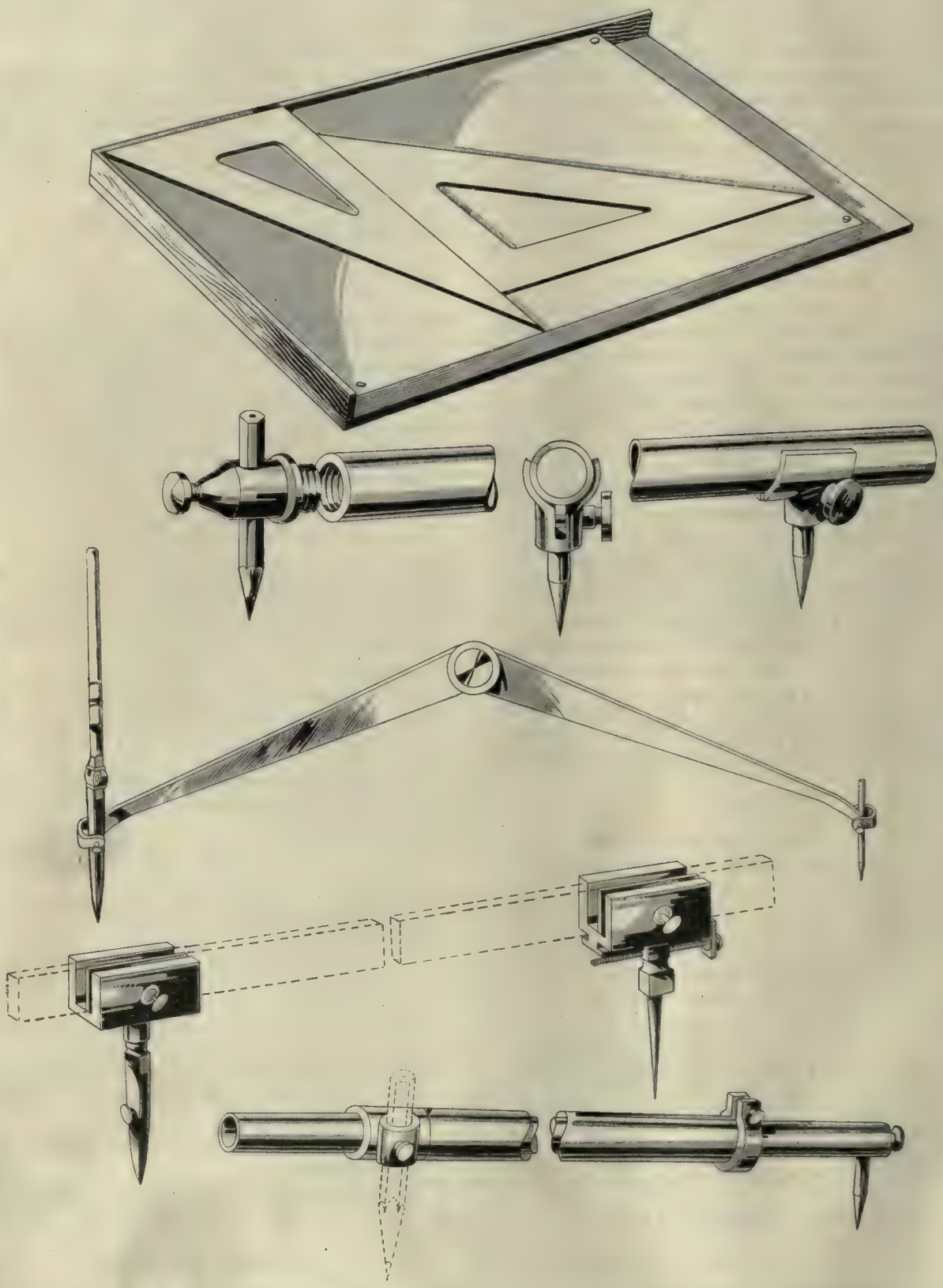
In the case of hooks of circular section, such as small hooks from round bar stock, the general formula reduces to:

$$S = \frac{1.273Pd + 10.186Pe}{d^3}$$

Where d is the diameter of the section in inches.

FOR SMALL SHOPS *and* ALL SHOPS

By J. A. Lucas



Knowing Your Insurance Policy—V

By CHESLA C. SHERLOCK

Do you know what provisions are made in your insurance policy regarding the cancellation of it? This article tells you why your policy should contain definite statements about cancellation, and it explains the rights of the insurer and of the insured in the event of an attempted cancellation of the insurance policy by either one. Other considerations entering into the matter, such as the status of the agent of the insurer, are also treated.

(Part IV appeared in our June 10 issue.)

Rescission and Cancellation

IT IS very often necessary to know when the assured can cancel an insurance policy, just as it is necessary to know when the insurer may take this step. Laws have been passed in so many jurisdictions safeguarding the right to cancel that it has come to be taken as a matter of course in most instances.

In the case of life policies, which we have treated only incidentally and by way of reference in these discussions, the right to cancel rests with the assured at any premium-paying date. He may simply refuse or neglect to make payment when due, and this will amount to a cancellation of his policy. In cancelling the policy, however, he loses all rights thereunder, even to have the premiums already paid refunded, unless there has been a prior agreement to the contrary.

In the case of fire and casualty policies, the laws are more lenient and they have enumerated in practically every jurisdiction just the basis upon which the assured may cancel and his rights thereunder. Generally a cancellation in the case of these forms of insurance does not amount to a forfeiture of all premiums paid, but merely a forfeiture of a pro rata amount required to be stated in the face of the policy itself.

In mutual companies, the certificate of membership, the charters and the by-laws will be consulted in order to determine just the basis upon which the assured may cancel his policy and membership. It is usually recognized that such companies have the right to prescribe the manner in which the rescission of the insurance contract may take place.

Conditions Necessary for Cancellation

Joyce says, in this connection: ". . . it may be generally stated that the right to rescind, abandon, or cancel a contract of insurance must arise either: (1) by virtue of some statute; (2) from the terms of the contract itself; (3) by reason of some breach thereof; or (4) under a power reserved therein; or (5) by mutual consent of the parties thereto. (a) If, however, the policy has been obtained under certain circumstances of fraud, misrepresentation, or mistake, a court of equity may order a cancellation; it may also rescind on a proper showing. (b) It is necessary in case of rescission or cancellation by agreement that there be a complete meeting of the minds, otherwise the agreement will not stand. (c) To the extent that insurance is a contract of indemnity that essential must be considered, as must, also, the right to have the policy continue in force according to its terms."

Where the statute provides that the assured may have a right to cancel upon request, it is held that as soon as the request is made to the insurer that it operates as a cancellation, in so far that a further continuance thereunder would be contrary to the expressed purpose of the statute.

In California, where the statute specifies grounds for the cancellation, it has been held that the assured has no right to cancel and ask for a pro rata share of the premium already paid, unless he enumerates the ground upon which he bases his action, in accordance with the statute.

Cancellation Effected by the Insured

In New York, the statute provides: "Any corporation, person, company, or association transacting the business of fire insurance in this state shall cancel any policy of insurance upon request of the insured or his legal representatives, and shall return to him or his representative the amount of premium paid, less the customary short rate premium for the expired time of the full term of which the policy has been issued or renewed, notwithstanding anything in the policy to the contrary. Where the laws of any state permit corporations organized under its laws to cancel policies of insurance upon different terms than herein set forth, corporations organized under the laws of this state may cancel policies upon risks in any such state upon the same terms as are provided for corporations organized under its laws."

The Massachusetts standard fire policy provides: "This policy may be cancelled at any time at the request of the insured, who shall thereupon be entitled to a return of the portion of the above premium remaining after deducting the customary monthly short rates for the time this policy shall have been in force. The company also reserves the right, after giving written notice to the insured and to any mortgagee to whom this policy is made payable, and tendering to the insured a returnable proportion of the premium, to cancel this policy as to all risks subsequent to the expiration of ten days, from such notice, and no mortgagee shall then have the right to recover as to such risks."

It is well settled and there can be no doubt but that the parties have a right to cancel by mutual agreement provided the rights of third parties will not be injured by such action.

Cancellation Effected by the Insurer

Very often the company reserves the right to cancel, or retains an option on the privilege, in the policy itself. It has been held that cancellation is not effected under an option by a mere request for the return of the policy for cancellation, nor is notice of an intention to cancel sufficient.

Cancellation may be effected by a failure to pay premiums, assessments or meet conditions as to payment expressed in the policy. It has been held in a Washington case that cancellation is effected where the insurer has directed the agent to cancel the policy on the company's books after the assured has received notice and after the expiration of the required time limit without payment.

Where it is stipulated in the contract or certificate that failure to pay premiums or assessments shall amount to a cancellation, such a failure to pay on the time set aside amounts to a cancellation. But in the case of assessment the company does not have a right to declare the contract cancelled unless such assessments were legal and binding. Illegal assessments cannot be used as a means of avoiding a valid contract.

In California, it was held that the company has a right to cancel for fraud, misrepresentation or concealment of facts material to the risk, and that where a company tendered premium back to the assured and gave notice of cancellation prior to commencement of suit that cancellation was effected.

And in a New York case, it was held that the company would have to tender dues as a condition precedent to cancellation, for the twenty-one years that they had been paid by the assured before it could cancel for misrepresentation as to age.

It has been held in another New York case that fraud of the assured is ample ground for the rescission of the policy. In fact, any misrepresentation as to a fact material to the risk which has misled the insurer in accepting the risk is proper ground for rescission or cancellation of the contract of insurance, as the case may be.

It is well settled that where the policy has been assigned to a third party as security, that the consent of the assured is necessary before the company can be permitted to cancel it.

Necessity of Giving Notice of Cancellation

It is necessary, in order to cancel the policy, to give the notice required by the statute, in substantially the required form and within the prescribed limits of time, before the actual act of cancellation can take place. The company cannot effect a cancellation by merely making an entry on its books to that effect, for such act is without the knowledge or consent of the assured. In New York it was held that, where the cancellation was effected by a written instrument induced by false representation on the part of the company's agent, the assured is not thereby stopped to assert his rights under the policy.

It has been held in Minnesota, however, that where the company has been given notice to the effect that more insurance has been taken out contrary to the express provision in the policy, that the failure of the company to elect to cancel the same under the terms of the policy and return a ratable proportion of the premium does not justify the conclusion that it elects to continue it in force.

The cancellation clauses in insurance policies should be clearly expressed so that they may be readily understood. As to the construction which the courts will place upon them, the New York court has said: "It is a question of vital importance to the insurer and to the insured as to the precise meaning of the cancellation clause of the standard policy. The situation is not a complicated one and the court desires to so construe the clause that its meaning may be made clear."

Status of the Agent of the Insurer

Ordinarily, the agent of the insurer has no authority to cancel, but he can act upon instructions from the insurer. It has been held that where the agent is instructed to cancel a policy by giving the prescribed notice to the assured and obtaining the policy, but through carelessness or negligence fails to do so, there is no cancellation.

And it has also been held that even though the agent has given notice to the assured but fails to tender or pay ratable premium returnable to the assured, that there is no cancellation. But, where notice has been given to the assured and he has surrendered the policy, but no money has been returned to him, there is a cancellation of the contract and the assured cannot assert his rights thereunder in case of loss.

It can be stated upon the weight of authority that where a cancellation of the policy is ordered by mistake upon the part of the insurer that the assured or those holding under him by assignment are not bound by it. And where cancellation is ordered by the insurer through the misrepresentation or fraud of the agent, it is not binding upon the assured. The New York court has said that where a clerk in the employ of the insurer enters a cancellation upon the company's books, even without notice or knowledge of the assured, that the latter cannot maintain an action upon the policy, but the majority opinion of the courts support the view first given.

Rights of the Insured Under Wrongful Cancellation of the Contract by the Insurer

In a Federal case, the court said: "Where one party to a contract to be performed in the future, before the time for performance arrives, refuses to perform, he thereby, so far as he is concerned, declares his intention then and there to rescind the contract. Such renunciation, however, in and of itself does not work a rescission, for one party to a contract cannot by himself rescind it. But by making the wrongful renunciation he entitles this other party, if he pleases, to agree to the contract being put an end to, subject to the retention by him of the right to bring an action in respect to such wrongful rescission. . . . A declaration of the promissor before the time for performance has arrived, of his intention not to perform, is not of itself, and unless acted upon by the promisee, a breach of the contract. Such declaration only becomes a wrongful act if the promisee elects to treat it as such. If he does so elect, it becomes a breach of the contract and he can recover upon it as such."

Probably no statement by the courts more clearly expresses the rights of the assured, in case the insurer wrongfully attempts to cancel or rescind, than the above opinion. It simply means that the assured has a right of action against the insurer for breach of the contract and that he is entitled to collect whatever damage he may be able to prove as a result of such wrongful act. Or, if he so desires, he may refuse to accept the wrongful attempt to rescind as a breach of the contract and continue under it. It is needless to add, that if the wrongful act is upon the part of the assured, that the insurer has the same rights as would be the case if the conditions were reversed.

Action Which Insured May Take

Joyce, speaking of the wrongful cancellation or termination of the contract by the insurer, says: "The general rule, however, which is undoubtedly the result of the authorities, is that upon such wrongful cancellation, repudiation, forfeiture, or termination of the contract by insurer, insured has the right: (1) To con-

sider the policy terminated and recover its just value in a proper action therefor; (2) To institute an equitable proceeding to adjudge the policy in force, and the question of forfeiture can then be determined; (3) To tender the premiums and when the policy becomes payable, an action may be brought upon the policy and the question of forfeiture be then tested."

A Connecticut Case

In a Connecticut case, the assured attempted to recover back the premiums paid, relying upon an implied promise to keep the policy alive; but the court refused to entertain the action, saying that the assured had only three remedies, and that they were the ones named.

It is well settled that the insurer cannot cancel the policy under circumstances which would work a fraud upon the assured. This means that the insurer has a right to cancel for increased risk, where it is done in good faith, but the insurer has no right to cancel when loss is imminent, as where an approaching conflagration threatens the property of the assured.

Where cancellation is attempted by giving notice by mail, it is a rule of law that the notice must be received by the assured before loss occurs in order to release the insurer from liability.

In the whole subject of cancellation, it will be found that the general principles of the law of contracts apply, modified and strengthened in some cases, but the evident intent of the law is to work the utmost justice between the parties in each case.

Research Work on Gears Needed

By R. J. Chapman

The *American Machinist* has from time to time published articles entitled "Strength of Gear Teeth," such as those in Vol. 51 by Willard A. Thomas, page 273, and S. J. Berard, page 925. The writer of practically every article on this subject makes good use of the well-known Lewis formula. This formula is in general use today, and is accepted without question as being based on correct assumptions, although some little difference of opinion may, perhaps, exist in regard to the stress allowable for various materials.

Success in designing gear drives to operate satisfactorily under specified conditions is, however, very largely a matter of appreciation of what has been done before under very similar conditions; and the Lewis formula, being a formula for strength only, is of no assistance in selecting the most suitable combination of pitch, diameter, face width and material for the purpose. Experience only can determine these proportions, because, even though the gears be made to a fine degree of accuracy, and are capable of transmitting the load without tooth breakage, it does not necessarily follow that they will be satisfactory in operation.

Further investigation could be made to advantage to establish reliable data relative to the various factors that determine the smooth operation and life of gear trains. These investigations could well be undertaken by any recognized independent authority, such as the American Society of Mechanical Engineers in the United States, or the National Physical Laboratory in England. The research could be divided into three sections. The work in section one would be to establish the most suitable material for use under given conditions, the allowable stress, the allowable pressure, the resistance to abrasion, the elasticity and such things being found for different materials. Investigation in section two would deal with methods of manufacture, and an attempt would be made to define the degree of error permissible for various grades of workmanship. Research in section three would determine the influence upon the life and quiet operation of gears of such variables as peripheral velocity, load per unit of breadth, number of impacts, ratio of reduction, grade of workmanship, heating, and the disposition of metal in the gear rims and arms. Methods of gear mounting to absorb vibration, and the lubrication of gears would also receive attention.

It will be agreed that successful research work along these lines would provide dependable data for the design of gears to meet any conditions in regard to load, speed, quiet running, life and such points. Alone, the Lewis formula can only be used to ascertain the maximum permissible load to ensure freedom from tooth breakage; and, unfortunately, with many gears this is the only point checked by the gear designer, with the result that they are transmitting excessive pressure, so that backlash and noise develop in a short time.

Bench Covering That Gave Satisfaction

By E. F. Creager

Some years since, in moving a manufacturing plant that had been arranged by a manager who had greater ideas of the office capacity needed than manufacturing knowledge, we had a large quantity of a good quality plain color linoleum left over after the offices were fitted up.

This lineoleum had already been in use for three years as a floor covering. When we set up the benches for the toolmakers and assemblers in the new plant they were not satisfactory as they had been in use for some time and were originally made of poorly seasoned material which had shrunk very much, also the surface was oil soaked and rough from use.

We could not at the time get lumber of any better quality than that in the old benches and not nearly as well seasoned, so we decided to cover the benches with the linoleum and see how it would work out. There were many sceptics. We scrubbed the old benches as well as we could, filled the cracks with wood strips and the worst depressions with a putty of saw dust, glue and calcined plaster and put on one thickness of "builders felt" paper. Over this we laid the linoleum, fastening it down with half in. No. 20 wire brads spaced one inch apart along the front edges and cross joints leaving the back edge loose for expansion. The brads were put $\frac{3}{8}$ in. from the edges of the linoleum.

These benches were used by toolmakers and assemblers on general work and after four years continuous work the covering was in excellent condition. It presented a smooth neutral-colored surface well liked by the workmen. It was of course both water and oil proof and easily kept clean. Since the above experience I have had covered several hundred lineal feet of 30-in. wide benches with linoleum which gave excellent economy and satisfaction.

On steel benches it is very good. It protects delicate work from contact with the bench metal and on large work the noise is practically done away with.

There are several cements that will hold it to the metal very satisfactorily; bicycle tire-to-rim or rubber patching cement have both given satisfaction.

Observations of a Field Editor

By FRED H. COLVIN
Editor, *American Machinist*

San Francisco Shops

THE machine-tool situation in and around San Francisco may be said to be similar to that in Los Angeles in many ways. The main difference is the predominance of shipbuilding and repair, and the increased saw mill and similar business in the northern end of the state. The annual machine-tool business north of the Tehachapis is estimated at about $1,500,000, or 50 per cent more than that in the southern half of the state, and giving a total of about $2,500,000 to the state.

The shipbuilding concerns utilize more large machinery than is found farther south. Then, too, there are builders of water-power machinery which runs into large sizes. This, however, is probably offset by the sugar-mill machinery of other sections, leaving the large shipbuilding interest the over-balancing factor in heavy machine tools.

The ship yards are also said to overbalance the labor market and labor conditions, being for the most part the only ones to employ specialists or operators. This, and other differences in both employing and working conditions has not tended to secure the best results during the labor differences of the past six months. It has led to a compromise or differential arrangement with the smaller shops which seems to be working out very well so far as it has had time to operate.

The Average Shop

Manufacturing of small devices, parts for automobiles or appliances or attachments for them, affords a market for a good number of machines, although in small lots. As an example, one concern has placed forty-two well-known high-grade cylindrical grinding machines during the past year and in very few cases has more than one machine gone into a single shop. Large and well-equipped garages absorb lathes, drilling, milling and grinding machines, although not in large numbers. In both machine tools and small tools the demand is in excess of the supply, with deliveries getting worse instead of better. This is due both to the delay in shipments recently and the effect of the tie-up in the Cincinnati district.

Possibilities of Manufacturing

Here, as elsewhere, the question of prices is being discussed from various angles, and while this is not likely to deter buying, so long as the need is urgent, there is a general feeling that the prices on some machines have now gone beyond the reasonable limit. The feeling will, of course, tend to stimulate the building of machine tools on this coast, which would meet with the hearty approval of many whose local pride is a large part of their make-up. The increase in the production of steel-mill products may make it possible for further advances in this direction, and if the coal from Alaska proves to be of the right quality, we may see a change in the dependency of the Pacific Coast on our eastern mills.

The settling of the labor difficulties here seems to bid fair to be of real benefit to all concerned. There is a sincere desire on the part of management to promote a real basis for mutual understandings with the men. One of the new developments is a differential scale graduated according to ability. The real open shop, in which a man may or may not belong to any organization, forms part of the terms of settlement. The forward looking managers are awake to the necessity of securing interest and co-operation and are keeping the men informed as to the work in hand and in other ways making them feel that they have a real stake in the business.

The results are just beginning to show in some shops, even though they are not running full handed. But production is coming along at a very satisfactory rate and in some instances, on work which can be compared with eastern products, actual production costs are said to be fully as low as in the East. This can be attributed only to better production per man because, as a rule, the quantity is much less and the machine equipment less highly specialized.

Ex-Service Men in Shops

As in other sections of the country, the question of trained men has been a serious one, and still is. In some classes of work, where there is repetition, as in turret lathe work, it has been found that ex-service men have done remarkably well. The army discipline helps in doing just as the instructor directs and it has made good men on this work with few exceptions. The well-set-up-ness of these men is rather striking, as one goes through a shop and sees machine after machine operated by young men who have apparently just stepped off the parade ground.

In some of the factories here, such as glass bottle making, and this is a well-established industry, men and women of different nationalities are working side by side without friction, regardless of race or color. San Francisco, like New York, is a cosmopolitan city, as it is the point on the West coast where probably more nationalities meet than elsewhere. The harmonious blending of workers reflects on the broadness and liberality of the management, as without it friction would be difficult to avoid.

Pacific Coast Motor Trucks

There seems to be quite a tendency to build, or rather to assemble, motor trucks on the Pacific Coast. And yet it is not altogether assembling, because the practice seems to be to build the frame and transmission, buying the motor and axles from standard makers of such parts.

Many of these plants were established before the war, but a number of them found their opportunity when the older and established builders were so tied up with war work as to make it impossible to supply local needs.

Some of the local builders have become well

enough established to enlarge their plants and almost all of them seem to have built up a good reputation for service and reliability. Four- and five-speed transmissions are included in the specifications, frames are heavy, and altogether there seems to be the foundation for much future business along the Pacific Coast. As these plants enlarge they will, of course, form a market for more and more machine tools of various kinds.

Some of the Problems of Pacific Coast Shops

While the problems of the machine shops on the Pacific Coast differ in many ways from those in the East, there is one which is common to them all—the need of men who can handle work satisfactorily as it comes along. The need of practical training is even more urgent in the extreme West as "operators'" are of little use in most places on account of the lack of manufacturing shops and methods. The cry is insistent for more men and for better trained men.

Whether this lack of trained men is entirely due to union restrictions on apprentices, as some claim, or whether it is partly due to the same causes as in the East, is not altogether clear. But the shortage is apparent and the remedy is not yet in sight although an earnest attempt is being made in a number of large shops to give ambitious boys a thorough training.

Training Mechanics

Considerable attention is also being paid to the technical high school as a foundation for mechanics of the higher grades, and for shop executives. In one case in particular the so-called technical school is, for the most part, a thoroughly practical trade school, except for such boys as are preparing for college. These boys get a year of shop work, the other boys get four years.

This shop work is thoroughly practical, is as commercial as the personnel and inclination of the school board will permit, and, so far as can be learned, actually turns out a good grade of mechanics who can go out and earn regular wages in any shop. Something over a hundred boys have been turned out from one school and a large percentage of these have worked their way up into executive positions.

The railroads, too, are paying considerable attention to the training of mechanics, as the nature of locomotive repair work demands men who can tackle almost anything which comes along.

All-Around Men Needed

Generally speaking, it may safely be said that the shops on the Pacific Coast require a better grade of mechanics than those east of the Mississippi River.

There is little special machinery, and men must find ways and means of utilizing whatever machines, tools and appliances happen to be available. The exact material desired may not be, and at present probably is not, available and the next best substitute must be used.

Initiative and resourcefulness must be a large part of the equipment of the man who is to succeed. The "one operation" man has no place in the machine shops of this section.

The present status of industrial relations between the men and management looks hopeful, even though the dove of industrial peace has not yet satisfied itself that the warfare has actually ended. Organized labor is very strong on the coast, especially in the San Francisco district, and as is usual where an organization of any kind, either secular or religious, becomes over strong, abuses and intolerance creeps in. Bosses of the same types as we find in city politics came into power and an armed peace developed into open welfare which lasted over six months, in fact the full treaty of peace occupies much the same situation as the one concerning our relations with Germany.

The blockade has been lifted, however, in most cases, most shops are at work with a partial force, many of the old men are back and there is an earnest effort to get together on a more satisfactory basis than before.

Management is trying to establish better industrial relations with its men; works councils and similar machinery for getting in closer touch with the men are being established to afford easy and democratic channels for discussing and settling problems as they arrive.

Those high in authority are endeavoring to lead the way instead of always remaining on the defensive as heretofore, and there seem to be indications that, after the smoke of battle has cleared, there will be a better understanding than ever before. Open shop means what it says, that both union and non-union men will be employed. And the next few months should see things on a much sounder basis in every way.

Raw Material

The Pacific Coast shops are handicapped by having two mountain ranges between them and their raw material. For while there is some iron and some coal they do not seem to be just adapted to the needs of pig-iron production. These very mountains, however, are full of streams which make it possible to produce electric power at a cost which makes the Eastern manufacturer green with envy, and rather extensive experiments are being made to secure iron and steel without the use of coke. In spite of these handicaps, however, it has been extremely interesting to find instances where small machinery has been produced and shipped East at a lower price than that of the Eastern manufacturer, and this without special machine equipment.

It is simply another case where ingenuity and initiative have devised new ways and means of getting results just as our forefathers did in the Naugatuck Valley and elsewhere, before the days of big manufacturing. For the work in this section can be called a jobbing shop business, where it is necessary to secure economical results with the least possible expenditure for special tools and fixtures. And they succeed admirably in most cases.

The Machine-Tool Business in Southern California

The machine-tool business in Southern California has, in round numbers, an estimated annual value of about a million dollars, according to some of the best-known dealers. This business very naturally and properly centers in Los Angeles which is growing as a manufacturing center, in addition to being so overrun with tourists as to make it difficult for business men from other cities to secure hotel accommodations.

The fields to which these machines go are varied both as to product and requirements. The more standard machines, such as lathes, drilling and milling machines and shapers, are naturally the most in demand. Automatic screw machines are for the most part confined to the few shops which turn out screw-machine products, but semi-automatics are beginning to find places in some of the larger shops.

Automobile Work Plays a Big Part

Although this is not an automobile-manufacturing center, it is estimated that the automotive industry takes from 30 to 50 per cent of the machine tools sold in this territory. This means for the most part that garages and automobile-repair shops buy many more machine tools than we are accustomed to find in the East and South. For here they do not seem contented to run an automobile-repair shop with a couple of files, a few wrenches and an oxy-acetylene outfit, with possibly a decrepit blacksmith's post drill. They have real shops with lathes, milling machines and now and then a real, honest-to-goodness cylinder grinding machine.

There are numbers of shops, not of large size yet aggregating considerable machine equipment, which make automobile parts such as light-weight pistons, piston pins, special cylinder heads, etc. Then, too, there are shops which build special motors for racing cars, for airplanes or other purposes, some of them well equipped with modern machine tools.

Stimulating Airplane Development

The airplane has perhaps more opportunities in and around Los Angeles than in most sections. For though it may be said to be bounded by the Sierra Madre Mountains on the East and the Pacific Ocean on the West, there are eleven good landing fields which can be reached with a dead motor from a height of 5,000 ft., and many emergency landing places. The present year is expected to see considerable development in the actual use of airplanes in this vicinity—and as nothing of this kind can develop without machine tools of some sort being involved, it will have its effect on the total volume of the demand. Special planes are being built in Venice, a suburb of Los Angeles, for local use.

The machine industries of Los Angeles and vicinity, which must take in San Diego, include Diesel and plain gas and oil engines; oil-well machinery of various kinds; steel mills; sugar-mill machinery; marine engines; cranes; trucks, which except for the motor are built here; lathes and special tools; special machines for making fruit baskets and many other lines. The new plant of the Goodyear people will also utilize a large amount of machinery and will add much to the industrial tone of the city. The Savage Tire Co., at San Diego, is also enlarging its plant.

Shipping to the Orient

The harbor at San Pedro, which is the port of Los Angeles, also boasts of direct connections to the Orient and this is making it a distributing center for goods which are to cross the Pacific. The people of Los Angeles are particularly proud of the fact that the cargoes now being shipped are almost entirely products of that city—97 per cent of the cargo of the last shipload being manufactured, or raised, within the city limits.

As in many large cities there is a tendency for manufacturing to leave the city proper for some of its suburbs. One of the well-known plants has expanded its capacity within the city limits, but others are going outside, some to a distance of fifteen miles, to secure suitable locations. The effect on labor in such cases seems to depend very largely on whether real-estate owners are reasonable human beings or belong to the hog family which we are now calling by the name of profiteer. But this is not a problem of Los Angeles alone—it is universal.

There is a movement on foot among automobile dealers and the better repair shops to insure more reliable work in garages. It is known as the Auto Crafts Association and aims to accomplish the much-desired end of securing reliable work when a car goes to a garage for any sort of overhauling. The State of Oregon enacted a law last year which required automobile repair men to be licensed the same as plumbers and electricians so as to make them responsible in case of poor work. Any move which will accomplish the desired result is to be commended by all.

Deliveries and Prices

And now for predictions or guesses as to the future of the machine tool business in this field, based entirely on the opinions of those directly in the business. The usual complaint of slow deliveries was to be expected, these being worse than usual because the effect of the rail strike was just beginning to be felt at the time of my visit.

There is every indication of continued business for the balance of the year if those in direct contact with the field are any kind of guessers. They feel, however, that prices have been boosted beyond the safe limit for a substantial business. They admit that pre-war prices of machine tools were too low in some cases but feel that the more recent advances have not been warranted by actual manufacturing costs and they fear that the reaction will not be for the good of the industry. They also resent what they conceive to be an indifference in some cases, as to the quality of material sent to the Pacific Coast, this applying more to actual materials than to machine tools.

Men and Management

One healthy sign is a widespread interest in the present and future relation of men and management in securing efficient production in the shops. This is noticeable with both factory and dealer, as the latter realizes that his future depends upon harmonious relations at the source of supply. Management in most shops is taking a personal interest in the welfare of men, is assisting in educational work in some of the shops and is trying to make conditions such as to secure co-operation and interest. The smaller number of men, the diversified line of work and the interest which this naturally brings, makes it more easy to avoid monotony and its evils in the shops, of labor turnover and lack of loyalty. There is a tendency toward frankness, toward laying the cards on the table as the saying goes, which can hardly help bearing fruit.

The superintendent of one large plant put it this way: "Times have changed, and for the better. It takes real managers to run a shop these days and it's a heap more credit to run one right than it ever was before."



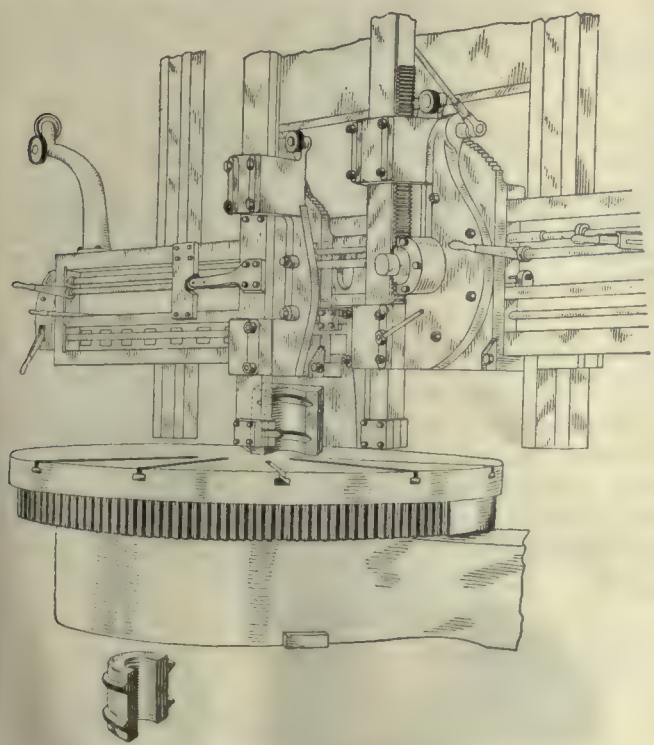
Form-Turning on a Boring Mill

By Frank C. Hudson

The accompanying illustration shows an interesting application of a form and roller to the boring of a pair of V-ways in the bed of a special gear-cutting machine at the Gleason Works in Rochester, N. Y. The form is fastened on the crossrail of the boring mill as shown, and the roll attached to the ram of the boring head. The angle of the form controls the path of the boring tool in both directions, the point of the cutting tool being set to the work by suitable gages. Both the upper and lower ways are bored from the same guide by simply adjusting the position of the roll on the ram.

The illustration makes further explanation unnecessary and shows an application which can be used in many other cases. The male member, which fits into the ways, is also turned on this boring mill by means of the same form or guide. The pieces to be turned are clamped to a special fixture so that two are turned at the same time.

This method has been used for some time and has proved perfectly satisfactory.



USING A FORM FOR TURNING V-GROOVES

Courting Trouble

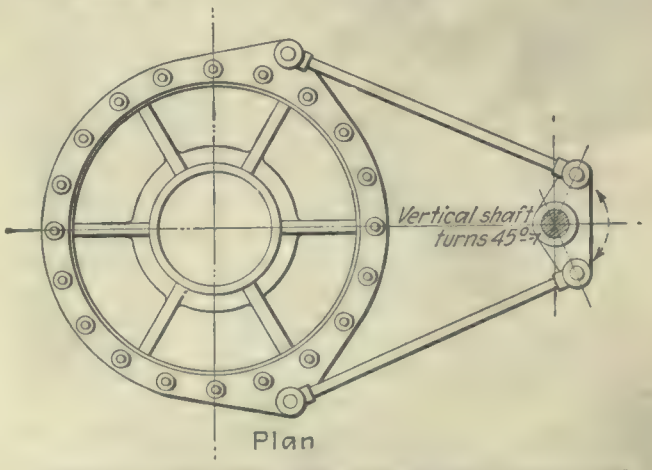
By John S. Carpenter

It is too bad that there isn't enough trouble in this world to go around. If you don't believe it, read my story.

The sketch shows a gate rigging for a water turbine as made by a back-number shop. The ring is rotated about ten degrees on its center by means of the vertical rocker shaft and the solid-end rods, thus admitting or shutting off the water that drives the turbine. The way the thing is made is interesting, in so far as it is the way not to do it right.

The length of the rods is figured to the nearest thousandth by the draftsman, who spends about two hours in figuring the various angles and lengths necessary. As was stated above, the rods are made with solid ends, so that no adjustment is possible. As the rods are usually about seven or eight feet long, and their surfaces are not faced off so that the layer-out can do his work with facility, you can see how much probability there is of getting the centers within a tolerance of fifteen thousandths.

Sometime a bonehead erector will grout in the machine without assembling the rods and trying out the movement, in which case, should the shaft centers be out as little as one thirty-second, the thing will not go together by about twice the amount out. With a rig like this, the dice are loaded against the erector. How much cheaper and safer it would be to have right and left threads on the rods, and to have the draftsman spend his time at detailing instead of figuring.



A POORLY DESIGNED GATE-OPERATING MECHANISM FOR A WATER TURBINE

In the construction shown, one rod in tension and the other in compression under load, suppose that the lengths are such that the rods will take the load equally. The probabilities are that one rod does all the work, which shows the possibility of using a slightly larger rod with adjustable ends, which should do the work more safely. Certainly, a one-rod job would be much simpler in detailing, manufacturing and erecting, and the operating characteristics would not be perceptibly different from what the designer thinks a two-rod proposition is. It is foolish to use a construction such as shown, because it provides no means of adjustment, either for the erection or for the operation of the machine.

The shop above referred to still cuts almost all of their threaded work to the sharp V-thread, so that the draftsmen must be careful not to specify U. S. Standard shape on the drawings. The toolroom does not have the necessary taps and dies.

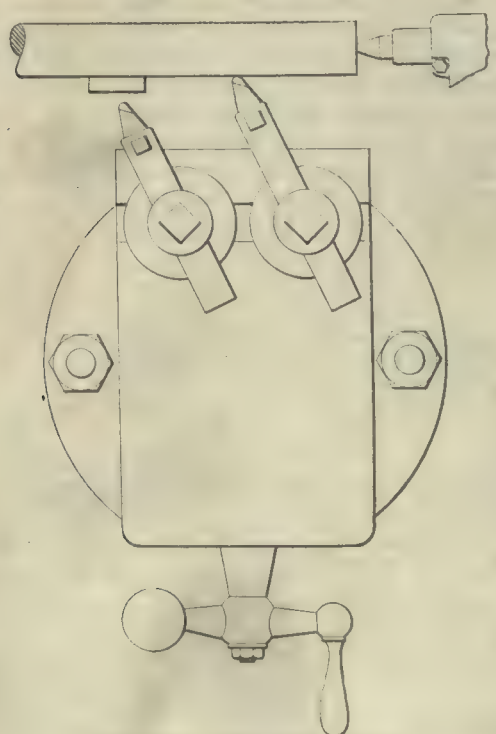
Using Two Tools at Once

By M. Jacker

From what Mr. Pusep says on page 393 of *American Machinist*, it might be inferred that I countenance using a piece of pipe on a toolpost wrench and I do not want to be construed in that way.

I will agree that the tapping or turning of the swivel from side to side that I mentioned in my previous article could be eliminated by following Mr. Pusep's instructions; with this difference, we see that tool *D* strikes the shaft before tool *C* hits the gage; when by simultaneously screwing back the compound rest and turning the swivel to the right, tool *D* is made to slide along the shaft until tool *C* touches the gage held between it and the shaft, after which the swivel nuts are tightened.

If this swivel adjusting is done in any other way it would require the alternate screwing and swiveling back and forth till finally the desired setting is reached.



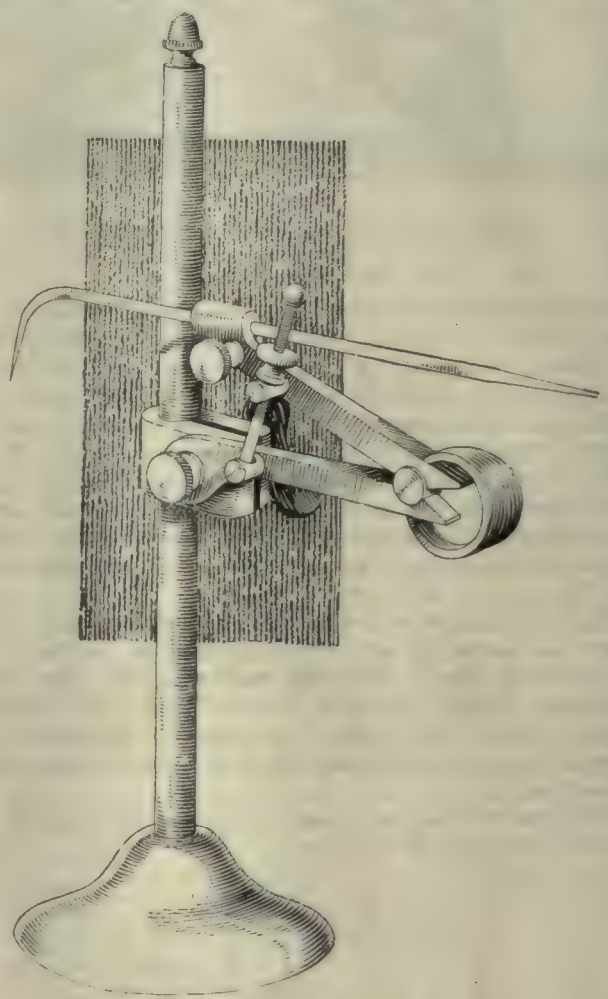
SETTING THE TWO TOOLS

Necessity the Mother of Invention

By W. F. Hollis

On page 867, Vol. 51, of *American Machinist*, L. M. Manley describes a makeshift surface gage, the essential feature of which was an inside caliper of the wing variety.

A later counterpart of this tool—a sort of step-brother, as it were—is to be found in my bench drawer.



AN IMPROVISED SURFACE GAGE

My surface gage, which may be seen in the accompanying illustration is made from an inside spring caliper with the addition of a scriber to render it a little more universal in its application.

Finding a Center by Trigonometry

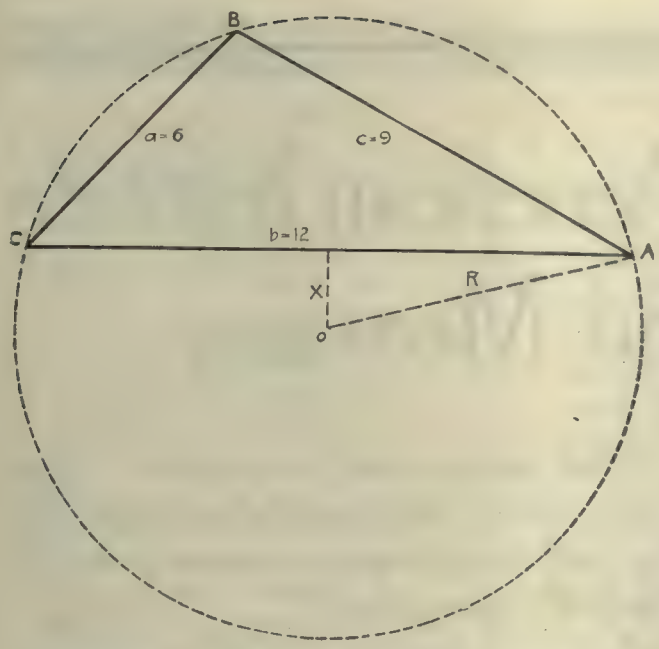
By Ernest T. Goodchild

The problem by Mr. Moore, page 584, Vol. 51 of the *American Machinist*, to find *R* and *X* may be solved more easily by using the ordinary formula for finding the diameter of the circumscribing circle of any triangle, the method being as follows:

$$\text{Diameter} = \frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

when *a*, *b*, *c* are the sides and *A*, *B*, *C* the opposing angles respectively.

$$2R = \text{diameter} = \frac{a}{\sin A} = \frac{6}{\sin A}$$



LAYOUT OF THE POINTS AROUND *O* AS A CENTER

$$R = \frac{3}{\sin A}$$

but, $\cos A = \frac{c^2 - b^2 - a^2}{2cb} = 0.87500 = \cos 28^\circ\ 57.3'$

Therefore, $R = \frac{3}{\sin 28^\circ\ 57.3'} = 6.1968$

$$X^2 = R^2 - \left(\frac{b}{2}\right)^2$$

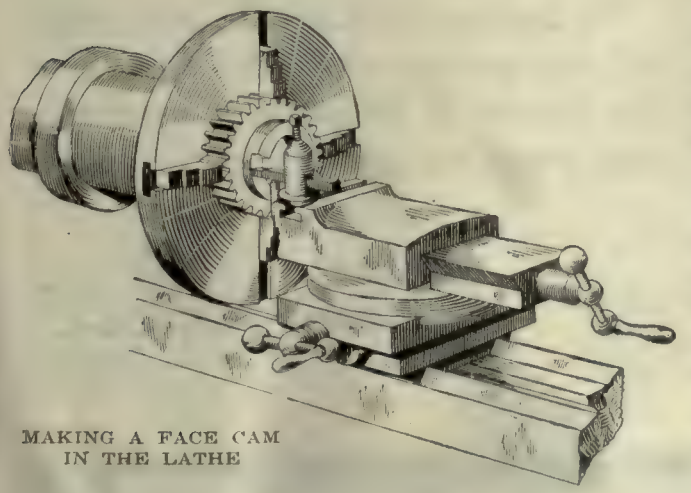
$$X = \sqrt{6.1968^2 - 6^2} = 1.549$$

With this information the holes required at *A*, *B* and *C* can be located on the circumference of the circle whose center is at *O*.

Cutting a Cam Without a Milling Machine

BY CHAS. D. FOLSOM, JR.

The accompanying illustration shows a job which puzzled me somewhat a few days ago, the problem being to machine the cam on the shoulder of the gear shown. The piece had been made in the toolroom of this shop by the following method. The blank was held in a dividing head chuck (with the chuck in a vertical position) on a shaper table. A guiding line was scribed by means of a piece of tin wound around the shoulder. The dividing head was then turned by hand while the tool, cutting straight across the edge of the shoulder, was fed down, also by hand.



MAKING A FACE CAM IN THE LATHE

This was simply a roughing operation, and some very nice filing was required to finish the piece properly. This method did not appeal to me, so I cast about for a better way. Of course the surface could be milled by gearing the dividing head up with the table feed but incomplete equipment would have made that very inconvenient, and the corner would have had to be filed out anyway. I was about to try milling, however, when a better idea came to me. This is the method I decided upon and used. I ran a one-sixteenth milling saw through one edge of the shoulder, and milled off some of the excess metal leaving the general form of the cam. I then put the blank in the chuck of a lathe and trued it up. I geared the lathe for two threads per inch, set up a flat tool as shown, threw out the back gears and with a large wrench turned the chuck around. When the tool came to the bottom of the cam I would release the lead screw nut, run the carriage back a half inch, and re-engage the nut according to the chasing dial, meanwhile feeding the tool in by the compound rest.

I had some trouble with chattering, as the spindle bearings of the lathe were in bad condition; hence for finishing I used a regular facing tool, and fed the cross slide in after each cut instead of the compound rest. This was a little tedious, but a fairly good surface was obtained; not quite so smooth as the skilfully filed surface made previously, but mathematically correct in contour. If the piece were to be made in any quantities, I should rough shape the blanks first and then set them up in a lathe with a good rigid spindle, so that a few light cuts with a broad tool would finish the job nicely. It is a question in my mind whether this would not be more satisfactory than milling even on a production basis.

Sweeping Back the Tide

BY A. W. FORBES

On page 1135 of the *American Machinist* Entropy suggests that it may be necessary to pay more for the rough and laborious work, than for skilled work. Similar suggestions are often heard from Socialists, only the Socialist proposes it as a matter of right, while Entropy proposes it as a matter of necessity.

My experience would indicate that there is no danger of such a change taking place for a long time to come. I find no difficulty in obtaining all the unskilled labor I want at wages from $15 per week down, but have not been able to find men of moderate ability at two or three times that amount.

The real cause of the shortage of unskilled labor is increase in the number of popular unskilled jobs, which carry some of the prestige of skill. Take, for example, the lathe hand: There are many lathe jobs of a routine nature that do not require half the skill needed to dig a sewer ditch; jobs where the tools are sharpened in the toolroom, and accuracy is not required. Yet persons holding these jobs will call themselves machinists.

It is competition with this class of work that produces the shortage of men for the disagreeable work. There is still an abundance of unskilled labor in comparison with the skilled.

Men Back of the American Institute of Weights and Measures

THE absurdity of the claims put out by the "one man club" of San Francisco, is the best answer to its so-called "arguments."

To say that 99 per cent of the people in the United States and Britannia favor the metric system and only one per cent are against it, makes even the most rabid prometric advocate gasp — and yet this is the claim made and repeated over and over in the literature sent out from the San Francisco headquarters.

However, as long as there are people willing—from whatever motive—to flood the country with untrue, distorted and ridiculous statements that may possibly be taken at face value by the unthinking and unreasoning—just so long will it be necessary for us to guard against the attempts to put over some sort of a compulsory metric law.

It is a shame for American business to always have to be on guard against absurd, and often dangerous, legislative drags. The average "reformer" has a hammer in each hand but no practical constructive ideas in his head.

Individually, the business men of the country have neither time nor the experience to combat the pro-metric propaganda. They must resort to some special organization, just as they would employ a lawyer to defend them in a damage suit.

Recognizing this, many of the best known men, companies and associations in the United States have joined the American Institute of Weights and Measures.

This Institute was described and some of the membership requirements outlined, in our editorial "A Watch Dog of American Industry," pages 904 and 905.

On the following pages will be found a list of the present officers and members of the Institute. Read these names over carefully and compare them and their respective standing with the names published by the prometric advocates.

The Institute stands for safe, sane, industrial principles and as such is backed by a large majority of the people and industrial enterprises of America.

Thos. Viall

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Watson-Stillman Co., Aldene, N. J.
Weimar Brothers, Philadelphia, Penn.
Westcott Motor Car Co., The, Springfield, Ohio
Weston Automatic Machine Screw Co., Elyria, Ohio
Westinghouse Air Brake Co., The, Wilmerding, Penn.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Penn.
Weston Electrical Instrument Co., Newark, N. J.
Whitcomb-Blaisdell Machine Tool Co., Worcester, Mass.
Whitman & Barnes Mfg. Co., Akron, Ohio
Whiting Co., George, Chicago, Ill.
Whitney & Son, Winchendon, Mass.
Williams, H. R., Hamilton, Can.
Williams, White & Co., Moline, Ill.
Willys-Overland Co., The, Toledo, Ohio
Wilmarth & Morman Co., Grand Rapids, Mich.
Wilmot Castle Co., Rochester, N. Y.
Wilson, H. D., Pittsburgh, Penn.
Winter Bros. Co., Wrentham, Mass.
Witry, L. W., Waterloo, Iowa
Woods Machine Co., S. A., Boston, Mass.

Yale & Towne Mfg. Co., New York City
Yeomans, Lucien I., Chicago, Ill.
Young & Co., J. S., Hanover, Penn.
Youngstown Sheet & Tube Co., Youngstown, Ohio

Zinn, Inc., Simon, New York City

EDITORIALS

Discouraging Airplane Building

ARE we to repeat again the colossal blunder of neglecting the development of our airplane resources?

Are we, at some future time, to waste millions in a "last moment attempt" to turn out machines for war purposes, as we did during the World War?

The millennium is not here. Wars are *not* over. A war may come quickly from an unexpected quarter. If it does, we will be at the mercy of enemy aviators unless we are ready to get off the mark at the crack of the pistol.

All other nations of our class are quietly mapping out an aeronautic program with commercial and military advantages in view.

The United States, however, is slumping back into pre-war conditions and forgetting all the bitter lessons of our humiliating experience in building war planes.

On June 11, the Curtiss Aeroplane & Motor Corporation, claiming 75 per cent of the entire output of the American aircraft industry, announced that it would practically abandon the manufacture of commercial planes.

This is the result of the failure of Congress to protect our markets from the dumping of foreign machines.

If this big corporation is compelled to discontinue the development of commercial machines, we will lose one of the greatest assurances we have for the preservation of peace.

Nothing can be done to definitely relieve the situation until Congress meets again, but in the meantime it is the duty of every loyal American to impress on his Congressman the importance of as early action as possible.

Again we want to urge the necessity of having practical business men, manufacturers and engineers in congress and in public office. E. V.

Fire and the Machine Shop

MACHINE shops do not, as a rule, pay sufficient attention to the fire hazards which exist on their own premises or on surrounding property. The average man sees little to burn as he walks through the aisles of lathes, milling machines and other tools. And yet one has only to visit any machine shop after a fire to see how much fuel the fire found on which to feed.

Too many place reliance on what we are pleased to call fireproof buildings, but many of these are a snare and a delusion. And even were the building itself fireproof we must not forget that it is the contents rather than the building in which we are most interested. We must not forget that combustibles such as oil and waste, can burn inside the strongest vault that was ever constructed.

No matter what the type of building may be, it is a safe plan to have its contents protected by some good sprinkler system. These are the safeguards recognized by all fire departments and fire-prevention engineers. They are the nearest to a real "safety first" device which has yet been produced.

In a recent fire on the Pacific coast a so-called fireproof or slow burning construction, was levelled in a night with a loss of over $100,000 in machinery, tools and fixtures. And because they had placed entire faith in a supposedly fireproof building, they carried but $12,000 insurance.

Fire prevention is one of our greatest problems because it involves the human element to such a tremendous extent. Carelessness causes millions in losses every year, the smoker being largely guilty simply because he carries fire in some form or other. Matches, pipes, cigars and cigarettes, carelessly handled, start many fires, and largely because we are lax in enforcing the fire rules.

"No Smoking" signs should not be put up unless they are to be obeyed by all, from the boss to the office boy.

And when they are put up, they should be rigidly obeyed by all. Rules which are not enforced soon breed contempt for all rules—which is a dangerous state of mind in any shop or community.

At this time, when production is so badly needed, every dollar and commodity lost in a fire caused by carelessness is a calamity—a crime against country and community. F. H. C.

Freight Car Orders

COMPETENT authorities estimate that we should have at least 200,000 more freight cars than are now in service ,to take care of transportation needs.

Approximately 100,000 new cars are needed annually to replace those scrapped.

On June 1, the total number of freight cars on order with car builders, amounted to about 41,000.

One large company wrote us that they didn't have an order on their books!

Most of the orders for the 41,000 were placed the last of May, and less than 3,000 freight cars were built in that month!

The builders have a present capacity of about 25,000 per month or 300,000 per year; 240,000 cars have actually been built in a single year in the past.

The fault for not placing orders lies, primarily, with the red tape, unbusinesslike methods and foolish handling under Government ownership. Following this the Interstate Commerce Commission has failed to settle the rate question, making it impossible for the roads to know where they stand in regard to future finances, and in consequence they cannot safely place any large order of any kind. If this Commission would spend less time prying into things it has no business to, and would settle a few really important questions the country would be a great deal better off. As it is, the car shortage is getting worse with no real remedy in sight.

E. V.

All-Metal Airplanes

THE recent announcement of the formation of a company to manufacture all-metal airplanes sounds good. The elimination of the fire hazard is a long step in the right direction, even if there were no other advantages. Of course, an all-metal airplane can stay in the air no better than the common kind if power fails, but this is being rapidly solved by the use of multiple engines. Along with the fireproof factor, the absence of struts and wires is a distinct advantage in the commercial development of the airplane, since lessened resistance means conservation of power. The much slower deterioration of parts makes the upkeep of the all-metal far less than that of the wood-and-fabric machine. It is entirely possible that in time the use of anything but metal in the construction of an airplane will be forbidden, on account of its greater degree of safety. E. V.

File Your Catalogs with the American Chamber of Commerce in France

IF YOU are making efforts to increase your foreign business, the American Chamber of Commerce in France is in a position to assist you greatly. It has inaugurated a catalog-file system, the object of which is to place catalogs of American firms before important and reliable French buyers.

Under this method preliminary correspondence can be abolished. French buyers come to this Chamber and, from an inspection of the catalogs, choose the articles they desire, without loss of time. They can then communicate immediately with the seller without having to wait two months or more to receive trade literature.

Your catalogs in this file serve the purpose of a representative in France. It brings your line of goods to the attention of French buyers and consumers. The catalog file is given extensive publicity, and all important French firms know of it. It is under the direction of courteous and experienced personnel.

An annual fee of ten dollars is charged by the Chamber to cover expenses incurred. This fee entitles each subscriber to have catalogs on file for the period of one year. The fee also entitles the subscriber to ten different headings in the Catalog Card Index. If the subscriber desires to be listed under additional headings (more than ten) an additional fee of one dollar per heading is charged.

Upon receipt of catalogs, address cards are filled out, showing name and number assigned to the catalog. These cards are systematically filed under the headings given by the subscriber. The catalogs are placed in individual file boxes, each box being given a number. This number is placed on each of the file cards.

For example: A firm interested in the sale of hardware wishes to appear under the following headings: "Bolts, Files, Locks, Saws, Hammers, Nails, Screws, Faucets, Cutlery and Wrenches." Accordingly, ten address cards are filed under the titles enumerated, each card bearing the catalog number. The system is so simple that prospective French buyers can easily obtain the catalog in which they are interested.

Write *now* to the American Chamber of Commerce in France, 32 rue Taitbout, Paris, France, for further details and for the Catalog File Entry Blank. Upon receipt of this blank, fill it out and send it in, together with your catalogs and subscription fee, and the Chamber will do the rest.

What Is an Engine Lathe?

BY L. L. THWING

There is probably not much, if indeed any, difference of opinion on the question of what an engine lathe is. It is usually considered to be a metal-turning lathe with back gears, or geared head, and screw-cutting parts. Possibly a screw-cutting lathe with an open-belt cone drive would also be so classified. A lathe without screw-cutting parts is called a plain turning lathe or sometimes a stud lathe; although this latter title is more frequently given to a plain turning lathe without back gears. Is there any common understanding on these points?

The old name was turning lathes, or slide lathes, and the first of these was the commonly used expression during the sixtiees. When the term engine lathe first came into use, what was its special significance? In one instance noted by the writer two lathes differing only in size were referred to as turning lathe and engine lathe, the larger lathe bearing the latter title, the headstock being referred to as the "engine." Possibly the readers of *American Machinist* can shed a little light on the derivation of this common expression.

WHAT to READ —for the man in a hurry



Suggested by the Managing Editor

MANY aspects of mechanical evolution may be seen from a study of old machines. It will do you good to postpone the analytical articles for a half hour or so and start right in with Associate Editor Ellsworth Sheldon's "leader" on "Some Examples of Early Machine Design." The old, old machine is sometimes retained out of a feeling of sentiment and if so, it will generally be found in the plant museum; however, many are covering floor space next to ultramodern machines and turning out their proportion of parts in a very satisfactory way. You will develop feelings of admiration and respect for the earlier designs after reading this story about the old-timers. Without half-trying, not so many years back, you could insert your elbow between spindle gear and back gear, on a lathe, or get your leg chewed up a bit by the exposed feed gears, or slide a finger between cone and headstock when shifting belts. As a planer operator, you became quite expert at getting clamps, plugs and wrenches from the bed before the table got back—until the day you became too careless. Then these conditions changed—the workmen's compensation laws, careful employers and safety guards have stopped almost all of the maiming. But lack of standardization of safety appliances in the various states, causes their satisfactory design and application to machines to be a very difficult task. "Standardization and the Safety Movement" by C. E. Oakes and J. A. Dickinson endorses a National Code for guards and devices to protect operators. The authors show how the adoption of standardization and National Codes in other ways has proved very beneficial and also what is being lost though lack of standardization in our safety devices—Page 9.

Drilling has always been considered about the easiest job in the shop. So it is, if the drill is ground correctly, and the feed and speed are right for the material being drilled. To get these things right is easy, too, if you know how. A great deal has been said and written concerning drills and drilling, and much of it has been really instructive. Now the movies are helping to disseminate the "know-how" and there is no reason why the information so presented shouldn't stick, having the advantage, as it does, of a very complete graphic method of instruction. On page 11 Western Editor J. V. Hunter tells the story of the Cleveland Twist Drill Co.'s educational film, "The Proper Use and Care of the Twist Drill."

Most of the prominent presidential candidates have announced their faith in education as a prime necessity for America. We indorse this stand without reservation. Many men in our field have had neither the time nor the money for the advantages of a college education but this is no indication that they are uneducated. To many such men "American Machinist" has been an invaluable aid. It is our aim to make it indispensable and certain comments that have come to us make us believe that we are on the right road.

We publish in full, beginning on page 14, the presidential address delivered by Elbert H. Gary, at the annual meeting of the American Iron and Steel Institute. The title is "The Ship of State." All are rightfully and dutifully concerning themselves at present with the ship of state, and can probably receive from this address, the facts or advice needed to clarify some uncertain points. It is a clear statement of the present physical and industrial status of the United States, and is a splendid argument for a universal policy of honesty and co-operation. Read it—page 14.

Part VII of W. R. Basset's series on Modern Production Methods treats of "The Central Control of Production." This is an important subject, well treated; it includes details which are going to be very useful to the man who is using this series as a guide to his work. This week's installment begins on page 17.

The third part of "Modern Aviation Engines," a series by the Managing Editor, gives some pertinent facts concerning British and German airplane motors and gives a very good explanation of the action of the United States in insisting upon our own standardized Liberty Motor. Page 20.

On page 25 begins the fifth of Chesla C. Sherlock's treatises on "Knowing Your Insurance Policy." He takes up cancellation in all its phases.

Editor Colvin has been examining the machine-tool field in the Pacific Coast states. His field notes, page 28, give a first-class analysis of conditions in California. The West is progressive and is in a location good for foreign trade. Its manufacture will increase and develop that demand for machine tools which has already been felt to a slight extent.

SHOP EQUIPMENT NEWS

-Edited By-
E. L. DUNN and S. A. HAND

SHOP EQUIPMENT • NEWS •
A weekly review of modern designs and • equipment •

Descriptions of shop equipment in this section constitute editorial service for which there is no charge. To be eligible for presentation, the article must not have been on the market more than six months and must not have been advertised in this or any previous issue. Owing to the news character of these descriptions it will be impossible to submit them to the manufacturer for approval.

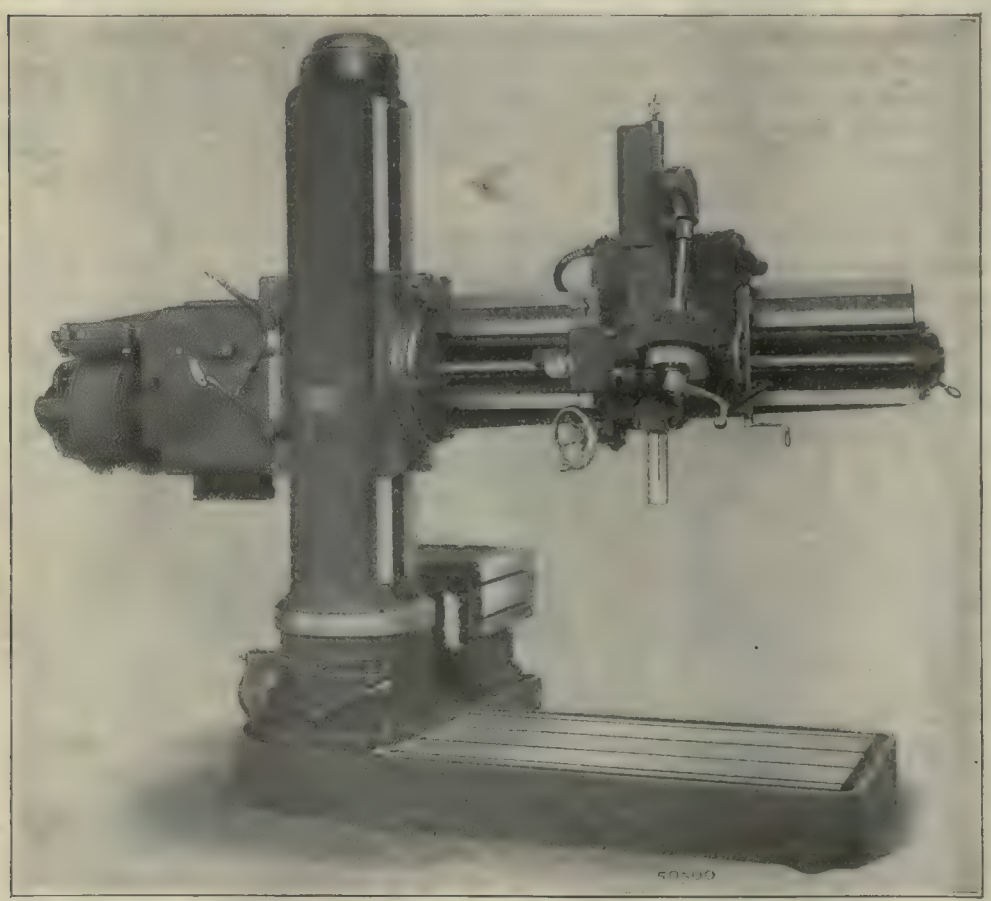
• CONDENSED • CLIPPING INDEX
A continuous record of modern designs • and equipment •

Niles-Bement-Pond Right-Line Radial Drilling Machine

Niles-Bement-Pond Co., 111 Broadway, New York City, has brought out a radial drilling machine, which is made with both 5- and 6-ft. arms and named the Right-Line Radial Drill. The accompanying illustration shows the 5-ft. full universal machine, although plain machines are also made. Probably the most noteworthy feature is embodied in the design of the column, which permits of a simplified drive. All controls are operated from the head, and the column clamp is electrically operated, so that the machine requires only electric power for its operation.

The base of the machine has an extension, which carries a table back of the column and at right angles to the main working surface. The column consists of two box-section members cast integrally at the top and bottom, the saddle of the arm sliding on V's on the front and back. Due to the wedging action of the V's, the arm and column are held very rigidly together when clamped. Since the column rotates with the arm, the bending stresses due to the cut are always taken by the column in the same plane, the two sections of the column being designed as beams to resist the bending action.

The column casting extends through the pedestal to the bottom of the base, and is supported vertically on a ball-thrust bearing at the bottom and laterally by two roller bearings. Flat steel springs lift the column a few thousandths of an inch, so that the flange clears the top of the pedestal. The arm and column can then be easily swung on the bearings, as the center of gravity of the moving aprts is located nearly directly over the ball bearing.



FULL UNIVERSAL, 5-FT. RIGHT-LINE RADIAL DRILLING MACHINE

Specifications: Distance under spindle to base: minimum, 12 in.; maximum, 68 in. Base: working surface, 5 ft. 11 in. x 3 ft. 6 in. Table top, 23 x 27 in.; height, 30 in. Spindle traverse, 18 in. Feeds: number, 8; amount, 0.006 to 0.06 in. per rev. Hp. of driving motor, 10. Spindle speeds, number, 28; amount, 20 to 400 r.p.m. Height, 11 ft. 6 in. Diameter of floor space required, 15 ft. 5 in.

To clamp the column so as to prevent turning, it is pulled down against the pressure of the steel springs supporting it so that the flange bears on the pedestal. This is done by means of a hinged conical ring which, when contracted, forces the column flange downward against the pedestal. The clamping ring is operated through a wormwheel by a small electric motor, which is controlled by the small switch at the left-hand side of the drill head. A lever for clamping by hand is also provided, this being located on the pedestal itself. The bearing surface between the column flange and the pedestal is wide, furnishing a large metal-to-metal contact and relieving the roller bearings from the drilling strains.

The arm is raised and lowered by power from the driving motor operating through a revolving nut on the station-

ary elevating screw, which is suspended from the top of the column and prevented from turning only by friction in its bearing. The small centrally-pivoted lever on the rear saddle of the arm engages the mechanism, while the two longer levers are used to clamp the arm in place. The elevating and clamping mechanisms are interlocking, so that the elevating mechanism cannot be disengaged until the clamps are released, nor can the arm be clamped until the elevating clutch is disengaged.

An automatic stop prevents accident in case the arm is run to the limit of its travel either up or down, the revolving nut coming in contact with a pin on the screw, thus causing the screw to turn and the arm to come to a stop. In case the arm or spindle strikes an obstruction in lowering, the elevating screw is lifted slightly from its bearing so that the screw turns freely. The cross-section of the arm is of unusual design. The upper guide for the saddle is of the dovetail type, and the lower bearing is set back so as to bring the horizontal driving shaft close to the spindle.

The motor is mounted on the back of the arm saddle, and drives the spindle through a horizontal shaft running between the column members. This makes it possible to have only four gears and one double-faced pinion between the motor and the spindle, and to apply the driving power to the lower end of the spindle. The back gears run in oil in a case located next to the motor.

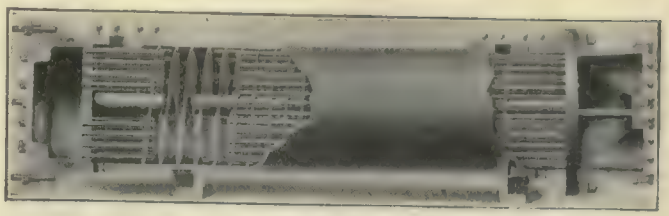
The driving motor is controlled by the lever shown at the lower right-hand side of the drill-head, making it possible for the operator to start, stop, reverse and vary the speed without changing position. This feature is particularly valuable when tapping. A 4-to-1 variable-speed motor is used when direct current is available, such a drive being shown in the illustration. For alternating current, a gear box is connected to the constant-speed motor to give the necessary speed range. Sixteen speeds are provided in either a high or low range. Dynamic braking is provided with both types of drive, so as to give the quick stopping necessary when tapping.

The feeds are geared, the gears running in oil. The feed is changed by turning the small disk conveniently placed at the left-hand side of the driving head at the same height as the horizontal drive shaft. The range of speeds and feeds is sufficient to take care of any boring ordinarily required, in addition to drilling and tapping.

The drill head is traversed along the arm by the small handwheel at the lower left-hand side of the head. For rapid movement of the spindle the knob-ended lever is turned by hand. When this lever is pulled down it engages the power feed. Hand feed is obtained by the handwheel at the right of the head. A depth gage with an automatic trip for the feed is provided, this being set by means of the large disk shown on the front of the driving head.

Griscom-Russell Multiwhirl Oil Cooler

The Griscom-Russell Co., 90 West St., New York, manufactures the device illustrated herewith for cooling oil used in lubrication of turbine bearings and reduction gears, or quenching oil in the heat treating of steel.



GRISCOM-RUSSELL MULTIWHIRL OIL COOLER

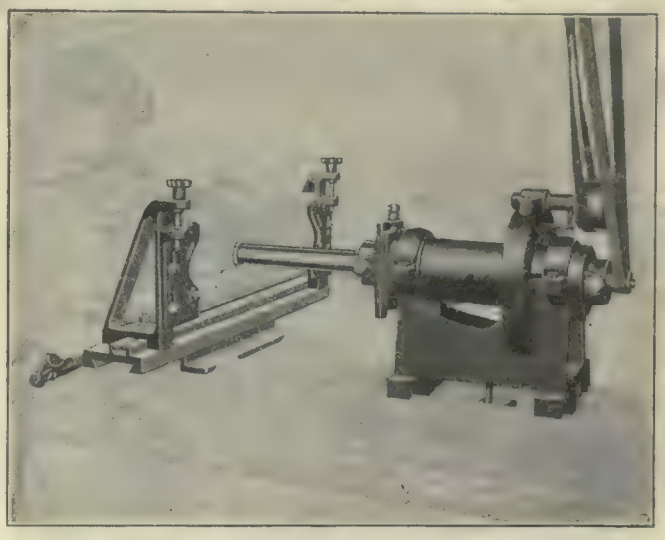
It is claimed that the oil is constantly circulated through the cooler, and kept at a constant temperature permitting both the continued use of the original quantity of oil and its maintenance at the proper viscosity for efficient results.

The apparatus takes its name from the whirling path of the oil, which path is accomplished by the use of the helical baffle which directs the oil in its flow. The baffle also serves to bring the oil into intimate contact with the cooling surface.

The shell is of cast iron and the tubes of seamless drawn brass or copper, expanded into a fixed tube plate at one end and into a floating head at the other, which latter permits expansion and contraction without strain on the tube joints.

Fox Cylinder Boring and Grinding Machine

The Sunderland Machine Shop, Omaha, Neb., has recently added to its line the machine shown in the accompanying illustration for re-boring and grinding automotive cylinders. The attachment is intended for garage and repair-shop work; and it is designed to fit a standard lathe, being entirely independent of the lathe headstock. The base of the grinding head can be



GRINDING CYLINDERS ON THE FOX BORING AND GRINDING MACHINE

Specifications: Size; to fit lathes of 14- to 24-in. swing; to hold blocks of 1 to 6 cylinders; to bore and grind cylinders of 2½-in. dia. and larger. Swing; over ways, 22 in. Length of spindle, 15½ in. Weight boxed, 500 lb.

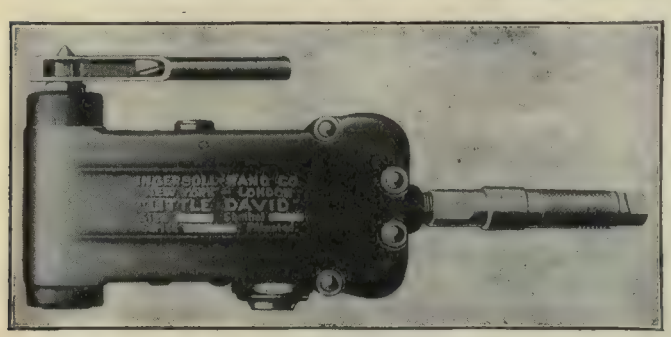
adjusted to suit different distances betwen the lathe Vs. The table upon which the cylinder blocks rest is fastened on the carriage of the lathe. The brackets can be adjusted to hold cylinder blocks of various sizes, and a micrometer cross-feed is provided for bringing different cylinders into alignment with the spindle.

The spindle carrying the grinding wheel is driven at high speed by a large pulley on the overhead countershaft, and it is mounted in three double-row ball bearings. A slow-moving spindle outside of the grinding spindle is driven through gears by a belt from a small pulley on the countershaft. The slow-moving spindle carries the boring tool; and micrometer adjustment is provided for regulating both the eccentricity of the tool and that of the grinding spindle.

The machine can be used on either open- or closed-head cylinders. It is claimed that the machine can be quickly attached to the lathe and that the changing from boring to grinding is easily done. The machine is completely equipped with all necessary attachments and a countershaft.

Ingersoll-Rand "Little David" Pneumatic Tools

Several types of small portable pneumatic tools have recently been added to the "Little David" line, manufactured by the Ingersoll-Rand Co., 11 Broadway, New York. The tools include a small size of close-quarter

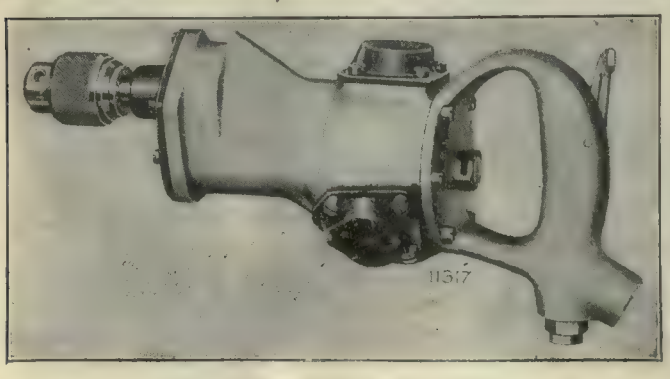


NO. 8 "LITTLE DAVID" CLOSE-QUARTER DRILL

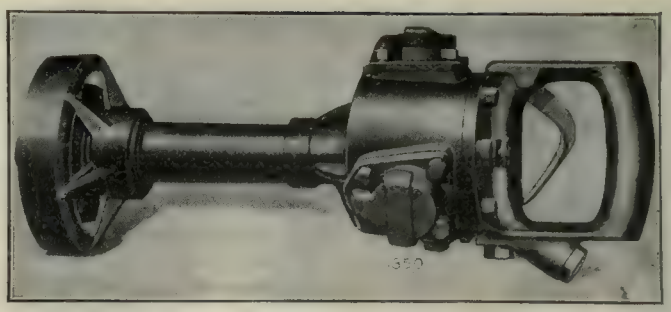
drill, No. 8, a small high-speed grinder in two types, Nos. 601 and 602, and a lightweight drill furnished in two styles, Nos. 6 and 600.

The No. 8 close-quarter drill is a machine for use close to a wall or corner. This machine runs at 250 r.p.m. without load, and will handle drilling, reaming or tapping up to 1¼ in. diameter. The spindle which turns the drill is operated by three rocking levers connected directly to the pistons through connecting rods. The motor is of the three-cylinder type with pistons acting at right angles to the levers.

The Nos. 601 and 602 grinders are light-weight high-speed tools running with a free speed of 4,200 r.p.m., and are suitable for grinding, buffing or polishing work. Both machines have the same type of motor but are



NO. 6 "LITTLE DAVID" DRILL



NO. 601 "LITTLE DAVID" GRINDING MACHINE

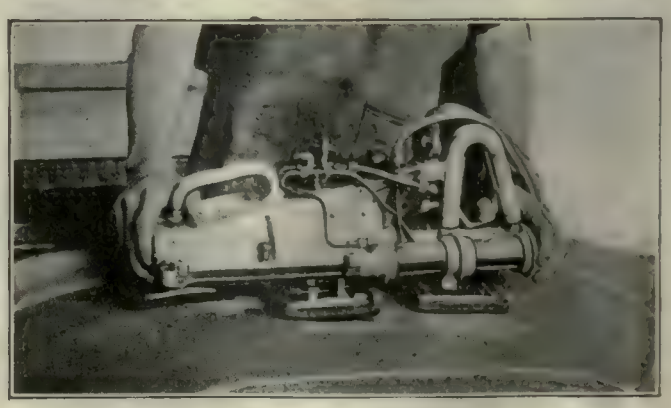
equipped with different throttles and handles, the 601 having the closed type of inside trigger handle, while the No. 602 is fitted with the rolling type of throttle handle. The three-cylinder motor runs constantly in a bath of oil, insuring lubrication of all the parts. The valve is integral with the crankshaft, simplifying the design. Ball and roller bearings are used throughout. The removal of a few screws enables the handle to be lifted off exposing the entire mechanism to view, making easy inspection of the parts.

The Nos. 6 and 600 drills are intended to meet the demand for light air-tools for drilling small holes without breakage of drills. They will handle twist drills up to ⅜ in. diameter. The free speed at 90 lb. air pressure is about 2,000 r.p.m. The two machines differ only in the handle construction, the motors being the same. The No. 6 has the pistol-grip type of handle, while No. 600 is furnished with breast plate and rolling throttle handle. Aluminum reinforced with steel bushings is used wherever possible and results in a very light-weight machine, the No. 6 weighing only 9 lb. The motor is of the three-cylinder type, and the cylinders are separate iron castings, easily accessible, renewable and interchangeable. The bearings are all either ball or roller type.

Brown Rubbing Machine

The Franklin Products Co., Inc., Syracuse, N. Y., has placed on the market the rubbing machine illustrated herewith. The machine is intended to supplant hand rubbing in paint shops and the claim is made for it that by its use twice as much work can be done as by hand rubbing.

The machine has two feet, or kickers, working in opposite directions and uses compressed air as a propellant. The construction of the rubbing feet makes it possible to rub on uneven or rounded as well as on flat surfaces. The frame and all parts possible are made of aluminum

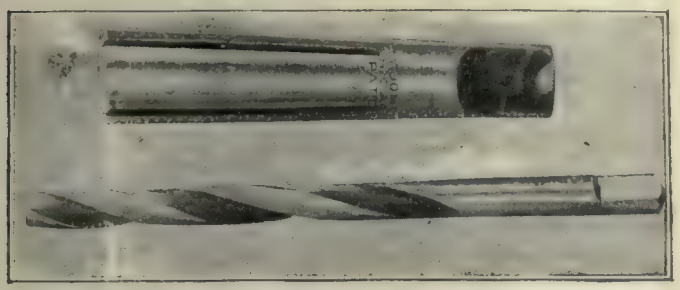


BROWN RUBBING MACHINE ON AUTOMOBILE WORK

and the total weight is but 20 lb. The machine can be used on both vertical and horizontal surfaces. It uses the same materials as are used in hand rubbing.

The Wearever Drill Chuck

The Scully-Jones Co., Railway Building, Chicago, Ill. has placed on the market the drill chuck, or collet, shown in the illustration herewith. The object of this



WEAREVER DRILL CHUCK AND DRILL WITH FLAT SPOT FOR DRIVING

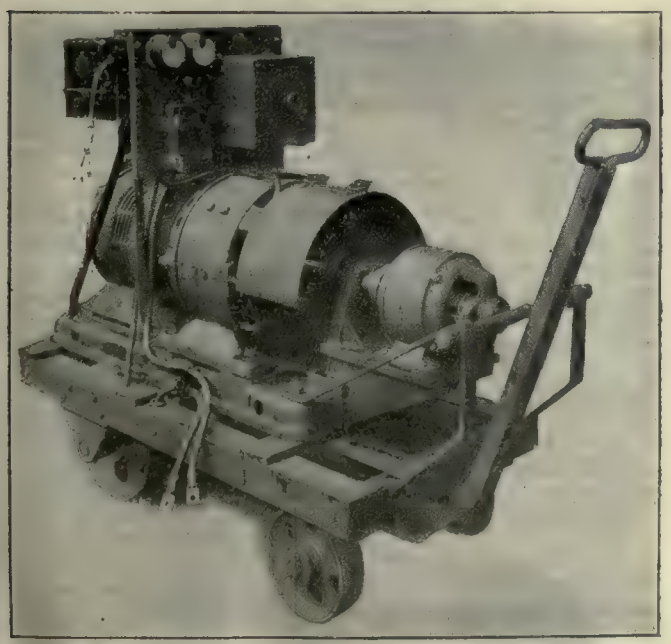
chuck is to provide a taper shank which can be used to hold a straight shank drill in the taper hole of a drilling-machine spindle. The only operation necessary to prepare a drill for use in this chuck is to grind a flat spot on the shank, as shown on the drill in the illustration.

One advantage claimed for this chuck is that when used in a multiple-spindle drilling machine, drills can be spaced much closer than if held in the ordinary type of drill chuck.

The chucks are made with tapers to suit all standard drilling-machine spindles and with holes to fit all sizes of straight-shank drills.

Westinghouse Single-Operator Electric Welding Outfit

The single-operator electric arc-welding equipment shown is manufactured by the Westinghouse Electric and Manufacturing Co., East Pittsburgh, Pa., and is said



WESTINGHOUSE SINGLE-OPERATOR ELECTRIC WELDING OUTFIT

to be exceptionally efficient because the generator operates at arc voltage and no resistance is used in circuit with the arc. The generator is designed to inherently stabilize the arc, thereby avoiding the use of relays, solenoid control-resistors, etc.

The generator has a rated capacity of 175 amperes and is provided with commutating poles and a long commutator, which enable it to carry the momentary overload at the instant of striking the arc without special overload protection.

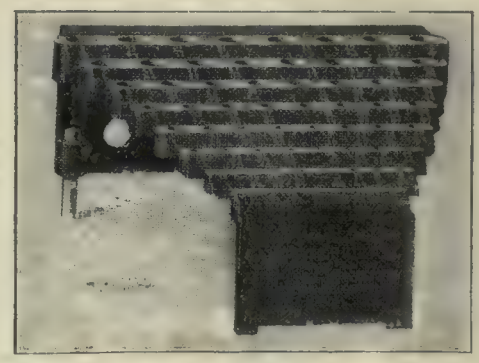
Very close adjustment of current may be easily and quickly made, and, once made, the amount of current at the weld will remain fixed within close limits until changed by the operator. There are twenty-one steps provided which give a current regulation of less than 9 amperes per step and make it much easier for a welder to do vertical or overhead work.

The generator is mounted on a common shaft and bedplate with the motor. A pedestal bearing is supplied on the commutator end and carries a bracket for supporting the exciter which is coupled to the common shaft. Either d.c. or a.c. motors can be supplied. Where an a.c. motor is used leads are brought outside the motor frame for connecting either 220- or 440-volt circuits. An electrician can change these connections in a few minutes' time. This feature is desirable on portable outfits which may be moved from one shop to another having a supply circuit of different voltages. For portable service, the motor-generator set with the control panel is mounted on a fabricated steel truck, equipped with roller bearing wheels. The generator is compound-wound, flat compounded, that is, it delivers 60 volts at no-load and also at full-load.

Peerless Gaging Drill Rack

The drill rack illustrated herewith is manufactured by the Peerless Machine Co., Racine, Wis.

The drills are placed in the holes with their points downward. The holes go clear through the rack and



PEERLESS GAGING DRILL RACK

each hole is of two diameters, the first part being the nominal diameter of the drill it is intended to hold and the latter part the diameter of the next smaller drill in the set. A drill larger than the first part of the hole will not enter and a smaller drill will fall through, but a drill of the right size will enter the hole intended for it a certain distance, where it will be stopped by the smaller diameter of the hole. Thus a drill that will enter a hole and stay there is necessarily in its right place.

The racks are made in seven sizes, the smallest for drills $\frac{1}{16}$ to $\frac{1}{2}$ in. and the largest for drills $\frac{33}{64}$ to $1\frac{1}{8}$ in.

U. S. Chamber of Commerce Conducts Referendum on Industrial Relations

Twelve principles of industrial relations, prepared by a special committee, were sent out to a vote today of the more than thirteen hundred industrial and commercial organizations comprising the membership of the Chamber of Commerce of the United States.

The principles are intended to include the fundamentals of employment relations. The committee that drew them up is composed of members of the Chamber's board of directors. It was appointed after the close of the President's First Industrial Conference to consider the principles presented by the employers' group in the conference.

The Committee's report, containing the proposals submitted for a vote is given as follows:

Employers' relations in American industry should accord with and express those ideals of justice, equality and individual liberty which constitute the fundamentals of our national institutions. The terms of employment should conform to the essential requirements of economic law and sound business practice. They should, through intelligent co-operation, based on a recognition of mutality of interest conduce to high productive efficiency. They should reflect in ever-increasing degree an effort to realize broad ideals of individual and social betterment. In Government and public service employment the orderly administration of government must be assured, and the paramount interest of the public protected. With these essential purposes in view, and conscious of the obligation of management to insure their observance and practical operation in industrial affairs, the Committee on Industrial Relations of the Chamber of Commerce of the United States of America, states its belief in the following principles:

I. Any person possesses the right to engage in any lawful business or occupation, and to enter, individually or collectively into any lawful contract, either as employer or employee. These rights are subject to limitation only through a valid exercise of authority.

II. The right of open-shop operation, that is, the right of employer and employee to enter into and determine the conditions of employment relations with each other, is an essential part of the individual right of contract possessed by each of the parties.

III. All men possess the equal right to associate voluntarily for the accomplishment of lawful purposes by lawful means. The association of men, whether employers, employees or others, for collective action or dealing, confers no authority over, and must not deny any right of, those who do not desire to act or deal with them.

IV. The public welfare, the protection of the individual and employment relations require that associations or combinations of employers or employees, or both, must equally be subject to the authority of the state and legally responsible to others and their agents.

V. To develop with due regard for the health, safety and well-being of the individual, the required output of industry is the common social obligation of all engaged therein. The restriction of productive effort or of output by either employer or employee for the purpose of creating an artificial scarcity of the product or of labor, is an injury to society.

VI. The wage of labor must come out of the product of industry and must be earned and measured by its contribution thereto. In order that the worker, in his own and the general interest, may develop his full productive capacity, and may thereby earn at least a wage sufficient to sustain him upon a proper standard of living, it is the duty of management to co-operate with him to secure continuous employment suited to his abilities, to furnish incentive and opportunity for improvement, to provide proper safeguards for his health and safety and to encourage him in all practicable and reasonable ways.

VII. The number of hours in the work day or week in which the maximum output, consistent with the health and well-being of the individual can be maintained in a given industry, should be ascertained by careful study and should never be exceeded except in case of emergency, and one day of rest in seven, or its equivalent, should be provided. The reduction in working hours below such economic limit, in order to secure greater leisure for the individual, should be made only with full understanding and acceptance of the fact that it involves a commensurate loss in the earning power of the workers, a limitation and a shortage of the output of the industry and an increase in the cost of the product, with all the necessary effect of these things upon the interest of the community and the nation.

VIII. Adequate means, satisfactory both to the employer and his employees and voluntarily agreed to by them, should be provided for the discussion and adjustment of employment relations and the just and prompt settlement of all disputes that arise in the course of industrial operation.

IX. When, in the establishment or adjustment of employment relations, the employer and his employees do not deal individually but by mutual consent, such dealing is conducted by either party through representatives, it is proper for the other party to ask that these representatives shall not be chosen or controlled by, or in such dealing in any degree represent, any outside group or interest in the questions at issue.

X. The greatest measure of reward and well-being for both employer and employee and the full social value of their service must be sought in the successful conduct and full development of the particular industrial establishment in which they are associated. Intelligent and practical co-operation based upon a mutual recognition of this community of interest, constitutes the true basis of sound industrial relations.

XI. The state is sovereign and cannot tolerate a divided allegiance on the part of its servants. While the right of Government employees—national, state, or municipal—to be heard and to secure consideration and just treatment must be amply safeguarded, the community welfare demands that no combination to prevent or impair the operation of the Government, or of any Government function shall be permitted.

XII. In public service activities, the public interest and well-being must be the paramount and controlling consideration. The power of regulation and protection exercised by the state over the corporation should properly extend to the employees in so far as may be necessary to insure the adequate, continuous and unimpaired operation of public utility service.

On page 2 of the June 10 issue of the *American Machinist* the title read: "Daniel Webster, in the Senate in 1883." This was a printer's error; the year should have been 1833.

A Letter to the Editor

Editors, *American Machinist.*

Gentlemen:

I am in receipt of a letter from the World Trade Club of San Francisco inclosing what purports to be a copy of a letter submitted to you by one of your correspondents. The letter follows, *verbatim ad literatim.*

Washington, D. C.,
23 March, 1920.

To the *American Machinist*

I see in this weeks' issue of the Machinist that Mr. W. F. Belding wants to hear the views of a mechanic in reference to your present antimetric propaganda.

Well, here you have mine. For the past 15 years on and off you have had articles covering this subject, and I always believed you were right. Have read everything that Halsey has written and also F. G. Barth et al. Maybe I am in error as to F. G. B., but there has been enough of the other M.E's, B.S's, etc., to fill many books.

Now I cannot flatter myself as to my school education, but I have learned a few things in the past 25 years, and one is that the metric measurement is very simple if a man will forget his 64th, 32nd, and so forth, take his little meter scale or micro and go to it.

It is now 30 months ago that I enlisted in the U. S. Engineers and was assigned to a college to make sound ranging instruments, where we had the misfortune (so I believed) of having everything metric, and I can tell you that for a few days the air was blue with profanity on account of it. The more so as I had been taught to believe that that sort of measuring was N.G. as per Halsey et al.

Well, to make a long story short, I had to learn it and forget our standard system. I now prefer it to the inch. Don't worry about the expense; we mechanics will not have to spend millions of dollars. No, only about $3 apiece and that will not break us. Most of your automatic machinery will require no extra attachments, and all lathes will need only a gear change to cut screws. Most milling machine work is worked to a stop or in jigs. Drill press don't count at all. Calipers work just the same, and when it comes to drills, well, I prefer to say .1 mm. or 1.2, —2.6, —7.3 mm., than run No. 1 down No. 60 and ⅛ in. up to 2 in. It is just as easy to read a micrometer to .01 mm. as .001 inch.

This is what I have learned in the past 30 months. Just forget about the so-called terrible monetary loss and in a year or two we will all be running along and never give our old system a second thought. Most of our manufacturers can make these changes so gradually that there will hardly be a ripple in their business.

I am inclined to believe that if they would not follow your advice so explicitly on this one subject they would come thru with very little trouble in their business.

You used to be my "guiding star," and still are, but on the C.G.S. system, I will have to "kick over the traces."

Yours very truly,
(Signed) F. W. GEIB.

I believe that this "practical mechanic," as he is called in the letter in which the above was an inclosure, in his enthusiastic support of what is to him a new idea, has, like the sponsors of metric legislation, overlooked some very important considerations to which I would direct his attention. In other words, he has become temporarily impractical.

In his third paragraph your correspondent says that he has learned (within the last thirty months of a period of twenty-five years) that "the metric measurement is very simple if a man will forget his 64ths, 32nds, etc., take his little metric scale or micro and go to it."

If that were all there is to it, I cannot well gainsay his proposition; but he has built into his formula the same stumbling block that has brought about the downfall of empires—the little word "if." Let us see what bearing this word has upon his precept.

Assuming that your correspondent has been successful in sweeping from his mind all remembrances of the English standards and their binary subdivisions, and has taken up his "little metric scale" to get a measurement of something that is already in existence; something that must be repaired or replaced. He will find that the measurement will not conform to any division of his metric scale for the reason that it was made without reference to metric units.

Whatever measurement he may desire to make, on whatever machine, apparatus or device constructed in this country since the time of the Pilgrim fathers, will present the same difficulty. Whether his measurements are to be taken in meters, liters or grams, the same trouble will be encountered; practically *nothing* will conform to his new standards. Surely the difficulty of translating the dimensions that are, to the dimensions he would have them be, would disturb his tranquil forgetfulness. Would not the necessity of taking off a little here or adding a little there to make concrete realities measure up to idealistic theories, compel him to recommit to his memory the knowledge of feet and inches, gallons, or bushels, that he had so carefully eliminated therefrom?

But let us assume that he ignores future troubles and has translated his first measurement to the 'steen hundredth part of a meter. He will go to his lathe or milling machine to reproduce the part of which he now knows the dimensions to the 0.0005 mm. only to find a new difficulty; all the screws are made to English measurements. A half turn of this wheel or a quarter turn of that handle would no longer mean anything—besides, he could not use a half turn or quarter turn, for halves and quarters are binary; not metric. He will be obliged to replace all the screws of his milling machine with screws made to metric leads and redivide the dials in accordance therewith. If he can do this on a single machine for $3 he need never worry about the metric system. In order to make screws of metric lead he must compound for his lathe a set of change gears that will involve some very awkward sizes or else require some of them to be made with a half-tooth, or perhaps two-thirds of a tooth; and though he should finally adjust this difficulty there are many lathes, requiring many gear cutters, to supply the millions of change gears that would be needed.

Fortunately, there are plenty of gear cutters, but alas! these too are all built to the alleged cumbersome English system of measurements, and to rebuild them would require the good office of the very lathes and milling machines for the rejuvenation of which the metamorphosed gear-cutters are desired. Just where, may I ask, would he begin to commence?

"We mechanics will not have to spend millions of dollars. No, only about $3 apiece." If your correspondent refers to those mechanics whose entire kit of tools consists of a hammer, a couple of chisels and a monkey wrench wrapped up in a jumper, I must concede the truth of his statement; but what of those mechanics whose kits are valued in hundreds of dollars, at least half of which amount represents fine measuring tools and standards?

He speaks of his "metric micro": Where can he buy a "metric micro" for $3? I do not want any, but according to my memory of their catalogs Browne & Sharpe and Starrett quote them at prices ranging from $7.50 to $50 or more, and if he knows where they are made and sold for $3 it is not a bit "clubby" of him to keep his knowledge to himself.

"Milling machine work is worked to jigs and stop screws": Sometimes. But the jigs and stop-screws, if already made, are made to English standards, and to be consistent your correspondent must replace them with others made to metric standards. I will venture to say that $3 would not go far toward such replacement.

"Drill presses do not count": Yet I have seen many drill-presses the sleeves of which were graduated in *inches* and all shaft and spindle sizes, as well as all distances between centers and shoulders made to English standards, thereby necessitating, when the time for repair or replacement comes, the entire reconstruction of the machine at once or else the perpetuation of the system of measurements that your corerspondent so much desires to forget.

Your correspondent does not like to "run down" drills from numbers 1 to 60 nor run them up from ⅛ to 2 inches; he would, therefore, do away with all existing drill gages. Replacing these gages with others of metric size would make further inroads upon the original $3. And did he never hear of reamers?—or taps?

The problem is not one of dollars and cents; nor of English versus French system of mensuration. There are no strings upon the writer of that letter to prevent him from measuring anything he likes in any way he likes. Why, then, should he seek to impose restrictions upon others that, if conditions were reversed, *he* would be prompt to resent?

I have no quarrel with the metric system! If any one is foolish enough to *want* to measure in a system that is so inconvenient, so utterly unrelated to anything that is, whose very foundation is a scientific error, let him "take his little metric scale or micro and go to it;" I shall never say him nay. I *am*, however, unalterably opposed to having such a system arbitrarily foisted upon millions of sane and sensible people at the instigation of a bunch of faddists who are not practical enough to know that the realization of their objective would plunge American industry into chaos.

HARRY SENIOR.

SPARKS FROM THE WOR

Valentine Francis

Four Thousand "Turn-Auto" Devices to Be Made

What is probably one of the largest industrial contracts in Knoxville for the current year was closed on June 3 when A. W. Knowles, treasurer of the Turn-Auto Corporation, and the Wm. J. Oliver Manufacturing Co., closed a contract for the manufacture of 4,000 of the product of the former company at a cost of $1,800,000. The contract will necessitate the employment of 400 men and the operation of the Oliver plant day and night for the balance of the year. The Turn-Auto machine is a newly invented machine by which the "get out and get under" feature of auto repair is eliminated.

The Turn-Auto machine enables an automobile to be run on the machine and then turned to any position convenient for the worker. It consists simply of a cradle into which a car can be run and in which it can then be tilted any desired angle. It is far superior to any elevated or pit track.

The contract came to the Oliver Co. after the Turn-Auto Corporation had tried unsuccessfully to have its product manufactured in Indiana and Bayonne, N. J. Labor troubles finally drove the company to the South and because of its facilities for handling the work, the Wm. J. Oliver Manufacturing Co. secured the contract.

Work on the contract will start as soon as possible. The contract is one of the indications of the gradual turn of the tide of industry from the North to the South and which it is believed will be particularly favorable to east Tennessee because of its natural facilities in the forms of fuel, ores and central location for transportation.

Ralph L. Rogers and W. P. Davis have secured the agency for nine states in which they will introduce the new machine.

Passing the Buck

A pleasant pastime known as "passing the buck" or "Let George do it" seems to have grown up in many of our shops. It is played to a greater or less extent in almost every business and pleases a lot of men who think that because they can shift their responsibility to George, they are climbing up the ladder of business success and are getting on in the world.

The only man in your organization who has any right to "pass the buck" is the boss, and remember, he doesn't do it because he wants to but because he hasn't the time to assume personal responsibility for everything that takes place in the shop.

When the boss asks you to do a thing, do it yourself or see that it is done properly. If the boss had wanted George to do it he would have asked George in the first place. The fellow who insists on "passing the buck" all the time is likely to come to work some day and find that George has his job as well as his responsibility.—From "Doehler Topics."

Chicago Pneumatic Tool Co. Elects A. E. Goodhue Vice President

The Chicago Pneumatic Tool Co., New York, announces the election of Allan E. Goodhue as vice president in charge of sales. Mr. Goodhue since May 1, 1919, has been managing director of the company's English subsidiary, the Consolidated Pneumatic Tool Co., London, England; also director of European sales for the Chicago Pneumatic Tool Co.



A. E. GOODHUE

Mr. Goodhue was for a number of years connected with the sales department of the Midvale Steel Co. and Midvale Steel and Ordnance Co., in Philadelphia, Chicago and Boston, leaving that company in March, 1918, to enter the service of the Government. From that time until Jan. 1, 1919, when he became connected with the Chicago Pneumatic Tool Co., he was assistant manager of the steel and raw material section, production division, of the Emergency Fleet Corporation.

Mr. Goodhue sails for New York on the "Olympic" and is scheduled to arrive in New York about July 3.

Industrial Cost Accountants Have New Association

The Industrial Cost Accountants Association was organized in Chicago on June 18, by representatives of leading manufacturers.

The object of the new association is the standardization of accounting and cost terminology and the adoption of standard governing principles; the promotion of active co-operation and interchange of average experiences between representatives of manufacturers engaged in similar activities; the education of the members and their business associates in the complex economic problems of industry; to assist standardization committees in each line of industry; in establishing uniform accounting and cost practices; to act as a clearing house in distributing to all members the development in cost practices to the end that uniformity, once established, may be maintained.

M. F. Simmons of Schnectady, N. Y., Supervisor of costs for all General Electric Co. interests, was elected president of the association. C. H. Smith of Wilmerding, Pa., director of clerical operations of the Westinghouse Air Brake Co. interests, was elected first vice president. Roland H. Zinn, of New York, chief of the cost accounting bureau of the Tanners' Council, was elected second vice president. A. A. Alles, Jr., of Pittsburgh, secretary of the Fawcus Machine Co. and treasurer of the Schaffer Engineering and Equipment Co., was elected secretary-treasurer.

The headquarters of the association will be in Pittsburgh, at the office of the secretary-treasurer, 1501 Peoples Bank Building.

Engineering Conference Addressed by Power-Press Experts

Safety engineers who have attracted national attention through their effective work in the safeguarding of power presses addressed the conference of the Engineering Section of the National Safety Council which was held in the auditorium of the Western Society of Engineers, Monadnock Building, Chicago, on June 24.

The entire afternoon session was devoted to a discussion of the safeguarding of power-press operations and the information brought out during this discussion was used in drafting the national safety code on power presses.

The evening meeting was held jointly with the Chicago Safety Council, the Western Society of Engineers, and the Accident Prevention Committee of the Illinois Manufacturers' Association.

LD'S INDUSTRIAL FORGE

News Editor

Brooklyn Bridge Builder Still Going Strong

Colonel Washington A. Roebling, vice president of the John A. Roebling's Sons Co., Trenton, N. J., on May 26 celebrated his eighty-third birthday by entertaining a number of relatives and friends at dinner at his home, 191 West State Street. Despite his age the Colonel is well and active, and makes daily trips to the Roebling offices to attend to business. Colonel Roebling was born at Saxemberg, Pa., May 26, 1837



COLONEL W. A. ROEBLING

and was graduated from the Rensselaer Polytechnic Institute, Troy, N. Y., when but 20 years old. Following his discharge from the army at the close of the Civil War he aided his father, John A. Roebling, in the work of bridge building. He completed the Brooklyn bridge at the death of his father.

Know What Your Truck Costs

The value of maintaining a cost and performance record of motor truck operation is obvious. Except those who do keep such records, however, few appreciate just how invaluable they are.

Some inexperienced truck operators are prone to dismiss the task of maintaining records with the argument that it is a waste of time and money. To the contrary, experience proves that time and money thus invested yield handsome returns.

Said a user of six trucks recently: "A few months after we instituted a cost and performance record system, we were able to spot leaks which accounted for 25 per cent of our expense of operation."

Another user, a contractor operating 10 trucks, recently declared that even the owner of two trucks should maintain records.

"It furnishes," he said, "comparative figures to show just which truck is being operated efficiently. When records show high operating cost it sounds the alarm to investigate the cause, whether it be the fault of the driver, the operating system, or the truck itself."

The most important function of cost records, however, is to furnish the operator with a basic and accurate figure which will permit of no delusion as to the cost of doing business. This is especially important in contracting, trucking and other lines of business in which haulage is a principal item. In such business, in fact, success or failure often depends solely upon a true knowledge of transportation costs.

Unless the operator chooses to install one of the various cost system forms which are sold at a nominal sum, it is simple for him to devise one that fits his own business. But it would be advisable for the operator to study these systems before attempting to perfect one of his own, as they embody the experience of thousands of truck users.

Automotive Engineers Against Compulsory Metric Law

On Monday, June 21, the Society of Automotive Engineers in business session at Ottawa Beach, Mich., unanimously adopted a resolution against the compulsory use of the metric system. The secretary was instructed to inform the Congressional Committees on the action of the Society.

Disposes of $500,000 Surplus War Equipment

The Willys-Overland Corporation has sold to the Peninsular Machinery Co., of Detroit, 1,500 machine tools worth approximately $500,000. This machinery was ordered during the war, a large portion being delivered following the end of hostilities.

J. J. Voelcker Made Foreman of Rockwood Co.

J. J. Voelcker, who recently took charge of the machine shop of the Rockwood Manufacturing Co., Indianapolis, has been a frequent contributor to the *American Machinist* for about fifteen years. His mechanical experience covers a wide field and he is only a little over forty. He learned the machinist's and toolmaker's trade in the good old-fashioned, thorough way, in the shop of the H. Mueller Manufac-



J. J. VOELCHER

turing Co., of Decatur, Ill., one of the largest plumbers' brass goods factories in the world. Later they made him foreman of their machine shop.

He next became foreman of the toolroom for the Link-Belt Co., Indianapolis, and left there to become superintendent of the Van Briggle Motor Device Co., in the same city. He stayed in this position three years and then went to the planning department of the Nordyke and Marmon Co. and from there to his present position. He has also at various times in his career, in order to gain experience, worked at the Rock Island Arsenal, Atlas Gas Engine Works, Stenotype Co. and the Ideal Brass Works.

Fred Thornley, director and works manager of W. Thornley & Sons, Ltd., Marrickville, Australia, is in this country for the purpose of purchasing new machinery. He is stopping at the Highland Court Hotel, Windsor Ave., Hartford, Conn., and is interested in toolroom equipment, including a hardening plant, grinding and milling machines, and automatic and turret lathes.

Platform of the New York Citizens Transportation Committee

The following declaration of principles was adopted by the Citizens Transportation Committee of New York City, May 27, 1920: "The welfare of the Community being dependent on impartial and uninterrupted transportation service, all classes of people and merchandise should be served by transportation and trucking facilities without discrimination and there should be no interruption to such service through industrial warfare except as a last resort when all efforts of adjustment have failed and there is no impartial tribunal available to the parties presenting a grievance.

"Employees on piers, docks, railroads, steamships, lighters, tugs and trucks should perform their usual service regardless of whether the connecting points which they serve or the facilities or vehicles through which the merchandise is received or delivered are manned by union or non-union men.

"Impartial service should be extended to all merchandise regardless of whether it has been worked upon or handled by union or non union men."

Personals

JOHN MC. C. PRICE has recently become associated with the Industrial Controller Co., Milwaukee, Wis., and has taken charge of the Chicago office. Mr. Price was formerly with the Mechanical Appliance Co., Milwaukee, as general sales manager.

WILLARD S. SISSON, secretary and treasurer of the D. & W. Fuse Co., Providence, R. I., will sever his connection with that company on June 15, as the plant is now operated by the General Electric Co., under a long-term lease. Mr. Sisson will continue in the electrical business.

T. W. MCMANUS for the last six years master mechanic for the Kellogg Switchboard and Supply Co., has taken over an interest in the Security Tool Works, Chicago. Mr. McManus has been elected vice president and has assumed the duties of general manager.

R. K. MORSE has been appointed Western manager of the Milwaukee Electric Crane and Manufacturing Co. Mr. Morse will have his headquarters in the Pittock Block, Portland, Ore.

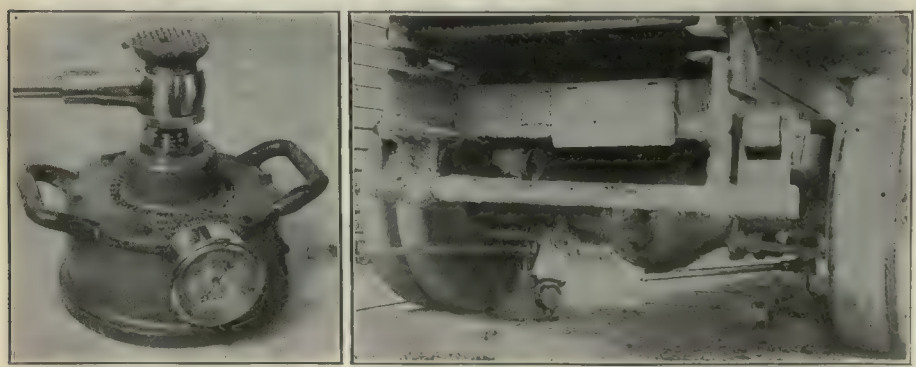
Resolution Against Metric System

By the Motor and Accessory Manufacturers Association at Atlantic City, April 26, 1920.

Whereas, the members of this Association have formally registered their opposition to the adoption of the metric system on the grounds that it is uneconomic; that the disadvantages of the metric system are not offset by the advantages; that the benefits of the metric system do not justify the enormous expense which would be entailed through the necessary changes in sizes of product and equipment (which would mean an excessive loss through destruction of the present equipment not adapted to the new system); and through the education of employees and customers.

Therefore, be it resolved, that this committee express for the members of the Motor and Accessory Manufacturers Association its opposition to any legislative action which would result in making the adoption of the metric system of weights and measures obligatory, and further

Be it resolved, that this committee commend to the members of this Association the work of the American Institute of Weights and Measures in opposing the compulsory adoption of the metric system.



The instrument illustrated herewith is called the Loadometer and is being manufactured by the Black & Decker Manufacturing Co., Baltimore, Md. It is a portable device for determining the weight carried by a motor truck. The rear wheels are jacked up clear of the ground and the sum of the readings on the gages tells the load being carried by the rear axle. Many county and state police are now using these instruments and where these indicate that the truck is overloaded, the owner of the truck is haled into court and usually fined for violating the law. Much of the criticism that is being passed on the highway commissions and road engineers because of rapid deterioration of roads is actually caused by the operating of trucks with excessive loads.

Obituary

Whitfield P. Pressinger

Whitfield P. Pressinger, New York, vice president of the Chicago Pneumatic Tool Co., died on June 10 as a result of complications following an operation. Mr. Pressinger was actively engaged in the penumatic tool and allied machinery industry for many years. He was general manager of the Clayton Air Compressor Co. for seven years and became widely known through numerous activities in the American Society



WHITFIELD P. PRESSINGER

of Mechanical Engineers and the Compressed Air Society. He was born in New York City in 1871. In addition to the foregoing societies he was a member of the Sons of the Revolution, Seventh New York Regiment Veterans, F. and A. M., and the following clubs of New York City: Engineers, Lawyers, New York Athletic, New York Railroad, Columbia Yacht and the Machinery Club.

Business Items

Labor troubles have caused the shutting down of the foundry department of the Brunswick Marine Construction Co., at Brunswick, Ga., and the company is preparing to ship the equipment and finished products of the department to another point, according to W. C. Irwin, manager of the plant.

The Yale & Towne Manufacturing Co., Stamford, Conn., has purchased the Industrial Electric Truck Division of the C. W. Hunt Co., of Staten Island. This new business will be combined with the Yale company's hoist depart-

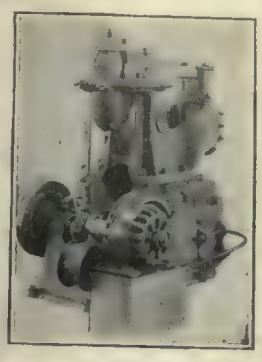
Condensed-Clipping Index of Equipment

Patented Aug. 20, 1918

Hammer, Helve, Motor-Driven

C. C. Bradley, Inc., Syracuse, N. Y.

"American Machinist," June 10, 1920



The hammer is controlled in the usual manner by a treadle, which applies and regulates the pressure of the idler pulley against the loose running belt. Formerly a motor was not included as part of the hammer equipment, and if used for the drive a separate countershaft with two loose pulleys between the motor and hammer was required. The illustration shows the drive arrangement now used.

Lathe, Geared-Head, 26-In.

Betts Machine Co., Rochester, N. Y.

"American Machinist," June 10, 1920



The headstock is of the all-geared inclosed type, being operated through an expanding-ring friction clutch operated from the apron. The movement which disengages the clutch automatically applies the friction brake. There are nine spindle speeds in geometric progression, two back gears being used. All shafts and gears are located in the lower half of the headstock, access being obtained by merely removing the cover. If individual motor drive is used, the motor is mounted on top of the headstock cover and geared to the main driving shaft.

Milling Machine, Smi-Automatic, Multiple-Spindle

Ingersoll Milling Machine, Rockford, Ill.

"American Machinist," June 10, 1920

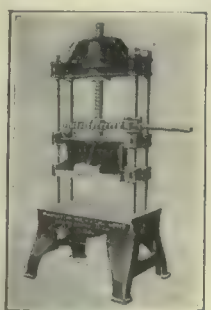


This machine is of the reciprocating-table type, the feed being automatically controlled so that it increases while the cutters are passing through the clearance space. After loading the first fixture and starting the cut the operator loads the other fixtures, and he removes each casting as fast as it is finished. The machine shown has individual motor drive and two vertical and two horizontal spindles, but other machines of this type are made with different spindle arrangements. Table, 14 x 67 in. Floor space, 34 sq.ft. Weight, 10,000 lb.

Press, Screw, Four-Post

Manhattan Machine and Tool Works, Grand Rapids, Mich.

"American Machinist," June 10, 1920



This press, known as type BB, is intended for testing punches and dies and for other experimental work where a hand press of considerable power is required. Capacity, 80 tons. Bed, 20 x 36 in. Maximum distance bed to ram, 22 in. Diameter of screw, 3 in. Height, 77 in. Floor space, 31 x 41 in. Weight: net, 2,270 lb.; for shipment, 2,425 lb.; boxed for export, 2,600 lb. Size boxed, 58 cu.ft.

Blasting Machine, Piston

Gray Machine Tool Co., Inc., Buffalo, N. Y.

"American Machinist," June 10, 1920



The machine shown is adapted to cleaning with steel grit or shot the insides of pistons up to 3½ in. outside diameter, the air consumption being 40 cu.ft. per min. at 70 to 90 lb. pressure. The piston is placed in a holder with the open end downward, and when lowered by means of a lever it starts rotating. The work holders operate independently, thus allowing the work to be changed in one while the other is revolving. The drive pulley runs at 100 r.p.m. Floor space, 36 x 42 in. Weight, packed for shipment, 800 lb.

Screwdriver

The Ackland Specialty Co., 146 College St., Springfield, Mass.

"American Machinist," June 10, 1920



This screwdriver with its attachments is intended for removing screws that cannot be turned by the ordinary hand tool. Three screwdriver blades, ⅜, ½ and ⅝ in. widths, are furnished. These blades fit into a case-hardened socket in the extension post, upon which a ratchet wrench is fitted. The bar upon which the pressure is applied to hold the driver in the screw is attached to the extension post by a ball joint.

Drilling Machine, Vertical, 20-In.

The Hoosier Drilling Machine Co., Goshen, Ind.

"American Machinist," June 10, 1920

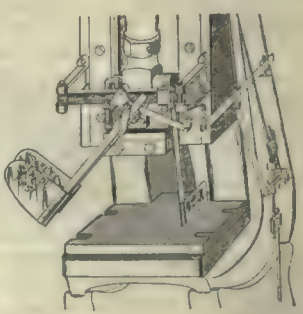


This machine is built in four different styles. No. 1 has a round base, plain drive and adjustable-lever feed; No. 2 is the same as No. 1 but has a rectangular base; No. 3 has a combined lever and worm feed; and No. 4, illustrated here, has back gears and power feed. An automatic stop attachment enables the operator to drill accurately to depth. The hole in the center of the table is machined in alignment with the spindle, so that it may be used for piloting a boring bar. Number of spindle speeds: 4 on plain-drive machine, 8 on back-geared machine. Three power feeds, 0.003, 0.005 and 0.008 in. Diameter of table, 16 in. Travel: spindle, 9¼ in.; table, 18 in.

Guard, Safety, for Power Press

D. & M. Guard Co., 6 State Street, Rochester, N. Y.

"American Machinist," June 10, 1920



The device has three guards, two of them standing normally at the left of the operator. The front guard moves with each stroke of the treadle, while the inner guard moves with each stroke of the ram. Each moves independently of the other, and serves to push the operator's hands away from the punch. A side guard prevents the feeding of the punch from the side. The device may be swung to one side to render the head accessible, and it may be easily attached to the press.

Clip, paste on 3 x 5-in. cards and file as desired

ment, and will thus put it in a position to furnish complete equipment for the moving of medium and light loads, either vertically or horizontally.

The Meisselbach-Catucci Manufacturing Co., of Newark, N. J., has purchased the shop of the Union Wheel Works, which is located at 51 Stanton St. in the Frelinghuysen Ave. factory development. The company is converting the building to meet its requirements, and with the added facilities afforded will be in a better position to meet the demand for M-C gears and M-C gear hobbing machines.

Recent advertisements of the Westinghouse Union Battery Co., Swissvale, Pa., have, unfortunately, led many to assume that the Westinghouse Electric and Manufacturing Co. was entering the storage-battery field. In order to clear away any misunderstanding, the Westinghouse Electric and Manufacturing Co. authorizes the statement that the Westinghouse Union Battery Co. is owned and controlled by the Westinghouse Air Brake Co., Wilmerding, Pa., and the Westinghouse Electric and Manufacturing Co. is not in any way connected with it.

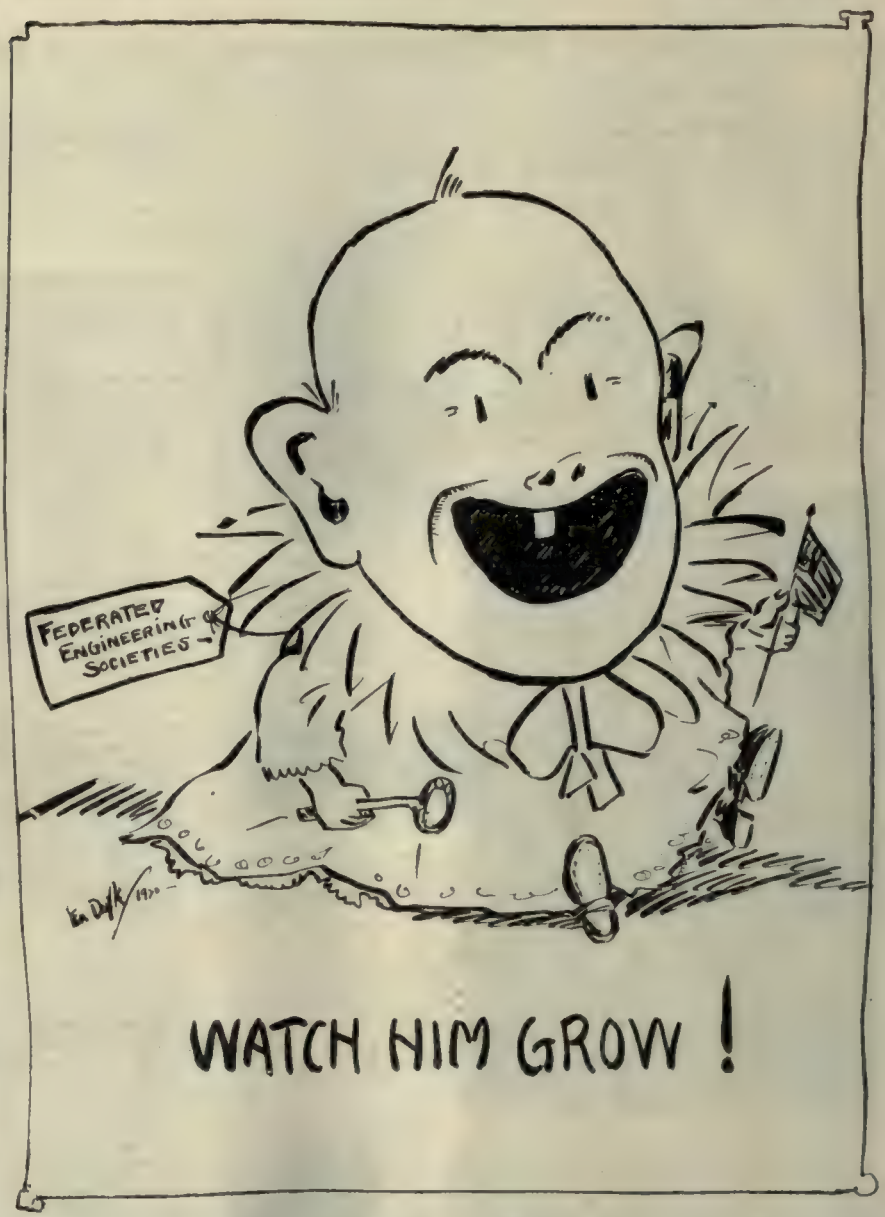
The Metal Saw and Machine Co., Inc., Springfield, Mass., has been especially organized to take over the production of Napier metal-cutting machines, band saws, etc. The same officers who were president and treasurer of the Napier Saw Works, Inc., are now president and treasurer of the Metal Saw and Machine Co., Inc.

The Velco Manufacturing Co., Greenfield, Mass., has been incorporated under the laws of Massachusetts with a capital of $250,000. It has purchased the entire assets of the V. E. Lapointe Manufacturing Co., of Manchester, Conn., which it has moved to its new plant at Greenfield, Mass., where new machinery and equipment is now being installed. Frank O. Wells is president and J. T. Seller, treasurer.

At a recent board meeting of the directors of Manning, Maxwell & Moore, Inc., New York, Robert A. Bole, who has been a director and who is its general sales manager on the Pittsburgh end, was elected vice president of the firm. Mr. Bole has been with this company for a great many years, and is well known in the railroad and metal industries.

The plant of the New England Oil Refining Co., Fall River, Mass., built by Aberthaw of Boston, was put into operation on the arrival of 60,000 barrels of oil from a Southern port. The full pumping capacity of the new refinery is 5,000 barrels per hour.

Oscar Lindbom, president of Aktiebolaget Oscar Lindbom, Stockholm, Sweden, machine-tool dealer, is visiting this country for the purpose of making arrangements with American manufacturers of machine tools. Aktiebolaget Oscar Lindbom has recently taken over the machine-tool business, including showrooms and selling organization, of Aktiebolaget Galco, Ltd., which firm will devote its entire energies to export trade from Sweden. Mr. Lindbom's address while in this country will be in care of American Galco, Incorporated, Grand Central Palace, New York City.



Export Opportunities

A manufacturing company in India desires to secure an agency for the sale of lathes and workshop gear, concrete and mortar mixers, locomotives and tipping wagons for broad and narrow gage lines, and cement, metals, etc. Quotations should be given c.i.f. Indian port. References. No. 33112.

A jute mills company in India desires to purchase a complete set of machinery for mill, machinery for preparing jute and spinning and weaving sacks. Quotations should be given c.i.f. Cocanada or Madras. Payment will be made cash on delivery of documents. No. 3,117.

An American trading company with connections throughout Europe desires to purchase and secure an agency for the sale of machines and tools for woodworkers, metal workers, blacksmiths, and toolmakers, also paper, cardboard, pulpboard, newsprint paper, etc. Payment will be cash against documents in New York. References. No. 33111.

A merchant in Scotland desires an agency for the sale in South Africa of baker, confectionery, and allied manufacturers' machinery. Quotations should be given f.o.b. New York. Payment will be cash against documents. References. No. 33126.

Forthcoming Meetings

The International Railway Master Blacksmiths' Association will hold its next annual convention at Tutwiler Hotel, Birmingham, Ala., on Aug. 17, 18 and 19. The secretary of the association is A. L. Woodworth, Lima, Ohio.

The American Steel Treaters' Society and the Steel Treating Research Society will hold their second annual convention and exhibition at the Commercial Museum, Philadelphia, Pa., on Sept. 14 to 18, inclusive. J. A. Pollak, of the Pollak Steel Co., Cincinnati, Ohio, is secretary of the former society.

The American Foundrymen's Asssociation will hold its annual convention and exhibit at Columbus, Ohio, on Oct. 4 to 9. C. E. Hoyt, 1401 Harris Trust Building, Chicago, Ill., is secretary.

An exposition of U. S. manufacturers at Buenos Aires, Argentine Republic, S. A., has been arranged for the month beginning Nov. 15. Information can be obtained from the American National Exhibition, Inc., Bush Terminal Sales Building, 132 West 42nd St., New York.

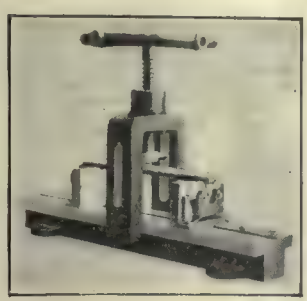
Condensed-Clipping Index of Equipment

Patented Aug. 20, 1918

Straightening Machine, Bar

Whitney Metal Tool Co., Rockford, Ill.

"American Machinist," June 10, 1920



This machine is designed to straighten bar stock up to 2 in. diameter. The work is supported on V-blocks while being subjected to the action of the screw. Upon elevating the screw, the two sets of spring-actuated rolls lift the bar above the Vs, so that it may be easily rotated.

Drilling Machine, Vertical, Geared

Minster Machine Co., Minster, O.

"American Machinist," June 10, 1920



This machine for quantity production is known as the No. 12 Minster Junior. The spindle is driven by gears through a double-keyed driving sleeve, a ball thrust bearing being used. Tight and loose pulleys are part of the regular equipment, but a reversing clutch can be furnished for use when tapping. The feed is through gears, and the depth of the hole can be controlled by a dial which disengages the feed at the proper point. A compound table can be furnished. Capacity: will drill in steel, 2 in. Length of feed, 16 in. Table size, 18 x 20 in. Feed changes, 4. Speed changes, 6. Net weight, 2,800 lb.

Drilling Machine, Vertical, 24-In.

J. E. Snyder & Son., Worcester, Mass.

"American Machinist," June 10, 1920

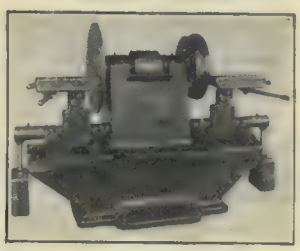


This machine has an adjustable head and tapping attachment and is designed for medium work. All gears are protected and the power feed is driven from the top shaft instead of the main spindle. A compound table and motor drive, either belt or chain connected, can be furnished. Capacity: drills to center, 24 in. Automatic feed., 10 in. Traverse: head, 17½ in.; table, 17 in. Diameter of table, 21 in. Ratio of back gears 5½ to 1. Speeds, 8. Feeds, 4. Motor required, 2 hp. Floor space, 22½ x 64 in.

Grinding Machine, Disk

Badger Tool Co., Beloit, Wis.

"American Machinist," June 10, 1920

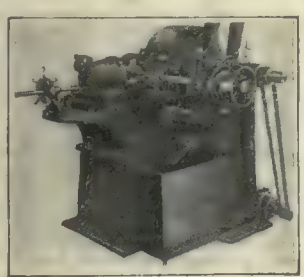


This machine, known as No. 8, has ball bearings for the spindle. The work tables are provided with lever feed and stops having micrometer adjustment. A pump and hoods for wet grinding can be furnished and the machine can be equipped with chucks to hold abrasive cylinders. Disk diameter, 26 to 30 in. Cylinder chuck diameter, 18 to 20 in. Speed: with disks, 6,000 ft. per min.; with chucks, 5,000 ft. per min. Work tables, 8 x 15 in. Shipping weight: domestic, 4,000 lb.; export, 4,500 lb. Export box, 130 cu.ft.

Grinding Machine, Cylindrical, Centerless

Russell, Holbrook and Henderson, Inc., 30 Church St., New York City.

"American Machinist," June 17, 1920



The model "B" machine is intended for grinding straight cylindrical work from ⅛ to 6 in. and up to 20 in. in length. The grinding wheel is 20 x 4 in. and mounted on a 3¼-in. shaft running in bronze bearings adjustable for wear. The feed wheel which holds the work against the grinding wheel runs at 48 r.p.m. For quantity production work a series of these machines can be used, each one reducing the work without changing the wheel adjustment. Where one machine is used it is necessary to pass the work through two or more times. Floor space, 48 x 68 in. Weight: net, 2,200 lb.; crated, 2,500 lb.

Torch, Oxy-Acetylene, Welding, Cutting

K-G Welding and Cutting Co., 556 West 34th St., New York City

"American Machinist," June 17, 1920



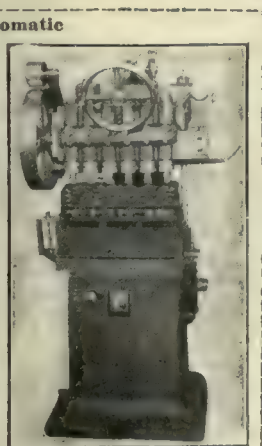


The heads, tips and nuts that are exposed to the heat are made of Monel metal. The claims made for the torches are low upkeep and long life, due to the high melting point and heat conductivity of the metal. The heat-resisting qualities of the tips are said to permit continuous work in certain cases without stopping to cool the torch before the weld is completed; also, that the joints are not likely to loosen from overheat and cause a flash back when working in corners and pockets.

Profiling Machine, Multiple-Spindle, Automatic

Automatic Machine Co., Bridgeport, Conn.

"American Machinist, June 17, 1920

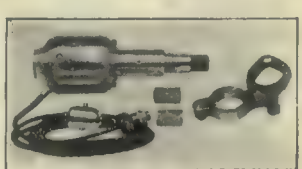


The machine is intended for rapid production of irregular contours. Six spindles or less may be carried, the head casting being changed to conform to different types of work. The spindles are each driven by a bronze helical gear meshing with a single long steel helical gear on the driving shaft. The head is moved parallel to the length of the table by means of the cam on the right driven by worm gearing, and the table is moved in and out from the columns by means of a similar arrangement. The fixtures and tools are designed to suit the particular pieces of work to be done. Independent motor drive can be furnished. Floor space, about 5 x 6 ft. Weight, 6,000 lb.

Truing Machine, Grinding Wheel

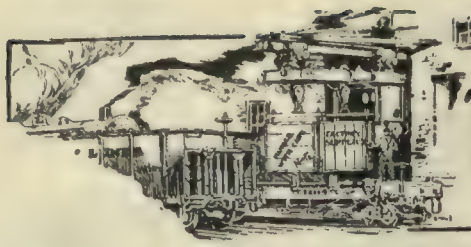
The Precision Truing Machine and Tool Co., Cincinnati, Ohio

"American Machinist," June 17, 1920



The machine is intended for use in place of a diamond in truing abrasive wheels. It consists of a motor, abradent nib and a holder for fastening the motor to the grinding machine, and it can be operated by current from a lamp socket. The revolving nib approaches the wheel at an angle and is fed across the face of it in the same way as a diamond. Three 1-in. diameter general purpose nibs are furnished, but special nibs can be supplied.

Clip, paste on 3 x 5-in. cards and file as desired



THE WEEKLY PRICE GUIDE

IRON AND STEEL

PIG IRON—Quotations compiled by The Matthew Addy Co.:

	Current	One Year Ago
CINCINNATI		
No. 2 Southern	$45.60	$29.80
Northern Basic	42.80	27.55
Southern Ohio No. 2	46.80	28.55
NEW YORK—TIDEWATER DELIVERY		
2X Virginia (Silicon 2.25 to 2.75)	49.65	31.90
Southern No. 2 (Silicon 2.25 to 2.75)	49.70	33.95
BIRMINGHAM		
No. 2 Foundry	42.00@44.00	25.75
PHILADELPHIA		
Eastern Pa., No. 2x, 2.25–2.75 sil.	46@48.25*	.....
Virginia No. 2	45.00*	30.85
Basic	44.50†	30.90
Grey Forge	43.50*	30.90
CHICAGO		
No. 2 Foundry local	44.25	27.25
No. 2 Foundry, Southern	47.00	31.75
PITTSBURGH, INCLUDING FREIGHT CHARGE FROM VALLEY		
No. 2 Foundry	45.65	28.15
Basic	44.40	27.15
Bessemer	44.90	29.35
MONTREAL		
Silicon 2.25 to 2.75%	43.25	.....

* F.o.b. furnace. † Delivered.

STEEL SHAPES—The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses at the cities named:

	New York			Cleveland		Chicago	
	Current	One Month Ago	One Year Ago	Current	One Year Ago	Current	One Year Ago
Structural shapes	$4.47	$3.97	$3.47	$5.50	$3.37	$3.97	$3.47
Soft steel bars	4.62	4.12	3.37	5.00	3.27	3.87	3.37
Soft steel bar shapes	4.62	4.12	3.37	.....	3.27	3.87	3.37
Soft steel bands	5.82	5.32	4.07	6.25	.....	.....	.....
Plates, ¼ to 1 in. thick	4.67	4.17	3.67	5.00	3.57	4.17	3.67

BAR IRON—Prices per 100 lb. at the places named are as follows:

	Current	One Year Ago
Mill, Pittsburgh	$4.25	$2.35
Warehouse, New York	4.57	3.37
Warehouse, Cleveland	3.52	3.22
Warehouse, Chicago	3.75	3.37

SHEETS—Quotations are in cents per pound in various cities from warehouse; also the base quotations from mill:

Blue Annealed	Large Mill Lots Pittsburgh	New York Current	New York One Year Ago	Cleveland	Chicago
No. 10	3.55–6.00	7.12@8.00	4.57	7.55	7.02
No. 12	3.60–6.05	7.17@8.05	4.62	7.65	7.07
No. 14	3.65–6.10	7.22@8.10	4.67	7.70	7.12
No. 16	3.75–6.20	7.32@8.20	4.77	7.80	7.22
Black					
Nos. 18 and 20	4.15–6.30	8.50@9.50	5.17	8.20	7.80
Nos. 22 and 24	4.20–6.35	8.55@9.55	5.22	8.25	7.85
No. 26	4.25–6.40	8.60@9.60	5.27	8.30	7.90
No. 28	4.35–6.50	8.70@9.70	5.37	8.40	8.00
Galvanized					
No. 10	4.70–7.50	9.75@11.00	5.50	8.50	8.15
No. 12	4.80–7.60	9.85@11.00	5.55	8.60	8.20
No. 14	4.80–7.60	9.85@11.10	5.60	8.60	8.35
Nos. 18 and 20	5.10–7.90	10.10@11.40	5.90	8.90	8.65
Nos. 22 and 24	5.25–8.02	10.25@11.55	6.05	9.05	9.05
No. 26	5.40–8.20	10.40@11.70	6.20	9.20	9.20
No. 28	5.70–8.50	10.70@12.00	6.50	9.50	9.50

Acute scarcity in sheets, particularly black, galvanized and No. 16 blue enameled.

Automobile sheets are unavailable except in fugitive instances, when prices are 9.45c per lb. for No. 16; 9.50 for Nos. 18 and 20, and 9.55c for Nos. 22 and 24.

COLD FINISHED STEEL—Warehouse prices are as follows:

	New York	Chicago	Cleveland
Round shafting or screw stock, per 100 lb. base	$6.25	$5.80	$6.00
Flats, square and hexagons, per 100 lb. base	6.75	6.30	6.50

DRILL ROD—Discounts from list price are as follows at the places named:

	Per Cent.
New York	50
Cleveland	50
Chicago	50

SWEDISH (NORWAY) IRON—The average price per 100 lb., in ton lots is:

	Current	One Year Ago
New York	$20.00	$25.50–30.00
Cleveland	20.00	20.00
Chicago	21.00	16.50

In coils an advance of 50c. usually is charged.
Domestic iron (Swedish analysis) is selling at 12c. per lb.

WELDING MATERIAL (SWEDISH)—These prices are the best we have been able to obtain for Swedish welding materials, of which it is reported that very little are on the market.

Welding Wire		Cast-Iron Welding Rods	
⅛, 5/32, 3/16, ¼, 5/16, ⅜, No. 8, 7/32 and No. 10, ½, No. 12, 9/16, No. 14 and ⅝, No. 18, No. 20	21.00 to 30.00	⅛ by 12 in. long	14.00
		3/16 by 19 in. long	12.00
		¼ by 19 in. long	10.00
		½ by 21 in. long	10.00
		Special Welding Wire, Coated	
		⅛	33.00
		⅝	30.00

Domestic—Welding wire in 100-lb. lots sells as follows, f. o. b. New York: 7/32, 8½c. per lb.; ⅛, 8c.; 5/32 to ¼, 7½c.

MISCELLANEOUS STEEL—The following quotations in cents per pound are from warehouse at the places named:

	New York Current	Cleveland Current	Chicago Current
Openhearth spring steel (heavy)	7.00	8.00	9.00
Spring steel (light)	10.00	11.00	12.25
Coppered bessemer rods	9.00	8.00	6.75
Hoop steel	6.07	6.50	5.32
Cold-rolled strip steel	12.50	8.25	10.75
Floor plates	6.80	6.00	6.77

PIPE—The following discounts are to jobbers for carload lots on the Pittsburgh basing card, discounts on steel pipe, applying as from January 14, 1920, and on iron pipe from January 7, 1920.

Inches	Steel Black	Steel Galvanized	Inches	Iron Black	Iron Galvanized
	BUTT WELD				
⅛, ¼ and ⅜	47%	20½%	¼ to 1¼	34½%	18½%
½	51%	36½%			
¾ to 3	54%	41½%			
	LAP WELD				
2	47%	34½%	2	28½%	14½%
2½ to 6	50%	37½%	2½ to 6	30½%	17½%
	BUTT WELD, EXTRA STRONG PLAIN ENDS				
⅛, ¼ and ⅜	43%	25½%	¼ to ⅜	34½%	19½%
½	48%	35½%			
¾ to 1½	52%	39½%			
	LAP WELD, EXTRA STRONG PLAIN ENDS				
2	45%	33½%	2	29½%	16½%
2½ to 4	48%	36½%	2½ to 4	31½%	19½%
4½ to 6	47%	35½%	4½ to 6	30½%	18½%

Stock discounts in cities named are as follows:

	New York Black	New York Galv.	Cleveland Black	Cleveland Galv.	Chicago Black	Chicago Galv.
⅜ to 3 in. steel butt welded	40%	24%	40%	31%	54@40%	40½@30 %
2½ to 6 in. steel lap welded	35%	20%	42%	27%	50@40%	37½@27½%

Malleable fittings. Class B and C, banded, from New York stock sell at plus 32%. Cast iron, standard sizes, net.

METALS

MISCELLANEOUS METALS—Present and past New York quotations in cents per pound, in carload lots:

	Current	Month Ago	Year Ago
Copper, electrolytic	18@19	19.25	18.00
Tin in 5-ton lots	48.50	61.50	72.50
Lead	8.00	9.00	5.35
Spelter	7.75	8.70	6.85
ST. LOUIS			
Lead	7.75	8.87½	5.10
Spelter	7.45	8.37½	6.50

At the places named, the following prices in cents per pound prevail, for 1 ton or more:

	New York Current	New York Month Ago	New York Year Ago	Cleveland Current	Cleveland Year Ago	Chicago April 8 Current	Chicago April 8 Year Ago
Copper sheets, base	33.50	29.50	26.00	32.00	26.50	36.00	27.00
Copper wire (carload lots)	31.25	31.25	24.00	29.50	26.50	27.00	23.00
Brass sheets	28.50	27.50	20.50	29.00	25.00	27.00	21.50
Brass pipe	33.00	32.00	30.75	34.00	33.00	35.00	31.00
Solder (half and half) (case lots)	33.00	39.00	38.00	40.50	41.00	38.00	39.00

Copper sheets quoted above hot rolled 16 oz., cold rolled 14 oz. and heavier, add 2c.; polished takes 5c. per sq.ft. extra for 20-in. widths and under; over 20 in., 7½c.

BRASS RODS—The following quotations are for large lots, mill. 100 lb. and over, warehouse; net extra:

	Current	One Year Ago
Mill	23.75	18.00
New York	25.00	19.50
Cleveland	27.00	24.00
Chicago	26.00	24.00

SHOP MATERIALS AND SUPPLIES



ZINC SHEETS—The following prices in cents per pound prevail:

Carload lots f.o.b. mill..... 12.00

	In Casks		Broken Lots	
	Current	One Year Ago	Current	One Year Ago
Cleveland	15.00	12.95	15.50	13.30
New York	14.00	12.00	14.50	13.00
Chicago	15.00	16.50	15.00	16.00

ANTIMONY—Chinese and Japanese brands in cents per pound, in ton lots for spot delivery, duty paid:

	Current	One Year Ago
New York	8 00	8.50
Chicago	9.50	10.00

OLD METALS—The following are the dealers' purchasing prices in cents per pound:

	New York			
	Current	One Year Ago	Cleveland	Chicago
Copper, heavy, and crucible	16.00	15.00	16.50	16.50
Copper, heavy, and wire	15.25	14.00	16.50	15.00
Copper, light, and bottoms	13.75	12.00	15.00	14.00
Lead, heavy	7.00	4.62½	7.00	7.00
Lead, tea	5.00	3.75	5.00	6.00
Brass, heavy	10.25	8.75	12.50	16.50
Brass, light	7.50	7.00	10.00	9.50
No. 1 yellow brass turnings	8.50	8.50	10.00	10 00
Zinc	5.25	4.25	5 00	5 50

ALUMINUM—The following prices are from warehouse at places named:

	New York	Cleveland	Chicago
No. 1 aluminum, 98 to 99% pure, in ingots for remelting (1-15 ton lots), per lb	33.00	34.00c.@35.00c.	33.50

COPPER BARS—From warehouse sell as follows in cents per pound, for ton lots and over:

	Current	One Year Ago
New York (round)	38.00	25.00
Chicago	29.00	28.00
Cleveland	32.00	28.50

BABBITT METAL—Warehouse price per pound:

	New York		Cleveland		Chicago	
	Current	One Year Ago	Current	One Year Ago	Current	One Year Ago
Best grade	90.00	87.00	74.50	79.00	60.00	75.00
Commercial	50.00	42.00	21.50	17.50	15.00	15.00

SHOP SUPPLIES

NUTS—From warehouse at the places named, on fair-sized orders, the following amount is deducted from list:

	New York		Cleveland		Chicago	
	Current	One Year Ago	Current	One Year Ago	Current	One Year Ago
Hot pressed square	+$4.00	3.25	$ .75	$1.90	$.50	2.00
Hot pressed hexagon	+ 4.00	2.70	.75	1.90	.50	2.00
Cold punched hexagon	+ 4.00	3.25	.75	1.90	.50	1.30
Cold punched square	+ 4.00	2.70	.75	1.90	.50	1.30

Semi-finished nuts, $\frac{5}{16}$ and smaller, sell at the following discounts from list price:

	Current	One Year Ago
New York	30%	50–10%
Chicago	50%	50%
Cleveland	50%	60-10-10%

MACHINE BOLTS—Warehouse discounts in the following cities:

	New York	Cleveland	Chicago
½ by 4 in. and smaller	List	20%	20%
Larger and longer up to 1½ in. by 30 in.	+20%	20%	10%

WASHERS—From warehouses at the places named the following amount is deducted from list price:

For wrought-iron washers:

New York..... list Cleveland..... $3.00 Chicago..... $3.00

For cast-iron washers, ⅜ and larger, the base price per 100 lb. is as follows:

New York..... $7.00 Cleveland..... $4.50 Chicago..... $4.75

CARRIAGE BOLTS—From warehouses at the places named the following discounts from list are in effect:

	New York	Cleveland	Chicago
½ by 6 in. and smaller	10%	15%	10%
Larger and longer up to 1 in. by 30 in.	10%	10%	5%

COPPER RIVETS AND BURS sell at the following rate from warehouse:

	Rivets		Burs	
	Current	One Year Ago	Current	One Year Ago
Cleveland	20%	25%	10%	10%
Chicago	net	10%	net	10%
New York	25%	40%	net	20%

RIVETS—The following quotations are allowed for fair-sized orders from warehouse:

	New York	Cleveland	Chicago
Steel ⅞ and smaller	30%	30%	30%
Tinned	30%	30%	30%

Boiler, ¾, ⅞, 1 in. diameter by 2 to 5 in. sell as follows per 100 lb.:

New York..... $6.00 Chicago..... $5.37 Pittsburgh..... $5.62

Structural, same sizes:

New York..... $7.10 Chicago..... $5.47 Pittsburgh..... $5.72

MISCELLANEOUS

SEAMLESS DRAWN TUBING—The base price in cents per pound from warehouse in 100-lb. lots is as follows:

	New York	Cleveland	Chicago
Copper	34 00	34.00	35.00
Brass	33.00	34.00	34.00

For immediate stock shipment 3c. is usually added. The prices, of course, vary with the quantity purchased. For lots of less than 100 lb., but not less than 75 lb., the advance is 2c.; for lots of less than 75 lb., but not less than 50 lb. advance is 5c. over base (100-lb. lots); less than 50 lb., but not less than 25 lb. 10c. should be added to base price; quantities from 10-25 lb., extra is 25c.; less than 10 lb., add 35c.

Double above extras will be charged for angles, channels and sheet metal mouldings if ordered in above quantities. Above extras also apply to brass rod other than standard stock sizes—stock sizes being considered as ⅛-2 in. inclusive in rounds, and ⅜-1½ in., inclusive, in square and hexagon—all varying by thirty seconds up to 1 in. by sixteenths over 1 in. On shipments aggregating less than 100 lb., there is usually a boxing charge of $1.50.

LONG TERNE PLATE—In Chicago No. 28 primes from stock sell, nominally, for $12.50 per 100 lbs.

COTTON WASTE—The following prices are in cents per pound:

	New York			
	Current	One Year Ago	Cleveland	Chicago
White	11.00@15.50	13.00	16.00	11.00 to 14.00
Colored mixed	7.00@10.50	9.00–12.00	12.00	9.50 to 12.00

WIPING CLOTHS—Jobbers' price per 1000 is as follows:

	13½x13½	13½x20½
Cleveland	55.00	65.00
Chicago	41.00	43.50

SAL SODA sells as follows per 100 lb.:

	Current	One Month Ago	One Year Ago
New York	$3.00	$2.25	$1.75
Philadelphia	2.75	2.00	1.75
Cleveland	2.50	2.50	2.75
Chicago	2.25	2.25	2.00

ROLL SULPHUR in 360-lb. bbl. sells as follows per 100 lb.:

	Current	One Month Ago	One Year Ago
New York	$3.90	$4.00	$3.65
Philadelphia	3.65	....	....
Cleveland	4.25	4.25	3.62
Chicago	5.00	5.00	5.00

COKE—The following are prices per net ton at ovens, Connellsville:

	June 10	June 3	May 27
Prompt furnace	$14.50@$15.00	$14.50@$15.50	$14.50@$15.50
Prompt foundry	15.50@ 16.00	15.50@ 16.50	15.50@ 16.50

FIRE CLAY—The following prices prevail:

		Current
Ottawa, bulk in carloads	Per Ton	$8.00
Cleveland	100-lb. bag	1.00

LINSEED OIL—These prices are per gallon:

	New York		Chicago	
	Current	One Year Ago	Current	One Year Ago
Raw in barrels (5 bbl. lots)	$1.63	$1.90	$2.02	$2.10
5-gal. cans (without cans)	1.66*	2.03	2.27	2.30

*To this *oil* price must be added the cost of the cans (returnable), which is $2.25 for a case of six.

WHITE AND RED LEAD—Base price per pound:

	Red				White	
	Current		One Year Ago		Current	One Year Ago
	Dry	In Oil	Dry	In Oil	Dry and In Oil	Dry and In Oil
100 lb. keg	15.50	17.00	13.00	14.50	15.50	13.00
25 and 50-lb. kegs	15.75	17.25	13.25	14.75	15.75	13.25
12½-lb. keg	16.00	17.50	13.50	15.00	16.00	13.50
5-lb. cans	18.50	20.00	15.00	16.50	18.50	15.00
1-lb. cans	20.50	22.00	16 00	17.50	20.50	16.00

500 lb. lots less 10% discount. 2000 lb. lots less 10–2½% discount.

NEW *and* ENLARGED



Edited by
L·V·FLETCHER

Machine Tools

The following concerns are in the market for machine tools:

R. I., Providence—Borland & Sons—one 15 ton hydraulic power press.

Md., Baltimore—The Carey Machine and Supply Co., 119 East Lombard St.—one horizontal radial drill with 25 in. horizontal traveling spindle, 24 x 65 in. table, distance between table and center of spindle about 29 in., to be equipped with arbor spindle arm adjustable to table.

Md., Salisbury—The Riverside Motor Co.—repair shop equipment.

N. J., Jersey City — The Universal Tobacco Machine Co.—one large drill press.

N. J., Newark—The Bd. Educ., City Hall—machine shop and forge equipment for Seymour Vocational School.

N. Y., Buffalo—The Auto Knitter Hosiery Co., 821 Jefferson St.—machine shop equipment.

N. Y., Jamestown — J. G. Townsend, Route 81—one blacksmith drill and press.

N. Y., New York (Borough of Manhattan)—Welborne & Co., Inc., 327 Bway.—planers, milling machines, slotters and lathes for export to Brazil.

N. Y., New York (Borough of Manhattan)—The Wern Mchy. and Eng. Co., 30 Church St.—one horizontal boring mill with 48 to 60 in. diameter and 8 or 9 in. boring bar.

N. Y., Schenectady—The General Electric Co., River Rd., A. R. Howgate, Purch. Agt.—for Baltimore, Md., plant—one open side planer with 30 in. x 30 in. x 10 ft. bed and 2 heads on cross rail, motor driven.

N. Y., Syracuse—The Franklin Automobile Co., 302 South Geddes St. — machine tool equipment for truck plant.

Pa., Pittsburgh—The Allegheny Forging Co., 511 Wood St.—one serpentine surface grinder, with 8 in. wheel for grinding trimmers in drop forge department.

Pa., Waynesboro—The Wayne Tool Mfg. Co.—one nut tapping machine.

Ga., Atlanta—The Abernathy Automatic Liquid Dispensing Machine Co., 2 North Pryor St.—drill presses, lathes, grinders, milling machines, power punches and motors.

N. C., Wilmington—The Atlantic Coast Line Ry., F. H. Fechtig, 1810 Princess St., Purch. Agt.—general machine tool equipment for repair and maintenance shops.

W. Va., Wheeling—C. L. Hills, 305 Natl. Bank Bldg.—one 30 to 36 in. x 10 ft. motor driven lathe (new or used).

Ill., Aurora—The T. Dunham Co.—one 1,000-1,200 ton hydraulic power press.

Mich., Detroit—The Standard Reamer & Tool Co., Elmwood Ave. and Hendric St.—equipment for machining small tools and reamers, electrically driven.

O., Cleveland—The Bd. Educ., East 6th St. and Rockwell Ave. — lathes, presses, saws, work benches and general shop and manual training equipment.

Wis., Fond du Lac—The Bulldog Tractor Co.—turret lathes, drill presses, shapers and a boring mill.

Wis., Milwaukee—The Amer. Value Rotator Co., 917 Chestnut St., H. Danischefsky., Purch. Agt.—milling machines, lathes, drill presses and grinders.

Wis., Milwaukee—The Badger Packard Mchy. Co., 338 South Water St., C. Mason, Purch. Agt.—vises, dies, drills and other bench tools.

Wis., Milwaukee — R. Lemke, 452 15th St.—one lathe with thread attachment.

Wis., Milwaukee—The Ramstack & Son Mfg. Co., 1826 Brown St.—drill presses.

Wis., Sheboygan—The Bd. Educ.—machine tools and machinery for machine shop.

Tex., Dallas—The Dallas Brass Mfg. Co., 1101 Ross Ave.—
One 16 in. x 6 ft. quick change gear engine lathe.
One small scroll saw for pattern shop.
One small jig saw for pattern shop.
One metal spur cutting saw (all used).

Tex., Ft. Worth—The Claypeel Machine Co., 1711 Calhoun St.—machine shop and foundry equipment.

N. B., Moncton—The Record Fdry. and Mchy. Co.—dustproof mills and stove top polishers.

Ont., Toronto—The A. R. Williams Mchy. Co., Ltd., 66 Front St., W.—one Blanchard high power vertical surface grinder.

Machinery

The following concerns are in the market for machinery:

N. Y., Buffalo—The Amherst Auto Body Co., 99 Grey St., S. Horn, Purch. Agt.—one sheet metal rolling machine and one hair picking machine.

N. Y., Buffalo—The J. Dold Packing Co., 745 William St., J. J. Cuff, Purch. Agt.—hog iron scrapping machinery and conveyor chains.

N. Y., Syracuse—The Atmospheric Nitrogen Corp., c/o J. G. White Eng. Co., 43 Exch. Pl., New York City—traveling cranes.
One 25 ton for 70 ft. span;
One 25 ton for 56 ft. span;
One 35 ton for 35 ft. span;
One 25 ton for 30 ft. span;
One 25 ton for 17 ft. 8 in. span;
One 25 ton for 17 ft. span;
One 25 ton for 62 ft. span.

Pa., Stroudsburg — The Pennsylvania Steel and Wire Co.—wire straightening machines.

Va., Newport News—The Newport News Shipbuilding Co.—one 100 ton overhead traveling crane.

Ill., Chicago—The Bunge Bros. Coal Co., 1646 West Lake St.—one rip saw and carrier, to rip 12 x 12 in. timbers.

Ill., Chicago — The La Salle Iron Wks., 2365 South Halsted St.—rolling mill, heat treating equipment and pickling equipment.

Ind., Ft. Wayne — The Engineering Co., Winter and Wabash Sts.—one set of bending rolls of pyramid type to handle 12 ga. sheets 73 in. wide, and to roll to 7 in. diameter (used).

Wis., Appleton—The Hayton Pump and Blower Co., 575 2nd Ave.—one hand power crane.

Wis., Madison—The City, E. Parker, 819 West Johnson St., City Engr.—crane for pumping plant.

Wis., Milwaukee — The Modern Pattern Co., 150 Clinton St., G. Vierheilig, Purch. Agt.—woodworking machinery.

Wis., Milwaukee—W. Steinmetz, 449 7th Ave.—one 30 in. band saw, one 14 or 18 in. jointer, one sticker and one ripsaw.

Wis., Milwaukee—The Unger Toy Mfg. Co., 509 2nd Ave.—one baling machine.

Wis., Waukesha—F. C. Blair & Son, 340 Bway.—crane for foundry work.

Wis., Wausau — The Anderson Bros. & Johnson Co., East Manson St.—one 5 ton crane.

Wis., West Allis — The Sterling Wheelbarrow Co., 63rd and Pullen Aves., I. R. Smith, Pres.—molding machines and one blower for foundry.

Tex., Dallas—W. C. Headrick, Hickory St.—$15,000 worth of machinery for manufacture of iron beds.

Tex., Houston—The Star Engraving Co., Texas and Louisiana Sts., G. C. Yax, Purch. Agt.—one 2½ x 4 and one 6 x 10 ft. modern die, 6 plate press.

Cal., Los Angeles—The Fabri-Cord Tire Co., 917 Citizens Natl. Bank Bldg.—for San Pedro plant—$200,000 worth of machinery for tire manufacture.

Metal Working

NEW ENGLAND STATES

Conn., Bridgeport — The Eastern Auto Body Co. will soon award the contract for the construction of a 1½ story, 60 x 90 ft. factory on Lindley St., for the manufacture of automobile bodies. Estimated cost, $35,000.

Conn., Bridgeport — The Morris Metal Products Co., Union Ave., has awarded the contract for altering its plant on Union St. Estimated cost, $20,000.

Conn., Fairfield—The Bridgeport Deoxidized Bronze and Metal Co., Iron Ave., Bridgeport, has purchased a 23 acre site along the tracks of the New York, New Haven & Hartford R.R., here, and plans to build a factory.

Conn., Hartford—The J. M. Ney Co., Elm and West Sts., will soon award the contract for the construction of a 1 story, 50 x 75 ft. addition to its plant, for the manufacture of dentists' supplies. Estimated cost, $20,000. Ford, Buck & Sheldon, Inc., 60 Prospect St., Engrs. and Archts.

Conn., Hartford — The Puritan Motor Sales Co., 334 Pearl St., is having plans prepared by Butler & Provoost, Archts., 292 Main St., Stamford, for the construction of a 1 story, 50 x 150 ft. garage on Farmington Ave. Estimated cost, $40,000.

Conn., Hartford—The Royal Typewriter Co., Inc., 150 New Park Ave., is building a 5 story, 50 x 66 ft. and 50 x 308 ft. factory. Estimated cost, $250,000.

Conn., New Britain—The Mendel Sicklick Co., 117 Willow St., is having plans prepared by F. C. Walz, Archt., 348 Trumbull St., Hartford, for the construction of a 1 story garage on Arch St. Estimated cost, $40,000.

Conn., Waterbury — The Dexter Baking Co., North Main St., will build a 1 story, 62 x 105 ft. garage. Estimated cost, $20,000.

Me., Biddeford—The Saco Lowell Shop, 77 Franklin St., Boston, Mass., has awarded the contract for the construction of a 1 story, 160 x 200 ft. foundry at its plant. Estimated cost, $250,000.

Mass., Dorchester — Simons & Weiner, c/o S. S. Eisenberg, Archt., 15 Court Sq., Boston, will build a 1 story, 150 x 180 ft. garage on Dorchester Ave. and Faulkner St. Estimated cost, $100,000.

Mass., Fairhaven — The Fairhaven Mills will build a 1 story machine shop at its plant. Estimated cost, $40,000. Noted June 17.

Mass., Holyoke—J. & W. Jolly, Inc., South East St., have awarded the contract for the construction of a 2 story, 100 x 100 ft. foundry. Estimated cost, $75,000.

Mass., Pittsfield — The General Electric Co., Columbus Ave., will soon award the contract for the construction of a 1 story, 100 x 400 ft. factory for the manufacture of electric specialties. Estimated cost, $250,000. Noted May 6.

Mass., Quincy—P. S. Yerxa, 1452 Hancock St., has awarded the contract for the construction of a 1 story, 70 x 100 ft. garage on School St. Cost between $45,000 and $50,000. Noted May 13.

Mass., Springfield—The Western Massachusetts Cadillac Co., 521 Worthington St., has awarded the contract for the construction of a 1 story, 102 x 107 ft. garage and service station on State and Oak Sts. Estimated cost, $65,000.

Mass., Worcester — M. N. Ullman, 50 Water St., will soon award the contract for the construction of a 1 story, 80 x 95 ft. garage on School St. Estimated cost, $50,000. E. T. Chapin, 340 Main St., Archt. Noted June 24.

R. I., Providence—The Packard Motor Car Co., Bway. and 61st St., New York City, will soon award the contract for the construction of a 2 story, 190 x 205 ft. garage and service station on Plenty St. here. Estimated cost, $400,000.

Vt., Brattleboro—The C. F. Church Mfg. Co., Willimansett, Mass., has awarded the contract for the construction of a 1 story boiler house and 1 story, 50 x 175 ft. and 50 x 100 ft. factory here, for the manufacture of plumbers' supplies. Estimated cost, $80,000.

MIDDLE ATLANTIC STATES

Md., Baltimore—The Natl. Enameling and Stamping Co., Race and Ostend Sts., has awarded the contract for the construction of a 3 story, 61 x 76 ft. addition to its tin stamping factory. Estimated cost, $100,000. Noted May 6.

Md., Frederick — The Frederick County School Comrs. have awarded the contract for the construction of a 2 story addition to the high school, to include a machine shop, etc.

Md., Salisbury—The Riverside Motor Co. is preparing plans for the construction of a 1 and 2 story, 60 x 100 ft. and 40 x 60 ft. garage and service station. Estimated cost, $25,000.

Md., Sparrows Pt. (Baltimore P. O.)—The Bethlehem Steel Corp., Bethlehem, Pa., plans to enlarge its plant here, to include new blast furnaces and the addition of 24 mills to the present tin plate plant. W. M. Tobias, Ch. Engr.

N. J., Newark — The McAllister Caron Co., 1001 Broad St., has awarded the contract for the construction of a 2 story, 70 x 150 ft. garage and service station. Estimated cost, $100,000.

N. J., Trenton — The Jackson Electric Motor Repairing Co. will build a 1 story, 42 x 100 ft. repair shop on Belvidere St. Estimated cost, $10,000.

N. Y., Batavia — The Batavia Specialty Co., Harvester Ave., plans to build a 70 x 250 ft. factory. Estimated cost, $100,000.

N. Y., Buffalo — The Eberhardt Steel Products Co., 41 Perry St., has had plans prepared for the construction of a 1 story, 100 x 200 ft. factory at 622-8 East Ferry St. Estimated cost, $30,000.

N. Y., Buffalo—The North Buffalo Hardware Fdry. Co., 743 Hertel Ave., has had plans prepared for altering its 1 story, 67 x350 ft. foundry. Estimated cost, $6,000.

N. Y., Falconer—The Jamestown Malleable Products Corp., Jamestown, plans to build a 400 x 400 ft. iron foundry, here. Estimated cost, $300,000.

N. Y., New York (Borough of Bronx)—J. W. Goff, 309 Bway., will build a 1 story, 100 x 220 ft. garage on Jerome Ave. and 177th St. Estimated cost, $50,000.

N. Y., New York (Borough of Brooklyn)—S. Ageloff, 126 Reid Ave., will build a 1 story, 200 x 256 ft. garage at 283 4th Ave. Estimated cost, $200,000.

N. Y., New York (Borough of Brooklyn)—The S. & R. Holding Co., 175 Bay 29th St., will build a 1 story, 100 x 173 ft. garage on Gold and Prospect Sts. Estimated cost, $150,000.

N. Y., New York (Borough of Brooklyn)—W. Nevin, 44 Court St., will build a 2 story, 100 x 107 ft. garage on Waverly and Fulton Sts. Estimated cost, $130,000.

N. Y., New York (Borough of Brooklyn)—S. Ransom, 401 West St., New York City, is building a 1 story, 150 x 200 ft. machine shop and transformer station at 518 Hamilton St., for marine repair work. Estimated cost, $250,000.

N. Y., New York (Borough of Brooklyn)—Stern & Friedman, c/o Cohn Bros., Archts., 361 Stone Ave., will build a 1 story garage on 60th St. and Ft. Hamilton Ave. Estimated cost, $30,000.

N. Y., New York (Borough of Manhattan)—L. Gold, 44 Court St., Brooklyn, will build a 5 story, 100 x 100 ft. garage and service station at 529 West 55th St. Estimated cost, $350,000.

N. Y., New York (Borough of Manhattan)—J. Reilly, 1901 Bathgate Ave., will build a 1 story, 75 x 110 ft. garage on 3rd Ave. and 175th St. Estimated cost, $35,000.

N. Y., New York (Borough of Manhattan)—The S. & Z. Bldg. Co., c/o J. M. Felson, Archt., 1133 Bway., will soon award the contract for the construction of a 3 story garage and service station on Manhattan and 130th Sts. Estimated cost, $120,000.

N. Y., New York (Borough of Manhattan)—S. Varschleisser, 215 East 67th St., will soon award the contract for altering his garage. Estimated cost, $50,000. J. M. Felsom, 1133 Bway., Archt.

N. Y., Syracuse—The Atmospheric Nitrogen Corp. has had plans prepared for the construction of a plant to include a 105 x 220 ft. machinery house, 62 x 105 ft. oxidation building and a 16 x 40 ft. hydrogen heater house. Estimated cost, $175,000. The J. G. White Eng. Co., 43 Exch. Pl., New York City, Engrs.

Pa., Pittsburgh—The Flocker Motor Co., Union Arcade Bldg., will soon award the contract for the construction of a 1 story, 75 x 100 ft. garage, service station and salesroom on Cypress and Aspen Sts. Estimated cost, $50,000. W. W. Williams, Magee Bldg., Archt.

Pa., Stroudsburg — The Pennsylvania Steel and Wire Co. is building a plant for the manufacture of cold drawn and cold rolled steel wire.

Pa., Wilkes-Barre — The W. B. Bertels Tin Co., Pennsylvania Ave., plans to build a 2 story, 70 x 75 ft. factory. Estimated cost, $30,000.

SOUTHERN STATES

Ga., Griffin—A. F. Gosset & Sons is building a 2 story, 48 x 210 ft. garage and sales room. Estimated cost, $50,000.

Ga., Savannah—The Atlantic Coast Line Ry., c/o J. E. Willoughby, Ch. Engr., Wilmington, N. C., plans to build additions to the Southover shops here and install machinery. Estimated cost, $250,000.

Tenn., Memphis—The Continental Piston Ring Co., 650 Marshall St., is building a 153 x 217 ft. plant. Estimated cost, $75,000.

Va., Schoolfield (Danville P. O.)—The Dan River and Riverside Cotton Mills, Danville, are having preliminary plans prepared by E. R. James, Archt., Danville, for the construction of a 3 story school and community house here, to include a manual training department. Estimated cost, $150,000.

W. Va., Parkersburg—The Baldwin Tool Wks. plans to build a large addition to its plant.

MIDDLE WEST

Ill., Chicago—The J. F. Jelke Co., 759 South Washtenaw Ave., is having plans prepared by Graham, Anderson, Probst & White, Archts., 1417 Ry. Exch. Bldg., for the construction of a garage and office building, each 2 story, 112 x 120 ft., on Washtenaw Ave. and Polk St. Estimated cost, $600,000.

Ill., Chicago—The E. Katzinger Co., 120 North Peoria St., manufacturer of bakers' supplies, plans to build a factory on Armitage and Cicero Aves. Estimated cost, $500,000.

Ind., West Hammond—The LaSalle Iron Works, 2305 South Halsted St., Chicago, will soon award the contract for the construction of a 1 story, 210 x 500 ft. plant here. Estimated cost, $650,000. N. Ronneberg, 10 South LaSalle St., Chicago, Engr. R. G. Pierce, 10 South LaSalle St., Chicago, Archt.

Mich., Battle Creek — The Montgomery Motor Sales Co. has awarded the contract for the construction of a garage. Estimated cost, $100,000. J. Woodward, Mgr.

Mich., Detroit—The A. Colton Co., 782 Jefferson Ave., will soon award the contract for the construction of a 2 story, 50 x 88 ft. addition to its factory for the manufacture of special machinery. Mildner & Eisen, 924 Hammond Bldg., Archts.

Mich., Detroit—The F. M. Foster Truck Co., 980 East Jefferson Ave., is preparing plans for the construction of a 4 or 5 story, 100 x 120 ft. service station.

Mich. Detroit — The International Metal Stamping Co., Artillery and Muster Aves., has awarded the contract for the construction of a 1 story, 79 x 532 ft. factory on Artillery Ave. Estimated cost, $130,000. Noted June 10.

Mich., Detroit—The Kirby Ave. Development Co., c/o Smith, Hinchman & Grylls, Archts., 110 Washington Arcade, is having plans prepared for the construction of a 2 story service station and garage. Estimated cost, $150,000.

Mich., Detroit—The Standard Reamer and Tool Co., Elmwood Ave. and Hendric St., will soon award the contract for the construction of a 1 story, 50 x 100 ft. factory on Elmwood Ave. Estimated cost, $15,000. Pollmar & Ropes, 45 State St., Archts.

O., Canton—The Amer. Roll and Fdry. Co. will soon award the contract for the construction of a 1 story, 59 x 140 ft. addition to its machine shop and a 2 story, 45 x 80 ft. pattern shop. Estimated cost, $100,000. The United Eng. and Fdry. Co., Farmers Bank Bldg., Pittsburgh, Pa., Engrs.

O., Cleveland—The Bd. Educ., East 6th St. and Rockwell Ave., is having plans prepared by W. R. McCornack, Archt., c/o owner, for the construction of two 3 story, 30 room schools, one on East 116th and Corlett Sts. and another on Woodland Hill Park, both to have manual training departments. Estimated cost, $4,000,000.

O., Cleveland—The Champion Bed Spring Co., 3717 Iron Court, has awarded the contract for the construction of a 2 story, 58 x 172 ft. factory at 6500 Park Ave. Estimated cost, $80,000.

O., Cleveland—The Jeavons Spring Co., 1603 Prospect Ave., has awarded the contract for the construction of a 2 story, 30 x 50 ft. addition to its factory at 2540 Prospect Ave. Estimated cost, $25,000.

O., Cleveland—The Newburgh and South Shore Ry., c/o N. Stewart, Eng., Jones Rd., has awarded the contract for the construction of a 1 story, 113 x 260 ft. car shop on East 71st St. and Park Ave. Estimated cost, $110,000.

O., Cleveland—The Reynolds Motor Co., 8811 Miles Park Ave., is having plans prepared by H. T. Jeffrey, Archt., Northern Natl. Bank Bldg., for the construction of a 3 story, 50 x 160 ft. garage and sales room. Estimated cost, $125,000.

O., Cleveland — W. D. Sixt, c/o S. H White, Archt., 1032 Schofield Bldg., will soon award the contract for the construction of a 1 story, 60 x 110 ft. garage and sales room at 6820 Euclid Ave. Estimated cost, $75,000.

O., Cleveland—The Superior Screen and Bolt Mfg. Co., 810 Hippodrome Bldg., is having plans prepared by the Realty Dept. of the Natl. Lamp Co., Archts. and Engrs., Nela Park, for the construction of a 2 story, 130 x 250 ft. factory, at 3652 East 93rd St. Estimated cost, $175,000.

O., Geneva—The Amer. Fork and Hoe Co., Swetland Bldg., Cleveland, has awarded the contract for the construction of a 1 story, 55 x 260 ft. factory, here. Estimated cost, $100,000.

O., Mansfield—The Ideal Electric Mfg. Co., 53 East 5th St., has awarded the contract for the construction of a 1 story, 160 x 450 ft. and 100 x 450 ft. factory and 2 story, 35 x 75 ft. office building. Estimated cost, $350,000.

O., Massillon—The Alloy Electric Steel Castings Co. has awarded the contract for the construction of a 1 story, 50 x 150 ft. mill. Estimated cost, $60,000.

O., Ravenna — The Natl. Furnace and Stove Co. is having plans prepared by D. C. Smith, Engr. and Archt., 4500 Euclid Ave., Cleveland, for the construction of a 1 story, 80 x 220 ft. foundry and office building. Estimated cost, $125,000. M. Minsman, Mgr.

O., Toledo—The Rock Bearing Co. will soon award the contract for the construction of a 2 story machine shop on Philip Ave. Estimated cost, $110,000. G. B. Phipafrank, 601 Gardner Bldg., Archt.

Wis., Fond du Lac—The Bulldog Tractor Co. has awarded the contract for the construction of a 1 story, 60 x 300 ft. factory.

Wis., Milwaukee—The Bd. of Pub. Wks. will soon award the contract for the construction of a 1 story, 50 x 120 ft. meter shop on Market St. Estimated cost, $50,000. C. E. Malig, City Hall, Archt.

Wis., Milwaukee—J. Luff, 864 16th St., will soon award the contract for the construction of a 1 story, 60 x 100 ft. garage on 11th St. Estimated cost, $25,000. G. Zagel, 144 Oneida St., Archt.

Wis., Sheboygan — The Bd. Educ. will soon award the contract for the construction of a 2 story, 270 x 300 ft. high school on Jefferson St. to include a machine shop. Estimated cost, $750,000.

Wis., Sheboygan — The Sheboygan Lime Wks., 822 Niagara Ave., has awarded the contract for the construction of a 2 story, 48 x 143 ft. garage and office building on South Water St. Noted June 17.

Wis., Waukesha—The Waukesha Fdry. Co. will build a 50 x 265 ft. factory for the manufacture of brass castings. Estimated cost, $30,000. F. J. Barker, Secy.

WEST OF THE MISSISSIPPI

Miss., Canton—The Farmers Gin Co. will build a factory for the manufacture of cotton gins. Estimated cost, $20,000. F. H. Parker, Secy.

Mo., St. Louis—The Advance Electric Co., 6315 Maple Ave., has awarded the contract for the construction of a 1 story, 50 x 100 ft. addition to its factory. Estimated cost, $15,000.

Mo., Salisbury—The Riverside Motor Co. will build a 60 x 100 ft. sales and service station. Estimated cost, $30,000.

Tex., Corsicana—A company is being organized with $100,000 capital stock, and plans to build a factory for the manufacture of terracing machines. C. E. Kerr, Corsicana, Pres.

Tex., Ft. Worth—The Simmons Co., 1347 South Michigan Ave., Chicago, will soon award the contract for the construction of a warehouse and factory here, to have 15,000 sq.ft. of floor space, for the manufacture of metal beds. Estimated cost, $200,000. L. L. Hawes, Clark Ave., Archt.

Tex., San Antonio—The Alamo Iron Wks. is building a 90 x 160 ft. plant for the manufacture of oil well tools and supplies. Estimated cost, $30,000.

CANADA

N. B., Moncton—The Record Fdry. and Mchy. Co. plans to build a 50 x 1140 ft. factory for the manufacture of stoves and furnaces. Estimated cost, $75,000. A. Wheeler, Moncton, Engr.

Ont., Ft. William—Sellers & Jones, Leith St., has awarded the contract for the construction of a 2 story, 60 x 100 ft. garage. Estimated cost, $35,000.

Ont., Toronto—Yolles & Rottenberg, 609 Kent Bldg., are building a 1 and 2 story, 50 x 120 ft. garage, on College St. Estimated cost, $20,000.

Ont., Windsor—C. W. Ripley, 519 Sandwich St., plans to build a foundry. Estimated cost, $25,000.

Ont., Windsor—The Universal Car Agency, Chatham and Pelisier Sts., are having plans prepared by J. C. Pennington, Archt., LaBelle Bldg., for the construction of a 2 or 3 story garage on Chatham St. Estimated cost, $75,000.

General Manufacturing

NEW ENGLAND STATES

Conn., Montville — The R. Gair Paper Corp., Thames River Division, will soon award the contract for the construction of a 2 story, 250 x 400 ft. factory and 1 story, 50 x 50 ft. power house. Estimated cost, $500,000.

Mass., Boston—The Women's Educational and Industrial Union, 264 Boylston St., Boston, will soon award the contract for the construction of a 4 story bakery, etc., on Boylston St. to have about 15,000 sq.ft. of floor space. Estimated cost, $75,000. F. A. Norcross, 46 Cornhill St., Archt. Noted May 27.

Mass., Cambridge—The Barta Press Co., 28 Oliver St., Boston, will soon award the contract for the construction of a 1 and 3 story printing plant here. Estimated cost, $125,000. Monks & Johnson, 99 Chauncey St., Boston, Archts.

Mass., Cambridge — The Limited Plate Glass Co., 30 Sudbury St., Boston, has awarded the contract for the construction of a 2 story, 100 x 200 ft. factory on Albany St., here.

Mass., Chelsea—The State of Massachusetts, c/o State Adjutant General, Boston, has awarded the contract for the construction of a 2 story, 35 x 90 ft. laundry and power plant at the Soldiers Home, here. Estimated cost, $125,000.

Mass., Gardner—The Amer. Fibre Corp. has awarded the contract for the construction of a 1 story factory on Coleman St., to have 18,000 sq.ft. of floor space. Estimated cost, $75,000.

Mass., New Bedford—The W. C. Jones Co., Nash Rd., will soon award the construction of a 3 story addition to its mill on Church St., for the manufacture of textiles. Estimated cost, $75,000. T. M. James, 3 Park St., Boston, Archt.

Mass., Woburn — The Cambridge Paper Box Co., 196 Bway., has awarded the contract for the construction of a 2 story addition to its factory. Estimated cost, $50,000.

R. I., Bristol—The Cranston Worsted Co., 180 Thames St., will soon award the contract for the construction of a 4 story, 100 x 130 ft. addition to its plant. Estimated cost, $160,000. Jenks & Ballou, 1035 Grosvenor Bldg., Providence, Archts. Noted June 10.

R. I., Providence—The Cudahy Packing Co., 346 Canal St., will soon award the contract for the construction of a 3 story, 40 x 100 ft. packing plant. Estimated cost, $50,000. Private plans.

MIDDLE ATLANTIC STATES

Md., Baltimore — The Chesapeake Mfg. Co., Sharp and Barre Sts., has awarded the contract for the construction of a 3 story, 42 x 125 ft. factory for the manufacture of furniture. Estimated cost, $125,000.

N. J., Paterson—The Sunburst Baking Co. will soon award the contract for the construction of a 3 story, 140 x 210 ft. bakery and a 2 story, 50 x 50 ft. stable. Estimated cost, $100,000. The McCormick Co., Century Bldg., Pittsburgh, Pa., Engrs. and Archts.

N. Y., Buffalo—The Auto Knitter Hosiery Co., 821 Jefferson St., has had plans prepared for the construction of a 2 story, 50 x 150 ft. addition to its factory, at 630 East Genesee St. Estimated cost, $37,000.

N. Y., Buffalo—The J. F. Pfister Co., 18 Metcalf St., manufacturer of vinegar, has had plans prepared for the construction of an addition to its factory. Estimated cost, $30,000.

N. Y., New York (Borough of Manhattan)—The Hill Ware Co., c/o the McCormick Co., Archts., 41 Park Row, will soon award the contract for the construction of a bakery on 165th St. Estimated cost, $100,000.

SOUTHERN STATES

Ala., Alexander City—The Avondale Mills is having plans prepared by J. E. Sirrine, Engr., Greenville, S. C., for the construction of an 80 x 150 ft. weave shed addition, 100 x 100 ft. warehouse addition and a 60 x 100 ft. cloth room.

Fla., Pensacola—The Alexandria Cooperage and Lumber Co., Alexandria, La., will build a cypress mill, here. Estimated cost, $200,000.

Ga., Griffin — The Georgia Cotton Mills has awarded the contract for the construction of a bleachery addition.

N. C., Durham—The Lawrence Cotton Mills will build a 3 story, 60 x 80 ft. addition to its plant.

N. C., Lexington — The Dacotah Cotton Mills is building a 2 story, 53 x 194 ft. addition to its plant.

N. C., Mooresville—The Mooresville Cotton Mills has awarded the contract for the construction of a steam plant and bleachery. Noted April 22.

S. C., Rock Hill—The Arcade Mills is having plans prepared by J. E. Sirrine, Engr., Greenville, for the construction of a 2 story, 106 x 315 ft. mill. About 6,000 spindles will be installed.

Tenn., Springfield — The Tennessee and Kentucky Tobacco Co. plans to build a factory to replace the one which was recently destroyed by fire.

Va., South Boston—The Halifax Cotton Mills has awarded the contract for the construction of an addition to its mill. Noted April 1.

MIDDLE WEST

Mich., Bay City—The Wildman Rubber Co., Book Bldg., Detroit, is maving plans prepared by the Osborn Eng. Co., Engrs. and Archts., 2848 Prospect Ave., Cleveland, for the construction of a 1 and 3 story rubber plant, here. Estimated cost, $2,000,000. Noted June 17.

Mich., Flint — The Standard Oil Co. of Indiana, 910 South Michigan Ave., will soon award the contract for the construction of a 2 story, 164 x 232 ft. oil distributing station to include a garage, office, warehouse and tank house. Estimated cost, $200,000.

O., Garretsville—The McWade Tire and Rubber Co., 711 Union Bldg., Cleveland, is preparing plans for the construction of a 2 story factory here, to have 30,000 sq.ft. of floor space. Estimated cost, $75,000.

Wis., Eau Claire—The Standard Oil Co. of Indiana, 910 South Michigan Ave., Chicago, will soon award the contract for the construction of a 1 and 2 story, 30 x 200 ft. oil distributing station, here, to include a warehouse, garage, office, etc. Estimated cost, $150,000.

WEST OF THE MISSISSIPPI

Kan., Ft. Scott—The Ft. Scott Oil Co. has awarded the contract for the construction of an oil distributing station on Mahoney Ave. Estimated cost, $27,000.

Kan., Ft. Scott—The Standard Oil Co. will soon award the contract for the construction of a 1 story, 40 x 40 ft. oil distributing station on Market and Wall Sts. Estimated cost, $30,000.

WESTERN STATES

Cal., San Pedro — The Fabri-Cord Tire Co., 917 Citizens Natl. Bank Bldg., Los Angeles, has purchased a 30 acre site on 17th St., here, and plans to build the first unit of its proposed plant, 3 story, 60 x 250 ft. Estimated cost, $80,000. Total estimated cost, $2,000,000.

CANADA

Ont., Brantford — S. C. Johnson & Son, 1737 Wisconsin St., Racine, Wis., are having plans prepared for the construction of a factory here, for the manufacture of floor waxes, varnishes, etc.

Ont., Ingersoll—The Dominion Cone Co., Ltd., Marrow Ave., plans to build a 3 story factory for the manufacture of paper boxes. Estimated cost, $50,000.

Que., Montreal—The Knit to Fit Mfg. Co., Ltd., St. Lawrence Blvd., will soon award the contract for the construction of a factory on Parthenais and Larvinere Sts. Estimated cost, $254,000.

Que., St. Anne de Monts—The Great Eastern Pulp and Paper Co., London, Great Britain, will soon award the contract for the construction of a pulp and paper plant here.

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Pages 380 to 415 Pages 380 to 415

July 8, 1920 American Machinist Vol. 53, No. 2

A Universal Measuring Machine

SPECIAL CORRESPONDENCE

This article describes the construction and the method of operation of a machine designed for the accurate measurement of pieces of all shapes. The machine is intended as a primary standard of measurement for use chiefly in making and checking gages. It has been made for some time in Switzerland, although it is a new machine to this country.

WHILE the system of interchangeable parts manufacture was first employed in connection with the making of rifles, rapid progress in the art of making mechanical measurements on a commercial scale began with the advent of the automobile. The production of cars on a large scale made interchangeability imperative in order to assure the perfect fitting of one part into or over another, especially in the matter of replacements and renewals. It is quite natural that the necessity of making great quantities of parts of the same form and dimensions should stimulate not only the production of gages for checking these parts in the shop, but also the development of the means of checking the working gages so that full control can be exercised over the sizing operations.

Gages that are in constant use for the checking of great quantities of parts show appreciable wear after being in service a short time. It is, therefore, of the utmost importance to keep a close watch on the condition of the working gages, and even on the inspection gages. The wear may be determined by suitable measuring apparatus or by means of reference blocks or reference gages. But reference gages themselves are subject to wear, although much more slowly, and it becomes necessary to check them against some sort of standard after more or less prolonged use.

Another serious difficulty experienced in testing laboratories is due to the great diversity in the form of the gages employed in shops. To check or verify the working gages it is necessary to make use of measuring appliances of various kinds, which appliances then become primary standards of reference. If these primary standards are of different make, to what extent will they agree among themselves, so as to assure proper checking of the gages or secondary standards? It is, therefore, seen that the matter of control of size is quite complex and may entail considerable expense, either as first cost or for maintenance.

Need of a Universal Machine

The problem of eliminating the various causes of uncertainty is by no means a simple one, the best theoretical solution being embodied in an instrument which will fill the following requirements:

1. The instrument must be of such a form or so designed that it will serve as the single primary standard for the control of all the secondary standards or gages that may be employed in the shops, no matter what their nature or form may be;
2. The precision of the instrument must be absolutely independent of wear.

Measuring machines that satisfy these conditions have a single graduated reference scale, which constitutes the primary standard. Instruments of this class are actually in use in the industries. They are made in the United States by the Pratt & Whitney Co., in England by the Newhall Engineering Co., and in Switzerland by the Société Genevoise d'Instruments de Physique. The machine made by the Société Genevoise

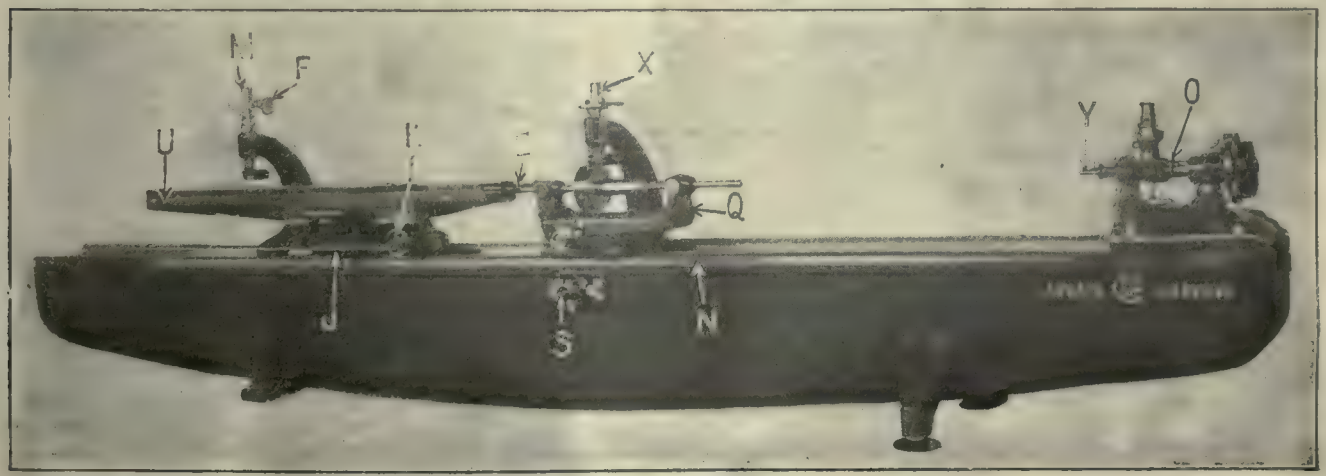


FIG. 1. GENERAL VIEW OF THE UNIVERSAL MEASURING MACHINE MADE BY THE SOCIETE GENEVOISE

will be here described, as it differs in principle from the other machines. The American representative of the maker is The Golden Co., 405 Lexington Ave., New York City.

This machine has been designated by its maker as a "universal" measuring machine, since it is designed with the object of measuring and comparing gages of every description, such as limit gages, plug, ring and snap gages, reference blocks, thread gages and screws. The measurement of threads includes the determination of the full or outside diameter, the diameter at the core or root of the thread, the pitch diameter, the angle and form of the thread, the lead, and either progressive or periodic error in the pitch. In addition, the machine may be used as a rapid comparator.

Measurements are made with reference to a standard scale, the accuracy of which has been certified. It is mounted on the machine in an inclosed case provided with sectional covers, and never comes in direct contact with the object or gage to be measured or with any of the accessories or attachments with which the machine is equipped. It is, therefore, not subject to wear or strains.

Construction of the Machine

Fig. 1 is a general view of the machine, together with one of the accessories in the form of a support used when observing and measuring threads and thread gages. A thread gage is shown mounted in position, with a goniometric microscope focused on the threads, this being in the center of the bed.

In Fig. 2 can be seen a longitudinal section, a transverse section and a top view of the machine, the model shown being shorter than the one in Fig. 1. The cast-iron bed of the machine is of strongly ribbed box construction. It is provided with ways on which rests the sliding carriage *U*. This carriage holds the standard reference scale *D*, as well as one of the measuring points or anvils *E*. Four spring-mounted rollers *A* serve to partly support the carriage and to reduce the friction on the ways. In order to displace the carriage quickly where a great traverse is desired, the locking device *C* is released by means of the handle *J*, and the carriage is pushed by hand. For small displacements or slow movements of the carriage, the motion is obtained, with the locking device engaged, by turning the handwheel *K*, which actuates through helical gears the screw *B* fitting in the block *L*. A complete turn of the wheel *K* gives an approximate displacement of 0.004 in., which enables the operator to adjust the position of the slider within 0.00001 in.

The bar *D*, on which the standard scale is ruled,

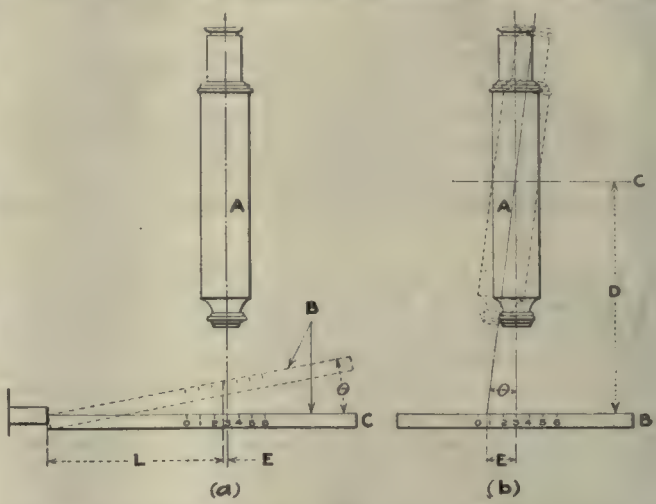


FIG. 3. ERRORS DUE TO NON-ALIGNMENT OF AXES

rests on the carriage at two points, one point *P* being a pivot, the other *G* being adjustable in a horizontal plane by two screws. The object of this arrangement is to provide for the setting of the scale parallel with the ways of the bed and in exact alignment with the axis of the measuring points. The bar is made of an alloy of steel and nickel, containing 58 per cent of the latter; the coefficient of linear expansion of the alloy is about 0.0000115 per degree Centigrade, approximately that of tempered steel. It is practically non-oxidizable and is not affected by the humidity of the air. The scale is ruled on a highly-polished side of the bar, the graduations being about 0.0002 in. wide and spaced 0.05 in. apart. The precision of the graduations over a length of 20 in. is 0.0001 to 0.0004 in. Tables of errors furnished with each machine enable the operator to make the necessary corrections and to make measurements to an accuracy of 0.000005 in.

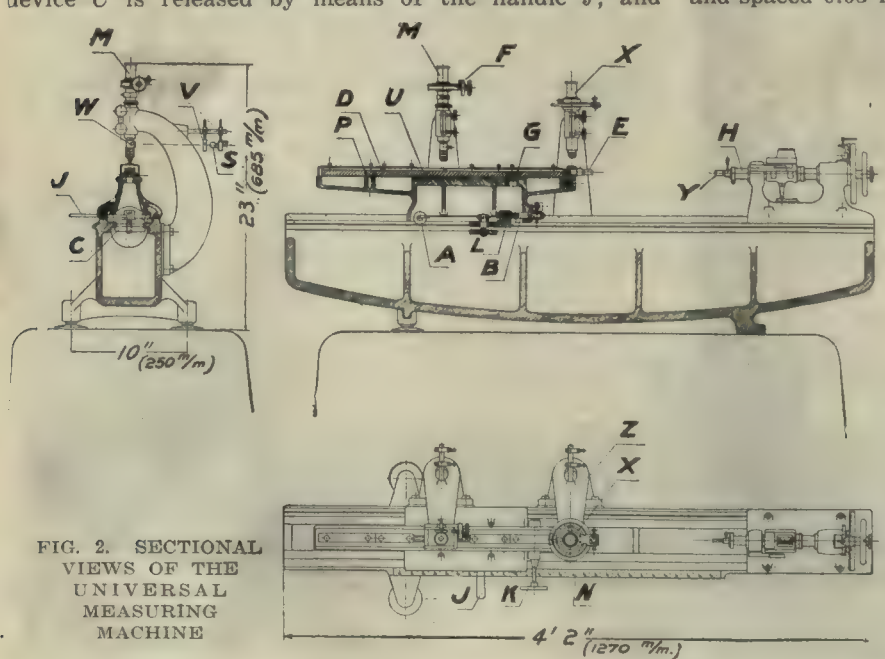


FIG. 2. SECTIONAL VIEWS OF THE UNIVERSAL MEASURING MACHINE

Fig.2

Principle of Operation

An important feature of the machine is the alignment of the axis of the scale with the axis of the measuring points, which reduces to a minimum errors of measurement due to possible accidental deviation between the axis of the scale and the axis of measurement. This is more readily seen on reference to Fig. 3 (a). *A* represents the fixed microscope, *B* the movable scale or reference standard, *C* the axis of measurement and θ the angle of deviation. This arrangement is the basis of the Société Genevoise machine. It is seen that $E = L(1 - \cos \theta)$, where *E* represents the error of the machine. It is pro-

portional to 1 — cos θ), which is a quantity of the second order and therefore negligible. In actual measurements it is claimed that E cannot exceed 0.00005 in.

In Fig. 3 (b), A represents a movable microscope, B a fixed scale (reference standard) and C the axis of measurement, which shows the principle on which some measuring machines are based. The error in this case

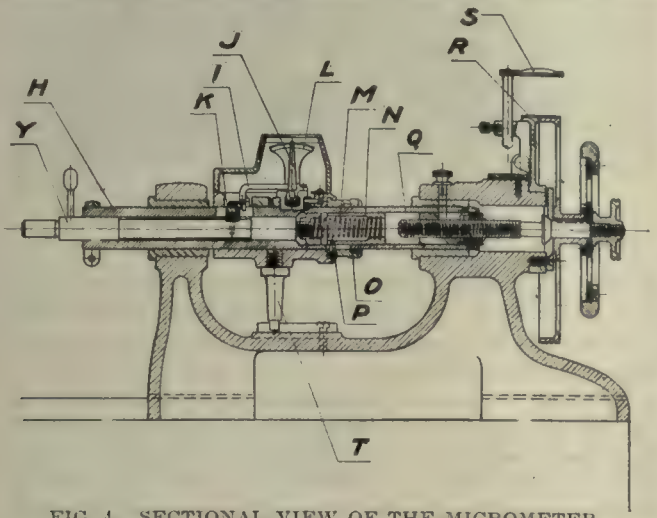


FIG. 4. SECTIONAL VIEW OF THE MICROMETER HEADSTOCK

is $E = D \tan \theta$. This error is a magnitude of the first order and may amount to several ten-thousandths of an inch in actual practice.

The Headstock

Fig. 4 is a longitudinal section of the micrometer headstock attached to the right-hand end of the bed. It is composed of a sleeve H containing a rod Y, the end of which forms the measuring point opposite to point E on the sliding carriage. On the sleeve H, which slides in hardened bearings, is attached a needle indicator composed of two multiplying levers I and J. The lever I is actuated directly by the hardened block K attached to the rod Y, and the multiplying ratio of the two levers is 1 to 1,000. The scale L is graduated in twentieths of an inch and has ten lines to the right and ten to the left of the zero point. A movement of the indicator J of one division on this scale corresponds to a movement of 0.00005 in. of the rod Y. The contact indicator, Fig. 1, differs somewhat from the one described, in that a microscope is employed for reading it.

The sleeve H contains a helical spring M fastened at one end to the rod Y, and at the other to the movable sleeve N. This sleeve, to which is attached the pin P, may be moved back and forth by means of the ring O. The ring has an internal helical groove which, as the ring is turned, causes the pin P and consequently the sleeve N to move parallel to the axis. The function of this arrangement is to put the spring M in either tension or compression by merely turning the ring O. In tension, the spring exerts a pull on the measuring point and puts the machine in condition for making internal measurements; with the spring in compression the apparatus is set for making external measurements. The same pressure is used when making all measurements, and when the indicator shows zero the pressure is about 0.5 lb.

Attached to the right-hand end of the sleeve H is a threaded piece into which fits the micrometric screw Q. The index wheel attached to the screw Q is graduated to read to 0.0001 in., and readings may be made to 0.00001 in. by means of the vernier R and the lens S. To prevent the sleeve H from turning, a pin T is attached to the housing of the indicator and slides between two hardened plates screwed to the headstock.

Making Readings

When making readings the position of the reference scale is determined by means of a 60-power micrometric microscope M. On the scale N, Figs. 1 and 2, the integral number and fractional parts of inches as small as one-twentieth are read. In the field of the microscope, Fig. 5, can be seen a scale B graduated on glass, a fixed hairline C, two lines D traced on the standard scale parallel to the axis, two hairlines E, which may be moved by turning the graduated index wheel F, and the lines H which are the magnified graduations of the standard reference scale.

Readings with the microscope are made by turning the wheel F until the movable hairlines E are disposed symmetrically to the right and left of the image H of the graduation. Multiples of 0.005 in. are read in the microscope, and multiples of 0.00005 in. on the index wheel F. The field of the microscope is illuminated by a small electric lamp S, a condensing lens V and an illuminating prism W, Fig. 2.

In addition to the micrometric microscope for observing the graduations of the standard scale, the machine is also provided with a goniometric (angle measuring) microscope X, which is attached to the fixed arm Z and used for measuring the angles of screw threads. By means of a number of accessories measurements may be made on gages of every description, as well as on other parts. Referring to Fig. 6, it will be seen that without the use of any accessory, by simply setting the sliding carriage at any desired position, the machine may be used as a rapid comparator. When so used, readings are taken only on the indicator, shown in Fig. 4.

Measurement of Plugs and Plug Gages

Where the plug to be measured is not over 4 in. in diameter, the fixture, Fig. 7, is employed. The plug is mounted between centers at right angles to the ways in a special support resting on four balls, which roll

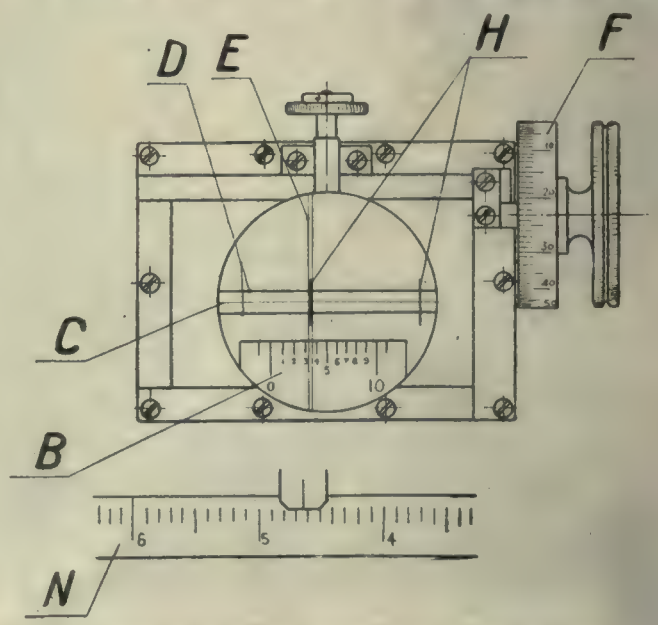


FIG. 5. FIELD OF THE MICROMETRIC MICROSCOPE M



FIG. 6. THE MACHINE USED AS A RAPID COMPARATOR

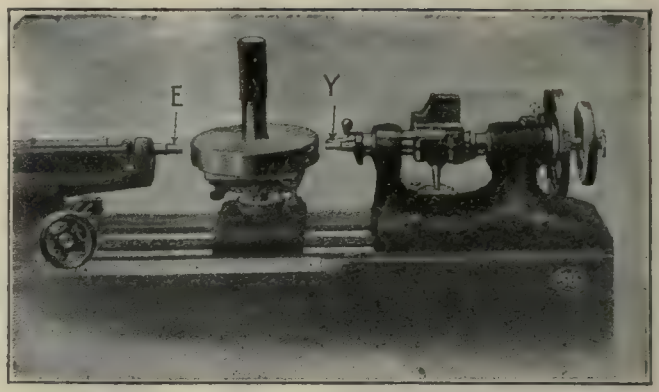


FIG. 7. ARRANGEMENT USED WHEN MEASURING SMALL PLUGS

freely in V-grooves parallel to the length of the bed. By revolving the plug it may be measured for eccentricity. The measuring point *E* of the sliding carriage is brought up to the plug and pressed against it; and, as the support moves freely on the balls, the plug in turn presses against the measuring point *Y* on the micrometer headstock. The indicator needle *J* is then adjusted to zero by means of the handwheel at the right and a reading is taken on the vernier *R*, Fig. 4. Plugs larger than 4 in. in diameter are placed on a support, see Fig. 8, and centered in the axis of the measuring points by means of the indicator.

For internal measurements, it is first necessary to turn the ring *O*, referring to Fig. 9, to the position marked *INT*, which sets the spring of the micrometer headstock to act in tension. The measuring points are fitted with special ends *J*, these being clamped in place by the locking rings *K*. The datum point for internal measurements is found or set by placing a standard 1¼-in. gap gage over the internal measuring faces, and adjusting the micrometer so that the contact indicator is at zero. The internal diameters of rings are measured in the same manner as in Fig. 9, except that the contact points used are spherical.

Measurement of Threads and Thread Gages

The outside diameter of a thread gage is measured in the same manner as the diameter of a plug gage.

When measuring the root or core diameter the screw or gage is mounted in the same way as for measuring the outside diameter. Triangular prisms *A* of hardened steel are suspended from the holder *B*, Fig. 10. The measuring points are brought up against the backs of the prisms, the sharp edges of which enter between the threads and reach to the roots. The distance between the edges of the prisms is then found by substituting for the screw a plain plug of known diameter and taking a measurement.

There are two common methods used for measuring the pitch diameter, one optical, the other mechanical. Both methods can be performed with this machine. The mechanical method consists in placing small measuring wires in opposite spaces of the threads, their diameters being such that they project above the crests of the threads. The arrangement is the same as that shown in Fig. 10, wires being substituted for the prisms at *A*. The diameter over the wires is measured; and the pitch diameter can be calculated by the following formula, the meaning of the symbols being shown by Fig. 11:

$$\text{Pitch diameter} = E - 2d + \tfrac{1}{2} P \cot \frac{\Theta}{2} - d \left(\frac{1}{\sin \frac{\Theta}{2}} \right) - 1$$

Measurements may be made to an accuracy of 0.00004 in. The mechanical method should be employed whenever possible, although the accuracy of the measurement depends to a great extent on the uniformity of the diameter of the wires and the accuracy of their measurement. The optical method, on the other hand, requires a trained eye to obtain good results.

The Optical Method

The optical method of measuring pitch diameter consists in setting the hairline of the goniometric microscope *X* successively on the two opposite flanks *N* and *O* of the thread, Fig. 12, by moving the screw transversely across the field of the microscope. The distance traversed *e* is the pitch diameter.

A perspective view of the fixture employed for this

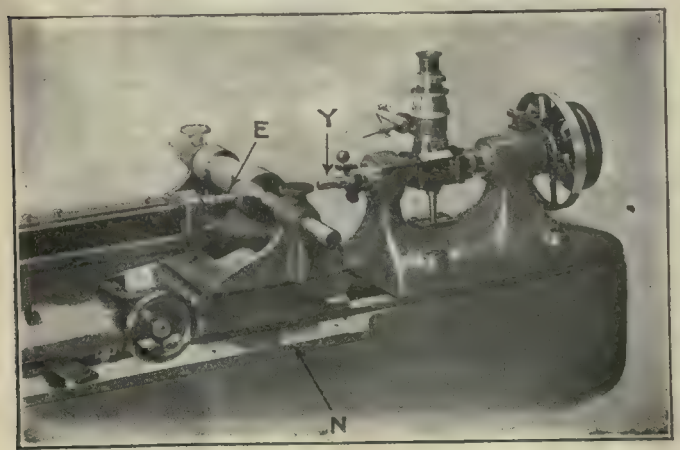


FIG. 8. ARRANGEMENT USED FOR MEASURING LARGE PLUGS



FIG. 9. ARRANGEMENT USED FOR INTERNAL MEASUREMENT

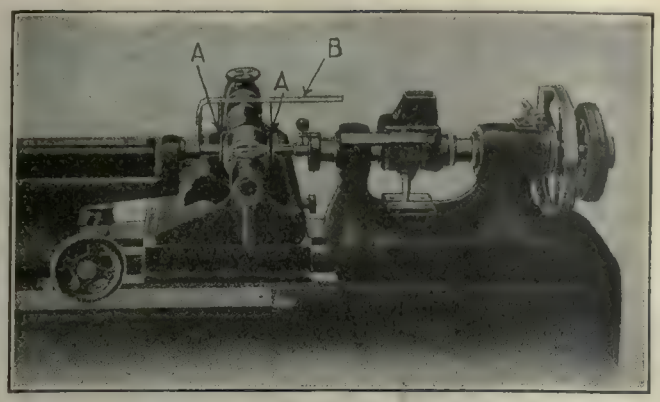


FIG. 10. MEASURING THE ROOT DIAMETER OF A THREAD

purpose is shown in Fig. 13, and it will be seen that the fixture is connected to the measuring anvil of the sliding carriage by the spring coupling *F*. Part *D* of this accessory slides on the bed, and the upper side of it is provided with V-grooves parallel to the ways. A set of four balls in these grooves permits the part *E* to move freely in a direction parallel to the length of the bed with any movement of the sliding carriage *U*. Another set of four balls resting in V-grooves in *E* gives freedom of motion to *Q*, in a direction perpendicular to the length of the bed. With the adjusting screw *G* the screw or gage to be measured may be brought into the axis of the microscope *X*. This arrangement is used for measuring pitches and thread angles of screws or thread gages up to 4 in. in diameter.

The field of the microscope is illuminated from below by a parallel beam of light which passes through an adjustable collimator *S*, capable of being both moved longitudinally and inclined so that the beam of light is parallel to the slope or inclination of the thread to the axis of the screw being measured. A scale *T* with an index and vernier controls the adjustment of the beam of light and permits reading to 10 min. of arc.

The circle *B* mounted on the center point is graduated in degrees. The scale *C* of the goniometric microscope *X* is graduated in half degrees and a vernier gives minutes of arc.

To measure the angle of a thread the movable hairline of the microscope *X* is set parallel, first, with the axis of the screw, then with the apparent right-hand flank of the profile, and last with the left-hand flank. The field appears as in Fig. 14. Care must be taken by the operator to observe the contour of the thread formed by a horizontal section through the axis of the screw and not the shadow of the profile outside of this plane.

Determination of the Pitch

To measure the pitch, the same fixture, shown in Fig. 13, is used, the hairline of the microscope *X* is set over the flank of one of the threads of the screw and a reading is taken with the micrometric microscope *M*, which has been set on a line of the reference scale. The sliding carriage *U* and the fixture holding the screw are then moved, and the number of threads passing under the field of the microscope *X* is noted. The hairline of the microscope is set over the flank of the thread under it and a reading is again taken on the reference scale. Of course, the pitch is equal to the

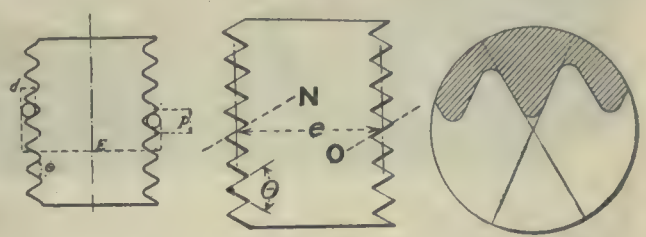


Fig. 11. Fig. 12. Fig. 14.

FIGS. 11, 12 AND 14. DETERMINING PITCH DIAMETERS AND MEASURING THREAD ANGLE

Fig. 11—Mechanical method of determining the pitch diameter. Fig. 12—Optical method of determining the pitch diameter. Fig. 14—Field or goniometric microscope when measuring angle of thread.

difference between the readings divided by the number of threads passed over. This method is very accurate.

For measuring progressive or periodic error the same procedure is followed, but the screw is moved a partial turn on its centers. By means of the graduated circle *B* the extent of the turn may be accurately determined.

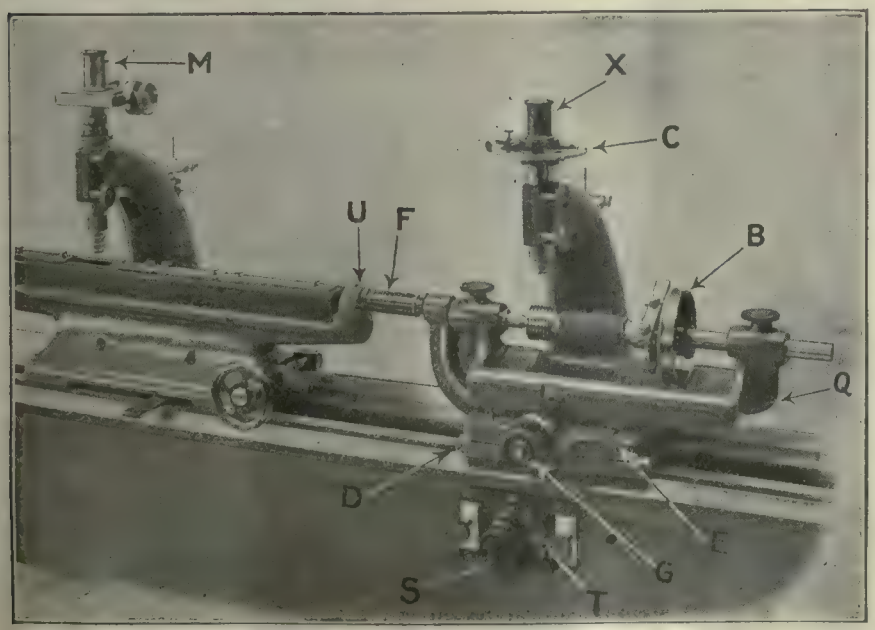


FIG. 13. FIXTURE USED FOR OPTICAL MEASUREMENT OF SCREW THREADS

For the optical measurement of the three principal diameters of a screw (outside, pitch and root) the support *Q*, Fig. 13, which carries the centering points, is removed. A similar support is used, which is provided with a special micrometer transverse screw with 20 threads to the inch and an index wheel equipped with a vernier so as to read to 0.0001 in. A small support carrying the work between centers is displaced by means of this micrometric screw, whose axis passes through the plane of the centers. This support is pressed against the screw by a spring, and rolls on three balls resting in V-grooves. Measurements are made with the microscope *X*, the hairlines being set parallel to the axis of the screw when the outside and core diameters are being measured, and parallel to one flank of the thread when the pitch diameter is measured.



WHERE close cutting to a line or pattern with a gas torch is desired, some mechanical device must be provided for guiding the torch. A properly constructed machine saves time, material and gas.

The more common mechanical devices in use are for feeding the torch in a straight line. These are used to cut bars, billets, boiler plate, armor plate and the like. An Oxweld straight-line cutting machine is shown in Fig. 275. An ordinary cutting torch is used in this case, and the end of a 12 x 12-in. billet has just been cut off. The feed screw may be turned from either end by means of handwheels, and means are provided for cross adjustment.

Another device, made by the Davis-Bournonville Co., is shown in Fig. 276. The pieces, which were cut the long way, measured 15 x 13½ in. This machine has a handwheel on one end of the feed screw and a cone pulley, for power drive, on the other. Unlike the device first shown this one is not mounted on legs but has a short section of I-beam for a base. On this account it may be placed on the object to be cut or laid on blocks or horses, as occasion demands.

The device shown in Fig. 277 differs from either of the foregoing in that racks are used in place of lead screws. This is made by the Great Western Cutting and Welding Co., San Francisco, Cal. The heavy structural iron base is so made that it may be placed on the work, laid on blocks or horses or mounted on legs. Means are provided for adjusting the torch up or down or at an angle.

XXIII. Cutting Machines*

Cutting machines using a gas torch do not offer the difficulties of operation inherent in those for welding. As a consequence, cutting machines are more commonly built and used. The machines shown in this article cover the principle types and makes.

(Part XXII appeared in our June 24 issue.)

Any of these machines may be used for cutting out marked square, rectangular, round or irregular shaped holes. Where the metal is thick, it is often better, especially on repetition work, to drill a hole through for starting.

The Radiagraph

The Radiagraph shown in Fig. 278 is made by the Davis-Bournonville Co. It is a motor-driven device, with oxy-acetylene or oxy-hydrogen cutting torch, adapted to cutting along straight lines or circles in steel plate from ¼ in. to 18 or 20 in. in thickness, the speeds varying from 2 in. to 18 in. per minute, according to the thickness of the plate. For straight line cutting, it operates upon a parallel track, and for circle cutting, with a rod and adjustable center. The device consists principally of a three-wheeled carriage driven by an electric motor attached to the carriage, which may be connected to the ordinary lighting or power circuit, either d.c. or a.c., 110- or 200-volt circuit. An adjustable arm and torch holder provides for raising or lowering the torch while in operation, and for adjustment at an angle for bevel cutting. The adjustable arm also permits of following an irregular line within a variation of 3 in. on either side of a straight line. The cutting torch is connected by hose to the gas supply. The machine is portable, weighing approximately 50 lb. complete, and has proven an invaluable aid in steel cutting, greatly facilitating such work in shipyards and steel mills, several machines being employed advantageously in some of the larger plants.

An example of some of the straight line cutting done

*For the author's forthcoming book, "Welding and Cutting."
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FIG. 275. CUTTING A BILLET WITH AN OXWELD MACHINE

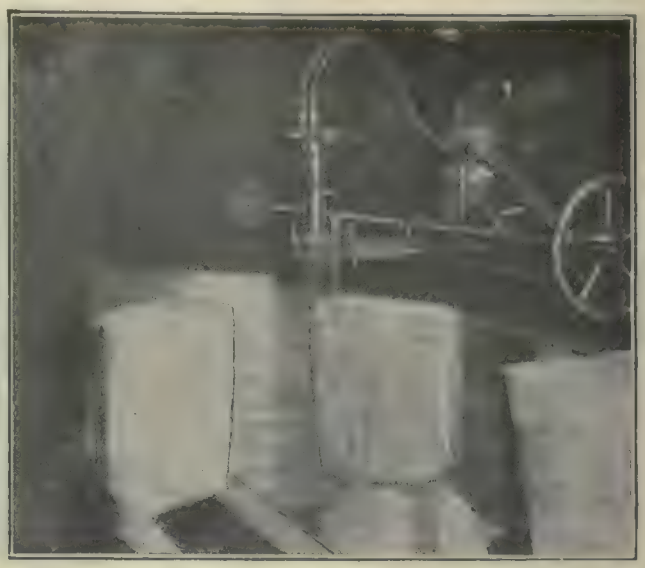


FIG. 276. ANOTHER STRAIGHT-LINE CUTTING MACHINE

by the Radiagraph is shown in Fig. 279. Here the track has been laid on a heavy piece of ship plate and the torch is fed along at a uniform rate by the motor.

The Railograph

For cutting railway rails the device shown in Fig. 280 is used. This is clamped to the rail while it is in position on the roadbed if desired. The cutting torch may be mounted in a holder on either side of the rail. Each holder is carried by a slide. Attached to each holder is a roller which runs in contact with a cam formed in such a way that it provides for maintaining the tip of the cutting torch at a uniform distance of about ⅛ in. from the surface of the work as the torch is fed around the rail. Feeding of the torches is accomplished by two handwheels which transmit motion through a set of suitable gearing. In operation the torch is first applied at one side of the rail and fed over the line on which the cut is to be made, one-half of the base and head of the rail and the web being cut in this way. The torch is next removed from the holder and mounted at the opposite side of the rail, where it is again passed over the line of cut, with the result that the remaining half of the base and head of the rail is severed. A 9-in. traction rail can be cut off in about three minutes.

The cutting of heavy steel plate in the great Schneider Works, Creusot, France, is shown in Fig. 281. The portable devices are very similar to those used in the United States. In the background is a huge machine so made that it can be used to trim ends, square up a plate and cut angles or circles. The torch carriage is fed along by a lead screw run by a motor seen at the extreme right. A motor-operated device will raise or lower the frame or give it a circular movement. The plates to be cut are run into position on small flat cars.

Circular Cutting

The Radiagraph cutting circles, is shown in Fig. 282. The work was 2½ in. thick and was cut at the rate of

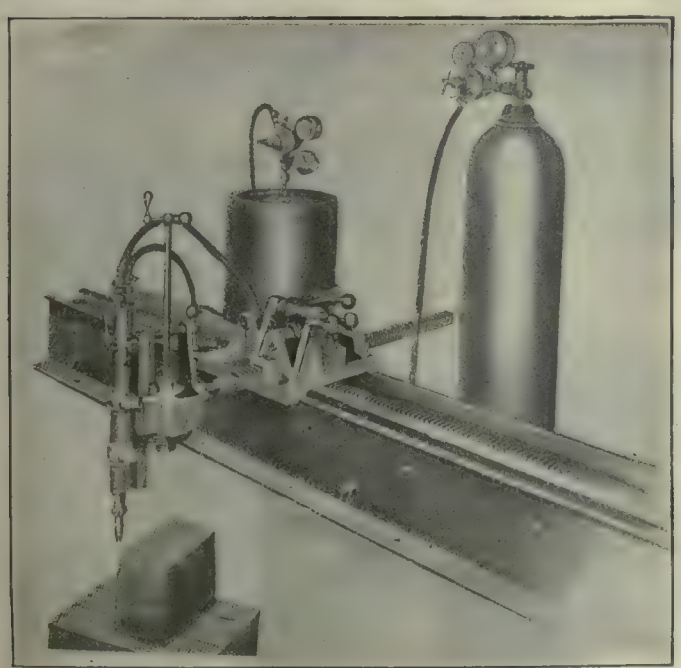


FIG. 277. PORTABLE CUTTING MACHINE WITH RACK FEEDS

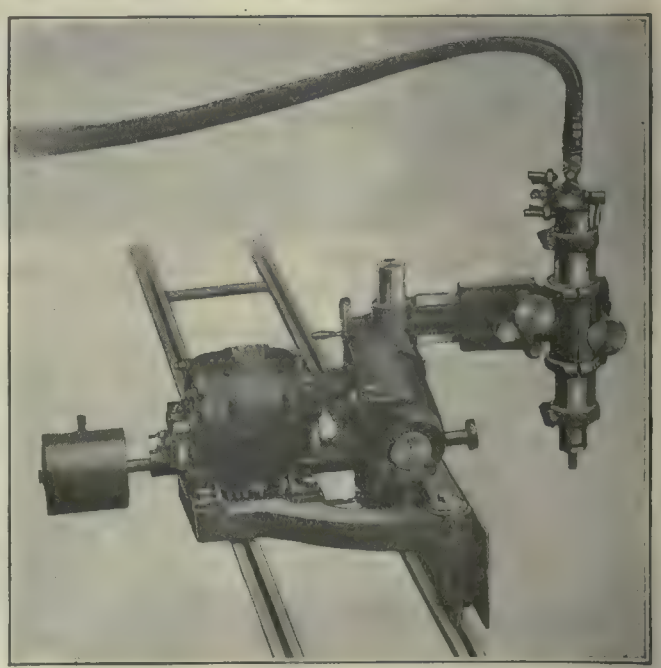


FIG. 278. DAVIS-BOURNONVILLE RADIAGRAPH

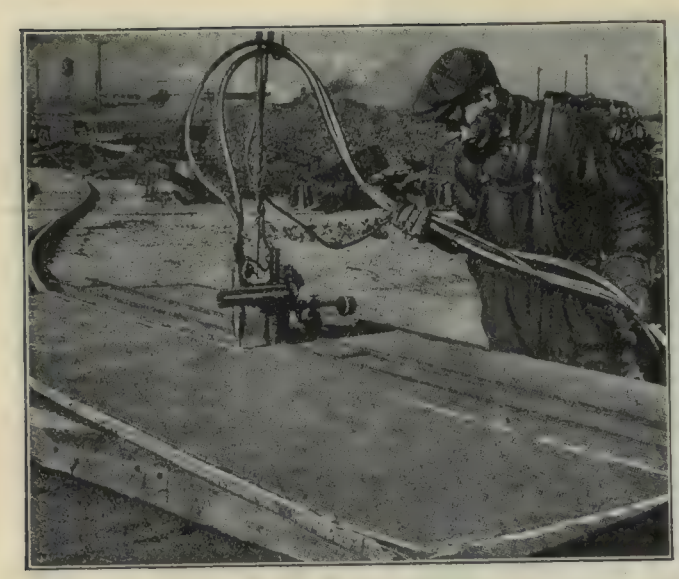


FIG. 279. RADIAGRAPH CUTTING STEEL PLATE AT THE NEW YORK SHIPBUILDING YARDS

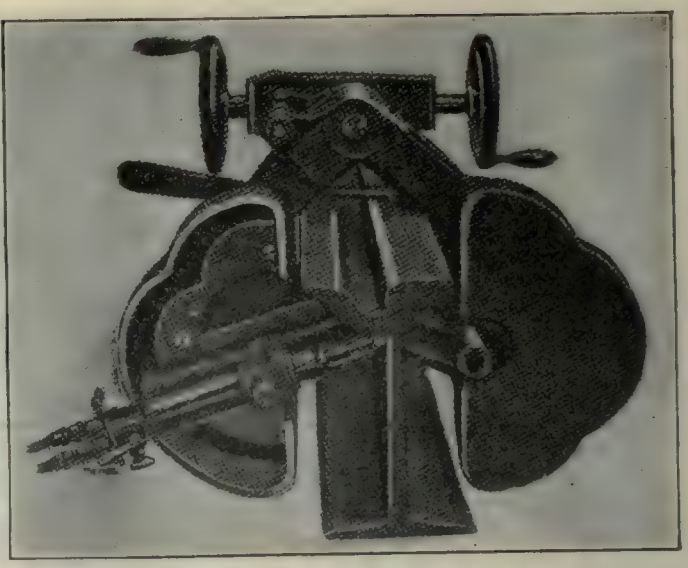


FIG. 280. DAVIS-BOURNONVILLE RAILOGRAPH

6 in. per minute. Note the true circle and surface of the cut. The pieces were for a special type of heater for the Government. The round piece, or flue sheet, is 30 in. in diameter and the ring, or flange, 45 in. outside diameter.

Another device is the Holograph, shown in Fig. 283. It is a device for cutting holes in the web of a rail, or in structural iron, of not more than $\frac{3}{4}$ in. thick. It is quickly attached and accurately adjusted. It pierces through the iron almost instantly, without any previous drilling, and will cut smooth round holes from 1 to 2 in. in diameter in from 30 to 60 sec. It is particularly adapted for railroad work, and enlarging or cutting holes in building and bridge work.



FIG. 281. CUTTING HEAVY PLATE AT THE SCHNEIDER WORKS, CREUSOT, FRANCE

THE MAGNETOGRAPH

The Magnetograph shown in Fig. 284 was designed for mechanically cutting circles up to 12 in. diameter in steel plate in perpendicular position, such as cutting port holes in the side plates of ships. Steel plate from $\frac{1}{4}$ in. up to several inches thick is cut quickly, with a finished and true surface, the movement of the oxy-acetylene or oxy-hydrogen torch and flame being given by handwheel and gears. Cutting is accomplished at varying speeds according to thickness of plate, from 3 in. up to 20 in. per minute, or even faster on

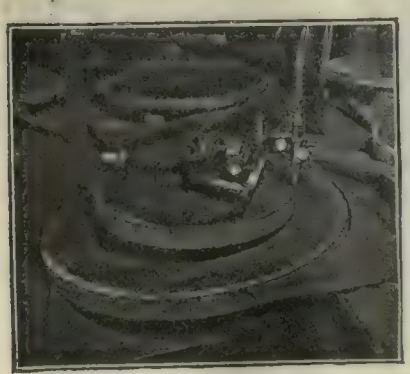


FIG. 282. RADIAGRAPH USED FOR CIRCULAR WORK

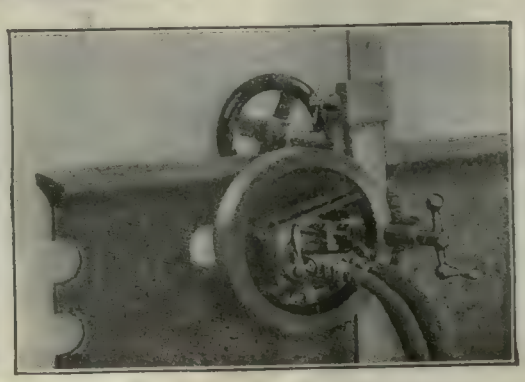


FIG. 283. DAVIS-BOURNONVILLE HOLOGRAPH

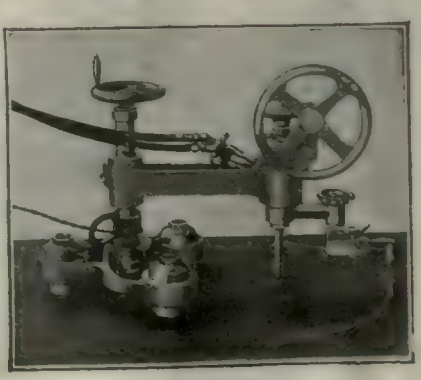


FIG. 284. DAVIS-BOURNONVILLE MAGNETOGRAPH

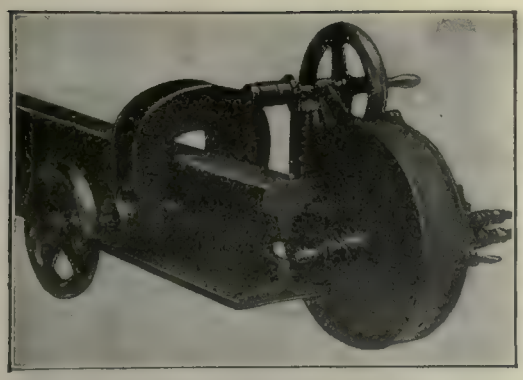


FIG. 285. THE CAMOGRAPH

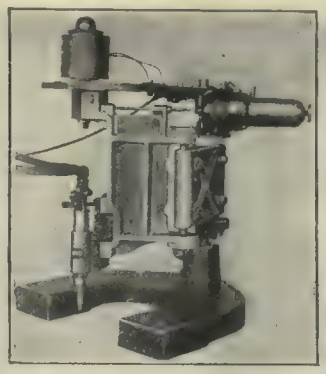


FIG. 286. CAMOGRAPH NO. 2

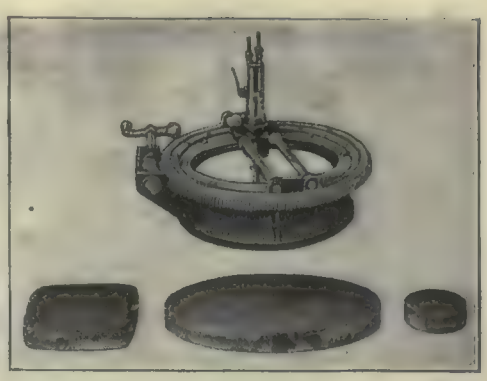


FIG. 287. GREAT WESTERN CUTTER

light plate. The device is constructed as much as practical of aluminum to obtain lightness, and is held firmly on the plate by means of three electromagnets, connected by wire to an electric circuit (direct current) or to battery.

The Camograph

The Camograph, Fig. 285, is an adaptation of the Holograph. It is of the same general construction, except that it is larger and has a wider range of work. It is fitted with a cam for each particular kind of work, and will cut almost any form desired, within the capacity of the machine. This machine requires special cams for each operation.

The Camograph No. 2, shown in Fig. 286, is a later development of the Davis-Bournonville Co. It is automatic in operation and is used for cutting openings in steel plates that cannot be done conveniently or economically on a drilling machine. The torch is mechanically traversed over a fixed path and at a predetermined speed. The path followed is controlled by an internal cam at the top of the machine, the shape of which determines the shape of the opening being made, the double-jointed radial arm permitting universal movement of the flame which perforates the steel. The principle of the cam guiding action is unique. The feed roller is magnetized by a powerful electromagnet, and is thus attracted to the inner face of the cam, the parts in contact being made poles of the magnet, one of which rotates and thus acts as a traction driver. The roller is driven by a small variable-speed motor through double worm gearing, the magnetic attraction being sufficient to cause it to travel along the face of the cam in a positive manner. Direct current is required owing to the magnetic feature, and the control consists of a double push-button switch for starting, stopping and also for energizing the magnet. Arrangement is provided whereby when the cutting oxygen is turned on the feed motion automatically starts. The nominal diameter of the largest hole cut is 7 in., but openings other than circular, having one dimension much larger, may be provided for. All thicknesses of plate used on the largest marine boilers are readily cut with this machine. The machine is 17 in. wide, 15 in. deep, 25 in. high, weighs 125 lb., and uses 110 volt, direct current.

The Great Western Cutter

The machine shown in Fig. 287 is made by the Great Western Cutting and Welding Co. It is designed to cut round, square or oval holes. Three master plates are furnished for holes of these shapes. By turning the handle the torch travels around the inside of the form, to which it is held by the two coiled springs shown. The machine is simple and light. Extensions are furnished for cutting large holes. For odd-shaped holes extra plates are required. This machine is especially adapted for boiler shops, shipyards, etc., in cutting hand holes, manholes, fire-box door holes, and holes in tube sheets.

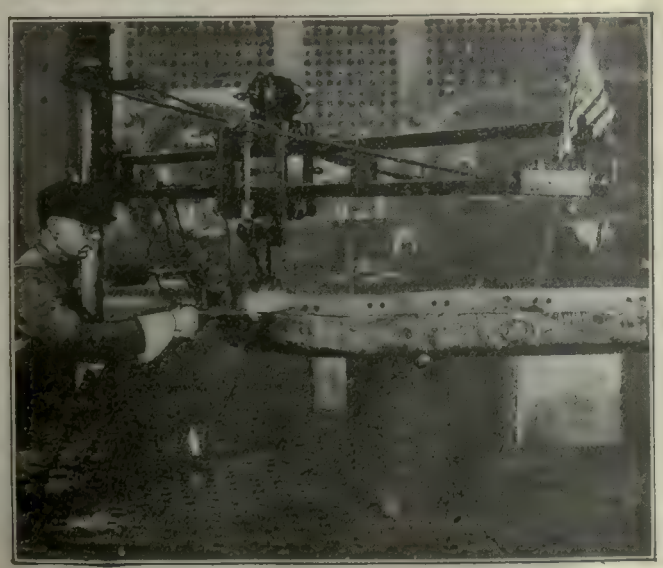


FIG. 288. PYROGRAPH TRIMMING AND BEVELING BOILER FLANGES

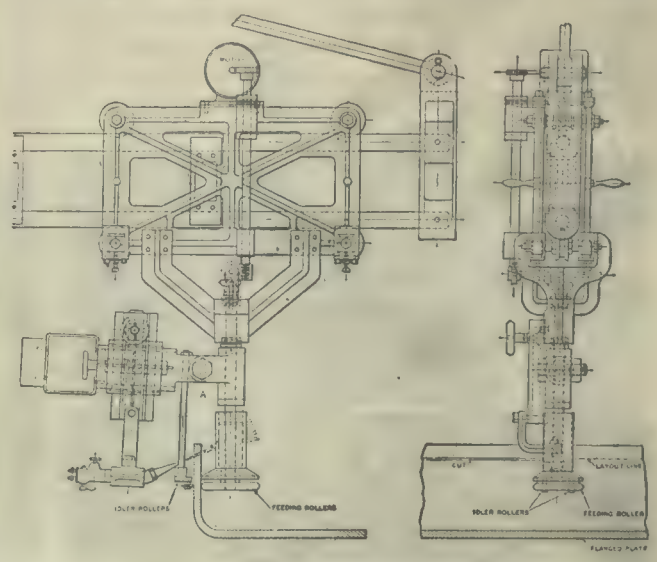


FIG. 289 DETAILS OF PYROGRAPH FEED MECHANISM

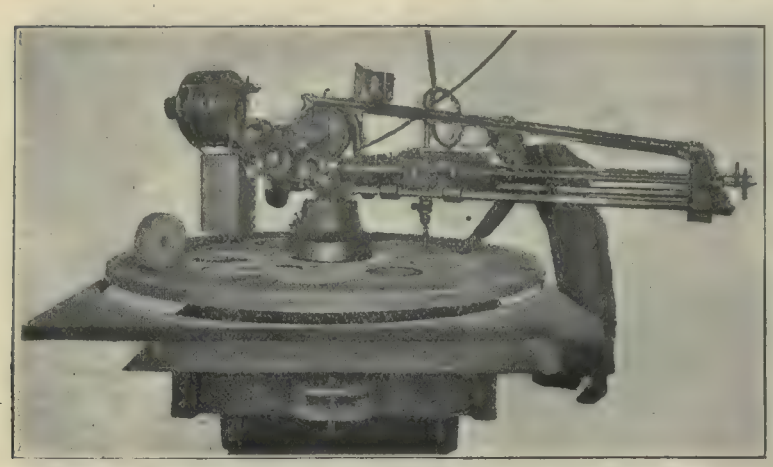


FIG. 290. AUTOMATIC UNIVERSAL CUTTING MACHINE

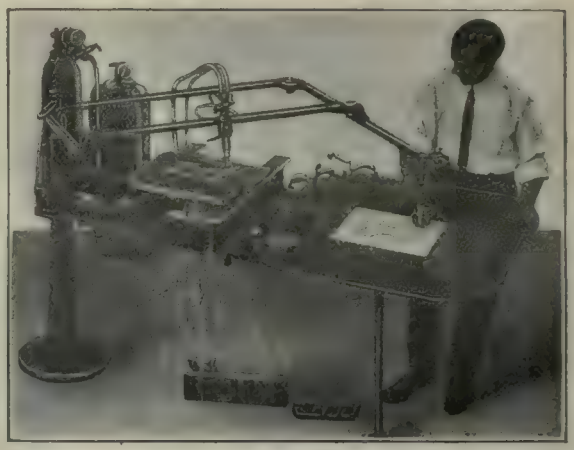


FIG. 291. SINGLE-TORCH OXYGRAPH

The machine shown in Fig. 288 is known as the Pyrograph and is made by the Davis-Bournonville Co. The model shown is not the latest, but well illustrates the general principles of the more improved ones. It was designed primarily for boiler-shop use in turning flanged boiler heads or cutting openings for doors, manholes and the like. In one shipyard boiler plant, flanged combustion chamber heads, ¾ in. thick with a flange periphery of 27 ft., were trimmed and beveled to the calking angle in 30 min., exclusive of the setting up.

As can be seen, the Pyrograph comprises a motor-driven carriage supported on a radial arm of a length that provides for cutting the flange of a 9-ft. diameter boiler head at one setting. While the largest diameter circle that can be cut at one setting is 9 ft., much larger work may be trimmed and beveled, inasmuch as the arm can be swung through a semi-circle of 20 ft. or a full circle of 20 ft. diameter, provided the shop conditions permit the arm to swing in a complete circle. Heads larger than 9 ft. diameter are reset as many times as may be found necessary to reach the flange all around.

The radial arm construction is light but rigid, consisting of two cold-rolled parallel round steel bars firmly tied together by end connections and intermediate spacer blocks, and supported by a truss rod. The vertical cast-iron pivot member of the radial arm is mounted on ball bearings at the top and bottom, in order to insure the maximum ease of movement. The steel post around which the radial arm swings is adjustable vertically by means of a crank operating a rack-and-pinion gear. A dog and rachet hold the post at any height within the limits of adjustment required.

The column has a broad flanged base which may be bolted to a cast-iron floor plate or a concrete foundation if required to be self-supporting, or the top of the post may be shackled to a column of the shop building and the base supported on an ordinary floor without an individual foundation.

The carriage is supported on the radial arm by four grooved ball bearing rollers which provide for the easy radial movement required to follow the feed action freely. The carriage and the arm derive their movements from the feeding mechanism which operates directly on the part to be beveled, the flange part itself acting as the track and guide for the feeding mechanism, as shown in Fig. 289.

The torch is adjustably mounted on the carriage beneath the radial arm, and the tip may be directed at any angle required to cut to the desired calking angle.

The flange to be trimmed and beveled is gripped between the three feeding rollers, two of which are small idlers on the side next to the torch while the driving roller, considerably larger, is located on the far side of the flange. The driving feed roller derives its motion from a small electric motor mounted on top of the carriage and driving through a reducing train of worm and bevel gears. Variations of speed are provided by making the upper worm and worm gear replaceable with worm gears of different ratios. The following speeds are available: 12 in. in 70 sec., 12 in. in 90 sec. and 11 in. in 60 sec.

The pressure on the feed rollers required to produce

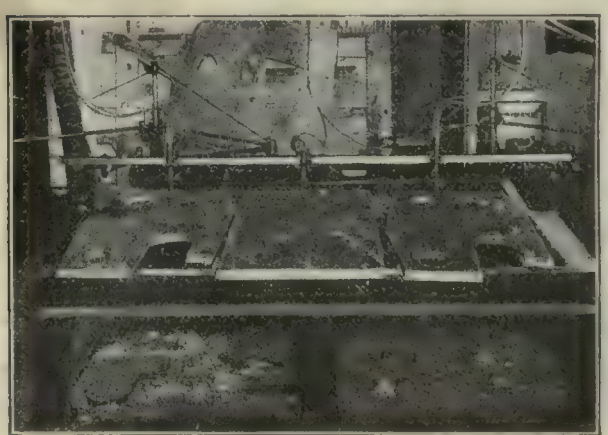


FIG. 292. OXYGRAPH WITH TWO TORCHES

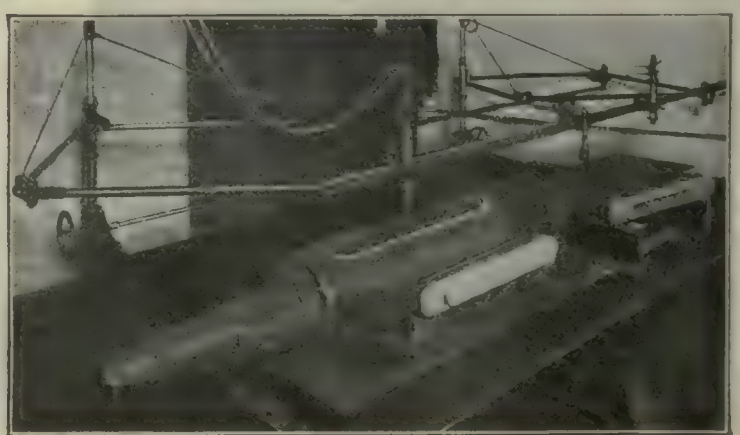


FIG. 293. CUTTING OUT A LARGE SLOT

the traction necessary to traverse the torch and carriage is obtained from the weight of the torch, the slide rests on which it is carried and the frame to which the two idler feed rollers are attached. The frame carrying the slide rests and idler feed rollers is pivoted, and the weight forces the idler feed rollers against the side opposite the driving roller with sufficient pressure to traverse the carriage positively. The feed mechanism operates on any shape whether straight or curved, thick or thin. Flanged sheets are generally rough, presenting a more or less irregular contour, but this does not interfere with the carriage traverse and the torch action. The operator may interrupt the feed at any point by raising the frame, thus relieving the pressure on the feed roller.

The driving roller and its shaft are protected by a shield of fireproof composition having a beveled flange at the bottom, on which the sparks and slag have no effect. The machine, once set, trims a flanged sheet evenly all around, provided the sheet has been properly leveled. Otherwise it is necessary to chalk a line to be followed.

In the plant of the New York Shipbuilding Corporation, three different combustible gases are used in cutting torches, namely, carbo-hydrogen, acetylene, and hydrogen. The combustible gas selected for different classes of work depends upon the thickness of the plates which have to be cut. The range of thickness handled by the different gases is as follows: Up to 3 in., carbo-hydrogen; 3 in. to 6 in., acetylene; and over 6 in., hydrogen. It will, of course, be understood that either of these gases is mixed with oxygen.

A Universal Cutter

A machine built somewhat along the lines of the Pyrograph, but a much more universal machine, has been developed for use in the shops of the General Electric Co., Schenectady, N. Y. This machine is shown in Fig. 290. It can be set for automatically making circular, spiral, radial or tangential cuts. Its rate of feed can be varied from 1 to 72 in. per minute, according to the character and thickness of the metal. The base of the machine is provided with a powerful electromagnet to be used if the machine is placed on a rough or uneven surface and also to hold it in position when it is necessary to perform cutting operations on work held in a vertical plane. Ordinarily, the weight of the machine is sufficient to hold it steady. As shown, the machine is mounted on a truck for easy transportation, as it weighs 1,900 lb.

The Oxygraph

With the Oxygraph, steel plate from 1 in. to 15 in. or more in thickness is cleanly cut with a narrow, smooth kerf, along straight lines, sharp angles, or curves, according to drawing or pattern. The pantagraph principle is employed, with a motor-propelled tracing wheel, with which the lines of the drawing are followed and reproduced with the cutting torch. Either the oxy-acetylene or the oxy-hydrogen cutting flame is used, with hose connection to the source of gas supply. The only power required is for revolving the tracing wheel, and this is supplied by a small motor attached to the tracing head, which may be connected to the ordinary electric light or power circuit. A universal motor, either d.c. or a.c., 110- or 220-volt circuit, with rheostat and friction governor is used. The speed of cutting varies from 2 to 18 in. per minute, according to the thickness of steel being cut.

One size of machine is applicable to small work and die cutting, within a cutting area of 16 in. square, a circle of 18 in., or a rectangular form 12 x 40 in. may be cut by extension of the tracing table. With this machine, a drawing or pattern double the size of the cut to be made is required, the drawing being placed on the tracing table shown at the right in Fig. 291.

Another machine is made for larger, heavier work. It has a double pantagraph frame and is fitted with two cutting torches for making duplicate cuts at the same time, the position of the torches and tracing wheel being adjustable. The entire pantagraph frame may be moved backward from the table to allow placing of heavy plate with a shop crane. This machine reproduces the cut of equal size with the pattern, or 1 to 1.

A machine with two pieces of work and pattern in place is shown in Fig. 292.

Another practical application of the Oxygraph is shown in Fig. 293. The piece worked on is a fishing tool used for fishing out broken tubes in oil wells. This Oxygraph has a bed frame 30 in. wide by 9 ft. long. The fishing tool is hollow, with walls 2½ in. thick, and weighs 900 lb. The total cut made of 21 lin.ft. was made in 21 min. or 1 ft. per minute.

Meters or Feet?

By F. D. Hood, *Polytechnic High School.*
Los Angeles *School Journal*

There is a movement on foot just now to make compulsory the use of the metric system in the United States. This means, of course, the retirement of the foot and its replacement by the meter, whether we like it or not.

The scheme seems to be engineered by the World Trade Club of San Francisco, whoever they are. Few people seem to know anything about the scheme, and maybe this is part of the plan until sufficient deadly work has been accomplished at Washington to insure its success.

One thing is certain in the minds of those who are in close touch with industry, and this is the field where the movement will have its most appalling results, and that means there will be industrial paralysis to begin with and eternal confusion thereafter, for the simple reason that the old units refuse to be displaced wherever it has been attempted, even in the country of metric origin, and we shall therefore have two systems of weights and measures instead of one.

Viewed from a pretty wide angle, the two countries using the English system of weights and measures as their legal standard, namely, the United States and Great Britain, have grown industrially and financially fat, much more so in the case of former than in any country where the use of metric system is enforced by the policeman's club. So the English system cannot be such an awful drag, as some are apt to think.

Surely these pro-metric advocates do not comprehend what this change means, either in money or goods, or they would not at this time urge its compulsory adoption. Hundreds of millions of dollars worth of gages and standards in the manufacturing industries alone will have to be scrapped and as many new ones made. Every automobile sign in the country indicating speed will have to be changed to read centimeters per second.

because every new speedometer will be in the same system. Owners of old ones can keep a set of conversion-tables handy. Every new length of pipe will be in metric threads; connection with English threads can be made with hose, perhaps, or pay toll in the shape of a transition-fitting. And so on *ad libitum*.

Surely the industries are sorely enough harassed as it is, without inflicting this upon them; production is years behind, as it is. If the arch-propagandist of Berlin had set his diabolical brains to scheming up something to set this country back industrially about ten years he could not have produced a more all-around effective plan than to make the metric system compulsory here and now.

And what is it all for? Nothing, but uniformity—deadly uniformity. Things will not be made any more rapidly, any better, any cheaper, nor in greater quantities than with the English system. No one has any quarrel with our present system of weights and measures, at least they keep quiet about it if they have, except those who do not use it anyhow, and they are in the minority, by far.

The case for the metric system would be stronger if it really had accomplished uniformity where it has been tried and made a clean sweep, though nothing is said about the twenty-four hours of the day, sixty minutes, sixty seconds and the three hundred and sixty degrees of the circle (nothing metric here), but if the kind of uniformity that the compulsory use of the metric system would bring to this country is the same kind of uniformity that its obligatory use has brought to France (to say nothing of the hodge-podge in other so-called metric countries) with her maze of yards, metres, aunes, kilograms, pouces, sous, moques, deniers, and Paris pounds—then Heaven forfend. We indeed have a uniform system in comparison.

Talking about making the thing compulsory, why, the Government would have the biggest job on its hands that it ever tackled if it tried to stop the American people from using the system if they wanted it. They do not want it, except just where it is, that is why it is where it is.

Casting Losses in Aluminum Foundry Practice in U. S.*

By Robert J. Anderson

Casting losses are a serious source of financial loss in iron and steel foundry practice, as well as in brass and bronze, but they are particularly serious in aluminum foundry work because of the high value of the aluminum. If a foundryman will study his daily production of defective and wasted castings, he will be able to trace the cause for losses and then make such corrections in his plant practice as will effect a considerable reduction in these losses—as much as 50 per cent in some. If all the present casting losses of the United States could be reduced 50 per cent by eliminating only the readily preventable defectives, a saving of several million dollars would accrue. In the aluminum foundry industry alone, the saving would amount to $600,000.

Light aluminum alloy sand castings may be rejected for defects resulting from one or a combination of causes, including cracks, sand holes, chill blows, and core blows, cold shuts, hard spots, porosity, leaks, and general unsoundness; uneven walls and core shifts, hard and soft ramming, breakage on trucking, handling, chipping and cleaning; cracking on welding, cope drop, short pour, dirty and broken cores, and sand or paste in the cores; run out, molds crushed in core setting, gates washed in, poor patching, wet sands, draws and shrinkage warping; broken molds and inferior metal. On account of the large number of variables in foundry practice, it is at times difficult to trace the exact causes for specific defects. However, the factors that will most likely cause defects in the castings can be classified; then it will be easier to trace the defects to a definite cause or combination of causes. By eliminating the causes, the defects will disappear. Admittedly, this is not always easy to do, but the first step to be made in attempting to reduce casting losses is a thorough diagnosis of the causes for defects.

A recent survey of the aluminum foundry industry by the Bureau of Mines has made data available regarding the losses sustained in the United States in the production of all kinds of commercial light aluminum-alloy castings. The average casting loss, including rejections of all kinds on the foundry floor, in the inspection department, and machine-shop returns, may be placed conservatively at 10 per cent. Variations in losses, as reported to the Bureau by numerous foundries, range from 0 to 75 per cent; no variation of losses is rare except for certain types of exceedingly simple castings, whereas 75 per cent is altogether too high. The indications are that an average figure of 10 per cent for all kinds of castings is approximately correct, although possibly a trifle low when referred to actual production records furnished by some representative foundries.

About 97 per cent of the output of sand castings is poured from an alloy containing about 92 per cent aluminum and 8 per cent copper, known in the trade as No. 12 alloy. The rest of the output is cast from various alloys including different kinds of binary aluminum-copper alloys, aluminum-magnesium alloys, aluminum-zinc alloys, ternary aluminum-copper-manganese alloys, aluminum-copper-tin alloys, aluminum-copper-zinc alloys, and aluminum-manganese-zinc alloys. Also some exceedingly complex alloys are cast, but these make a small percentage of the total output.

The total output of light aluminum-alloy sand castings of all kinds in the United States in 1919 is placed at 81,000,000 lb. The cost of scrapping a pound of rough casting may be placed at $0.125, although variations are from $0.10 to $0.25. On the basis of the figures available, the total monetary values of the losses, incurred annually in the United States because of the rejection of defective castings, may be readily calculated.

81,000,000 pounds = total output.

10 per cent = average casting loss.

$0.125 per pound = cost of scrap.

81,000,000 = 90 per cent of the actual castings poured, or

81,000,000 ÷ 0.90 = 90,000,000;

90,000,000 × 0.10 = 9,000,000 pounds of castings scrapped;

9,000,000 × $0.125 = $1,125,000, the total monetary loss.

If the present average losses could be reduced 50 per cent, which is possible by eliminating the occurrence of readily avoidable defects, a saving of at least $600,000 would accrue to the country. That a reduction of losses by at least 50 per cent is possible, has already been shown in some large foundries.

*From Bureau of Mines Report for April, 1920.

Machining a Gear-Type Water Pump

By FRANK A. STANLEY

Auxiliary apparatus is vital to the successful operation of internal combustion engines, though interest in the construction and manufacture of such apparatus is apt to be overshadowed by the consideration generally given to the engine itself.

THE gear pump shown in the accompanying illustrations is used on the 200-hp. gasoline engines of motor cars operated by the Southern Pacific system. The two steel gears forming the internal mechanism of this pump are of 5-in. pitch diameter, three diametral pitch and 3½-in. face.

The cast-iron casing forming the pump body is bored out to form the gear chambers to a diameter of 5.672 in. providing a total clearance outside the gear teeth of 0.005 in. or 0.0025 in. on each side. The centers to which the gear chambers are bored are of course 5 in. apart. The pump casting is shown by Figs. 1, 2 and 3 and the latter view represents the interior. It may be noted that the casing is broken out in Figs. 3 and 4 in order to show the valve seats, pipe joints, etc., in the chamber at the side.

The first operation on this work is driling the bracket holes at the side of the casing, which is done with the simple jig shown in Fig. 1. This jig is an angle plate with bushings in base and upright for a ⅬⅢ-in. drill and having a locating lug at the side for positioning the jig on the casting. The holes drilled are for the bolts by which the pump is secured in place when in service. They are also used in various machining operations for holding the work on its fixtures.

In Fig. 2 is shown the second operation, the machining of the gear chambers referred to above. This is performed on a small vertical boring mill which is fitted with an auxiliary table in the form of a faceplate having parallel slots planed across its face for locating the work-holding fixture by means of a tongue entering one of the slots. The position of the fixture along the slot

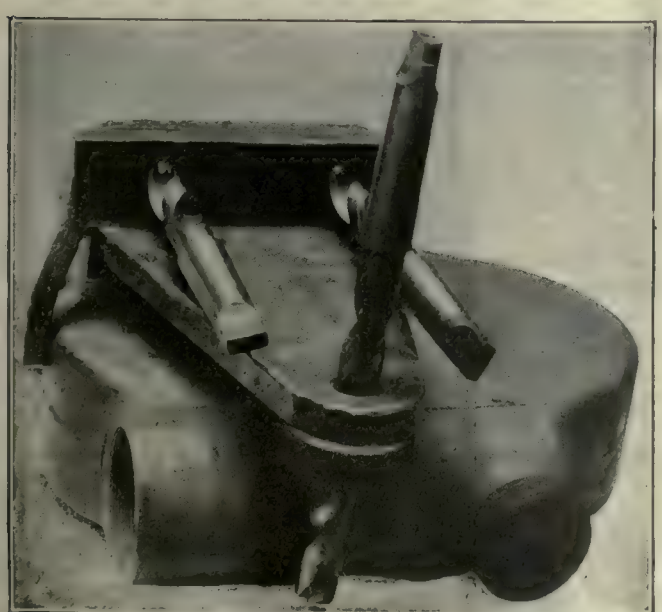


FIG. 1. JIG FOR DRILLING BRACKET HOLES IN GEAR PUMPS

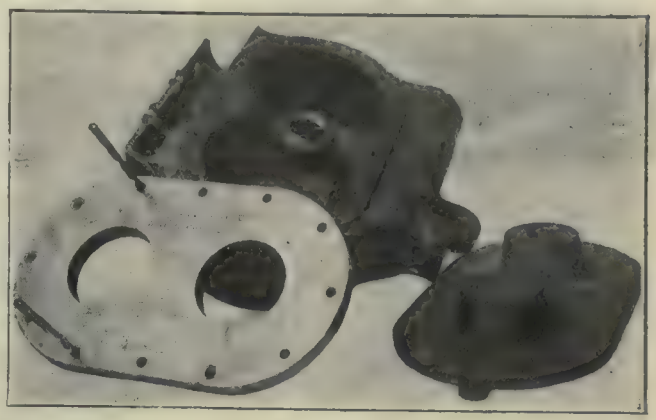


FIG. 3. JIG FOR GEAR CASE AND COVER

is fixed by a locating pin which enters a hole in the faceplate, and the center distance for the two gear chambers is readily obtained by shifting the pin to a second locating hole in the plate. The fixture is clamped in place by four capscrews, and the work is held to the fixture by three ⅜-in. bolts through the holes drilled in the first operation.

There are three turret tools used in this operation. The first two are for roughing and finishing the bore and face; the third is a square-end tool for finishing the bottom of the seat. This is made narrow enough to pass down along the bearing boss at the bottom of the chamber for the gear shaft and thus reach the bottom surface which is seen in Fig. 3.

The jig for the third operation is a bushed templet, Fig. 3, which serves for the holes in both the pump case and the cover. The fourth operation is the machining of valve seats, etc., with the aid of the fixture shown in Fig. 4, which is mounted upon an auxiliary table on the vertical machine. As already mentioned, this view shows the work with the side of the valve chamber cut away, in order to illustrate the section through the walls and at the same time give an idea of the method of applying the series of tools to their respective cuts.

The sketch, Fig. 5, is a partial section showing the openings that are machined by the boring bar, cutters and taps shown in Fig. 4. There is a ⅬⅦ-in. hole at the bottom of the valve chamber for the valve stem and above this comes the beveled seat for the valve. Then comes a 2⅛-in. tapped and counterbored opening for the reception of a brass valve seat and guide, and in the outer wall a 2¾-in. tapped hole for a brass valve cap. The boring bar shown in Fig. 4 carries the cutters for boring the holes to be threaded, forming the valve seat, counterboring the seat for the inserted brass valve seat, and facing the upper or open end of the chamber. These cutters are all held by hollow setscrews setting flush with the surface of the boring bar. The latter is of course piloted to enter the smaller hole for the valve stem at the bottom of the chamber.

Two machine taps are used. These may be seen on the table of the boring mill. Both are 16 threads per inch, and provided with aligning and retaining collars. The combination seating tool and drill shown in the left side of the turret will be recognized as the equip-

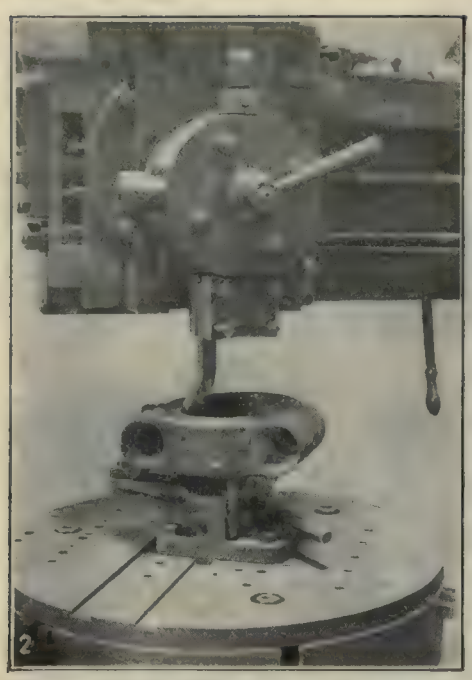


FIG. 2. MACHINING THE GEAR CHAMBER

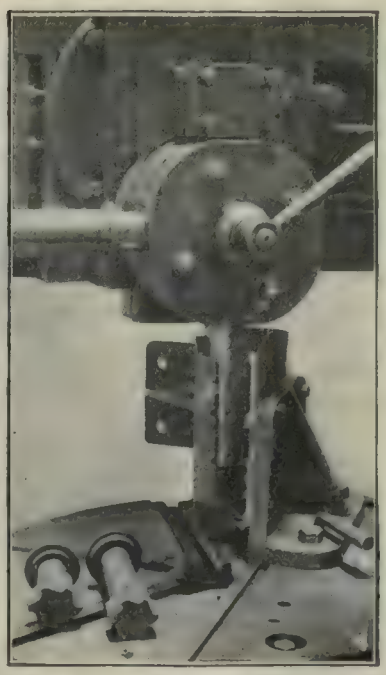


FIG. 4. TOOLS FOR BORING AND THREADING VALVE SEATS, PIPE JOINTS, ETC.

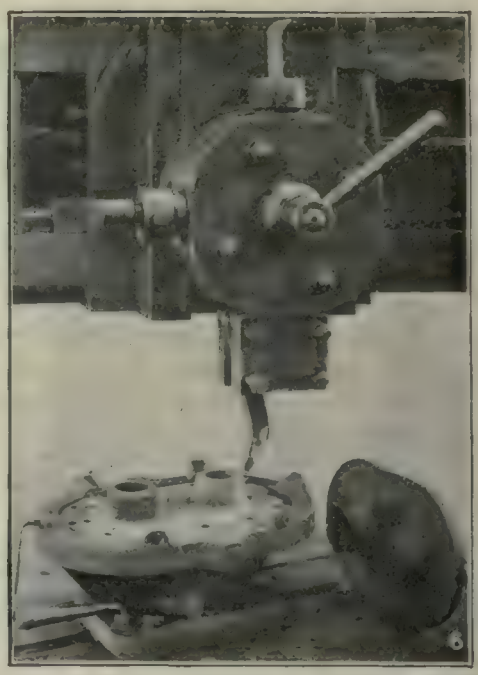


FIG. 6. MACHINING GEAR-CHAMBER COVER

ment for drilling the $\frac{13}{32}$-in. hole at the bottom of the chamber and for forming the lower valve seat, the finishing of which is shown underway with the flat cutter in the lower end of the bar in the work. This valve seat is given its final finish by grinding in the valve in the usual manner.

The fifth operation on the pump is the machining of the gear-chamber cover which is accomplished with the fixture seen in Fig. 6. Like other fixtures described, this device has a locating pin for giving it two definite positions along the slotted auxiliary table on the boring mill, thus assuring correct center distances for the operations around the two bores and hubs. The fixture has a chamber in its upper face which admits the cover and in which the work is secured by six hollow set-screws placed at a slight angle to the horizontal to force the work down into place on its seat.

The tools described above are in use at the Sacramento shops of the Southern Pacific Railway Company.

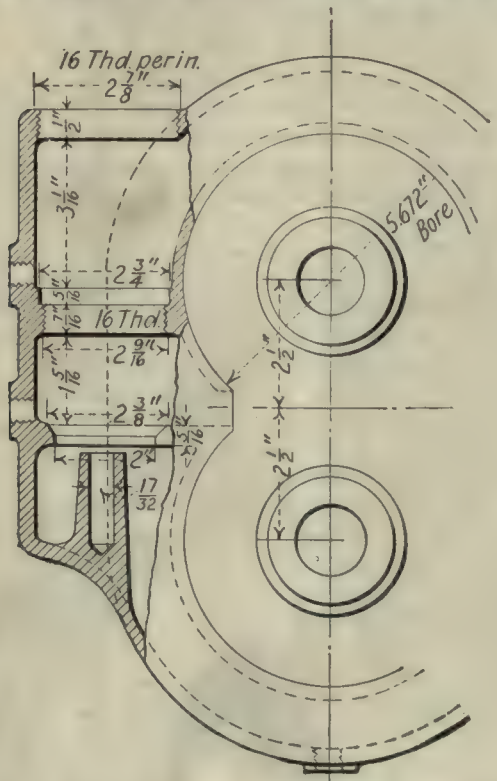


FIG. 5. SECTION THROUGH VALVE CHAMBER

Unclaimed Suggestions

By Peter F. O'Shea

The suggestion system of the Greenfield Tap & Die Corporation involves the use of standard blanks which are numbered serially and have a coupon bearing the same number which the employee tears off and retains to entitle him to any reward accruing from the suggestion. The employee's name does not appear on the suggestion itself. This, therefore, is sure to be considered on its own merits whether it comes from the general manager or from a truck boy who has a bright idea.

It was found that many of the suggestions are never claimed by their originators even though they may have a reward attached to them. A certain number of people have made suggestions from an entirely disinterested spirit and prefer not to have their identity known even though they pass up the reward.

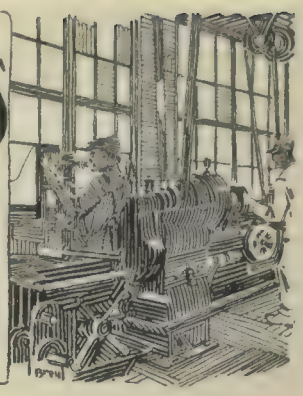
They would probably say if approached that they did not make the suggestion for the reward in it, but simply that it was time such an idea was acted upon. In other words, this illustrates the tendency of the average man to want to have things go right, apart from his own personal interest.

To call the attention of the remainder of the employees to the fact that there are suggestions unclaimed, the list of serial numbers is posted on the factory bulletin boards and if this does not clean up all the suggestions the numbers are then printed in the shop paper which goes to everyone in the plant. The management always wants to know who has made good suggestions because such are the employees who are worth developing.



MODERN PRODUCTION METHODS

By
W. P. Basset
of
Miller, Franklin, Basset & Co.



(Part VII—Continued from last week)

The next step is to develop the machine load, Fig. 35, from the schedule control. The machine load is built up to give the management a guide to hiring men selling the product and, to a certain extent, in following up purchased material. The most important function is as a guide to the selling policy for the future. If the machine load is light, it becomes a guide to the management in helping them decide what to release to the shop for making to stock for expected future sales.

It should be obvious that it is impossible to produce any more work from the shop than the primary machines can handle. If, however, the first one or two operations are performed on a tool which has surplus capacity, it is not advisable to consider this as the primary operation, but to look further on down the routing and find the first operation which is of considerable magnitude or on which there tends to be a congestion of work.

Economical manufacturing dictates that the shop demand should control the receipt of material; that is, enough material should be in the plant to keep the machine tools busy. If the factory produces solely on order and does not build ahead in dull times, the sales schedules and the machine load will tie together. If the product is standard, and the machine load does not show enough work to keep the machines busy, the management must decide whether to let the machines be idle and lose a part of the organization, or to build ahead of the sales schedule and hold the finished material in stock in expectation of future business.

The machine load, Fig. 35, shows the number of hours of work ahead of each machine. We do not, however, go so far as to develop a load on the individual machine. It is only necessary, as stated above, to pick up the load on the primary machine. If there happen to be several identical primary machines, it is possible to load the group instead of the individual machine tools.

The machine load is developed from the schedule-control graph. Thus, if the schedule control shows that, during a given week, the first operation on 500 pieces of D41-1 must be performed, and that the time on that operation is 20 hours, we note on our machine load the part number, operation number, quantity and time. We keep on adding to the machine load the various operations which are performed on each group of machines until we have each group loaded. If there is more work than capacity, what is left must be loaded onto the succeeding week. We usually like to arrange the machine load in periods of a week.

Control graphs are not made out to cover all of the orders on the books. Usually, they are not made out for more than eight weeks at the most. The machine load is made up by weeks for about six weeks in advance and taken from the control graphs. All of the orders on the books farther ahead than six weeks are figured separately by formula—(a formula of machine load is made for each type of transmission)—and is very readily made up by months for all remaining orders on the books.

The machine load taken from the control graph is a guide to the works manager or superintendent for the manning of his shop. The burden thus taken off is a prophecy and is therefore not absolutely accurate, having a probable 10 per cent error. Even so, it guides the man power in a department with sufficient accuracy so that there is not the tendency to keep full crews on when it will be weeks before there is a full load on the machines of the department in question.

The machine load taken from the balance of orders is a guide to the sales department only. This being a prophecy into more distant future, it has correspondingly increased chance for error. As it is used, however, for an influence on rather broad sales effort, the need for accuracy is less.

It is easy to see that to assign a delivery date for new work, it is merely necessary to run through the machine load record to see when there will be time available for starting new work. For example, if all of the machines—except one set, which is loaded completely—will have available time in September, and

WCAo. MD130

MACHINE LOAD

Period_____

Department _____

Machine 204-306-777					Time Available 180 Hrs.	Machine 68-77-21-10					Time Available 200 Hrs.	Machine					Time Available ..... Hrs.	Machine					Time Available ..... Hrs.	Machine					Time Available ..... Hrs.
Part Number	Series	Operation	Quantity	Time	Balance Time	Part Number	Series	Operation	Quantity	Time	Balance Time	Part Number	Series	Operation	Quantity	Time	Balance Time	Part Number	Series	Operation	Quantity	Time	Balance Time	Part Number	Series	Operation	Quantity	Time	Balance Time
D41-1		1	500	20.0		D41-1		4	500	40.0																			
		3	500	30.0		D42-17		6	500	87.6																			
D41-6		2	500	27.5		D17-6		2	1000	67.1	5.3																		
		3	500	67.0	10.5																								

FIG. 35. MACHINE-LOAD RECORD

ROUGH STOCK DELIVERY REQUIREMENTS

The Purchasing Department will get the following parts into the plant before the week indicated.

PART No.	USE		Week Starting 4/3	O/S	Week Starting 4/10	O/S	Week Starting 4/17	O/S	Week Starting 4/24	O/S	Week Starting 5/1	O/S	Week Starting 4/7	O/S	Week Starting 4/14	O/S	Week Starting 4/21	O/S	Week Starting 4/28	O/S	Week Starting 5/5	O/S
D41-1		Quantity Needed											500		500		500		500		500	
		Rough Stock																				
D41-2		Quantity Needed											500		500		1000		500		500	
		Rough Stock																				
D41-4		Quantity Needed													500		500		500		500	
		Rough Stock																				
D30-5	D22-5	Quantity Needed							500	O	500		1000		500							
		Rough Stock																				
		Quantity Needed																				
		Rough Stock																				
		Quantity Needed	S																			
		Rough Stock																				
D41-1		Quantity Needed											500	O	500	S	500	O	500	O	500	
		Rough Stock											600		100		1500		1000		500	
D41-2		Quantity Needed											500	O	500	O	500	O	500	O	500	
		Rough Stock											1500		2000		1500		1000		500	
D41-4		Quantity Needed													500		500		500		500	
		Rough Stock													500		500		500		500	
D30-5	D22-5	Quantity Needed							500	S	500		1000		500							
		Rough Stock							0		1000		1000		500							
		Quantity Needed																				
		Rough Stock																				
		Quantity Needed																				

FIG. 36. ROUGH-STOCK DELIVERY REQUIREMENTS

an inquiry includes parts which must pass through the heavily loaded machines, the plant can not take on that order until it has completed the existing work on the heavily loaded group.

In such an event, the management may decide to set back the delivery dates on the prior orders, in order to take on the new work. Or perhaps it can "farm" the extra work out to some neighboring concern that is not busy. In any event the decision is an intelligent one, based on the information given by the machine-load record.

Machine Load a Guide for Purchasing

Let us now see how the machine load is a guide for purchasing. From the schedule-control graph, we know just what date each part must be started in process. These are, of course, the limiting dates for receiving the raw materials. In order to obtain the material when it is needed, the purchasing department must be informed sufficiently far in advance to be able to get this material into the shop. To this end the planning department sends to the purchasing department the rough stock delivery requirements, Fig. 36. Market and plant conditions must govern, but, as a rule, we have found it advisable to tell the purchasing department what raw material the shop will need at least eight weeks in advance.

At the left of the form, Fig. 36, are placed the part numbers which are shown to be required by the machine load. If a required part is made up from some other part, the part from which it is made is indicated in the second column. The different weeks in which this material must be brought in are indicated under "week starting."

The line called "quantity needed" shows the total quantity of raw material which should be brought into the shop during that week, as shown by the machine load. "Rough stock" shows the quantity of stock already on hand. Each week, this form is extended to show any new orders received, in order to keep the purchasing department in close touch with requirements. If the rough-stores quantity is greater than the quantity needed, a letter "O" indicating "overage" is placed in the column headed O/S. If the rough stock available is less than the quantity needed, a letter "S," denoting shortage, is placed in the same column instead of the "O." When additional stock is received, if the quantity is great enough to overcome the shortage in any given week, a letter "O" is placed around the "S" indicating that the shop is covered to that point, and any balance that is left is applied against the succeeding weeks, until it is exhausted.

Now we are at the point where we want to lay out a schedule of the work on the individual machines. This is done graphically on the machine schedule, Fig. 37, from the information furnished on the production routing sheet.

Opposite the number of each machine in a department is drawn a line showing the length of time each series of parts will be on the machine. It is really but a detail of the schedule-control graph for the latter schedules simply as to operations, while the former specifically assigns the work to a definite machine. This record is kept in the central planning department and the actual performance is entered on it daily, as will be explained later, so that future assignments can be adjusted to today's performance.

The Machine Schedule

The machine schedule is laid out to cover one or two weeks. On the left-hand side are listed the numbers of all machine tools in the department. The distance between two vertical lines represents an hour of elapsed time.

From the production routing sheet for parts D41-1&2, the schedule man notes that the time required for operation 1 is two hours per lot, or 20 hours per series. He sees also from his routing that it is possible to perform this operation on machines 204, 206 or 227. He notes from his machine schedule that machine 204 will be available at 8 o'clock Monday morning, machine 206 at 12 o'clock Monday noon and machine 227 at about 10 o'clock Thursday morning. He might decide to schedule his work on the first two machines so as to bring out his 10 lots at about the same time, or he might schedule the operation altogether on either machine 204 or 206. Let us assume that he decides to schedule it all on 206. His first step is to draw a

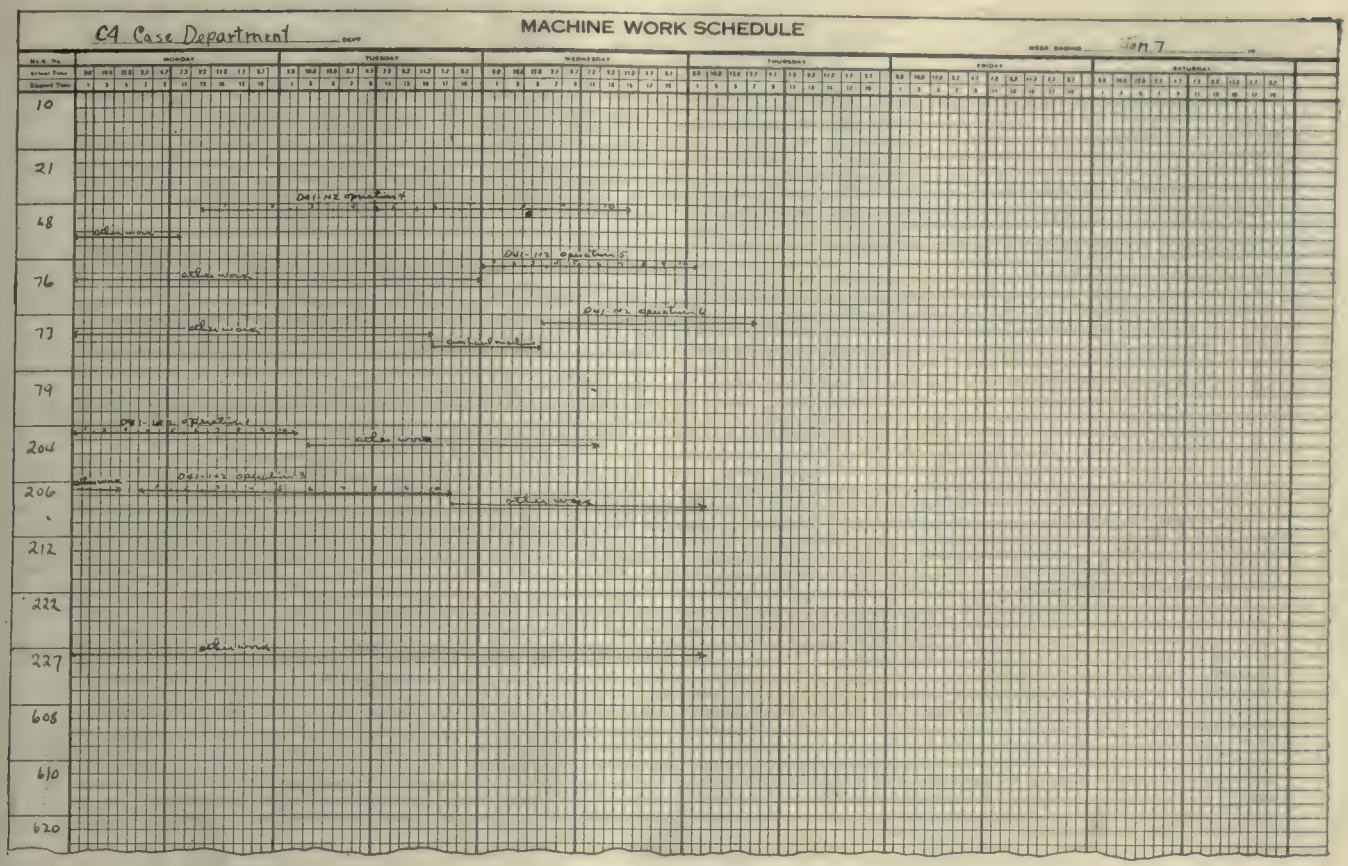


FIG. 37. MACHINE WORK SCHEDULE

line enough over 20 hours long to cover the set-up. This line he marks off to indicate the lots. Over this line he writes part, lot and operation number, and so on, for each of the ten lots. It is advisable, on the machine schedule, not to attempt to schedule more than three days ahead, because conditions will arise in the shop such as machines being down for repairs, operators being off, and the hundred and one ailments to which a machine shop is heir, and which are liable to disrupt any plans.

After having scheduled the work on the first operation, if the second should start immediately, the first lot should be scheduled in on the machine required, leaving a lapse of six to ten hours between the time it should finish on the first and when it should start on the second, to allow for inspections and trucking between operations.

After drawing in the line representing the first lot on operation 1, the machine on which operation 2 is to be done should be noted, below the right-hand end of the line, and when operation 2 on the same lot is scheduled and drawn in, a red check should be put against the first operation. By means of this check-mark it is possible, by looking over a schedule sheet after it is supposed to be completed, to tell whether all lots have been carried forward, and no sheet should be discarded until all lots are checked in order to make sure that none are dropped. If this were not done, an important lot might become sidetracked and not worked on for weeks.

When the schedule man schedules the last operation in his department he passes the tickets for all following operations on to the man scheduling the next operation, with a note as to the approximate time when the parts should reach the next department. This gives the next schedule man an advance notice of work that is on the way to his department, and so allows him to prepare to receive it when it arrives. The first schedule man will also ask the second what machines the work will go onto in his department and will then place this machine number on the move order and service card.

Advantage in Keeping Machines Busy

The purpose of the machine schedule is to keep the fewest possible number of machines busy all of the time and still keep ahead of the schedule of work. It is much better to have five machines busy all of the time than six most of the time, as the operators are kept more contented by means of it.

Where there are several machines close together on any one of which the same operator can work and on which the operations are generally very short, the machines may be taken together and scheduled as a group. In scheduling for a group, place the machines on the schedule sheet the same as before, but note in a bracket down the side by the machine numbers that they comprise a group. In drawing in work, no attention is paid to which machine will probably run it, but each one is loaded in turn until all work to be done is taken care of. If there were four machines in a group one might show as having no work scheduled to it at any time, but still might actually be used all of the time and some other one be the idle one.

The schedule man should keep close watch on the amount of idle time in his department and should make recommendations as to the taking on and letting off of men or as to the advisability of working overtime.

We have now determined when we shall start our work and have made sure that the raw material will be in the plant in time. Really, the next logical step is

to show how the progress of the various parts from rough stores through the shop is controlled until they arrive in a completed state in the finished stock. But that is a subject which can best be described separately and so will be discussed in the next article. There are a few other activities in the way of control which are handled by the central planning department. So, while the records of this department are fresh in the reader's mind, we shall jump ahead a bit and show how this central control is exercised.

So far we have shown how the schedule-control graph and other records of the central planning department are used to plan—that is to foresee—work and needs. It is also necessary to record the actual progress of the work in the shop.

When an operation on any part is completed the central planning department is notified by a copy of the workman's service card and that information is noted on the graph.

This is done by placing a large headed pin at the first dot on the first operation, or on whatever operation or lot the service card calls for.

If on any date all of the pins for the parts of an assembly are ahead of that day's line, all is going smoothly on that particular assembly. But if some of the pins are several days ahead of the line, and the rest are lagging from five to twenty days behind, an effort should be made to bring the laggards up. If any of the parts which are behind can be done on the machines that are doing the operations on the parts which are ahead, the schedule man should divert these machines to the slow-moving parts, in order to bring them up even with the others. Balanced production is what the schedule control aims to give, and if it even appears impossible to make the assigned date for an assembly, the production man must remember that it is far more important to have all the parts come out at the same time, even though a few days late, than to have 90 per cent arrive on time and 10 per cent fifteen days later. It is finished assemblies we really want—not finished parts.

After the information on the service card has been reflected on the schedule control, the next step is to post the information it contains on the operation check sheet, Fig. 38. This operation check sheet is really an analysis of the work in process in the shop. Not only does it give quantities but it also shows which lots are lagging and which are moving ahead. It is also used by the production manager to keep track of the operating end, so that he can see whether or not the different operations are being performed in the proper time.

The third use of the service card is to keep up to date the production stock and demand record. All pieces that are not good are entered as rejected, the final classification and disposition of these pieces, whether scrap or reclaimed, being reported by the salvage department. The service card is next used by the schedule man to ascertain the total time that the job has taken.

When the first operation is done and the report comes to the machine schedule on the white service card, the line denoting the corresponding operation will be checked off in blue and the time actually used in doing the operation will be drawn in on the schedule at the point where it occurred. This shows the schedule man the degree of efficiency of that job and if the time taken is over 10 per cent greater than the time allowed, it is reported to the general foreman in charge of that division who investigates the matter immediately.

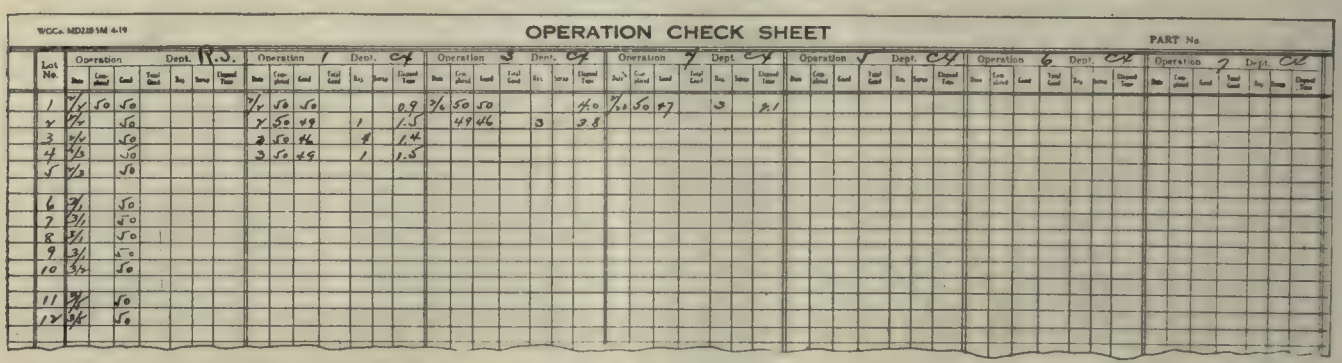


FIG. 38. CHECK SHEET

The white copies of service cards for completed operations are brought in to the schedule man at least every half hour.

These copies keep him in very close touch with his department. The operation is checked, as frequently the lot will be worked on several hours or even days away from the time it is scheduled and as a result it might be difficult to find which lots were done or yet to be worked on.

The machine schedule man thus can keep ahead of the shifts in scheduling, which becomes necessary when the work in the shop—as invariably happens—varies from the standard or estimated time given on the machine schedule. This does not mean that he has to go back and change what he has already done, but means that he can—in scheduling another day's work—observe how departure from the standard for the last few days will affect his future plans.

We have now seen how the central planning department lays out the work for the shop, and how it checks up to make sure that the shop lives up to schedule. But plans, no matter how good, are worthless unless they are executed, and many planning systems fail because the plans of the somewhat remote central department are not followed by the shop. How the planning is carried to the men in the shop will be described in the next article.

Fixed Habits of Thought

A lady on being told how easily (?) the metric system could be learned replied, "I do not believe I could ever learn the meter, so as to think of it other than as 1 yard 3 inches and a little more."

Are You a "Before-and-After" or a "Single-Track" Man?

By HERMAN L. WITTSTEIN
Works Manager, The Chapman Valve Manufacturing Company, Indian Orchard, Mass.

The method which was employed in solving a problem encountered in the shop is the subject of this article. The author shows both the right and the wrong way of attacking a problem, and he emphasizes the importance of making a thorough analysis before rendering a decision as to the solution.

ONE of the chief difficulties I have experienced with the average man, be he shop mechanic, foreman or clerk, is due largely to the fact that he is not a "before-and-after," but a "single-track" man. By "before-and-after" I mean a man who has perspective, who analyzes conditions both leading up to and subsequent to a difficulty—a man who does not lose sight of the whole in too close a scrutiny of a small integral portion of it. Your "single-track" man sees the difficulty and, without hesitation, sails right in to overcome it—hammering away with one idea only in mind. He jumps to conclusions quickly, and the great difficulty seems to be in getting him to stand off and study his problem from all angles. In a good many cases it is much better and cheaper to go around than to go through.

To illustrate the foregoing, we recently experienced considerable trouble due to an abnormally large percentage of rejections in the testing of brass gate valves of the type illustrated in Fig. 1. Too many of these valves, all sizes, were failing to pass the test on account of leakage at the joint *A* between the cap and body. The manner of testing was to apply pressure on one side of the closed gate, and note whether there was any leakage past the gate *B* or at the joint *A*. There was no trouble in obtaining a tight job on the gate, but a very large percentage of the valves were rejected as "leakers" at *A*. Our "single-track" man started right in hammering away at the threading of the cap—in his judgment this was the whole source of the trouble. As was found later the threading had nothing whatever to do with it. He went right ahead, however, trying solid dies and self-opening dies and in every conceivable manner attempting to improve something which needed no improvement.

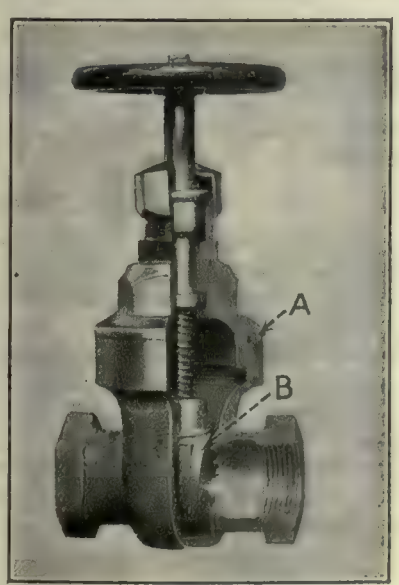


FIG. 1. BRASS GATE VALVE, SHOWING POINTS OF POSSIBLE LEAKAGE

When the matter was finally brought to the writer's attention the "single-track" man was instructed to check up very carefully each operation of both the body and cap.

No defect was found in the body; but the trouble

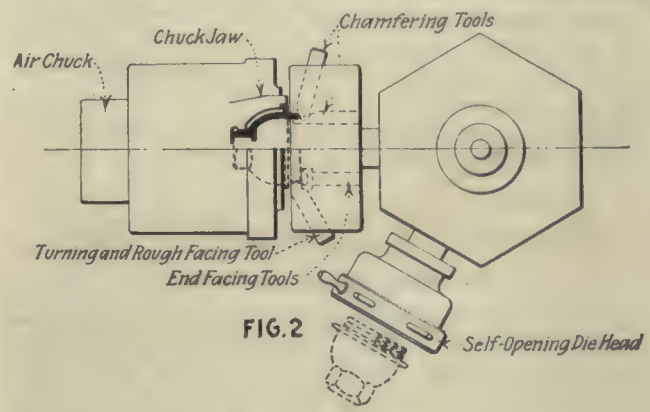


FIG. 2

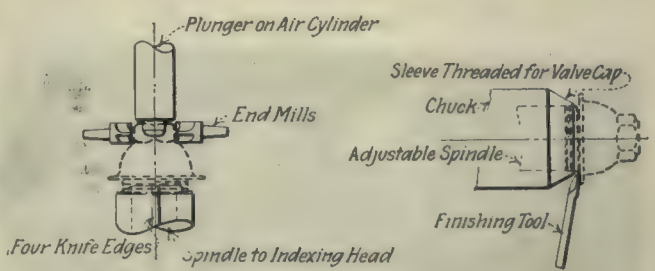


FIG. 3 FIG. 4

FIGS. 2 TO 4. MACHINING OPERATIONS ON THE VALVE CAP

Fig. 2—Method of machining the flange. Fig. 3—Milling the nut. Fig. 4—Finishing the flange face, before the trouble was analyzed.

was very quickly located in the cap, with the result that it was immediately cured. The percentage of "leakers" was reduced to a negligible number, and at the same time an operation was eliminated, thereby reducing the cost of manufacture.

Sequence of Operations

Figs. 2, 3 and 4 show the sequence of operations used before the trouble was analyzed for finishing the flange on the cap. It will be seen in Fig. 2, that one tool *C* turned the diameter, which was later threaded, and also rough faced the flange which formed the joint. Fig. 3 shows the next operation, the cap being held against the knife edges while the faces of the nut were milled. If the knife edges were not properly set or were so broken as to burr the lower face of the cap, the latter would not set true when screwed into the chuck against the adjustable plunger for the finishing operation shown in Fig. 4. This caused angularity in the facing of the flange and consequently a poor fit at the joint *A* (Fig. 1) when the cap and the body were assembled.

It was decided to finish face the cap at the first operation instead of roughing it, Fig. 2, and to eliminate entirely the operation shown in Fig. 4. While this takes slightly longer than the operation of rough turning, and there is a little more frequent grinding of the tool *C*, there has been a marked saving in the cost of machining the caps, to say nothing of the elimination of the previous disassembling and salvage cost of "leakers."

This was a perfect solution of the problem, the trouble lying "after" the point where the "single-track" man made his attack. He is now a confirmed "before-and-after" man.

I have seen so many similar cases where the trouble has been either before or after the point of attack that I cannot emphasize too strongly this general principle of procedure.

Develop perspective—it saves time and money. Be a "before-and-after" man.

Some Small Railroad Shop Devices

EDITORIAL CORRESPONDENCE

Although the Savannah shops of the Central Railroad of Georgia are not large, they handle considerable work and contain a number of interesting devices. In common with practically all railroad shops, the equipment is not modern in many ways although it has a few fairly up-to-date machines.



FIG. 1. PORTABLE OIL HEATING FURNACES

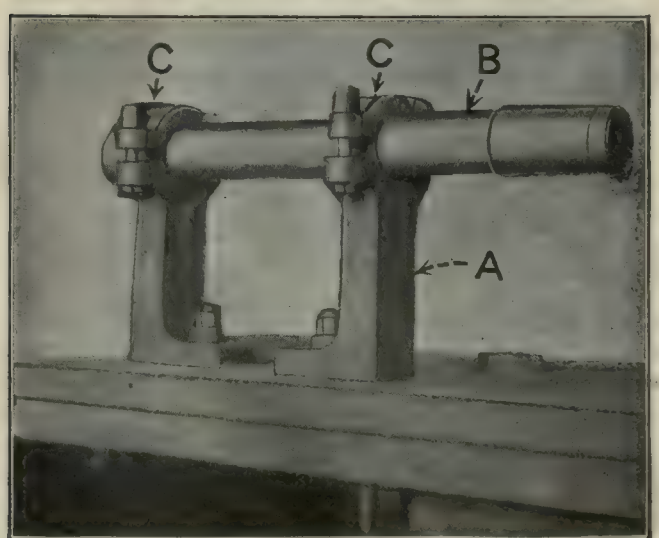


FIG. 2. MANDREL FOR PLANING CROSS-HEADS

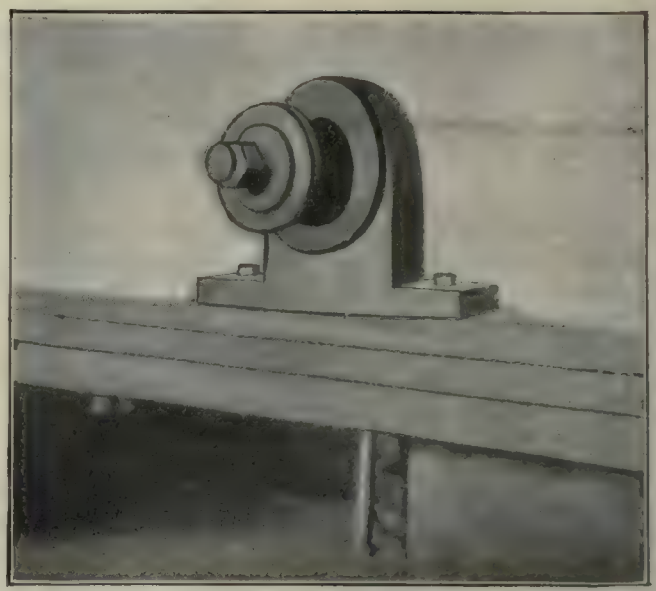


FIG. 3. MANDREL FOR PLANING ROD BRASSES

Among the special equipment noted was the portable oil heating-apparatus for use in connection with the removing and replacing of tires on locomotive drivers and also for other purposes where heat was necessary in isolated places. Fig. 1 shows two forms of the portable furnace used, the main difference being in the kind of wheels provided and in their load carrying frames.

These devices simply convert the fuel oil carried in

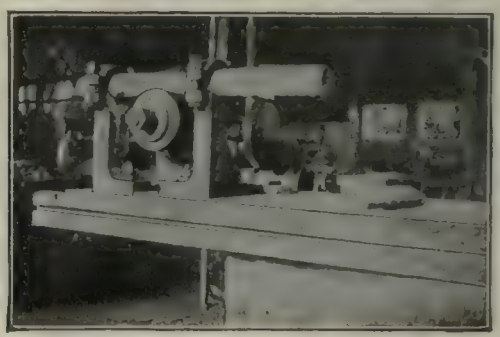


FIG. 4. THE TWO MANDRELS OUT OF USE

the tanks *A* into a gas by means of the regenerating or gassifying furnaces *B*. From here the gas is piped either to the tire heaters or used in any way that may be desired.

TWO INTERESTING PLANING FIXTURES

The machine shop contained two interesting planing fixtures which are shown in Figs. 2 and 3. The first is used for planing crossheads so as to insure the sliding surfaces being parallel with the piston rod and also an equal distance from it. This consists of a framework *A*, which carries the mandrel *B*, the projecting end of the mandrel being turned to the same taper as the piston-rod fit in the crosshead. The crosshead is simply mounted on this as though it were a piston rod and the upper surface planed. By loosening the clamping bolts *C*, the mandrel is turned 180 deg. and the other side of the crosshead planed in the same manner.

The other mandrel shown in Fig. 3 is for planing connecting-rod brasses. The brasses are first bored and then clamped on the mandrel shown, suitable bushings being used to fit the brass and insure the box being held

centrally. The box can then be easily turned so as to present all four sides for planing.

These are simple fixtures which answer their purposes admirably and they are kept at the end of the planer table, as shown in Fig. 4, so as to be always ready when wanted. Master Mechanic S. A. Whitehurst and Foreman G. C. Shivers keep things moving as well as possible with the facilities available.

Washing Ball Bearings

By E. A. Dixie

The caption for this article should have been "Washer for Ball Bearings" but as it might have been imagined that I meant a round flat thing with a hole in it instead of a very ingenious little device for washing them, the title was altered to what it now is.

The spindle of the Taylor & Fenn bore-grinding machine runs in ball bearings. Anyone who has handled

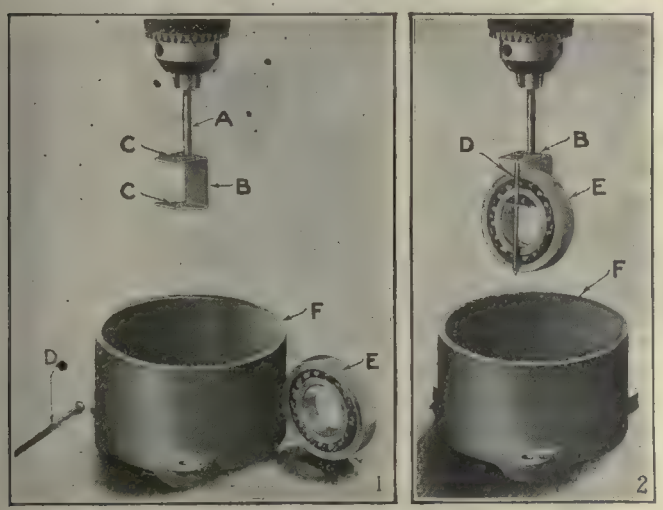


FIG. 1. THE BALL BEARING WASHING OUTFIT
FIG. 2. BEARING IN PLACE IN THE FIXTURE

ball bearings as they come from the factory knows that they come filled full of vaseline. The high-speed spindle of a bore-grinding machine must be mounted as nearly rigid as it can be so far as any shake is concerned, but it must run as freely as it is possible to make it run.

During the operation of assembling the spindle in its housing, dust and other foreign matter is almost sure to get into the bearings where their presence is detected by the binding of the spindle when in certain positions. When dust does get into a bearing of this sort the only thing to do is to thoroughly clean out everything in it, including the vaseline. This is a tedious job and takes a lot more time than one would imagine. After having washed out a number in the old tedious way, the young Scotsman who has charge of assembling the spindle units decided that it was taking far too much time, so he devised the simple little washer shown in Figs. 1 and 2, which is used in conjunction with a sensitive drilling machine.

The shank *A*, Fig. 1, is a piece of ¼-in. drill rod about 4 in. long. Riveted to this is the bent piece of cold rolled flat steel *B*. It will be observed that there are two holes *C* about ⅛-in. in diameter in *B*. These are a loose fit for the common wire nail *D*.

The application of the device to the washing of bearings is shown in Fig. 2. The bearing *E* is placed in the bent member *B* and the nail *D* is passed through the holes *C* to prevent the bearing from being displaced from its seat in *B* when the drilling spindle is running.

On the table of the drilling machine and under the spindle is the receptacle *F* which is filled with kerosene or gasoline. With the spindle of the drilling machine in motion the rotating bearing is lowered into the liquid in *F*. This not only washes out all the vaseline but the dirt along with it and these heavy particles fall to the bottom of *F*.

With this simple device twenty to thirty bearings can be washed perfectly in less time than a single bearing could be done by the old method where it was often necessary to remove the balls and cage in order to make sure that every particle of dirt was removed.

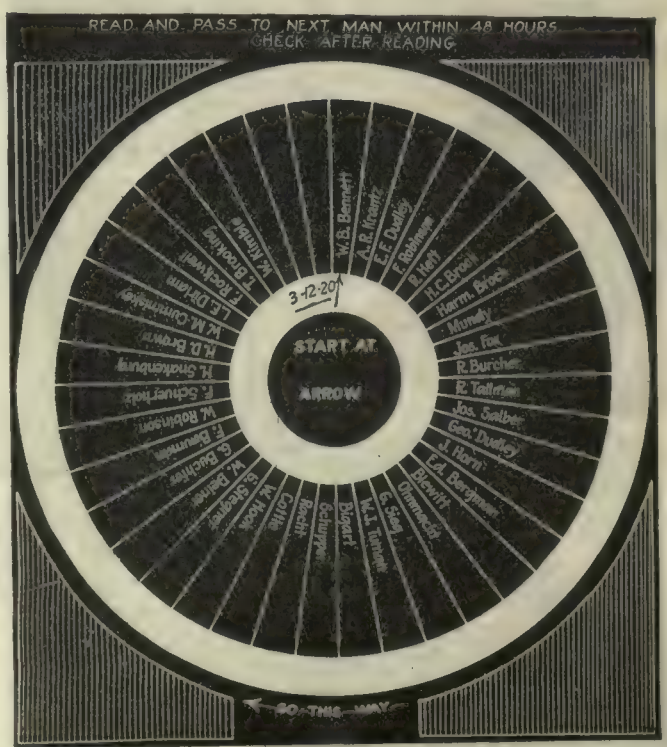
A Routing Panel

By W. B. Bennett
President Wayne Engineering Works

In your issue of March 4 the writer noticed, at the top of the cover, the following: "Are you using the routing panel? It's on the Contents page." Noting the way you have arranged this panel we thought you would perhaps be interested in our method, which has been in use in this plant for over a year.

The sketch reproduces one of the blueprint sheets that we attach to every magazine or catalog which is received here and which we think will be of interest to various employees. Previous to making out these sheets we made a canvass of every department and found out the names of those men who would be interested and who would read the periodicals in question. Thus the sheet we are sending you is representative of a department.

In a way it is more flexible than your list, because the individual who receives and issues the magazines can determine the proper name to start with, with reference to its importance. For example: if there



ROUTING PANEL

are several important items which would be valuable to a foreman or gang boss at an earlier time than to some other workman, the magazine is first directed to him.

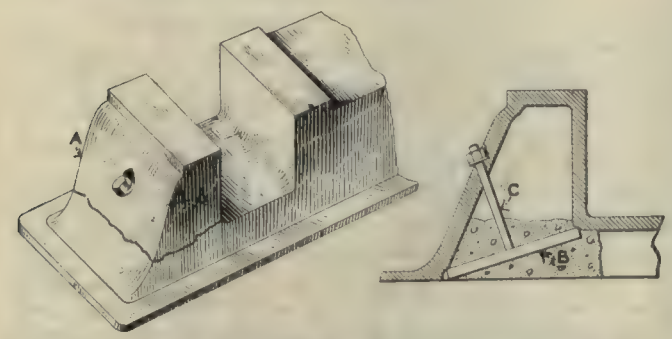
The round white border is reserved for checking off. When the list is complete the magazine is returned to the planning office where the reading matter is cut out and properly filed.

The credit for this design belongs entirely to our Chief Engineer, Mr. William Cummiskey.

Repairing an Air Compressor

By Frank C. Hudson

The illustration shows a pillow block on an air compressor which parted along the broken line, just when it was needed to keep up the air service for pneumatic tools and other work in the shop.



HOW THE PILLOW BLOCK WAS REPAIRED

Getting a new bed within three months was out of the question and the compressor was needed every minute.

The broken part *A* was taken out, and a plate *B* was made to go inside the cored space in the pillow block. The stud or double-threaded bolt *C* was next made of the proper length to reach up through the broken part *A*, which was then drilled for the bolt and spot faced for a collar or washer under the nut.

Locating the plate *B* in its proper position, the plate and stud were grouted into position with some concrete mixed to flow freely. After this was poured, the broken part was put back with the upper end of the stud through the hole drilled for it.

When the concrete had thoroughly hardened the collar and nut were put in place and the broken part drawn down into place. The shape of the break helped to hold it in place and it has now been used for about two years with no sign of giving way.

Theory (Calculation) vs. Use

In discussing the pros and cons of the metric question, it has been aptly said that the pros are represented by the *pro*fessors and the cons by the *con*structors.

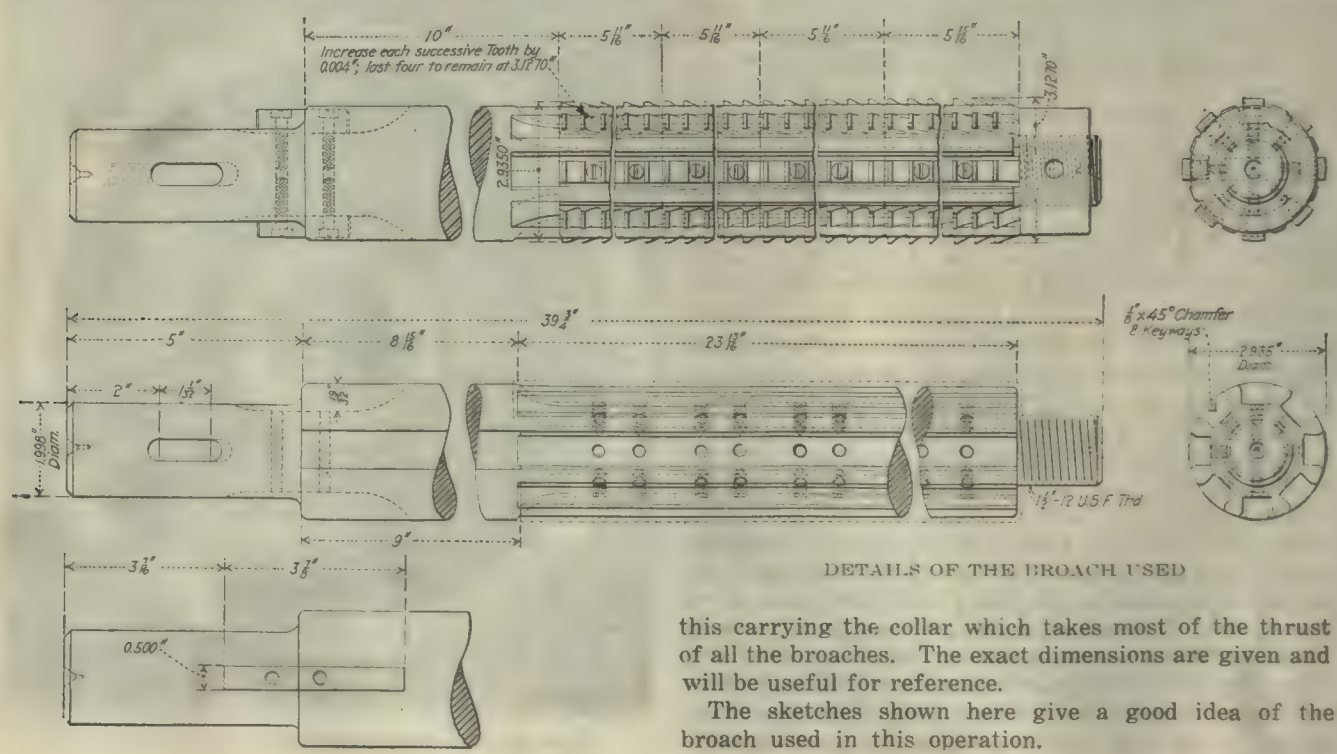
Broach for Airplane-Propeller Hub

By I. B. Rich

Definite information in regard to broaches of fairly large size is not always available, this being particularly true of broaches having sectional teeth.

The broach illustrated herewith shows the practice of the Lincoln Motor Co. in making the splines in the Liberty motor propeller hub which has to be a close fit. The body is of machine steel, carbonized and hardened, the eight slots being chamfered $\frac{1}{8}$ in. and at 45 deg in order to leave grooves between the sides of the inserted cutters and the body. Allowance is made for grinding after the body is hardened, in this way taking out what little distortion may be due to spring.

The broaches are in four sections as can be seen, and it will also be noted that the tooth diameter is increased by regular increments of 0.004 in. from 2.935 to 3.127 in. The last four teeth are left the same size. The end of the broach has a 1.5-in. thread, 12 pitch, U.S.F.,



DETAILS OF THE BROACH USED

this carrying the collar which takes most of the thrust of all the broaches. The exact dimensions are given and will be useful for reference.

The sketches shown here give a good idea of the broach used in this operation.



The Evolution of the Workshop—X

By H. H. MANCHESTER

After the English colonists had introduced the art of metal working into America the colonies began to develop rapidly along industrial lines. The growth and development of the system of workshops tells an interesting story of the enterprise and genius which characterized the citizens of the new country. This article treats of the metal-working industry in America up to 1810.

(Part IX was published in our June 3 issue.)

BEFORE the discovery of America by Columbus the Indians knew nothing about working iron. The Aztecs of Mexico and the Incas of Peru were quite skilled in the handling of gold, silver and copper, and in what is now the United States the aborigines valued copper so highly that runners were sometimes sent a thousand miles to obtain a little of it, but they employed only the simplest tools. Fig. 61 shows the first picture of an American workshop which was printed, the explorer Benzoni being credited with the making of it.

The first attempts to work iron in the United States seem to have been made in Virginia by the European colonists. In 1585 Raleigh's expedition reported having discovered iron ore there, and according to a statement of the time by Francis Maguel there was an attempt to manufacture iron in that colony in 1610, only three years after the founding of Jamestown. The settlers started to build a furnace on Falling Creek in 1619, but it was destroyed in the massacre of 1622.



FIG. 61. THE EARLIEST PICTURE MADE OF A WORKSHOP IN AMERICA, PERUVIAN OR INCA METAL WORKERS FROM BENZONI, 1565

At that period the colonists were keen to discover iron ore because the forests of England were giving out and the only known fuel for smelting was charcoal or wood. In Massachusetts a monopoly for smelting was temporarily granted as early as 1641, and Saugus bog ore was mentioned in 1642. The first iron works there seem to have been begun at Lynn about 1644.

In 1646 probably the first patent to an American machinist was given to Joseph Jenks for an improved scythe and edged tools and a more efficient mill with which to make them. The improvement in the scythe was simply an added thickness to the back of the blade which permitted it to be increased in length. In 1652 Jenks made dies for the new mint, two years later a fire engine for Boston, and in 1667 he was loaned by the colony a set of tools for drawing wire.

The first slitting mill in America seems to have been set up at Milton, Mass., by 1650, not so many years later than such mills were first introduced into England. Soon afterward there was one at Middleboro and two in Hanover. By this date the colony had also a steel furnace, and a plating forge with a tilt hammer. In 1710 another slitting mill was started by Jackson in Dorchester, and a foundry by Joseph Mallinson at Duxbury. A mill for grinding scythes was set up at Andover in 1715, and in 1720 Nathaniel Ayres began heavy forging at Boston. In 1732 there were six furnaces and nineteen forges in New England. At Bridgewater, Mass., Hugh Orr began

the manufacture of edged tools with the aid of a trip hammer in 1738, and ten years later made 5,000 stand of arms for the province.

In 1750 Parliament forbade the importation of machinery or even of skilled machinists into the colonies, and did all it could to discourage American manufac-

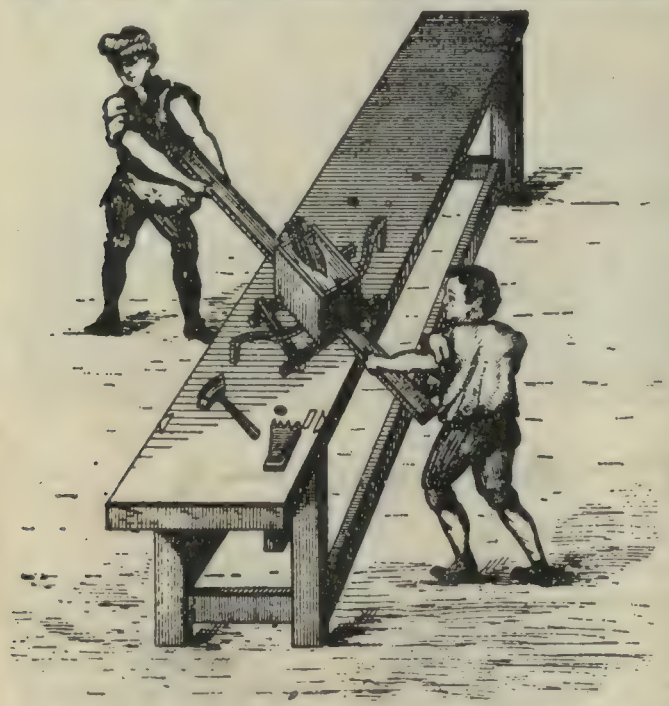


FIG. 62. A PLANING MACHINE IN THE U. S., 1775

tures. This law was based on the prevalent "mercantile theory" of political economy that the colonies should supply the raw materials and the mother country the manufactures. At any rate the law did much to retard the development of the machine shop in the colonies.

Many of the devices and machines which were developed at this time were for the cutting of wood, some of them being shown by Figs. 62, 63 and 64; but they furnished the experience necessary for the building later of metal-working machinery.

In 1775 Nathaniel Niles of Norwich began to manufacture iron wire to be used in cards for wool, and two years later Oliver Evans of Philadelphia constructed a machine to make such cards.

One industry which originated in America was that of cut nails. As early as 1775 Jeremiah Wilkinson of Cumberland, Rhode Island, was cutting out small tacks and nails and forming the heads in a vise. Other machines for nail cutting were designed by Ezekial Reed in 1786, who lived at Bridgewater, Mass., and by Samuel Briggs of Philadelphia in 1789. Briggs' patent was a general one for nail, screw and gimlet machinery, and the first one of that scope. Probably the most important of the early nail manufacturers was Jacob Perkins, who in 1790 established at Newburyport a mill for both cutting and heading nails by machinery. In the next decade there were twenty-three patents taken out in this field.

In 1790 Samuel Slater and Sylvanus Brown built the first cotton mills in America at Pawtucket, R. I. It has been declared that in constructing the machinery according to Slater's designs, Brown invented a slide lathe. If this has not been exaggerated, it is important, for the date is earlier than that assigned to Maudslay's slide rest. The earliest reference, however, which the writer has been able to find on the question dates from 1866, and is in a "Historical Sketch of the Town of Pawtucket," by the Reverened Messana Goodrich. It reads, "As early as 1791, therefore, he (Sylvanus Brown) invented a slide lathe for turning rollers, spindles and like articles; and followed it with an invention for fluting and planing rollers." Goodrich gives no proof, and as it stands this is altogether too slight authority to be convincing.

There is no doubt, nevertheless, that David Wilkinson, who worked on the machinery for the second Slater mill, had constructed a slide lathe before 1798, for he received a patent for it in that year. Fifty years later, Congress voted him a reward of $10,000 for his invention. His lathe was applied to screw cutting and later operated by water-power at Pawtucket.

In his famous "Report on Manufactures" Hamilton stated that water power was used to make spikes and nails, but added that this was also an industry carried on largely at home. In 1797 Benjamin Seymour invented some rollers for slitting mills. The next year Robert McKean took out a patent applying steam power to saw mills.

Beginning of the System of Interchangeable Parts

Eli Whitney, who was getting little return for his epoch-making invention for ginning cotton, in 1798 signed a contract to manufacture 10,000 stand of muskets for the government. He expected to do this in two years, but it was ten years before the contract was completed. A very important point about his work was that he attempted to make the parts interchangeable, and to do so, built or invented machines to produce the parts in order to have them more accurate and uniform. Thus the idea of fabrication in quantities rather than finishing piece by piece was, so far as practical application goes, born in America. When this method was later tried in Europe, it long continued to be known as the "American system."

A planing machine was patented by John Bennock in 1805, and the next year a method of welding iron and steel by Daniel Pettibone. In 1807 Jesse Reed of Boston patented an important machine for cutting and heading nails at one operation, Fig. 65 being a reproduction of an

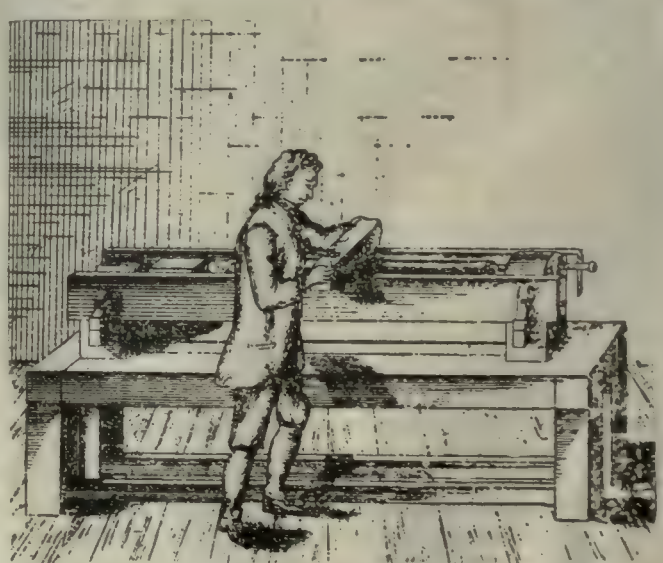


FIG. 63. A MOLDING MACHINE IN THE U. S., 1775

old print of the machine. Two years later fifty-two of his machines were said to be in service in the United States.

The first fairly complete conception of the industries of the country which dealt with iron and other metals is given by the reports of the United States marshals that were made for the census of 1810. On the one hand these are incomplete and on the other they include among manufactures, products which were made in the homes, but this was at the time a highly considered method of manufacture.

The largest number of forges was in Pennsylvania, which had 78, producing 10,969 tons of iron with a value of $1,156,405. New York, Connecticut, Massachusetts and Virginia followed in the order named. The incomplete returns of the country listed 329 in all, and there were undoubtedly a number of others. Vermont, which with 26 forges ranked fifth, had the largest number of trip hammers, 65, at work, with Pennsylvania, New York, New Hampshire, Rhode Island and Connecticut all having above thirty. There were 316 in all in the no doubt imperfect lists sent in by the marshals.

There were 42 rolling and slitting mills enumerated in the country. Of these Pennsylvania had 18, producing 4,502 tons of rolled iron and 98 tons of slit iron. The value of their combined products was given as $606,426. In this field Massachusetts was a bad second with only five such mills.

Importance of the Nail Industry

The most important metal manufacture of the country was undoubtedly nails. The marshals listed 446 naileries, and a great many were produced in private families. The leading state in nail fabrication was Pennsylvania, where there were 175 factories producing 7,270,825 pounds of nails with a value of $760,862. Massachusetts with only 36 nail mills was a close second in the value of the product, while Vermont with 67 nail makers make only $34,560 worth, which suggests that the work there was carried on chiefly in blacksmith shops or at the home. Ranked according to the value of the nails produced, New York was third, Maryland fourth and New Jersey fifth. The industry had even spread beyond the mountains, for the eastern district of Tennessee, though noting only four nail mills, claimed a production worth $104,406. There were also naileries in Ohio, Kentucky, the western district of Tennessee and Indiana.

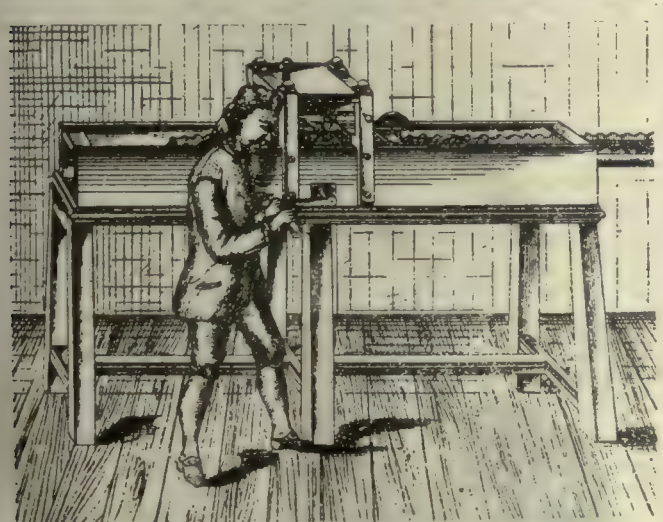


FIG. 64. DRESSING BALUSTERS IN THE U. S., 1775

The marshal of Massachusetts reported a manufacture of guns worth $229,085, without giving the number of the shops. Pennsylvania listed 115 gunsmiths and a production valued at $176,370. In this industry Virginia, Connecticut and the eastern district of Tennessee followed as named.

Pennsylvania had three boring mills, two saw factories, six wire works, 111 cutlers, four plane makers,

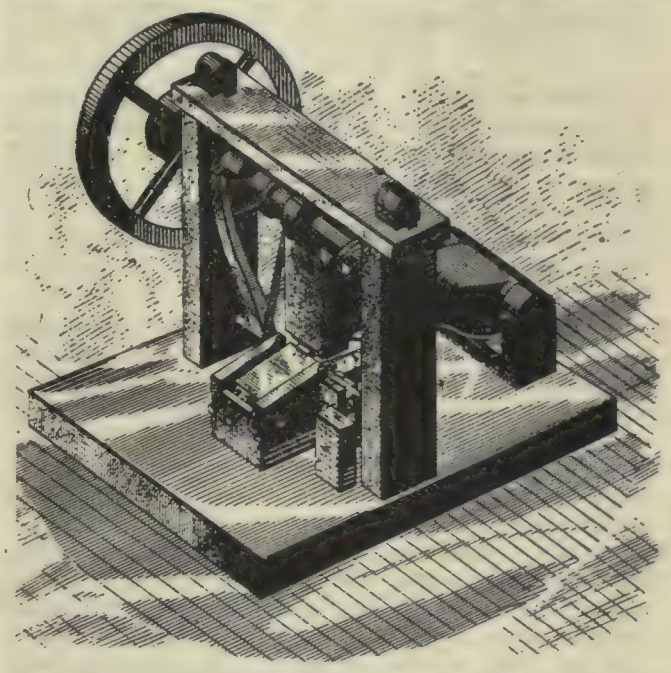


FIG. 65. A NAIL-CUTTING MACHINE IN THE U. S., 1810

one file factory, and two flatiron mills, while the marshals of the other states fail to mention these industries particularly. Pennsylvania and New Jersey each mention a wire-drawing mill. Massachusetts manufactured eleven million tacks with a value of $2,000. Door-lock factories were to be found in New Jersey and Virginia, and shops making augers in Virginia and Maine. There was one screw and spring factory in New Jersey.

Ordinary blacksmith shops were not enumerated by most of the marshals, but Pennsylvania was credited with 2,562, the value of the work done in which was estimated at $1,572,627.

There were also a number of factories dealing with copper, brass, tin and other metals or alloys. Massachusetts made products of this sort whose value was given as $225,160. Connecticut had four brass founders manufacturing $49,200 worth of ware. Rhode Island with one brass foundry produced 6,000 pounds of brass, the value of which then was $4,500. Brass clock and watch makers were mentioned in Virginia, Maryland, Vermont and Orleans, and no doubt clocks and watches were included in the brass wares produced in Connecticut. The tin plate work, which probably was for the most part merely tin smithing, was estimated as worth $139,370 in Connecticut, $91,500 in Maryland, and $73,715 in Massachusetts.

The last of the eighteenth and the first of the nineteenth century was a highly interesting period in the history of both wages and prices. It was the era of the French Revolution and Napoleonic wars, which created a great demand for both men and materials. In 1790 a skilled mechanic in the United States received about 54 cents a day, with which he could have purchased about three bushels of wheat for his week's work. At

the beginning of the century wages had reached a dollar a day with wheat fluctuating in accordance with shipping conditions, but perhaps averaging $1.25 a bushel. In 1812 wages were about $1.40 a day and wheat $1.94 a bushel. After the war wages declined to $1 a day and wheat to $1 a bushel, but the skilled mechanic could purchase twice as much for his week's work as in 1790.

Harmful Tendency in Trade Education

By B. A. Tibbab

Trade education, so far as public schools and education in general are concerned, is a comparatively new thing in education, and, like all new things, is adopted as proper by those who know and also by those who do not understand. Expense of equipment and operation have deterred some communities from entering this field, while others have spent with a too lavish hand in equipment and operation.

Between these two extremes are many and varied conditions. The question of expense of equipment and operation has been met in some places by expecting the shops to produce enough to help pay the operating expenses at least. From the business standpoint this seems perfectly feasible, yet, upon analysis, it is very much like the old, old question of serving two masters.

Let us consider it from the standpoint of the instructor: He is burdened with not only instruction and discipline, but is also charged with making a certain amount each year for the school support. Graduates are demanded, and machine product is expected. What will the poor teacher do when confronted by both demands? Which is slighted when pressure comes? Those in authority know immediately if mechanical output is reduced, though they cannot so readily note a drop in efficiency of a graduating class over that of the previous year.

Too many Boards of Education, in fact too many principals and instructors, place more emphasis upon the machine product than upon the boy. Many of those in authority do not realize that many times the boy is being sacrificed for the product, yet this is too true.

Have you ever visited the shops in your trade school? What is the boast of the instructor? What is that to which he points with the greatest pride? There are, of course, exceptions, but in many cases the photograph of the thirty speed lathes or the two hundred and fifty spindles for Blank & Co., or the hundred arbor presses being made for the Podunk Engineering Co. from their own castings and drawings, are the pride of the shop.

The harmful tendency of such work is not that it is unsuited to teach the desired principles of machine-shop practice, but rather the primary place this product has in the mind of the shop instructor and those in charge.

Here is the harmful tendency of our trade education. If we continue to place the emphasis upon the machine and the production of machines and exploit the student, then sooner or later the conditions will not be so far different from those in our factories.

In some of our schools the boy becomes as much of a producer, compared with the mechanical output of the plant, as does the boy in the factory. Is there any reason for this aside from the desire to produce a quantity of machines?

In the two hundred and fifty spindles for Blank & Co. referred to above, there is the cutting off, centering, facing, rough-turning, finish-turning, turning to shoulder, key-seating, grinding, and perhaps other operations, all of which may be given to different individuals and all of which may be divided among the class in such a way that all will receive the proper training.

Very few shops have more than one cylindrical grinding machine, which means that considerable planning must be done to give each boy some grinding. The two hundred and fifty spindles give a grand opportunity for just this training. Let each boy who has done enough elementary work to be fitted to take up the grinding machine have his turn at the job. When he becomes a producer so far as ability to handle the machine and do accurate work—from the school standpoint—in a reasonable length of time, the instructor should find something different for him to do in order that the boy may be always progressing, always learning, never being used to promote the shop or the instructor. The time for any boy to be changed from one machine or operation to another is when he becomes a producer. This should be the instructor's cue.

It has been my privilege to come in contact with many graduates from trade schoo's, first from the educational side and later from the position of the manufacturer. Boys have confessed to me that they have not had an opportunity to work upon all the varieties of machines found in the shop and had been kept upon one machine almost throughout their entire term of service. Only a few days ago, I had occasion to interview a young man who was in search of a position. I offered him a shaper job and he honestly told me that he was not able to do the work for he had never operated a shaper.

Inquiry brought out the fact that in nearly two years of work in a trade school he had not touched the shaper or planer, but had spent almost his entire time on a lathe. He had operated a milling machine some and had worked upon a drilling machine, but the major part of his time had been upon a lathe on turning jobs. He could do that work well, but I wanted a man and was willing to hire one even though he was not as experienced as the trade-school graduate was with the lathe.

The only reason that the boy could give for being kept on the lathe was that there seemed to be a lot of turning to do in the shop and he could do it faster and with less trouble to the instructor than other boys. The instructor may have had a good and sufficient reason for keeping the boy upon the turning job, but the statement certainly appeared to be an honest one from an apparently sincere boy.

I am not questioning the honesty and sincerity of any instructor, for, knowing these men as I have in the past, I know that there is a genuine endeavor to make their departments real, their work accurate and commercial, and to impart useful instruction to their classes. Noting the present tendencies, however, I cannot refrain from calling to the attention of those interested the necessity for keeping in mind the fact that the boy must not be neglected in order to make a profitable showing.

The boy must be the first consideration, but before the shop instructor can accomplish much in this direction we must have Boards of Education which will demand that their principals and instructors be something more than men with technical knowledge who have been successful in business management.

European Conditions as Affecting the American Machine-Tool Trade*

By Carl F. Dietz
Vice President, Norton Co., Worcester, Mass.

THERE are about as many opinions on industrial conditions in Europe as individuals expressing themselves thereon—even among those who had an opportunity to personally study the ground complete unity of thought is not found. It depends so very largely upon the manner of penetration, the industries visited, individuals interviewed and then on the proper analysis of this multiplicity of data.

As everywhere else in the world the demand for every commodity is beyond the ability of industries to furnish. Unlike ourselves, Europe is now mostly dependent upon imports—those imports coming largely from us.

The war left her pretty well paralyzed industrially, and only gradually will the situation right itself. Such wholesale disarrangement of industry, even omitting destruction, complete financial exhaustion and credit strain, to say nothing of morale collapse, cannot be overcome in one or two years.

Europe for the moment with the possible exception of England requires credit and requires it in very large doses. She cannot continue indefinitely to purchase more heavily than she sells, still further straining credit and depressing her currency values, without inevitably going bankrupt.

The result is that purchases from countries whose currencies are at a premium will be held down to bare necessities and the buying power directed toward the markets where advantages may be had; friend or late enemy—economic necessity will control, quite stripped of sentiment.

During the war relatively huge quantities of machine tools were shipped to England and France, some to Italy, many of which served gallantly in the production of needed war materials, but many also never saw service and with the others have since been either put to useful service in France and Belgium or cataloged and are being held for the reconstruction and needs of the destroyed industries in the war area.

Machines Ransacked by Germany Now Being Returned

When the Germans ransacked Belgium and France they did it thoroughly, not by any hit or miss method, but with a system that can leave no doubt as to their complete knowledge of the existence of every tool and its best possible service to them. Everything was ultimately either transported to Germany, or demolished, if of no direct military value. Now many of these tools are being returned—allied commissions spotting them throughout Germany and returning them whence they came.

We found one of our own grinders, one of the very early ones, machine No. 17, built in 1902, which was operated at the Bolinck plant in Brussels until June 1917, but after August 1914 by the invaders. It was then taken to Germany, set up and operated at a plant near Bonn, but now again through the activities of the allied commissions, has been returned to its original foundations and is merrily doing the same work as before the war.

This is true of many Belgian and French tools. In many cases they require considerable repairs, as in the case of this Bolinck machine. The tremendously high prices at present considered, it is economy to use as much of this material as can be salvaged until economic strength for replacement of antiquated equipment is gradually developed.

The impetus which the war has given to the machine tool industry will prompt many foreign machine tool builders to challenge the American product not only in their own countries but in foreign markets, even to a greater extent than ever before in our own domestic market.

English makers will not be content to let American products have the sway of pre-war days, but will try to meet the demand of her growing mass production industries, especially the automobile development. Through its machine-tool association, English builders will invade systematically and in force other markets worthy of development and capable of an adequate return.

Exchange Favors British

At the moment the rate of exchange favors British builders, and even if everything else were equal, the American tools are heavily handicapped with 20 per cent monetary shrinkage to carry. Wages in Great Britain have risen sharply, so that in some cases with the bonuses paid the average hourly rate is not materially different from our own, but in a large number of metal working plants the average is still a shade under 50 cents per hour (normal rate of exchange) for the whole shop force. On the other hand, it is freely admitted that the British worker does not produce as much as ours. In the automobile industry a prominent manager stated that he was actually equipping several large plants with 50 per cent larger machine-tool capacity for comparable production than he did in America.

There is in England at this time a very active demand for machine tools, and British manufacturers are indeed hard pressed to meet it. The long-drawn-out molders' strike of last winter in which 50,000 strikers for more than 20 weeks affected upwards of 300,000 shop workers, is in a measure responsible for the accumulated demand. This fact in spite of the handicap has prompted the placing of orders of no small consequence in the American market, and we still have the advantage of some special types of machines which, until the foreign builders have further developed their activity, will continue to come from here.

France and Belgium will with the gradual rebuilding of their industries continue to require machine tools, but a great deal must precede the placing of this equipment. They must first reconstruct their plants and then be sure of their raw material, coal for power, iron and steel to be worked with, also a more stable labor condition. Unless machine tools are not acquired

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for the immediate production of wealth creating objects it would be folly for Belgium and France to place orders with us at the present high prices and with the dollar at the premium it commands. For example, a tool that in 1914 cost $2,000, equivalent roughly to 10,000 francs, today costs in America not less than $4,000 and at the present exchange rate 60,000 francs. So far as the French or Belgian buyer is concerned, to him the price has advanced sixfold. He naturally hesitates and seeks either to get along without new American equipment or turns his attention to other markets that may serve his purpose to better financial advantage.

Italy is in the same relative position and any of these countries can, provided delivery may be secured, buy to better advantage in England so long as the dollar pound sterling exchange shows 25 per cent depreciation.

Much has been said of the effect of German machine tools on the market outside of Germany. There appears to be a popular delusion that Germany is going to promptly step in and bid for the machine-tool demand of the world at what would be to us ruinous prices. Nothing can be further from the truth. To be sure, not long after the armistice, when the German marks went tobogganing, wonderful bargains resulted in buying such German tools as were available. So far as we were able to learn these were very promptly snapped up by the neutrals and to some extent by France, Belgium and Italy.

Average German Monthly Export

For a considerable period last year the average monthly outgo for export of German machine tools amounted to about 50,000,000 marks. This sounds very large, but when it is considered that the prices at which such tools were sold range from 12 to 17 times pre-war prices, it could after all not have been a very large tonnage. The German makers are crowded with orders, many of which they took at fixed prices, and then found themselves in the dilemma of not being able to get raw material, or, if they got it, at a price that would not admit of the transaction being carried through without a heavy loss to which was further added the extremely uncertain and constantly upward tendency of labor.

Contrary to all that has been said of the Germans going back with renewed energy, a willingness to work for the sake of retrieving their economic losses, we did not learn of a single instance where such a spirit was even remotely indicated. On the contrary, demands of the workers have gone to almost preposterous lengths, not so much from the standpoint of wage increase, which considering the increased cost of living is at least justified and probably still somewhat too low, but because of their attitude toward production as a whole. According to our conception of the word production, the broad statement can be made that they are not producing and adhere to the legal eight-hour day of slothful activity with a rigidity than can be called hardly anything else but stubbornness. Of course, in many cases raw materials are lacking, but even when these are available, instead of taking advantage of the opportunity to again make of themselves a producing nation along economic lines, they now prefer to spend their time in going on strike for petty reasons, and scheming out new ways for bringing about socialization of industry that in the end can spell nothing else but ruin, if not checked soon. Freedom in shop management according to any conception of industry's needs is almost wholly denied and the principal control of shop policies rests almost entirely in the shop council. According to the wording of this law it is supposed to operate for the benefit of employer and employee alike, but in practice it has resolved itself into nothing else but a bargaining committee usually antagonistic to everything excepting that which procures for the worker a larger measure of return without regard for what he gives in exchange.

Now a further step has been undertaken which is virtually a forced recognition of the union. If one quarter of the shop council, which by the way is chosen entirely without prejudice from any other source, by the workers themselves, elect to have a union delegate take part in any of its deliberation with the management, the latter has no choice but to recognize such delegate as a factor in his shop relations and, of course, the delegate dominates the situation. The only doubtful ameliorating provision is that the employer has the right to call in a member of the Employer's Association of the particular district in which he happens to be operating, presumably for moral support.

Living Costs and "Hand Outs"

To be sure, living costs generally, due to the breaking down of transportation systems, shortage of fuel and food products and clothing, has been driven upward to about fifteen times the pre-war basis and rates. In order to make up the difference the workers have from time to time in practically every industry demanded what can be termed nothing else but a "hand out" of so many hundreds or thousands of marks per person to cover the extraordinary living cost. In some cases wages are more or less regularly made retroactive, usually back to the time of the last wage increase agreement.

With such economic conditions and so distorted a national sense of economic needs, one cannot conceive of a German machine-tool manufacturer becoming much of a factor in the world's markets in the immediate future.

Financiers have recognized the altogether intolerable condition resulting from the currency depreciation and the far reaching demoralizing effects of exports to foreign countries on the mark basis. Some restrictions have already been imposed and many are under serious consideration. Even now most German machine-tool manufacturers are quoting on the basis of the currency of the country into which the products are to go and at a price in some cases slightly lower than that at which the same commodity can be purchased there irrespective of the market values at which these goods are sold in Germany itself. This is not unreasonable, since an income must be secured from all available sources.

Those who have placed orders for commodities in Germany are finding themselves either unable to get the product at any price or only at the prices for which the German manufacturer is willing to let the product go, when it is finally ready to ship.

No one could blame Belgium, France and Italy for buying products in Germany, in view of the advantage that can be taken of the exchange rate between their respective currencies and the mark. They are still financially better off than when purchases of similar commodities are made in England or the United States.

Belgium has a huge quantity, over seven billion,

German marks left at the time of the armistice and assumed by that country for release of financial obligations to the allies. The only market open to relieve her of this financial white elephant is Germany. France and Italy have the advantage of exchange rate if the Germans do not still further force their prices to prohibitive levels.

Given a stable condition, a national sense of effort, raw material and transportation facilities, Germany could and would become a factor to be recognized, but with these attributes lacking she cannot be looked upon as a serious menace for some years to come.

During the period of complete isolation due to the war, German manufacturers made faithful copies of some of our well known American tools and are marketing them without regard for our origin of design. They will in due course try to invade other markets with these products, but after all we have not stood still and have gone far beyond the status of the machine-tool trade of five or six years ago. The newer developments making users less dependent on either the skill or personal interest of the worker cannot fail to command attention and respect that will result in a continuance and even further extension of our machine-tool industry, in foreign parts, even though for the moment foreign demand is at low ebb.

It is not only understandable but perhaps even gratifying that this demand is low. We all have more than we can do to take care of the home requirement and it is very much to be doubted that any of our prestige or respect for our tools is materially suffering in Europe because of this.

A Wage Leveling Process

There is a leveling process going on—never again will we see the disparity between wages here and abroad—the world has grown smaller as it were and in the various manufacturing countries in due course the same general fundamental conditions will prevail. Price will not be nearly so important a factor in the future trade relations. While this process of economic adjustment is going on and Europe begins to manufacture after her plants are re-established and raw materials are available, why not take advantage of the instrument happily made available through the Edge law. The means thus given us should be taken advantage of in the broadest possible way as a counter to similar foreign trade expansion by others, notably England. Beyond this have we not the ingenuity to continue the development of machine tools more than sufficient to counteract whatever handicaps there may be? We were able to do fairly well when merit had to fight price—can we not do even better when we force the foreign competitor to depend more upon merit than price, I think so, in fact am sure of it, and as a consequence can see no dark clouds on our foreign market horizon that are not lined—and heavily lined—with silver.

Photographs on the Shop Bulletin Board

By Frank H. Williams

The shop bulletin board is, in a certain sense, the heart of the shop. On this board appear all the notices which vitally affect the workmen, and on it is carried the message of inspiration which, when successful, fires the men with enthusiasm for the concern for which they work. But, too frequently, the bulletin board notices, which are intended to enthuse the workers, fail in this purpose and create distrust and sarcasm instead.

How can the bulletin board notices be made to function at 100 per cent in securing and holding the interest of the readers and in arousing the enthusiasm of the workers? One of the ways in which they can be made more successful in accomplishing such results is by the use of photographs instead of plain type to carry the desired messages. This is the age of visualization. People are accustomed to being shown by means of pictures instead of being forced to make mental pictures for themselves from the descriptions conveyed to them through the medium of type alone. Pictures nowadays have an immense hold on the public, as is attested by the popularity of motion pictures and the value of illustrations to magazines and papers. Consequently, when the shop bulletin board conveys its messages by means of photographs supplementary to the type, it is assuring for itself a wider reading and a deeper impression than would otherwise be the case.

For instance, suppose the shop has inaugurated a nursing service whereby any employee who has sickness in the family can secure the services of a nurse free of charge, and suppose that the men of the shop view the service with considerable skepticism, if not actual aversion. They feel that there is a catch in it somewhere and it can't be as good as it looks. It is right here that the bulletin board, by visualizing the nursing service through photographs, can entirely change the sentiment of the shop regarding the proposition. Suppose that instead of merely telling about the service in type the proposition is presented on the board by means of photographs. Let these photographs show the nurse in her costume and portray some of the duties she will perform in cases of sickness. Then, too, the steps necessary to securing the nurse's services can be shown in pictures, the first picture showing the man by the bedside of his sick child, the second showing him entering the shop superintendent's office to apply for the nursing service, the third showing him filling out the simple blank which will secure the service, and the fourth picture showing the nurse entering his home and the wife wearing a look of satisfaction. Wouldn't pictures like these be much more likely to catch and hold the attention of the shop worker than mere typo announcements?

Suppose, too, that a change in the method of paying the employees is inaugurated or that they are to be paid at different windows than formerly. Whenever anything of this kind is done there is invariably a vast amount of confusion, because the printed announcement of the change fails to convey the message understandably to a lot of the men. Suppose that the matter be presented by photographs also. Let the board show photographs of the buildings or departments from which the men would receive their pay at window *A*, and suppose that it presented a picture of this window and its location. Such a plan as this would make it mighty hard for the men to go wrong, and it would be like giving each man an individual guide to show him just where he must go for his envelope.

In a number of other ways the bulletin board could utilize photos to good advantage in place of the type announcements which now so frequently appear alone. When photographs are used it will be found that the message is given a clarity and a force which it does not otherwise have, unless it is so simple and unmistakable that no explanation is needed.



A Few Splitdorf Details—I

By S. A. HAND and K. H. CONDIT
Associate and Managing Editors, *American Machinist*

An eminent physicist has said that in his opinion the ignition magneto ranks with the greatest achievements of electrical science. When one considers its performance under the most adverse conditions, that statement sounds reasonable. In this article we propose to describe briefly the operation of one type of magneto and begin the story of its manufacture.

BOTH battery and magneto ignition systems for internal-combustion engines can count their advocates by the thousand and consequently it seems safest to say that under certain conditions the first system will prove most commercially satisfactory, while under different ones the other will be the obvious choice.

In a paper read before the Society of Automotive Engineers some time ago, the author, Colonel Vincent, in describing the problems encountered in designing the Liberty motor, made the statement that at the time the design was started there was no magneto on the market capable of producing 12 sparks at the uneven rate required. The design was therefore made with battery ignition as a component part. He also stated that during the war several very good magnetos for this work had been developed.

One of these was the Splitdorf aircraft magneto, built by the Splitdorf Electrical Co., of Newark, N. J. It was simply a modified form of their standard aëro type, designed to give sparks at intervals of 45 and 75 deg. as demanded by the 12-cylinder Liberty. There are magnetos and magnetos and they differ greatly in minor points and even in electrical principle.

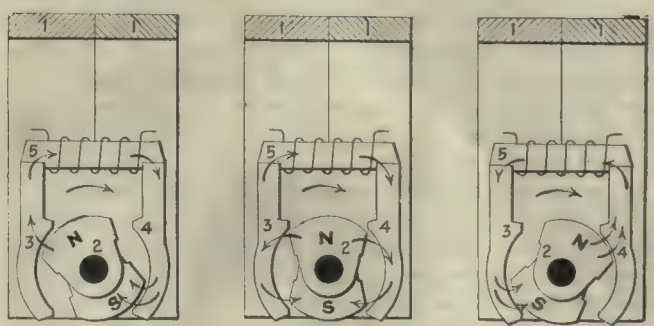


FIG. 1. MAGNETIC DIAGRAM OF SPLITDORF MAGNETO

The Mason principle is not new, as magnetos of this type have been made for some years, but it is so different from that of the usual run that it will be given here. The basic principles being the same for all models it will be simpler to take the four-cylinder type and work with that only. This magneto is what is known as the true high-tension type, electric current at a sufficient pressure to jump the gap between the spark plug point under the pressure existing in the engine cylinder being generated in the instrument itself without the use of any outside coils or other supplementary devices.

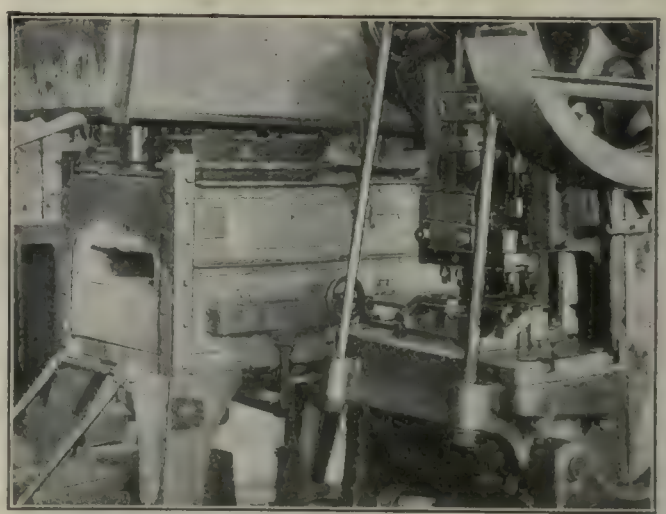


FIG. 2. MAGNET-HEATING FURNACE AND PUNCH PRESS

The ordinary high-tension magneto is practically a dynamo-electric machine run as a generator. Permanent magnets are used instead of electro-magnets and there are two windings on the armature, the primary winding consisting of a few turns of relatively heavy wire and the secondary winding consisting of a very large number of turns of fine wire. Rotation of the armature by mechanical means within the magnetic field set up by the permanent magnets results in the generation of an electric current of low voltage in the primary winding. Interruption of this current when it reaches its maximum value causes a sudden reversal of the magnetic lines in the soft-iron core on which the coils are wound and induces a very high voltage current

AUTOMOTIVE CONSTRUCTION

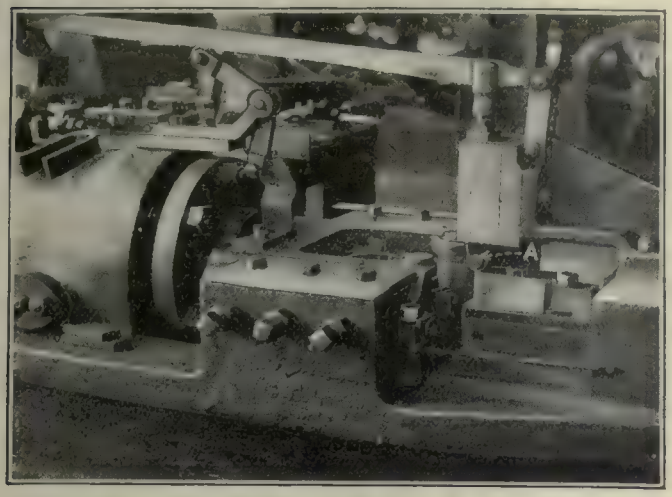


FIG. 3. BENDING MAGNETS IN A BULLDOZER

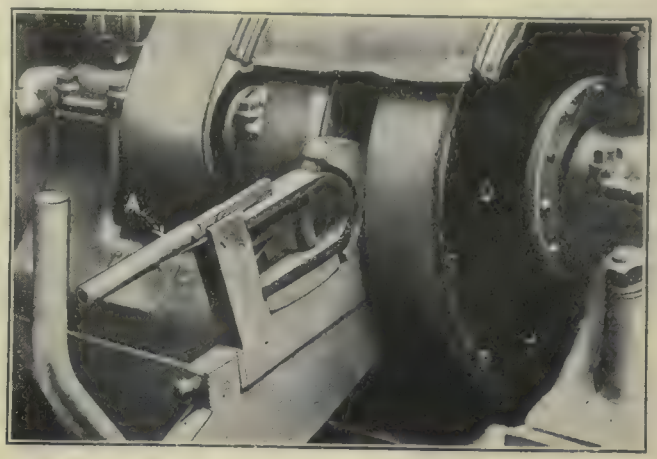


FIG. 5. FINISH-GRINDING THE SIDES

in the secondary winding which is sent to the proper spark plug by the distributor and high-tension wire.

This is only a bare outline of what actually takes place, but it will probably be sufficient to bring out the difference between the two systems. In the Splitdorf type the rotor, instead of having the two coils wound upon it, carries four malleable-iron wings, insulated from each other by a brass section, two always adjacent to the north magnetic pole and clearing it by a very small amount and the others occupying a similar position with respect to the south magnetic pole. Instead of the magnets being parallel to the rotor axis so that the lines of force flow at right angles to the axis, they are placed at 90 deg. from this position so that the ends of the shaft project through holes in the magnets. The coils are wound on a laminated iron core, the location and shape of which are indicated in Fig. 1. Extensions of the core form pole shoes through which the magnetic lines travel as shown by diagram in Fig. 1.

It will be seen that this method does away with rotating coils and simplifies the construction of the rotor to a considerable extent. As in the other type the interruption will break the primary circuit when the current is at its maximum, or when the left-hand corner of the wing *N* leaves the upper corner of the pole shoe, and again 180 deg. later.

Reduced to its simplest terms, the difference between the two systems is that in the armature type the coil rotates within the magnetic field, reversing twice per revolution, while in the Aëro type the coil is stationary and the direction of the lines reverses four times per revolution, thus producing the greater electrical efficiency.

Probably the most difficult part of a magneto to manufacture and the part upon which the successful operation is most dependent is the magnet. It is not sufficient to get good magnets part of the time; they must all be good and they must stand up, or the instrument soon gets a bad name.

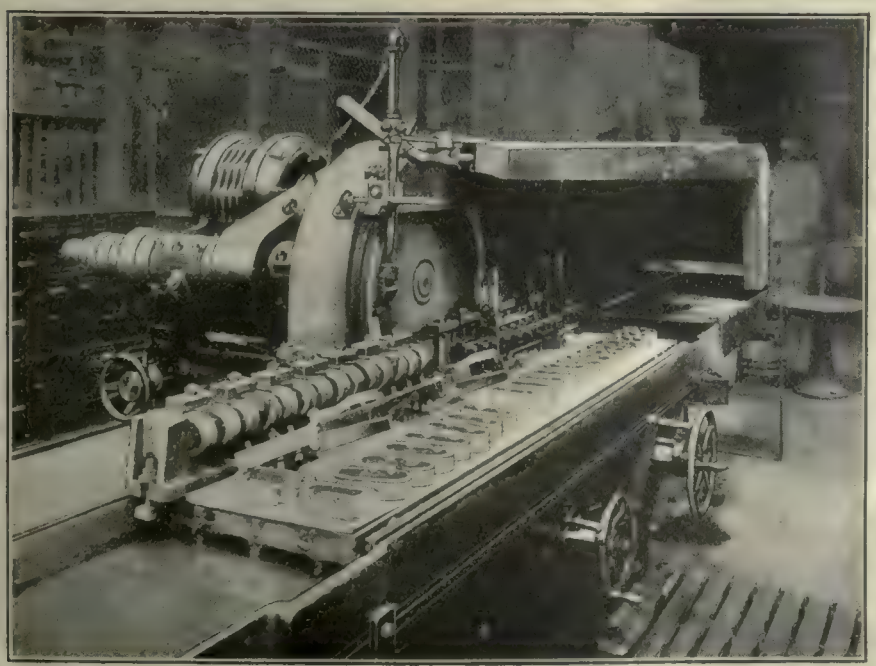


FIG. 4. END-GRINDING IN A DIAMOND MACHINE

Manufacture of the Magnets

The magnets are sheared cold to the proper length from chromium-steel stock. The strips are then heated in the automatically fed, gas-fired muffle furnace shown in Fig. 2 at the left. Passage through this furnace takes about 40 min. and the temperature is controlled by an automatic electric pyrometer.

As the magnets, when finished, are used in pairs set side by side, it is necessary that clearance for the rotor shaft and other parts be provided. This is done by punching in the press shown at the right in Fig. 2, where semicircular pieces are cut from the sides of the magnet bar so that when put together the clearances will form a round opening. From the punching machine the bars are slid down an inclined chute to the bulldozer shown in

AUTOMOTIVE CONSTRUCTION

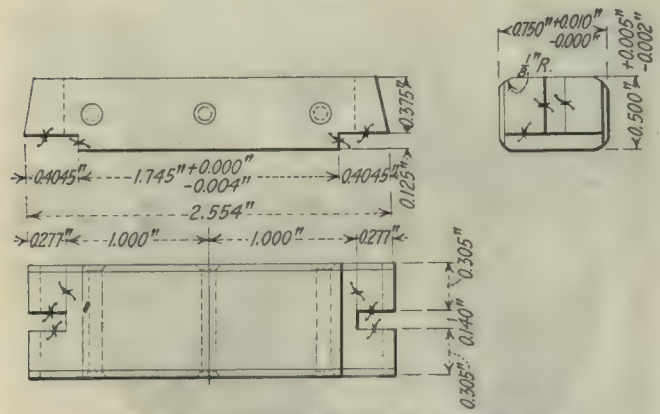


FIG. 6. LAMINATED CORE ASSEMBLY

Fig. 3. Here they are bent to the customary U-shape. No reheating is necessary as the bars are handled so quickly in punching and in their delivery to the bulldozer as to retain enough of their heat for the bending operation. As may be seen in the illustration, the movable die is equipped with rollers for the bending, during which any tendency for the bar to creep or crawl is prevented by the sharp-edged roller *A* which bites into it at the central part of the curve. This roller is automatically brought into contact with the work as the movable die advances and released in the same manner as it recedes. The method of operation will be easily understood by examination of the levers and connections as shown in the illustration.

As the bending leaves the legs of the U of somewhat uneven length and also rounds the edges at the bend, it is necessary to grind both the ends and sides of the magnet. The ends are ground on a heavy Diamond face-grinding machine, as shown in Fig. 4, where a long string of magnets held in fixtures may be seen upon the table.

Grinding the sides is a rough-grinding operation and is done singly between two disks on a Besly disk-grinding machine, as shown in Fig. 5. In this operation the work is held in the fixture by pressure of the operator's hand on the lever *A* so that no time is lost in manipulating clamps.

After grinding, the magnets are heated to 1525 deg. F. in a Frankfort furnace and quenched in oil and are then taken to the magnetizing table. There is nothing special in the operation of magnetizing, though it may be noted that the amount of magnetic force is indicated on a translucent scale by a beam of light reflected from a mirror attached to the pivot of a galvanometer needle.

As the magnets when assembled must be in close magnetic contact, their contacting faces must be practically plane and for this purpose these surfaces are ground on a Blanchard rotary grinding machine. Here they are grouped and closely nested on the magnetic table of the machine which can be loaded with 338 pieces at one time.

The Core Structure

One of the characteristic features of the Aëro magneto, as mentioned before, is the laminated core structure upon which the coils are wound. The core assembly appears in Fig. 6. The laminations are punched from iron strips slit to the proper width. An automatic punch press is used for this job. The blanks then go to the assembling bench where they are staked together. The outside pieces, which are thicker than the others, are countersunk for the rivet heads. With the rivets in place the core is squared up in a press with special dies, the line of action of the press ram being parallel to the laminations. This usually results in some increase in the thickness of the pile of laminations, so a succeeding press operation flattens them to size within 0.010 in., after which they are squared up again. They are then annealed and brushed, ground, milled and slotted.

Finally they are impregnated with varnish.

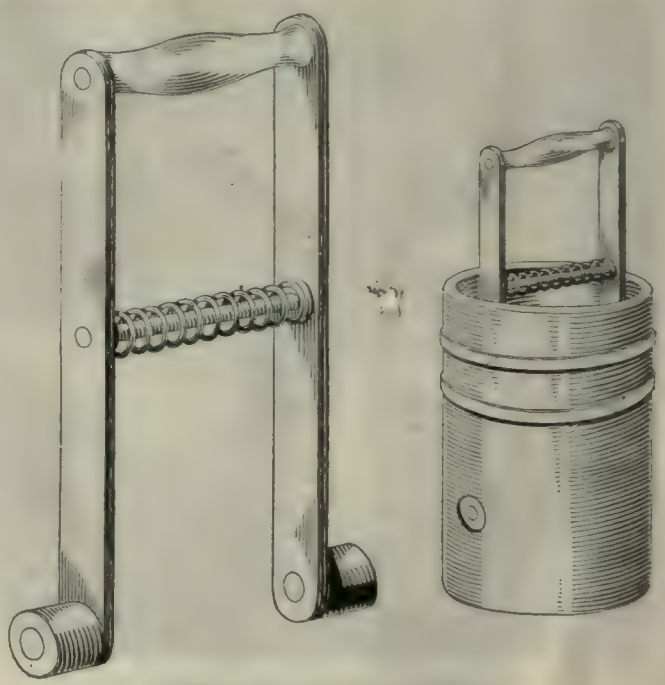
Except for the squaring operations the laminated pole pieces which form extensions of the core receive the same treatment as that already described. Both these parts are made of soft iron to offer an easy path for the rapidly changing lines of magnetic force.

Device for Fitting Pistons

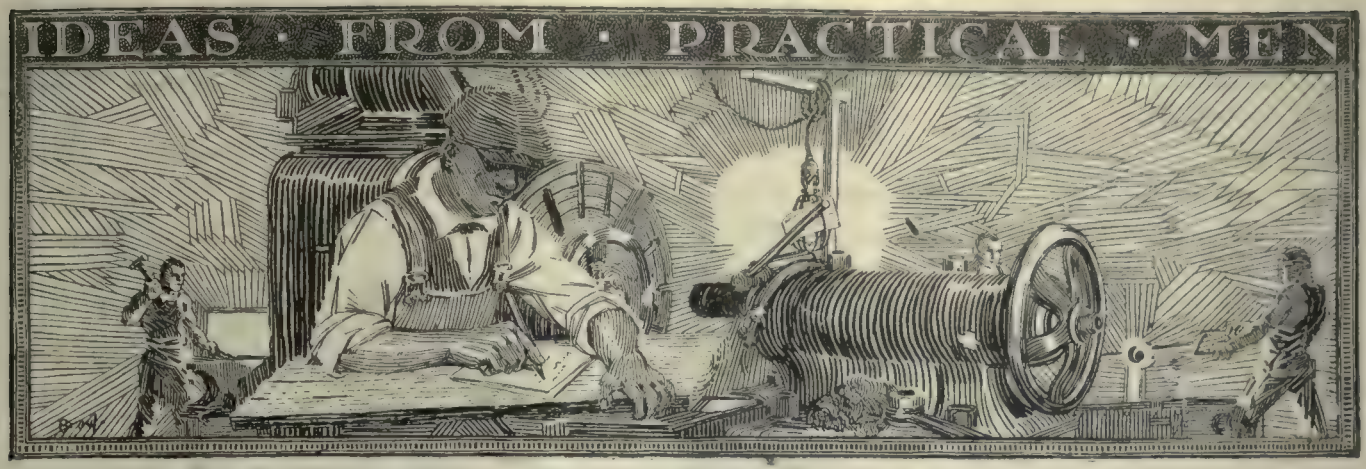
By J. H. Vincent

In a large gas-engine factory the pistons are fitted individually to the cylinders in which they will be assembled. The assembler slips different pistons into each bore and tries their fit until he finds one that is correct and the device shown in the illustration is the tool he uses to expedite the insertion and withdrawal of the pistons.

It consists of two flat bars with round bosses on their lower ends which are sprung into the wrist-pin holes from the inside and are held in position by the center spring. The upper ends are joined together by the handle which the assembler holds in one hand as he slides the piston up and down in the bore while feeling its fit.



DEVICE FOR FITTING PISTONS

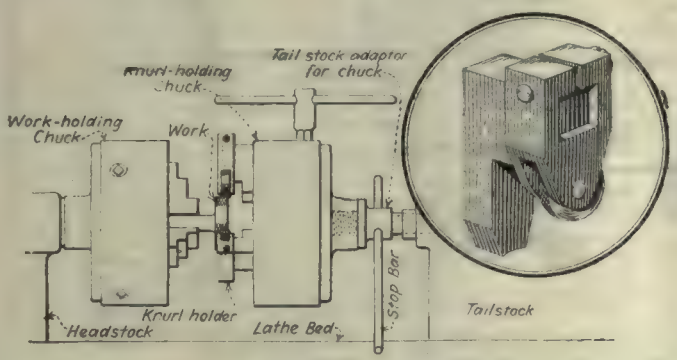


Using the Lathe Chuck as a Knurl Holder

By H. H. Parker

This addition to the different knurl holders previously described consists of three holders attached to the jaws of a universal chuck. The holders are made from blocks of cold-rolled steel and should be exactly alike.

The chuck preferably should be stationary in order to make it easier to adjust to the work and is shown held in the tailstock by an adapter that has a screw on



THE KNURL HOLDERS

the outer end the same as the nose of the head spindle, while the other end is tapered to fit the tail spindle. The hub is drilled and a rod put through it which rests against the lathe bed and prevents the chuck from rotating.

The work to b nurled is held in another chuck or by other suitable mea. and rotated at a proper speed for knurling. Pressure is applied to the work by means of the chuck wrench.

Setting the Milling Machine Vise in Alignment

By Charles D. Folsom, Jr.

The operation of setting a milling-machine vise in alignment has been discussed in the *American Machinist*, Vol. 52, by four different men, each of whom had a different opinion as to how it should be done. Mr. Grill started the ball rolling by telling on page 356 how to use a micrometer clamped on the arbor of the machine, taking readings against a parallel strip held in the vise. Mr. Cunau, on page 589 in a later issue, agrees, but claims that a dial indicator is better than a micrometer for this purpose, which, of course, is quite true and obvious—provided you have the indicator. Both of these gentlemen, however, were a little off the track, as is pointed out by Mr. Raught on page 556, where he straightens the matter out nicely. But then Mr. Hanneman, on page 846, comes along and gets it tangled up again. I note that Mr. Hanneman begins his article with these words: "Referring to the method of setting a milling-machine vise parallel with the *cutter*, described by John A. Grill . . . ." Now Mr. Grill's words were: "A good way to set a milling-machine vise square with, or parallel to the *table* . . . ." I assume, however, that Mr. Hanneman refers to parallelism with the table, because that is the usual requirement. His method is to put an indicator on the arbor contacting with a square in the vise, and turn the spindle instead of traversing the table. In that case h would be setting the vise jaw square, not with the table, but with the spindle of the milling machine, and in an old machine he would find that would make a lot of difference.

Your readers at this point will probably think I have conglomerated the hypothesis hopelessly, but the operation in question is really a simple one. It requires no skill, no calculating, just common sense and a knowledge of what you want—that is the important part. As an

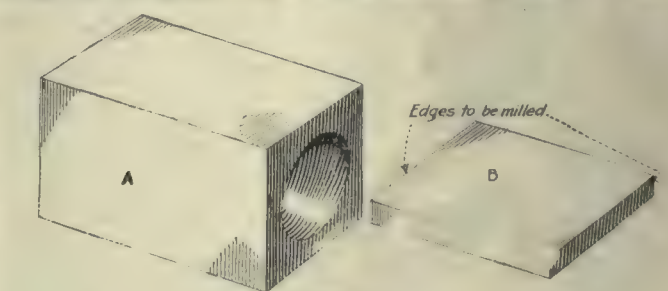


Fig. 1

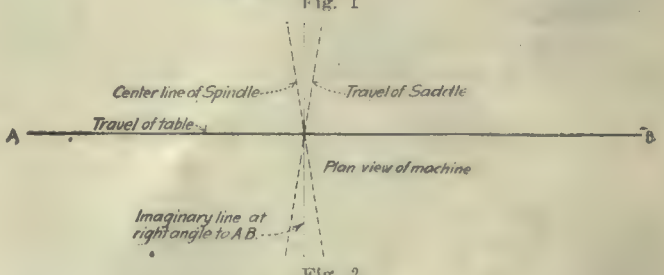


Fig. 2

FIG. 1. TWO TYPES OF MILLING-MACHINE JOBS. FIG. 2. FACTORS TO BE CONSIDERED IN ALIGNING WORK ON A MILLING MACHINE

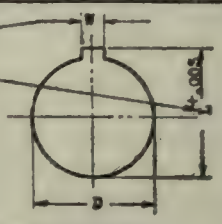
illustration, take the pieces shown in Fig. 1. Let us say that the hole in *A* must be bored through it parallel to the sides and that two parallel edges of *B* must be milled square with the two previously machined edges. Would the same method of setting the vise do for these two jobs? With a new machine it probably would, depending on the accuracy required; with an old machine it probably would not. In the case of *A*, you should move the cross-slide, or saddle, in and out with the indicator against the vise jaw; you would then be setting the jaw parallel with the travel of the cross-slide. In the case of *B*, you should move the table in a longitudinal direction, with the indicator against the blade of a square held in the vise. You would then be setting the jaw square with the travel of the table. In both cases you would be avoiding, rather than including, errors in the machine slides.

If this seems to be splitting hairs too fine, don't fool around with an indicator at all; use blocks in slots in the bottom of the vise. If these are not available, hold a square against the column of the machine and line up the jaw directly with the blade; or, for setting the vise parallel with the table, use a surface gage with "gage pins" against the edge of the table. But, if you are going to use an indicator, which can be made to give very accurate results, give it half a chance to do its work right. The diagrammatic sketch, Fig. 2, shows some possible errors in a milling machine upon which this discussion is based. The center line of the spindle need seldom be considered, probably only when using a star feed or other facing attachment.

Those to whom this is not yet altogether clear would do well to look over the article on "Testing Methods Employed at the Becker Milling Machine Co.'s Plant," in the April 15 issue of the *American Machinist*.

Title. STANDARD DATA FOR ENGINEERING DEPARTMENT. DRN. CKD. APD.

Dimensions of keyways in hubs to be shown thus:



To calculate the dimension L the following formula should be used: $L = \sqrt{\left(\frac{D}{2}\right)^2 - \left(\frac{W}{2}\right)^2} + \frac{W}{2} + \frac{D}{2} + .005$

A tolerance of +.003 should be allowed.

DIMENSION—L—IN INCHES.

Width of Keys W	1/16	3/32	1/8	5/32	3/16	7/32	1/4	5/16	3/8	7/16	1/2	9/16	5/8
No. of Std. Woodruff Key	1	2,4	3,5,7	6,8,10	9,11,13 6,9,26	12, 14, 17, 20	4,5,18,21 22,24,27	8,C,D,29 25,28, S	E,F,G, 29,T,30	U, 31	V, 32	33	34
5/16	.345												
3/8	.409	.440											
7/16	.480	.486											
1/2	.516	.548	.559										
9/16		.592	.622										
5/8		.673	.686	.698									
11/16		.737	.749	.762									
3/4		.799	.813	.823	.846								
13/16			.875	.887	.909								
7/8			.938	.950	.965	.978							
15/16			1.001	1.014	1.027	1.039							
1				1.077	.090	1.102	1.116						
1-1/16				1.139	1.153	1.165	1.179						
1-1/8				1.202	1.215	1.228	1.242						
1-3/16				1.264	1.279	1.292	1.305						
1-1/4					1.342	1.354	1.367	1.379					
1-5/16					1.404	1.417	1.430	1.442					
1-3/8					1.466	1.480	1.493	1.505					
1-7/16					1.530	1.542	1.555	1.568					
1-1/2						1.604	1.620	1.646	1.669				
1-9/16						1.667	1.682	1.707	1.732				
1-5/8						1.730	1.745	1.771	1.796				
1-11/16						1.793	1.809	1.834	1.859				
1-3/4						1.857	1.871	1.897	1.923	1.946			
1-13/16							1.933	1.960	1.985	2.009			
1-7/8							1.996	2.022	2.045	2.069			
1-15/16							2.060	2.085	2.112	2.137			
2							2.122	2.149	2.176	2.200	2.223		
2-1/4							2.368	2.401	2.427	2.453	2.477	2.500	
2-1/2							2.623	2.652	2.678	2.705	2.729	2.753	2.776
3									3.186	3.208	3.234	3.269	3.285

Dimensions within heavy lines are for the correct Woodruff keys for use with various shaft diameters

TABLE SHOWING DIMENSIONS OF INTERNAL KEYWAYS

Dimensioning of Keyways

By Hans Ernst

It is generally conceded that the most satisfactory way of dimensioning keyways in hubs of pulleys, etc., is to give the dimension from the bottom of the keyway to the opposite side of the hole, as shown at *L* in the accompanying diagram; yet this is seldom done owing to the extra work it entails on the part of the draftsman. To avoid the necessity of calculating this dimension each time it is required, the accompanying table was drawn up and incorporated in the book of standard data for use in the drafting room, each draftsman being furnished with a copy. This table gives the value of dimension *L* for every practical combination of keyway and shaft up to 3 in. in diameter.

To find the dimension, for example, with a shaft 1 in. in diameter and a keyway 3/8 in. wide, follow along horizontally opposite 1 in. and in the vertical column under 3/8 in. will be found 1.102 in., which is the value of the dimension *L*. In every case an allowance of 0.005 in. has been made to insure that the key will not fit on the top. The dimensions within the heavy lines indicate the sizes of standard Woodruff keys recommended for use with the corresponding shaft diameters.

The various numbers of standard Woodruff keys shown in the second horizontal row have the same widths as the dimensions directly over them, thus eliminating the use of a separate table.

WHAT to READ
—for the man in a hurry



Suggested by the Managing Editor

ACCURATE physical measurement is becoming more of a practical shop process and less of a theoretical laboratory problem every day. With this change has come the standard gage and with it the necessity for some accurate means of checking the standard itself. A Swiss instrument for this purpose has just been introduced in this country and is described in detail in our leading article this week. It is the product of the Société Genevoise d'Instruments de Physique (thank Heaven we can write that out and don't have to say it over the telephone!). It will be worth while to compare its construction and principles of operation with those of some of our own machines that are designed for precise measuring.

What to read was not a difficult matter to decide two hundred years ago when books were few and magazines unheard of. It is far different now when so much reading matter is offered to pass the time pleasantly or profitably as the reader chooses. We are doing our utmost to make the "American Machinist" not only profitable but indispensable as a clearing house of ideas and news of the machinery world. This page is the editors' advertisement of their section of the paper. It gives the high spots.

The various machines employing the oxy-acetylene flame for cutting metals are taken up in Part XXIII of Ethan Viall's welding series beginning on page 54. Both foreign and American machines are described in portable as well as fixed types. The savings in time and expense made possible by these cutting machines are so remarkable that it behooves every engineer and shop man to be familiar with their possibilities.

On page 63 we have the conclusion of Part VII of Basset's Modern Production Methods. This installment takes up machine scheduling, stock-delivery requirements and machine load records. Their relation to modern production planning and shop control is brought out clearly.

Part X of H. H. Manchester's historical series on the evolution of the modern workshop starts on page 71. The last installment wound up the articles dealing with the industry in Europe and this one shifts to America and traces the early attempts at manufacturing in the English Colonies. Eli Whitney's pioneer attempt at interchangeable parts manufacture is mentioned and the records of the United States marshalls for the 1810 census are discussed as giving the best indication of the growth of the industry in the new republic.

Reports on conditions abroad as we get them from the daily press are so confusing and at times utterly contradictory that we are glad to be able to publish a statement from a man who has just come back from the seat of the disturbance. In this issue we have a paper presented by Carl F. Dietz, vice president of the Norton Co., before the annual convention of the National Association of Machine Tool Builders at Atlantic City late in May. Mr. Dietz's picture of German labor troubles and the ability of German manufacturers to flood the market with cheap products is rather different from some we have seen. "Contrary to all that has been said of the Germans going back with renewed energy and willingness to work for the sake of retrieving their economic losses, we did not learn of a single instance where such a spirit was even remotely indicated." A very positive statement and one that is rather disquieting to the student of world affairs, but comforting to the competitors of those German shops.

Mr. Dietz is optimistic regarding the future of our foreign markets for machinery, but he warns us of the strength of the British association of machine-tool builders and urges the fullest use of the provisions of the Edge law which permit associations of manufacturers and merchants for foreign trading. In this connection we want to call your attention to a very similar statement concerning the British competition in foreign trade made by Frederick Palmer, the famous war correspondent, in his address before the summer meeting of the Society of Automotive Engineers on Lake Michigan. See page 84. This matter is a serious one and merits immediate consideration.

General shop articles by Frank A. Stanley, Herman L. Wittstein and two members of the staff appear on pages 61, 67 and 78.

Another one of our London correspondent's informal accounts of British affairs appears on page 91. Mr. Chubb, who writes these letters, is well fitted to give an accurate picture of English shops and markets because of his wide acquaintance among the island machinery men. We follow up his general letter with two of his accounts of local conditions in Halifax and Birmingham which appeared in our European edition.

Summer S.A.E. Meeting

THE dates June 21 to 25 will go down in history in red letters as the occasion of the biggest summer meeting of the Society of Automotive Engineers ever held. There will undoubtedly be bigger ones in the future but never a more enjoyable one. Last year's session at Ottawa Beach, Mich., was so successful that the meetings committee decided to stage a comeback and their decision met with widespread approval among the members.

Five days of perfect weather added much to the success of the occasion the only drawback being the temperature which stayed too low to make bathing an unmixed delight. The members arrived by train, by boat and by automobile to the number of about eight hundred and taxed the capacity of the four hotels on the bay, which had been chartered for the meeting. A few were expected by airplane but for some reason failed to put in an appearance.

As usual, the meeting was opened by the sessions of the Standards Committee and reports were received from the divisions on Aeronautics, Automobile Lighting, Electrical Equipment, Electric Transportation, Engine, Iron and Steel, Miscellaneous, Motorcycle, Roller Chain, Shaft Fittings, Springs, Tire and Rim, Tractor and Transmissions. Due to the lateness of the New York Special, which brought the Metropolitan Section, the Standards meeting was continued in the afternoon. The first rounds of the tennis tournaments were started on Monday afternoon as well as the qualifying round in the golf tournament.

After dinner the semi-annual business meeting was held and the usual reports and addresses were passed on and listened to. Col. J. G. Vincent, president of the society, took up in detail the three great problems which are now facing the automotive industry, the discriminatory attitude which the bankers are assuming toward automobile manufacturers in the course of the general restriction of credit decided on by the Federal Reserve Board to put the country on a sounder financial basis; the construction and maintenance of improved highways to carry the ever-increasing motor traffic of the country; and the growing seriousness of the rapidly-diminishing fuel reserve. He closed with a summary of the air craft situation in which he stated. "* * * I will venture the prediction that the time is not far off when we will see a plane equipped with a 180- or 200-hp. engine, capable of carrying 10 passengers at a speed of more than 100 miles per hour with a fuel economy of eight miles to the gallon or better. * * * The only complete answer to this problem, as I see it, is to develop commercial aeronautics, and it is largely up to us engineers to bring this about, partly by engineering and partly by a united educational campaign. * * * The United States positively will not be in a safe position until this result has been accomplished."

The business meeting also took final action on the amendments to the contsitution proposed six months previously. At the request of Vice President Wall, who stated the conclusions arrived at by the council, most of the amendments were voted down. The only changes resulting from the whole agitation were those making the dues of junior members ten dollars instead of five and making the ages of automatic increase from junior to senior rating 30 instead of 26.

A short discussion of the merits of the metric system followed, several members with electrical training advocating its adoption. A motion to place the society on record as being against the compulsory adoption of the metric system was loudly seconded by half the men in the room and carried unanimously. Several members asked to be put on record as favoring the ultimate gradual adoption of the system although they were against compulsion in the matter.

The first professional session opened at 10 o'clock Tuesday morning with Henry M. Crane in the chair. This meeting was designated as a fuel session and papers on Carburetion and Distribution of Low-Grade Fuel and The Fuel Problem, from the Refiner's Viewpoint, were presented by O. H. Ensign and R. L. Welch respectively. A symposium on engine design was presented by Messrs. H. M. Crane, C. A. Norman, W. E. Leigh, and P. S. Tice. The report of the Automotive Fuel Committee was presented by the chairman, H. L. Horning. Animated discussion followed the presentation of



BLACK LAKE AND THE SAND DUNES



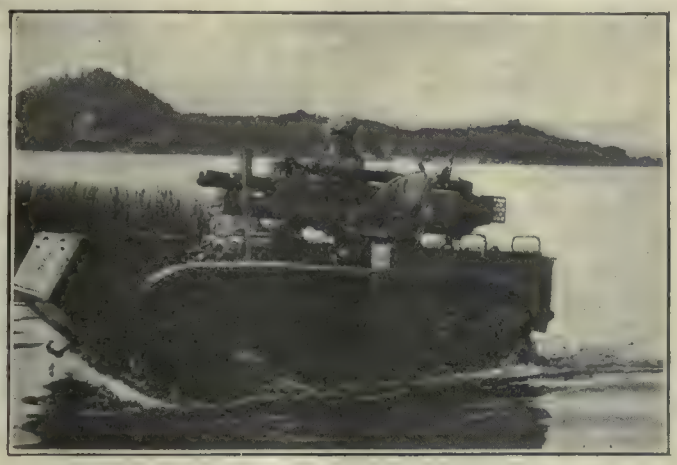
THE PRINCIPAL CENTER OF INTEREST



THE NEW 2½-TON TRACTOR

each paper and resulted in the postponement of the paper by W. S. James of the Bureau of Standards on "Intake Manifold Temperature and Fuel Economy" until the following afternoon.

Mr. Welch, who is general secretary of the Petroleum Institute, made the presentation of his paper rather brief and then devoted more than one hour to answering more or less pointed questions from the floor. He made it very clear that the country, at the present time, is consuming the various fuels refined from petroleum at a rate exceeding the production, and he urged the fullest co-operation on the part of the automotive industry to obtain a solution of this critical problem. Among other things, he suggested the inefficiency of using high-powered multi-cylindered cars for use in the overcrowded city streets.



THE SELF-PROPELLED 75-MM. GUN MOUNT

Tuesday afternoon saw a continuation of the baseball championship series and of several rounds of the golf and tennis championships.

At eight o'clock that evening, Col. Frederick Palmer, dean of the American War Correspondents, gave a very interesting talk on conditions in Europe at the present time. As Mr. Palmer has just returned from six years on the other side he was well fitted to give an accurate picture of the situation.

Mr. Palmer brought out very clearly the workings of England's superb organization to secure world trade. He told of the close co-operation of the British Diplomatic Service with the British merchants and manufacturers and gave some instances to show how well prepared they are to start trade with Central Europe. He urged the importance of some form of League of Nations for the preservation of the smaller European nations, particularly the new ones formed by the Peace Conference.

Colonel Palmer painted a dark picture of the economic and social conditions in some countries but expressed his opinion that the near future would show a complete recovery and the restoration of normal conditions.

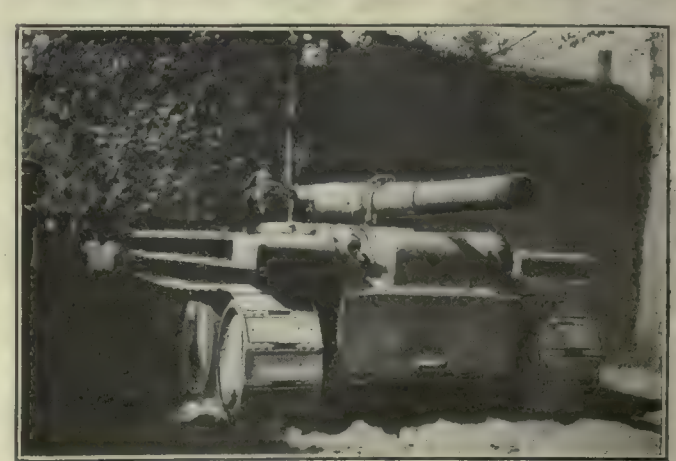
The Wednesday morning session was devoted to transportation problems and was presided over by Colonel Vincent. G. A. Green presented a paper on "Motor Bus Transportation," Col. B. F. Miller, M. T. C., U. S. A., one on "The Relation of the Motor Transport Corps to Commercial Transportation," and Col. E. S. Gorrell one on "Air Navigation."

The proposed program of the S. A. E. Committee on the Science of Truck Operation was discussed by the chairman, F. W. Davis. Sec. H. G. Shirley of the Federal Highway Council gave the road builder's point on the problem of perpetuation of our highway system.

"Some Inland Waterway Transportation Problems" were discussed by Carl J. Baer of the St. Louis Chamber of Commerce and B. E. Lacey.

Promptly at 2 o'clock Wednesday afternoon the big program of field sports was started by the official announcer, Harry Knepper, and his staff of judges and timers. Instead of resorting to handicaps the committee in charge divided the contestants into classes according to age and weight with the result that the competition in most of the events was very close. According to the announcer remarkably fast time was made in the fat men's race, a record of 5 seconds for 50 yards on the grass being hung up. Even more remarkable was the speed of the winner of the stout ladies' 30-yard dash, who covered the distance in 4½ seconds. This was the figure given by the announcer and is presumably official, although the correspondent had no stop watch and consequently has some little hesitancy about vouching for the honesty of the timers in this event. High and broad jumps and the shot-put were also closely contested and baseball throwing for the ladies brought out some remarkable talent.

The Wednesday evening lecture was delivered by Major Thurman H. Bane, head of the Technical Section of the Army Air Service, and covered the work done at McCook Field by his division since the Armistice. He showed slides of the new engines and planes



SELF-PROPELLED MOUNT FOR 155-MM. GUN

which have been and are being developed and followed this with "movies" showing parachute jumps and the action of the new planes in the air. The Army's entrant for the Gordon-Bennett cup attracted some attention as did the armored triplane developed for use near the ground against enemy troops. This machine mounts four Lewis guns in a row, pointing downward, and Major Bane stated that its effect on the field is very much like that of a plow.

A new 18-cylinder Liberty engine was shown and also a large and a small 12-cylinder aircraft engine being built by the Packard Co. for the Army. There were also slides of English and American air-cooled fixed radial engines for use in smaller planes.

The morning session on Thursday was devoted to the discussion of "Power Farming." E. A. Johnston was charman of this session and papers were presented by O. B. Zimmerman on "Analysis of Fundamental Factors Affecting Tractor Design;" by Percival White on "The Operating Speeds of Agricultural Implements," and R. W. Lohman on "Power Farming."

The sports program was concluded in the afternoon with the finals in the golf and tennis tournaments and with water sports. The latter included swimming and diving and canoe racing and tilting. In the canoe tilting one of the contestants performed a rather unusual feat by falling into the opponent's canoe without upsetting it or his own.

Earlier in the afternoon the Army Ordnance Department staged a demonstration of three new Army tractors. The smallest one was the new 2½-ton tractor which is notable for its highly developed control. When this machine is in action on smooth ground it turns and twists with a rapidity which reminds one of a water bug. Not the kind that lives in city apartments, but the variety that travels around on top of the water in country brooks and pools. This tractor hauled a 3-in. gun and limber through the cellar of a burned down house and through a swamp and brook two feet deep with the utmost ease.

The other small tractor mounted a 75-mm. gun and was designed for work in wet country. The Cadillac engine is fitted with a long vertical intake which permits it to be run completely submerged with only the top of this pipe and the driver's head above water. In the demonstration the driver evidently preferred to stay dry but he proved to every one's satisfaction the ability of this self-propelled gun mount to travel in four feet of water as easily as on dry land. A tug-of-war between these two smaller tractors wound up their exhibit and resulted in two very deep holes in the sand of the beach where the contest was staged. The 2½-ton tractor finally pulled the amphibious gun mount back six inches and was declared the official winner.

A larger gun mount of distinctly different type and with great possibilities was also demonstrated. This machine was designed by Walter Christie, and includes features which are entirely new. It mounts a French 155-mm. G. P. F. gun and weighs only 22 tons as compared with the usual 30 to 40 tons for this type of vehicle. The caterpillar track instead of running on the usual small steel wheels is carried on disk wheels mounting solid rubber tires about 3 ft. in diameter. There are four of these wheels on each side of the tractor. A 6-cylinder engine gives this truck a possible speed of 12 miles an hour in soft going.

The most interesting feature is the ability of the machine to run 20 miles an hour on hard roads on its rubber tires with the caterpillar tracks removed. A trained crew can remove these in three minutes and replace them in five. Their removal automatically connects the steering gear which is used when the machine runs of its wheels. Some snap shots of these trucks in action are shown in these pages.

Another exhibit of more than passing interest was that of the Goodyear Co. It was their new heavy-duty pneumatic tire truck which has two rear axles in tandem and consequently runs on six wheels instead of four. This machine was used throughout the week to transport the members from the dock to a farm where demonstrations of tractors and farming implements were carried on every afternoon.

The grand ball and dancing contest were held Thursday evening and marked the climax of the meeting.

On Friday morning the professional session devoted to production was held and the most interesting paper of the whole meeting was presented by A. F. Knobloch of the Cleveland Tractor Co. In this paper Mr. Knobloch discussed the importance of the human element in manufacturing and gave some almost unbelievable figures of increased production per man resulting from a careful study of this element. Other papers presented were on "Production Control, and Systems of Accounting," by A. G. Drefs, and "Inter-departmental Production Contests," by R. R. Potter.

Old Baldy Would Have Murdered This One

By Charles D. Folsom, Jr.

Mr. Remacle's story on page 1154, Vol. 52 of *American Machinist* reminded me of another example of "Cá Canny tactics" that I saw some time ago, that would have made "Old Baldy" see red. The man in this case was a milling-machine hand—he really was—when he felt like it; but on this occasion he did not feel like it.

His job was to mill some brass castings with a surface about 2 x 5 in., with about ⅛ in. to come off. The machine was a vertical, and the cutter was a 5-in. face mill.

Well, he put on the fastest speed and the slowest feed and piled right into it. It looked as though he was going to kill the job. But not only was he fast, he was very accurate. In order to be sure to hold within the limits (+.001 or so) he felt it necessary to let the cutter run entirely across and off the work, and then instead of resorting to the back-breaking process of returning the table by hand, he reversed and let it feed back.

Sometimes on this return cut, for the sake of variety, he would raise the cutter about an eighth of an inch above the work; in that case he placed a piece of cardboard in front of the cutter, ostensibly to prevent chips from flying around, but possibly also to keep prying eyes from discovering his unique method of securing extreme accuracy.

Later on I had occasion to do the same job myself, and just for fun I did a little figuring. I found that our friend had used a cutting (sometimes) speed of 223 ft. per minute, and a feed of 1.4 inches.

Now if this incident had occurred in "Old Baldy's" shop, my article would have had a very interesting ending, but as it was nothing happened—he got away with it. So the reader will have to imagine, if he can, what "Old Baldy" would have done to him.

SHOP EQUIPMENT NEWS

-Edited By-
E. L. DUNN and S. A. HAND

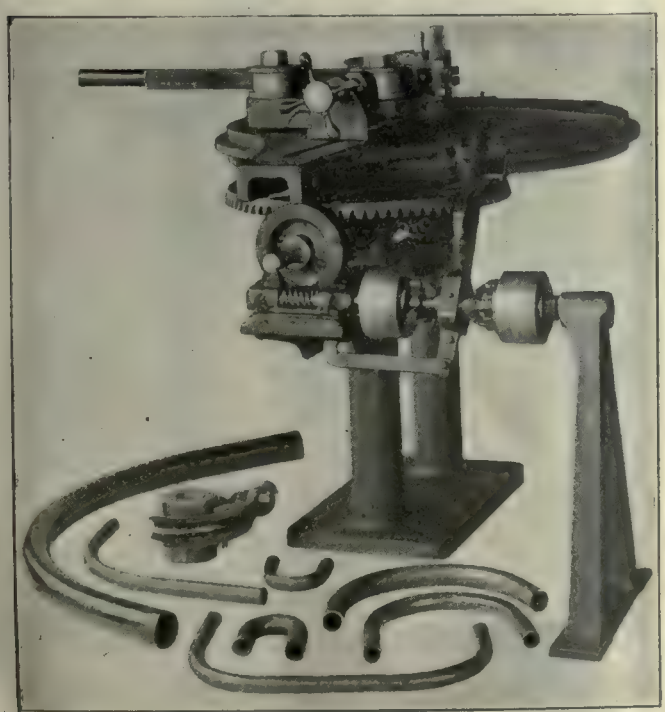
SHOP EQUIPMENT • NEWS •
A weekly review of modern designs and equipment

Descriptions of shop equipment in this section constitute editorial service for which there is no charge. To be eligible for presentation, the article must not have been on the market more than six months and must not have been advertised in this or any previous issue. Owing to the news character of these descriptions it will be impossible to submit them to the manufacturer for approval.

• CONDENSED • CLIPPING INDEX
A continuous record of modern designs and equipment

Wallace 5-A Bending Machine

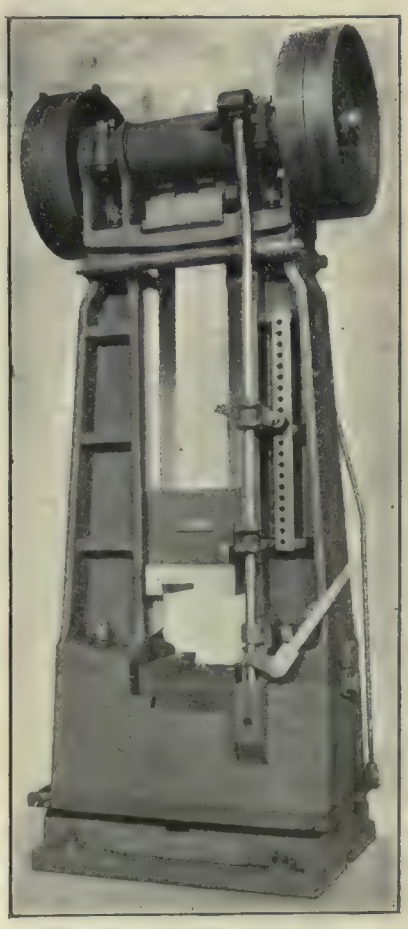
The machine shown is designed to bend cold bars of any shape as well as various sizes of pipe and is manufactured by the Wallace Supplies Manufacturing Co., 412-20 Orleans St., Chicago, Ill. The machine is controlled by a lever that engages friction-clutch pulleys for forward and reverse and is provided with adjustable stops to suit any degree of bend required. The stops are arranged to slide around the edge of the table and a table projection acts as an ultimate limit stop when a revolution is nearly completed. To bend angles, channels and similar material, it is first necessary to make a form and follower bar of correct shape. The material to be bent is clamped to the form, the follower bar operating between the material and the roller. When the bend is complete the machine stops automatically. The roller bracket for the follower bar is adjustable to and from the center, providing a range of circular bends as large as 25 in. radius. Machines with greater adjustment can be furnished when required. Distortion of the material being formed is prevented by a U-shaped clamping plate that holds the work close to the follower. When arranged for bending pipe the machine equipment includes four standard forming heads suitable for pipe ranging in size from 1 to 2 in. These heads will form bends of 90 deg., the radius ranging from 6 to 14 in., according to the pipe size. Bends can be made cold with the above equipment without the use of an inside follower or floating mandrel, and, it is claimed, without flattening the pipe. Special forms with inside follower bars or floating mandrels can be furnished to order for bending light gage tubing. The machine weighs approximately 1,200 lb.



WALLACE 5-A BENDING MACHINE

"American" Drop Hammer

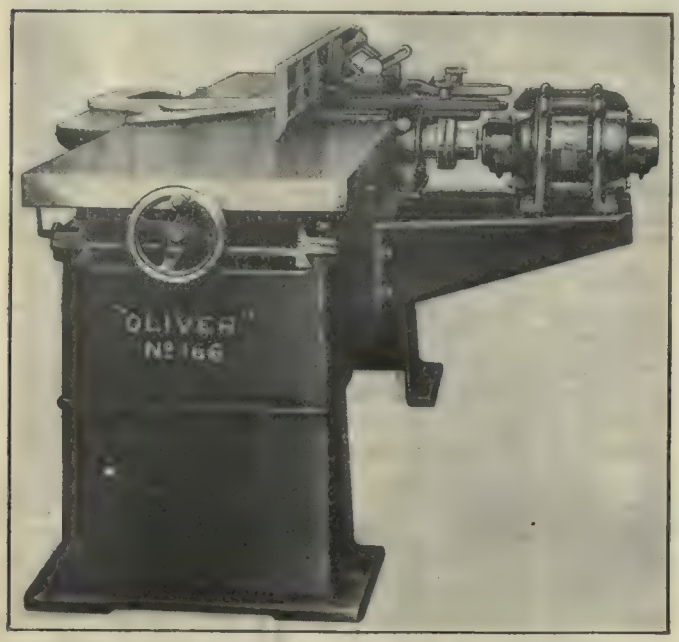
Board drop-hammers of the type shown are a late development of the Long & Allstatter Co., Hamilton, Ohio. Superfluous parts have been eliminated and the increased distance between the V-guides permits the use of extra wide dies, such as are used in the manufacture of agricultural machinery. The frame adjustment for aligning the upper and lower dies is designed for a movement of 0.004 in. and is prevented from loosening by a positive automatic arrangement. The weight of the anvil in proportion to that of the falling ram is approximately fifteen to one and means are provided for recording the various heights at which the ram should be released for each set of dies, thus assuring duplicate work at different periods. The hammer is made in eight sizes, with falling weights ranging in sizes from 100 to 1,200 pounds.



"AMERICAN" DROP HAMMER

Oliver Hand Planer and Jointer

The machine shown herewith, known as No. 166, is made by the Oliver Machinery Co., Grand Rapids, Mich., and is arranged so that a d.-c. motor or an a.-c. motor



OLIVER HAND PLANER AND JOINTER

for one, two or three phase in various voltages can be furnished. In other respects the machine is the same as described in the *American Machinist*, July 17, 1919.

Westinghouse "HK" Motor

For severe intermittent varying speed service where heavy starting torque is required, such as for cranes and hoists, the Westinghouse Electric and Manufacturing Co. has recently brought out the type "HK" direct-current, series-wound motor, especially designed for use where the load consists of a series of starts, stops and reversals.



WESTINGHOUSE "HK" MOTOR

The motor is of inclosed construction with small openings in the lower part for ventilation. Covered openings in the top half of the frame give access to the brushes and the commutator. A prominent feature is its compact construction, giving small overall dimensions, light weight and great mechanical strength.

The motor has a forged open-hearth steel frame and solid forged-steel feet, and when above 3 hp. rating is equipped with commutating poles so that high momentary loads can be carried without series sparking.

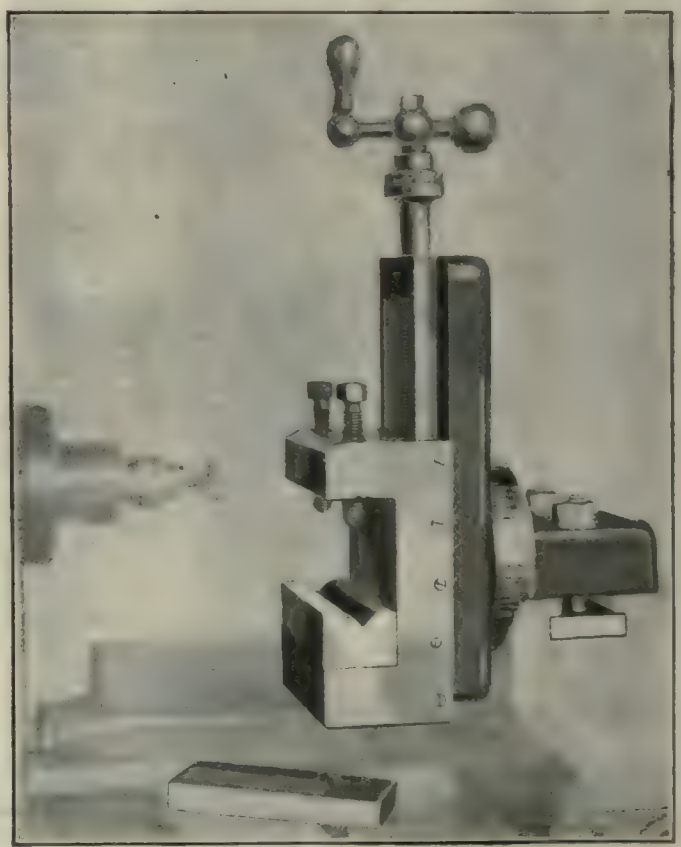
The armature coils are form-wound and thoroughly insulated and impregnated before being placed in the slots. A blower is placed in the rotor which effectively ventilates both armature and field windings. This allows a smaller diameter armature to be used, resulting in low flywheel effect, consequently, little energy is required to start and stop the motor.

Electrically operated, shoe-type brakes are supplied when ordered. They are bolted to the machined lugs on the motor bracket, making a compact unit of motor and brake. The brake is simple and rugged and provision is made for adjusting for wear of parts.

In order to utilize to advantage the ventilated feature the "HK" line of motors has been rated on the one-quarter hour basis.

Davis Milling Attachment for Lathes

The illustration shows the Davis milling attachment built by the Hinckley Machine Works, Hinckley, Ill. This attachment is held on the tool carriage of a



DAVIS MILLING ATTACHMENT

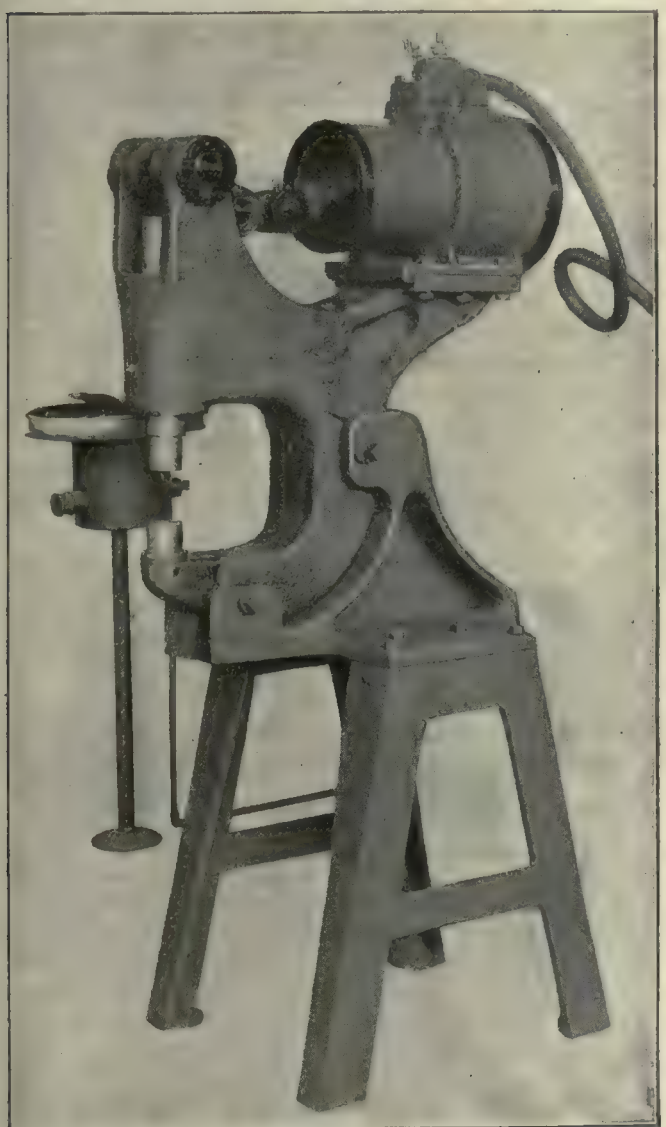
Specifications: Vertical hand feed, 7 in., graduated to 0.001 in. Will swivel in vertical plane to 180 deg. Vise jaws, 1¾ in. deep; 5⅛ in. wide; maximum opening, 4 in. Weight, net, 50 lb.; boxed for shipment, 65 lb.

lathe and serves as a handy device for doing a great variety of milling such as keyseating, squaring ends of shafts, sawing, splitting bushings, drilling and boring.

The illustration shows the attachment in one position on the compound rest of a lathe. By swinging the compound rest it can be brought to any desired angle.

Baird Type Riveter with Stationary Mounting

The illustration shows a pneumatic riveter made by the Baird Pneumatic Tool Co., Kansas City, Mo., and supported on a stand instead of being suspended by a bail. The arrangement of the riveter and stand is intended for use in riveting traction plates on the rims of



BAIRD TYPE RIVETER WITH STATIONARY MOUNTING

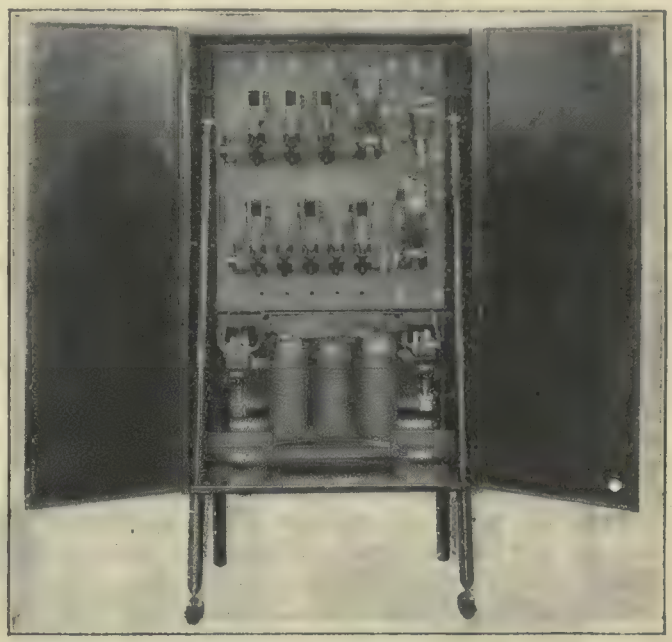
pneumatic tires. The riveter has a 10-in. reach, a 9-in. gap and will deliver a maximum squeeze of 70 tons with 100 lb. air pressure.

General Electric Automatic Starter for Induction Motors

The General Electric Co., Schenectady, N. Y., has developed the automatic starter, shown in the accompanying illustration, for use with squirrel-cage induction motors driving line shafts, pumps, compressors and similar devices. This starter is designed to start by push button, or by the operation of a float switch, pressure governor or some similar automatic accessory.

The starter consists of one 5-pole contactor for starting, one 3-pole contactor for running, a current-limit relay for controlling the contactors, two inverse-time-element overload relays and a set of compensator coils. All this apparatus is mounted on a panel and inclosed in a case which can be locked shut when desired.

The acceleration of the motor is accomplished independently of the operator's judgment. This is accomplished through accelerating relays or current-limit relays, which operate the contactors so as to disconnect the auto-transformer, and to connect the motor on the line



GENERAL ELECTRIC AUTOMATIC STARTER NO. CR-7052 FOR INDUCTION MOTORS

when it is properly accelerated. In starting, the operation is as follows: When the master switch is closed, the 5-pole starting contactor is closed, which connects the compensator coil to the line and to the motor primary leads, thus reducing the starting voltage on the motor. The accelerating relay is also connected to the line circuit, and it operates at a pre-determined current value, opening the circuit to the starting-contactor coil and closing the circuit of the 3-pole running-contactor coil. This circuit is held closed by means of a small shunt coil.

The starting contactor is provided with an interlock, normally open, which makes it unnecessary to hold in the start button or other device during the starting period.

The contactors have solid copper contact tips that are easily renewable, and they are provided with magnetic blow-outs and moisture-proof coils. The compensator winding has two coils for 2-phase motors and three for 3-phase, so as to give balanced starting currents and maximum starting torque. Overload protection is furnished by the two inverse-time-element relays, which are operative during both starting and running. After an overload they may be reset without removing the cover of the inclosing case, by means of handles which project through on the back of the panel.

What Other Editors Think

We Must Save the Railroads

From *Manufacturers' Record*

A MILLION tons of steel and iron are reported as on the cars in the Pittsburgh district, which cannot be moved because of freight congestion.

Much of last year's grain is piled on the ground in Kansas and Texas and elsewhere because cars and locomotives are not available for handling it.

Manufacturers have in some cases sold their product for a year ahead, but their plants are almost idle because they cannot ship the stuff.

Merchandise, manufactured and farm products, running in value to billions of dollars, are held in warehouses, or in cars, on farms or in the factories, because the stuff cannot be moved.

The railroad system of the country, partly through lack of management and partly through unwise Governmental regulation and inaction, is being strained almost to the breaking point. The lack of transportation has already cost the country in the last ten years an amount probably equal to the total invested in all railroads. Our development has been halted, the expansion of trade at home and abroad has been throttled, and the wealth which might have been created has not been brought into existence.

What we have lost by lack of transportation is, however, far less than we will lose unless present conditions are promptly righted. All the energy, all the initiative of the financial strength of the country needs to be thrown into the expansion of transportation facilities ere it be too late to save business from a collapse.

The folly of those who years ago made investments in railroads practically impossible by insisting that railroad builders and investors should have not more than a nominal rate of income, and their action in keeping capital out of railroads by unwise legislation and demagogic appeals to the mob spirit, has cost the country so many billions of dollars that it is difficult to measure the evil influence of the blind leaders of the blind in the fight against a full measure of profit on railroad investments commensurate with the profit in industrial and banking and mercantile properties. We are paying the penalty, and paying it by the billions.

A solution of this great problem is essential to the salvation of our business interests from a breakdown.

Putting aside all of the prejudices of the past, all of the hostility to the railroads engendered by unwise railroad managers, the nation must recognize that it is the people who are suffering more than the railroads.

Unless our railroads are saved and expanded the aggregate loss to the people will be far greater than the total loss to stockholders would be if every dollar of investment in railroad property was wiped out.

With these facts driven home to every farmer and merchant and manufacturer, every professional man and every day laborer and mechanic, there should come a new spirit of appreciation of railroads before there can be a rebirth of railroad expansion in keeping with the country's needs.

An Honorable Labor Union

From *Iron Age*

WHEN the steel strike of last fall was declared, and for some time afterward, the radical leaders, of whom the most prominent was the syndicalist, William Z. Foster, were unable, by pursuasion, intimidation, or any other means, to force the Amalgamated Association of Iron, Steel and Tin Workers, one of the oldest labor organizations in the country, to break its contracts with the steel companies in order to promote the strike. The attitude of the Amalgamated made it so unpopular with the radicals that an open disruption was imminent. The soreness which was felt at that time was never healed, and has just culminated at the recent Montreal meeting of the American Federation of Labor in the decision of the Amalgamated to withdraw from the National Committee of the Federation. At the meeting of the Federation, David J. Davis, vice president of the Amalgamated, said:

"The Amalgamated Association is through with this committee for all time, unless its officials get out. We do not agree with their methods of organization and cannot with honor continue to co-operate with them. The committee would have us violate our contracts with the independent steel concerns, which we are in honor bound to respect."

The position taken by the Amalgamated in Montreal, as well as its action at the time of the strike, reflects great credit upon it. We distinctly recall that at the beginning of the Foster steel strike the one clear note from the side of labor came from M. F. Tighe, president of the Amalgamated, who said to the members:

> Our association has entered into contracts with many employers who recognize and treat with the association in its many functions. These contracts are bonds of honor between men, and it becomes us to honor them as such.
>
> The pledges given by the officials and representatives of both the manufacturers and our association at Atlantic City to hold these contracts inviolate must be ever in the minds of our membership during this scale year.
>
> The strict observance of these contracts on the part of our membership at this time will bring to them and to the association the credit that comes from fair dealing. It will also demonstrate to the world at large the benefits to be derived from the principle of collective bargaining, embodying the spirit of mutual co-operation.
>
> Thousands of our members at this very time are preparing to make every sacrifice to secure for themselves the principle of collective bargaining. Let those of our membership who have that prize show by their fealty to that principle the benefits derived by strict adherence to every feature of it.

It is worth while at this time to recall the above words and realize that there are still some labor leaders who adhere to the old-fashioned notion that a contract is a contract, which even the labor union has no right to violate. It is not surprising that the Amalgamated is breaking away from the Federation, whose president failed to take any stand against the syndicalist, Foster, when the evidence of the vicious teaching of that radical was presented to him.

Business Conditions In England

FROM OUR LONDON CORRESPONDENT

SOMEWHAT sensational reports from New York regarding falls in retail prices were taken up by the press here; let us hope with the view that few things are more effective than example. But when thoughtful articles on the American position reached Great Britain, such as that on the subject contributed by Alexander D. Noyes to your *Evening Post*, it was concluded that general conditions on the two sides were not so very different. We saw the storekeepers in New York advertising in your papers: "The message is sweeping the country. Less 20 per cent.—one-fifth off;" and after a lengthy interval they are being imitated by somewhat similar storekeepers in London, but the reduction offered is considerably lower.

This notwithstanding, the cost of living still tends to rise and is at somewhere about two and one-half times the figure of the immediate pre-war period. Such declines as are noticed are mainly of seasonal good, and even here prices were lower a year ago when under government control. Others relate to articles of food (canned) which the average British person would be more or less content to go without.

Settlement of the cost of living problem has been of real importance to the whole future of the country, because most claims for wage increases have been based on such figures. But for some time a departure has shown itself. The rise in status, as measured by wages, of a body of workers is being boldly urged, one trade or industry being pitted against another by the respective trade union leaders. Once again the women are said to be the tempters. Mrs. Railway worker finds herself a much less considerable purchasing, and therefore social, power than her neighbor Mrs. Docklaborer.

The demands of the railway men have already increased the wages paid yearly on the railways by something like £100,000,000; that is, as compared with pre-war period. Now further moves have been made. The effect will be seen in the estimate that, if the new claims are substantiated, a fare which up to three or so years ago was 20s. will necessarily be increased to 42s. Fares have already been raised by 50 per cent and the new demands imply a further increase by 40 per cent on present fares.

Certain retail businesses have for some few months been showing declines and prophets of bad times ahead have grown rather more numerous.

Real depreciation in the values, to use the commercial phrase, of non-ferrous metals is shown by a comparison of figures for the earlier months of this year. Copper has steadily declined; tin has shown an even greater fall; spelter (zinc) has gone down, and also has lead. In fact, a director of the British Metal Corporation thought fit to issue a circular ascribing the fall to excessive speculation for a rise, alarm at the possibility of a levy on increase in wealth, and withdrawal of credits by the banks. The price of Egyptian cotton, too, has shown marked declines and, because of shortage of orders, during the recent holiday period some Lancashire mills were closed down for a longer period than usual. No real alarm has however been manifested.

METALS AND MACHINERY NOT IN GREAT DEMAND

For various reasons, but mainly high prices, inquiries from the continent for most metal goods have fallen away markedly. But home orders in hand are numerous and no sharp decline need be anticipated. All the same, dates for delivery of engineering finished products certainly get shorter, particularly as applied to machine tools, and of usual sizes the smaller the tool the greater the likelihood (in fact, one might almost say certainty) of getting from stock.

A glance through recently issued lists suggests that British turret and capstan lathes can be obtained from stock up to about three months delivery, or five months for larger sizes. Ordinary center lathes are from stock in the smaller sizes up to three months, and vertical milling machines are entered at from stock up to three months. Small slotting machines can be obtained from stock and hobbing machines in from six to eight months. In short, the supply of machine tools from stock is now much more probable than it was at the beginning of the year.

Great Britain seems to have a plethora of automatics. Many are on the market in second-hand condition, this being a result of the sale of special munition plants, and the demand is by no means equal to the supply. The writer knows of a case in which a well-known American machine, delivered soon after the signing of the Armistice and not unpacked, was bought back by a representative of the firm concerned and sold recently at half the recognized price. Doubtless in this instance special causes could be found. The auction sales of government stocks removed from munition and similar factories continue, and no difficulty is experienced when the tools are of a form that is suitable for peace production purposes. On the other hand, special shell boring and turning machinery is frankly being advertised and offered for sale by weight.

An insight perhaps into the heavier side of the machine-tool market can be gained by comparing two quotations for lathes of practically the same size and type and both from the same manufacturing center. In one instance the machine was 36 in. in height of centers, admitting 16 ft. 6 in. long and weighed 33½ tons. The price, which was firm, was about £5,000, or say £170 to the ton, and delivery was promised for seven months. In the other case was a lathe admitting the same length between centers but 38 in. in height of centers, its weight being 45 tons net. Here the price was subject to the usual conditions and was just about £10,000, or more than £210 a ton, and delivery was in ten to twelve months.

THE OLYMPIA EXPOSITION

Incidentally, it may be suggested that the general commercial and industrial conditions will necessarily have their effect on the machine-tool exhibition which will be held at Olympia, London, W., from Sept. 4 to 25. The exhibition is of course organized directly by the Machine Tool Trades Association, the immediate successor of the Machine Tool and Engineering Association, which was formed at first as a protest against exploitation by private exhibition promoters.

Some few years ago a general engineering exhibition was held at Olylmpia, W., and the floor space of the hall was not more than half covered. The exhibits were mainly machine tools and there was no doubt that everyone showing was perfectly satisfied when, finally, expenses were compared with orders directly received. Consequently, when for the corresponding period of the following year a similar exhibition was projected the scheme was taken up much more thoroughly and the show was more nearly representative. But in the interval trade had slumped. The promoter made quite a considerable sum by way of stand rents, etc., but exhibitors were, owing to the fault of nobody, left in the cold. An exhibition may certainly give a fillip to trade, but will not readily contend against general declining conditions. This was seen at the Frankfurt Fair, held at the beginning of May; here, owing to what has been described as business stagnation, most of the exhibitors were disappointed.

Whether German advertisements shall be accepted by the British technical press has in the past few years been largely decided, it would seem, by various trade organizations that have sprung up or were in existance before the war. The Machine Tool Association, for example, caused its members to insert a clause in their contracts reserving the right to cancel if advertisements of German manufactured goods were also taken. The Federation of British Industries has now, it seems, been approached for a state-

ment of views, but declined to express any definite opinion, leaving the matter for the decision of the individual trader.

By the way, a new business district is being developed between Victoria Station and Hyde Park, a district which will be known to Americans in London having occasion to pay visits to their own government official headquarters. The Associated British Machine Tool Makers, Ltd., now of course have their center in Grosvenor Gardens, having moved from Victoria St. some time ago; near by, they have as neighbors the Cambridge & Paul Instrument Co., Ltd. The would-be tenant in this district however has to go warily, for sub-leases are as numerous as in the case of a successful London theater, and every agent and intermediate lessee has to be indemnified.

The Gas Supply

Through the president of the Board of Trade the government has introduced a bill for fixing the price and quality of gas supplied by municipal corporation and public companies. Instead of the illuminating value, the thermal value of the gas is to be the basis of charges. That is, gas will be sold at so much per 100,000 British thermal units, and the official name for this unit is the therm. The standard price is to correspond, as well as is possible, with the ordinary price per 1,000 cu.ft., allowing for increases in costs and charges since the opening of the late war. It is also proposed that the dividend payable shall depend on the price of gas supply. This has applied to many cases in the past, dividend and price per 1,000 cu.yd. varying inversely, the lower the price the higher the dividend permitted by law to be declared, provided of course it is earned. As is usual, before alterations can be made in declared thermal value the company or corporation supplying the gas must, at their own expense, effect the necessary alterations or replacements in the burners for the consumers. Other provisions relate to the appointment of gas examiners, etc. The minimum pressure in any main or service pipe of 2-in. diameter or upward is to be 2 in. of water, "except as may be otherwise provided." To administer the act a gas fund is to be formed, to be raised from the various undertakings by a levy not exceeding £15 per 100,000,000 cu.ft. of gas made. Undertakings making less than 100,000,000 cu.ft. of gas in the year, these totalling about 10 per cent of the gas made, are exempt, as not justifying cost of collection. It is expected that more than £30,000 will be thus levied per annum.

The Austin Motor Co., the finance of which has been receiving some measure of public criticism, is, it is claimed, now in full producing condition as regards chassis and tractors; that is, for the capital at present issued. Apparently about 2,000 of the new Austin motor cars and 600 agricultural tractors have been delivered, foreign markets being particularly considered in the distribution. In fact, according to the directors' report, the company pursues a definite policy in this respect. It is admitted that the issue at the beginning of the year of £1,500,000 of 10 per cent preferred ordinary shares did not meet with a very ready response from the public, though it was fully underwritten.

In view of failures that have been recorded in these columns (some are being redeemed, though) it may be well to state that the new appeals to the investing world in connection with housing loans promoted by the counties round London have been a considerable success. On the other hand, the new treasury bonds, intended to deal with a floating debt of £1,000,000,000 or more, cannot be so described. The latest figures that have come to the notice of the writer indicate a subscription of about one and one-third million pounds a week. It is recognized that the floating debt must be reduced rapidly, but the terms of the new bonds, with their rate of interest that varies according to circumstances, seem to be rather too complicated for the average investor.

Whatever may have been anticipated of the effect of budget proposals on company promotion, the fact is that registration of new companies has been proceeding at the rate of thirty and more companies a day, the cinema business being responsible for more than a fair proportion. The average capital suggested is perhaps lower than had been expected, the higher duty imposed by the budget having its effect.

Industrial Reviews

HALIFAX.

The further advances in the prices of all classes of iron and steel goods, necessitated by the increased cost of fuel, have brought a temporary pause in business. Quotations for high-speed steels have advanced between 20 and 30 per cent, the trade having derived substantial benefit from the United States market.

In some quarters there is an impression that the top of the boom has been reached. Crucible-steel makers are not as busy as was anticipated, but, judging by the orders being placed for electric steel melting furnaces, there are evidently those who have faith in the future. We understand that the rolling mills and steel foundries are congested with work. At the moment there is a very heavy call for marine castings from the shipbuilding centers in the north and to a lesser extent on export account. Makers of mild steel continue to handle a big weight of orders. Makers of mining plant have a good number of orders in hand for South Africa and Australia. Belgium and Japan are also good customers just now. There is an excellent demand for automobile steel, especially case-hardening material.

Evidence of easier conditions in the heavy engineering trades has become increasingly apparent during the past week or two. Apart from the holidays, the chief cause appears to be the marked falling off in the demand from continental markets. Substantial contracts placed by firms in France and Italy have been modified and others definitely cancelled.

The high costs of production continue to be a serious menace. Again, the Halifax Corporation has increased its rates 6s. 11d., now making the total rates 19s. 9d. in the £. In addition, the assessment of business premises, offices, etc., has been put up 25 per cent.

A few calls among Leeds engineering works show most branches visited to be in a very healthy condition, though shortage of plates still hampers the locomotive builders and the difficulty of obtaining adequate supplies of castings has a restricting influence on output. Electrical engineers, locomotive builders and hydraulic engineers all seem to have as much work as they can conveniently handle. Rice & Co., Ltd., have a wide range of hydraulic machine tools in progress; these include portable hydraulic riveters and presses of fairly large dimensions.

Crosthwaite Engineering and Furnace Co., Ltd. (formerly Scriven's), report a good demand for shipyard and constructional engineering plant. We may specially mention a 5-in. bar shearing machine and a four-spindle horizontal machine designed for drilling the holes in rails for the fish bolts. The drills operate in pairs from both sides of the rail. The spindles are 3 in. in diameter and the weight of the machine is 4½ tons. In this firm's plate-edge planing machine plates up to 35 ft. in length can be dealt with. The driving screw has a double thrust bearing, while the tool-holder is arranged to turn over by hand for double cutting.

Fairbairns have recently completed the first of a batch of vertical drill machines. These tools are driven by fast and loose pulleys through a nine-speed gear box, the diameter of the spindle is 2½ in. and the distance from the center of spindle to column is 18 in. The machine is capable of drilling 2½-in. holes in steel and the approximate weight is 3½ tons. This firm is experiencing a good local demand as well as a good demand from abroad. They recently completed a 20-ton propeller turning lathe with 36-in. centers, and have improved their planing machines. New patterns are now available for planing from 2 ft. square to 16 ft. square up to any length.

The demand for locomotive shop tools is well maintained. This firm recently built a machine for cutting-off the rising heads of steel railway wheels. It weighs approximately 9½ tons without the motor, and the distance from the spindle to the bed is 3 ft. 6 in. The spindle has a 24 in. hole through and an outer stay supports the work. The drive is by a 30-hp. variable-speed motor, while the floor space occupied is 9 ft. 6 in. x 4 ft.

J. Buckton & Co., Ltd., Leeds, recently completed a batch of very powerful vertical-spindle boring mills, with electric motor drive. The diameter of the work table is 50 in. The spindle, 9 in. in diameter, runs in an adjustable bearing, with an improved footstep bearing, the weight of the table proper being taken on circular ways submerged in an oil bath. The boring bar is balanced by a counterweight and has 34-in. variable automatic feed through rack and pinion, worm and wormwheel, and positive gears with disengaging motion and quick hand adjustment. A horizontal hub facing slide similarly has self-acting or hand feed motion, automatic stops being fitted. The work table is driven by a direct-geared variable-speed 15-hp. motor, or by cone and belt drive; in either case a 3-speed change gear box is used, the final drive being by spiral pinion or multi-thread worm of hardened steel, meshing with a cut ring on the faceplate. A friction clutch is fitted for quick stopping and starting, and for safety. If required, the table can be fitted as a 5-jaw concentric chuck with the jaws also separately adjustable.

BIRMINGHAM.

While there is no such serious relapse as to affect current activity in the shops there is a pause in buying perceptible enough to cause questionings as to what it portends. For the time being there are orders on hand which assure employment for some little time to come. Makers of special tools have still considerable arrears to overtake. As regards the general run of common types and sizes, however, delivery can be obtained much more quickly than was the case at the beginning of the year, and buyers are increasingly disinclined to place orders far in advance.

The salient fact in the local situation is that the automobile industry is not opening out opportunities of new business on any great scale. An immense amount of plant has been installed since the armistice, and from one cause and another these installations are not giving results which are calculated to stimulate new enterprise. Output is still suffering from the after-effects of the strike in the foundries and makers of incidental parts and accessories are alleged to have let the motor engineers down by their failure to execute orders punctually and their unreadiness to accept risks with regard to firm contracts at practicable prices. The new taxation proposals have resulted in the cancellation of some orders for cars. This does not cause any immediate concern, as the demand is still much larger than the output and some of the big makers are glad to be able to give more attention to their heavy commitments abroad. The large importation of American cars is being jealously watched and endeavors are being made to speed up production of those classes of cars for which buyers are being forced to look abroad. The cycle trade is not doing much at present in the way of new equipment. Rolling stock yards have plants which suffice for their present needs; in fact the difficulty is to get enough suitable labor. Future developments in this industry hinge very much on reversion to more reasonable prices.

Grinding machines continue in strong demand. Comparatively few find their way into stock, and in those rare instances they are soon snapped up. Generally speaking delivery cannot be obtained under about six months. There is still a brisk demand for planers. There is not the pressure for milling machines that there was, but business still reaches a fair level. A fair number of inquiries are reported for shapers. So much attention has been paid in recent years to gear-cutting installations that something of a reaction has supervened. Drilling machines are in moderately good request. The call for lathes is much less insistent. Toolroom equipment has been elaborated to such an extent that demand seems largly satisfied, though makers of small lathes for miscellaneous purposes are still getting a fair number of orders.

A scheme has been prepared for extending the Birmingham Corporation's electricity works at Nechells at a cost of over 1¾ million pounds. At present the city is without any reserve plant. Consumers are warned that there will be a substantial rise in the present charges for current.

The City of Sheffield Development Committee is issuing the third impression of their pamphlet on Sheffield and the Manufacture of Steel. The list of steel manufacturers will be useful for reference purposes.

We learn that by order of the Secretary of War the use of the metric system is to be discontinued in the American War Department. Despite other statements, its use extended no further than the graduation of gun sights, speedometers, and other instruments to make them conform to French practice and co-ordinate with French maps; in short there was no general adoption of the system.

Alfred Herbert, Ltd., Coventry, is now issuing a pamphlet giving a list of surplus stocks of engineers' small tools. Generally speaking, it is on much the same lines as those of the well-known list of machines in stock, etc. Discounts are stated. Apparently the new list is to be issued periodically. It starts with twist drills and ends with the metallograph for marking small tools, and this will indicate the range.

Sure! Why Not?

BY H. R. SMITH

Elstow, Sask.

Why all this fuss about the metric system? Why should machine tool manufacturers object to it? Machine tools and equipment need not be scrapped, but kept to make repair parts for machines in use until the latter are worn out. A lot of metric machine tools and equipment would be needed to make goods to the metric system and the purchaser of these, the maker of goods, could simply add the extra expense to the price of his goods and let his customer, the ultimate consumer pay it.

A repair man like me would keep all his present tools for repairing present machinery and get an outfit of metric tools for repairing metric machinery; adding cost of same to the bill of the ultimate consumer.

The country could be re-surveyed on the metric system, roads and fences shifted, and any building that would obstruct the new roads moved out of the way; this



would make work for the unemployed for some time and the farmers could pay for most of it (as they have most of the land) and charge it up to the ultimate consumer of their produce.

New railroad equipment of metric gage could be used with present equipment by adding an extra set of rails to the present track. It might take some work to arrange the switches but the section men could do that; they haven't much to do except in winter. The cost could be collected from the ultimate consumer, the passenger, on the ground of extra safety, for the extra rails would act as guards to prevent derailed cars running into the ditch.

P.S. Perhaps you had better not publish this, Mr. Editor. I happen to be an ultimate consumer of several things myself.

SPARKS FROM THE WOR

Valentine Francis

Whitman & Barnes To Manufacture Twist Drills and Reamers Exclusively

The Whitman & Barnes Manufacturing Co., Akron, Ohio, is now manufacturing twist drills and reamers exclusively. The merger of its two drop-forge and wrench factories at Chicago, Ill., and St. Catharines, Ontario, with J. H. Williams & Co., of Brooklyn, N. Y., was officially consummated on June 23.

A. D. Armitage, president of Whitman & Barnes, will be vice president of J. H. Williams & Co., and W. E. Rowell, Whitman & Barnes' secretary, Western manager of J. H. Williams & Co. at the Chicago factory.

The Whitman & Barnes Manufacturing Co. will remain in the twist drill and reamer business exclusively, retaining for this purpose its Akron, Ohio, factory where twist drills and reamers have been made in the past. A new and enlarged plant will be constructed, the plans for which are rapidly developing. When completed, the new factory will be the last word in equipment and facilities for producing twist drills and reamers and will rank among the largest in its class in the country. The present plant facilities are unable to supply the demand for its product and the company reports constantly increasing sales over production.

Coast-to-Coast Record Claimed by Packard

What is claimed as a record for a coast-to-coast truck run was established a few days ago when a Packard three-ton truck, equipped with Goodyear pneumatic tires, arrived in New York from Los Angeles, Cal., having made the entire distance of 3,451 miles in 13 days, 13 hours and 15 minutes.

This remarkable trip demonstrates the long distance hauling possibilities of motor trucks equipped with pneumatic tires. The previous record, made in 1918, for a coast-to-coast trip stood at 17 days and 3 hours. The entire trip was made on one set of pneumatic tires without change.

One of the most interesting things about the record is the fact that it was made by a truck which was not especially constructed for the test. This truck already had rolled up a mileage of over 120,000 miles.

The truck was driven by Howard Scholler and Herbert R. Temple, of Akron, Ohio. It was equipped with 44 x 10 pneumatic tires on the rear and 38 x 7 pneumatic tires in front.

Meeting of American Society for Testing Materials

The American Society for Testing Materials, Engineers' Club Building, Philadelpnia, Pa., held its twenty-third annual meeting at the New Monterey Hotel, Asbury Park, N. J., June 22 to 25.

The first session opened on Tuesday, June 22, and after the usual business was transacted, reports and papers were read on non-ferrous metals and metallography. In the afternoon session, Wrought and Malleable Iron and Corrosion were reported on by committees and papers. Of the latter, H. A. Schwartz spoke on the "Effect of Machining and of Cross-Section on the Tensile Properties of Malleable Cast Iron."

The third session was held on Tuesday evening and included the president's address and reports of administrative committees. This session was followed by an informal dance and smoker.

Steel was the topic chosen for the fourth session and in this connection papers by J. E. Howard and H. M. Howe and E. C. Groesbeck were of interest.

The former's paper was entitled "Shattered Zones in Certain Steel Rails, with Notes on the Interior Origin of Transverse Fissures." Howe and Groesbeck's paper was on "Stresses Caused by Cold Rolling."

The following session covered committee reports and papers on a variety of subjects not analagous to machinery.

While You Are in France

Every member of every commercial body in the United States will be heartily welcome at the offices of the American Chamber of Commerce in France, 32 rue Taitbout, Paris, during his sojourn in France. Fine library facilities—private rooms for conferences—full lists of commercial houses—information on all France.

Every facility offered to Americans in America by its commercial organizations is offered to Americans in France.

Correspondence in relation to French business matters will be thoroughly answered or referred in the proper direction for a full answer.

Federated American Engineering Societies Endorsed by American Engineering Council

The Engineering Council has, in numerous ways, expedited the creation of a comprehensive, representative body to perform for the engineers of America in a larger fashion, such functions as it has performed for the past three years. At its meeting in October, 1919, the council endorsed the general plan for a national engineering council, as outlined by the joint conference committee of the founder societies.

On Jan. 23, 1920, it assembled in joint meeting in the Engineering Societies Building, the governing bodies of all its member societies and United Engineering Society, at which meeting the plan was given strong impetus. Through its Washington office, and otherwise, the council aided the organizing conference of technical societies, held June 3 and 4, in Washington.

At its regular meeting on June 17, 1920, after hearing a report on the organizing conference, the engineering Council took the following actions:

"Voted: That Engineering Council heartily endorses the plan of organization of the Federated American Engineering Societies and the American Engineering Council, adopted by the organizing conference of technical societies in Washington on June 3 and 4, and authorizes its executive committee to proffer and perform on the part of the council such assistance as may be practicable in completing the work of the organizing conference and of the joint conference committee of the founder societies in establishing the American Engineering Council.

"Voted: That Engineering Council authorizes its executive committee to deal with any question of co-operation with the joint conference committee of the founder societies, relating to the permanent organization of the Federated American Engineering Societies, which may come up during the summer.

"Voted: That the secretary be instructed to invite to future meetings of Engineering Council delegates of the societies participating in the organizing conference in Washington, June 3 and 4, and editors of technical journals who may be interested."

ALFRED D. FLINN, Secretary.

The entertainment committee did its work well, every amusement from roller-chair riding to golf being arranged.

LD'S INDUSTRIAL FORGE
News Editor

Charles A. Schieren Co. Has Motion Picture on Leather Belting

One of the most impressing things brought out in the Chas. A. Schieren Co.'s four-reel motion picture on the manufacture of leather belting, is the thoroughness with which hides are tanned and prepared. The time consumed before a hide is ready for shipment to the belt factory is from six to eight months.

From the tanneries the picture shifts to the New York factories where each separate operation in converting a hide into finished belting is shown. A great many special machines shown are interesting, and, on the whole, a correct idea is easily obtained of the processes used in belt manufacturing.

The picture opened with the president of the firm in consultation with two other officers. They did their parts admirably and there is no doubt but that they could become regular "movie" actors with a little coaching. In fact, the personnel of the company was well directed, but few being caught looking into the camera.

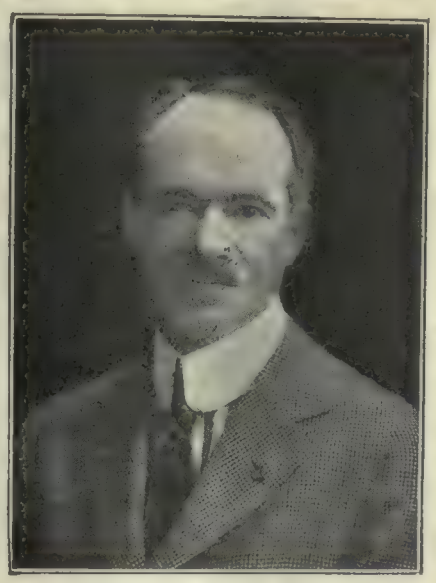
These reels were shown for the first time before a small audience invited by the Charles A. Schieren Co. at the Machinery Club, New York City, and were prepared at the company's tanneries, Bristol, Tenn., and at their factories and office, New York City. They are ready to be released in a series of educational industrial films. Any responsible organization can obtain a loan of the films or have them brought to their meeting and exhibited.

Henry McCoy Norris An Old Contributor to the A. M.

H. M. Norris has contributed to the *American Machinist* for over twenty-seven years. He was born at Trenton, N. J., on Jan. 21, 1868, and after concluding his studies at Lawrenceville, N. J., served an apprenticeship with Bement, Miles & Co., Philadelphia, Pa. Later he spent a year at drafting with the Phoenix Iron Co., Trenton, N. J., and then entered the engineering course at Cornell University. In 1892 and 1893, he was draftsman at the Ferracute Machine Co., Bridgeton, N. J.; the Brown & Sharpe Manufacturing Co., Providence, R. I., and the Pond Machine Tool Co., Plainfield, N. J. In 1894 and 1895 he was superintendent and engineer of the Appleton Manufacturing Co., and the Riehle Bros. Testing Machine Co., Philadelphia, Pa. In 1896, he was general manager of the Campbell & Zell Co., Baltimore, Md., and in 1898 became a stockholder and the superintendent, engineer and works manager of the Bickford Drill and Tool Co., Cincinnati, Ohio. His present position is that of secretary of the Cincinnati-Bickford Tool Co.

He early turned his attention to the design of radial drilling machines, and in 1901 published some of his ideas in "56 Points of Vantage." Another of his designs was the high-speed lathe described in our issue of Jan. 11, 1903, and he has been granted patents on many later inventions.

His first article appeared in these columns Feb. 2, 1893, since which time



HENRY McCOY NORRIS

he has contributed nearly sixty others under such titles as: "Systematic Machine Designing," "A Simple and Effective Method of Shop Costkeeping," "Depreciation of Plant and Its Relation to General Expense," "The Premium Plan of Labor Remuneration," "Power Absorbed in Drilling Various Metals at Various Speeds and Feeds," "An Efficient Routing and Follow-Up System," "The History of the Drilling Machine," etc.

Mr. Norris has been president of the Ohio Society, Sons of the Revolution, governor of the Ohio Society of Colonial Wars, president of the Cornell Association of Southern Ohio and chairman of the Cincinnati Section of the American Society of Mechanical Engineers. He was chairman of the entertainment committee at the joint meeting of the A. S. M. E. and N. M. T. B. A. held in Cincinnati in 1917. He was an officer in the American Protective League and served in the Council of National Defense.

New York City No Longer the Sport of Truckmen's Controversies

The freight which has been accumulating since last March on the piers of the coastwise steamship companies in New York has now been practically cleared away.

This operation sets a mark in the industrial history of New York City from which reckoning will be made in the future. It establishes a new principle—the principle that the business of the city cannot be made the sport of controversies between employers and employees and that the public will hereafter define and maintain its right to the uninterrupted transportation of its merchandise.

The strike and walkout of the coastwise longshoremen began March 13. Union truckmen supporting this strike refused to haul freight to or from the coastwise piers.

The merchants of the city, after trying in vain to bring about a settlement of the difficulty, announced that they proposed to organize their own trucking facilities, which should give impartial service regardless of strikes.

The first step was the formation of the Citizens' Transportation Committee, which includes representatives of the Chamber of Commerce, the Merchants' Association of New York, the Board of Trade and Transportation, the Chamber of Commerce of Brooklyn and the Chamber of Commerce of Queens.

The committee's problem was twofold: First, to create a fleet of rented trucks, since it was not proposed to purchase them, and, second, to provide money for their operation.

It was decided to create an underwriting fund which would be available not only for the trucking enterprise but for any other demand that may be made in the campaign to put an end to the interruption of the transportation of merchandise in and out of the city and in the city itself. The underwriting fund was first set at $1,000,000, then raised to $5,000,000, and now it is aimed to obtain subscriptions of $10,000,000. Its collection is being carried on chiefly through meetings of trade and commercial organizations which undertake to raise money among themselves.

The announcement in the newspapers of what the Citizens' Transportation Committee intended to do brought offers of trucks. These came chiefly from individuals who tendered from one to three trucks, mostly with chauffeurs. In this way a fleet of about 250 trucks was secured.

It was not known when the enterprise was launched what the result was to be and the organizers, therefore, had to prepare for nothing less than a strike. It was thought quite possible that the teamsters and chauffeurs might walk out and endeavor to paralyze trucking of all kinds throughout the city. The committee, therefore, deemed it wise to prepare for such an event so far as possible and to take over all the trucking which union men refused to handle.

The committee established a principle that no strikebreakers were to be used, that all men employed should be New York men, that no private guards were to be employed, and that no employee of the committee should carry weapons of any kind. The policy was established that the constituted authorities should be asked to afford protection and that complete reliance should be placed upon them.

Trucks were engaged upon short-term contracts of two weeks with a renewal privilege. They were all five-ton trucks. Pier superintendents, helpers, longshoremen, checkers, clerks, and all the various employees which the enterprise required were engaged. In supplying the personnel, it was made clear that no man desiring to work would be discriminated against because he was a union man.

It was decided to incorporate the trucking facilities under the name of the Citizens' Trucking Company, incorporated. This company is now a permanent concern, ready at all times to render impartial trucking service if existing trucking companies refuse to handle the business to the detriment of the city's commerce and trade.

This company obtained the names of the consignees of the freight held up at the coastwise steamship piers and canvassed them for authority to remove this freight. Consent was rapidly and in most cases enthusiastically given.

The unions at first were skeptical of the ability of the commercial organizations to establish their trucking machinery upon such short notice. They called the movement "a bluff" and declared that the enterprise which had been undertaken was "impossible of performance." They, therefore, remained quiescent for the first week of operations, but when they saw that goods were actually carried to and from the piers they began to show activity through their pickets and their delegates. However, no violence was shown.

The most important result of the trucking campaign was to bring independent truckmen upon the piers. It was, of course, impossible for the committee to create almost overnight a trucking concern of high efficiency, but when the small independent truckmen saw that freight was being moved from the piers without precipitating violence they began to take orders and they have actually moved more than twice as much freight as the Citizens' Transportation Committee's organization has moved. This participation was welcomed by the committee as the fulfillment of its chief object which is to insure the uninterrupted movement of merchandise.

The Citizens Trucking Co. is about to be placed upon a self-sustaining basis and the volunteer emergency force will retire from its operation until called upon to meet some new emergency.

Being Faithful

By Lucille Crites

Every feller can't be wealthy;
Lots of folks must still be poor,
Just one President is needed
At a time, you may be sure.
All the folks can't boss the railroads,
Or be in a Senate fight;
But each man can still be faithful
To his job—and do it right.

—From *Floating Power Plant News.*

Midwest Engine Co. Being Reorganized

Plans for the complete reorganization of the Mid-west Engine Co., Indianapolis, Ind., and for increasing its output to more than double its present capacity, were announced recently by Stoughton A. Fletcher, principal shareholder of the company.

According to Mr. Fletcher, articles of incorporation of the new company, which is to be known as the Midwest Engine Co., will be filed with the State of Delaware.

The company has completed arrangement for issuing $8,000,000 of preferred stock.

Associated with Mr. Fletcher in the reorganized company are a number of the most successful manufacturers in the Central West, including Lucius M. Wainwright, president of the Diamond Chain and Manufacturing Co.; Walter C. Marmon, president of the Nordyke and Marmon Co.; J. J. Cole, president of the Cole Motor Car Co.; Carl G. Fisher, formerly president of the Prest-O-Lite Co.; Charles B. Sommers, president of the Gibson Co., and James A. Allison.

The Midwest Engine Co.'s main plant and general offices are situated in Indianapolis. The company owns a tract of sixty-five acres on which are buildings and shops having a total floor space of 208,000 sq.ft. The company also owns and operates a large plant at Anderson, Ind., devoted to the manufacture of pumps and small turbines. The company employs at present about 2,400 workmen, many of whom are skilled.

The Technical Institute of the Polish National Alliance of Cambridge Springs, Pa., has obtained from the Government $4,000 worth of machinery, at a cost of $600, in accordance with the provisions of the Caldwell bill, empowering the Secretary of War to sell equipment to technical and mechanical schools at 15 per cent of cost. During the war this institute executed many Government orders of machine tools for the manufacture of guns and bullets. In 1918, the Government sent 400 soldiers to the institute, where, under the guidance of Polish instructors, they became expert mechanics.

Obituary

Louis L. Brinsmade, formerly manager of the Westinghouse Machine Co., and previously for twenty-two years with the Western Electric Co., died on June 16 in New York at 235 West 103rd St., after a brief illness. At the time of his death he was at the head of his own machinery concern. He was born in this city in 1875, and belonged to the following clubs: Engineers, Lawyers, Crescent Athletic, Railroad and the Society of the Colonial Wars.

Personals

Stanley P. Rockwell has resigned his position as vice president of the Weekes-Hoffman Co., Syracuse, N. Y., to become metallurgist of the Whitney Manufacturing Co., Hartford, Conn.

Alfred Spangenberg has been appointed works manger of the Reading Valve and Fittings Co., Reading, Pa., having succeeded J. T. MacMurray, who has resigned.

Edward C. Bailey, formerly manager of the claims department at the plant of the Greenfield Tap and Die Corporation, Greenfield, Mass., is now office manager of the New York City store of the company. He has been succeeded in Greenfield by Harold Shumway who was formerly his assistant.

E. J. Boggan has recently resigned his position as factory manager of the U. S. Metal Goods Co., of Cleveland, to enter the executive organization of the Dittmer Gear and Manufacturing Corporation of Lockport in the capacity of sales engineer. He will devote his entire time to looking after sales matters including the supervision of sales representatives.

Alois Hauser has been appointed assistant to the works manager in charge of engineering, of the Timken Roller Bearing Co., Canton, Ohio. For the past several years Mr. Hauser has been efficiency engineer at the Saucon plant of the Bethlehem Steel Co.

H. L. Wheeler is now with the Carthage Machine Co., Carthage, N. Y., as assistant superintendent. The company manufactures pulp and paper mill machinery.

C. T. Stiles has joined the mechanical goods division of the United States Rubber Co., being located at its Philadelphia office. Mr. Stiles has followed the power transmission engineering

business for eighteen years and has been connected with some of the largest belt manufacturers in this country.

R. R. HOEFER, formerly in the New York territory for the Heald Machine Co., of Worcester, Mass., for several years, is now with the machinery department of the Cleveland Tool and Supply Co., of Cleveland, Ohio. Mr. Hoefer began his new duties on the 15th.

JOHN R. BENSLEY, vice president and general sales manager of the Mercury Manufacturing Co., tractor builders, has recently returned from a seven weeks' trip through the South and in the course of his itinerary he visited Memphis, New Orleans, Jacksonville, Charleston and Baltimore. Mr. Bensley reported great industrial activity throughout the South and looks forward to a good business from this region.

J. W. DE HAAS, director of the Dutch East Indian division of the American Steel Export Co., New York, has left on an extended trip to the Dutch East Indies, Straits Settlements, Federated Malay States, Siam, Indo-China and Burma, in the interest of his company and to develop the trade of these territories in American steel products. Mr. De Hass will be gone for about a year.

Business Items

The Safety Car Heating and Lighting Co., is preparing to move its factory from Jersey City, N. J., to New Haven, Conn., and will give up the Jersey plant entirely. The new factory was used by the Martin Rockwell Co., in the manufacture of munitions during the war.

The Anderson Brothers Manufacturing Co., Rockford, Ill., has moved to the new plant which it has recently built, located in the east end of town at Eighteenth Ave., and Kishwaukee St. This new plant gives the company considerably more floor space and it is planning to expand with increasing business.

The Kelley Foundry and Machine Co., Elkins, W. Va., general foundry and machine business, was organized recently with capital stock of $25,000; the incorporators are Samuel T. Spears, C. H. Hall, S. H. Watring, J. W. Watring, D. J. Blackwood, J. F. Kelley and J. P. Kelley, all of Elkins.

The plant of the Hawthorne Manufacturing Co., Bridgeport, Conn., including the buildings and land, was purchased at auction by Edgar W. Bassick, of the Bassick Co., of the same city, for $105,000. The equipment will be sold at auction later.

At a special meeting of the board of directors of SKF Industries, Inc., held May 13, 1920, the resignation of B. G. Prytz, as president, was accepted, Mr. Prytz having been elected managing director of the parent company, with headquarters at Gothenburg, Sweden. At the same meeting F. B. Kirkbride, vice president since the organization of the company, was elected president to succeed Mr. Prytz.

The Meigs-Powell Co., Montgomery Bldg., Milwaukee, manufacturer of calipers and other precision tools, has acquired a plant at 522 Sixteenth Ave., Milwaukee, which will give them 1,060 sq.ft. additional floor space.

The National Check Writer Co., of Webster City, Iowa, will move its manufacturing plant to Waterloo, Iowa. The company manufactures the National check writer, a machine used for protection in writing checks. The officers of the company are: H. J. Buell, president; W. J. Zitterell, vice president; W. B. Rooed, treasurer; J. A. Boeye, secretary; all of Webster City. The management of the factory will be in the hands of Waterloo men.

Aktiebolaget Galco, Ltd., Stockholm, Sweden, represented in the United States by American Galco Incorporated, Grand Central Palace, New York City, has discontinued its machine-tool business and will in the future devote its energies entirely to the export trade from Sweden. In this connection it has allied itself with Aktiebolaget Bofors, one of Sweden's largest manufacturers, owning extensive steel works, foundries, forge shops and machine shops and rolling mills in the town of Bofors, Sweden. The production in these plants will consist largely of bolt and nut forging and threading machinery, hardware specialties, axes and mining tools.

The Service Casting Co. has recently been organized at Blanchester, Ohio, and will specialize in making small gray-iron castings for the trade. The foundry has been in operation since Feb., 1920, doing contract work. The personnel consists of R. B. Huyett and Charles N. Secrist, both of whom have had wide experience in foundry and machine practice.

The Liberty Machine Tool Co., of Hamilton, Ohio, and the Rockford Lathe Co., of Rockford, Ill., are now represented in the New York district by the Henry & Wright Co., of 136 Cedar St.

The Bertschey Engineering Co., Cedar Rapids, Iowa, has taken over the interests of the Bertschey Manufacturing and Engineering Co., the Peerless V-Belting Co., and the Bermo Welding and Equipment Co. A. J. P. Bertschey is president and Glenn M. Averill, secretary.

The Bullard Machine Tool Co., Bridgeport, Conn., through its agent, Harry A. Burnes, Lovell Building, Stratford, Conn., will dispose of its plant on Broad, Allen and Lafayette Sts., and Railroad Ave., Bridgeport, Conn. The Bullard company has now moved to the new plant in the Black Rock section of Bridgeport. The old factories on Broad St. and Railroad Ave. comprise a floor space of 138,222 sq.ft. available for manufacturing purposes, complete with power, heating, lighting and sprinkler system. The new plant in Black Rock is the one constructed during the war to be used by the Bullard Engineering Works, in the manufacture of large guns, etc., and is a most modern and up-to-date plant in every respect.

The Gray Machine Tool Co., 2661 Main St., Buffalo, N. Y., held a stockholders' meeting and voted to change the name of the concern to the Gray Machine and Parts Corporation.

Chicopee Falls, Mass., is to have the headquarters of the automotive equipment department of the Westinghouse Electric and Manufacturing Co. G. B. Griffith is in charge of this branch of the company's business, but will make his headquarters in New York for the present.

The American Axle Co., Barton, Wis., is a new organization, being capitalized at $150,000. E. M. MacAvoy is president, Peter C. Wolf vice president and treasurer, and George H. Gabel secretary. The directors include W. C. Dayton, M. H. Grossman, Andrew Hauser, S. J. Driessel and H. W. Suckow.

It has been announced that the Silver Sheet Metal Works, of New York City, is now called the Eastern Sheet Metal Works, Inc.

New Publications

Automobile Starting, Lighting and Ignition Systems. By Victor W. Page, M. E., member S. A. E., author of "Automobile Repairing Made Easy," etc. 6th edition. 815 pp., 7 x 5 in., 492 illustrations. Published by the Norman W. Henley Publishing Co., New York. Price $3.

This book is the new 1920 revised edition. It is invaluable to motorists, students, mechanics and repairmen. The subjects are described in a simple, untechnical manner, being easily understood. All forms of automobile-engine electrical ignition systems are described; and included are authoritative series of instruction pertaining to starting and lighting systems and wiring diagrams. Storage-battery construction, charging and maintenance, magneto and ignition distributor timing, care of generators and motors, and systematic location of all electrical faults are also fully described. The book contains over 250 complete wiring diagrams and special instruction is given for using meters in testing. The book is claimed to be the most complete treatise of its kind, practically all 1920 electrical systems being described.

Electric Furnaces in the Iron and Steel Industry. By W. Rodenhauser, E. E., of Germany, J. Schoenawa, Metallurgist, of Austria, and C. H. Von Baur, E. E., formerly chief engineer of the American Electric Furnace Co. Translated from the original by the latter and completely rewritten for this revised third edition. 460 pp., 6 x 9. Illustrated by photographs, drawings and diagrams. Published by John Wiley & Sons, New York City. Price $4.50.

The opening chapters of this work are devoted to the history of the comparatively new art of making electric steel and to the principles underlying the electric furnaces employed. The various successful commercial furnaces are then taken up in detail. To avoid comparing one furnace directly with another the ingenious expedient of comparing each one with a theoretically ideal furnace has been resorted to. A general review chapter completes this section.

Part II deals with the practical features of the operation of electrical furnaces and with the electro-metallurgy of iron and

steel. The materials of construction are taken up in detail as well as the cost of operation of the various types.

We have taken occasion before to call attention to the involved or even incorrect English encountered in technical books and this one is no better than the average. In a case like this one, of a German work translated into English, there may be some small excuse for the Teutonic cast of an occasional sentence, but in books written by American engineers for American engineers to read, there is none whatever.

The reader's attention is called sharply to this defect by the preface to the third edition of this book. Not one sentence in it will stand analysis and the last one is practically meaningless.

Standard Educational Tests. Arranged and standardized by M. E. Haggerty, Professor of Educational Psychology, University of Minnesota. Published by the World Book Co., Yonkers-on-Hudson, N. Y. Price of a sample set of tests, 75 cents.

Two of the first tests in the series are intended for group intelligence testing, and another for testing both intelligence and achievement in reading at the same time in grades 1 to 3. For grades 3 to 9 two different tests are provided. The first test is an illustrated achievement examination in reading. The second is an intelligence test based upon the Army intelligence tests and adapted to both individual and group testing. The examiner needs scoring keys for each test and a manual of directions, the latter being a 64-page pamphlet with instructions for giving and scoring the tests. The examination booklets are sold in packages of 25.

The tests have several valuable features, as they are very easily given and scored and are suitable to pupils of different ages and conditions. The age, forms and grade standards given are based on the extensive use of the tests in both large cities, small towns and one-room rural schools.

Design and Construction of Heat Engines. By Wm. E. Ninde, M. E., Associate Professor of Mechanical Engineering, Syracuse University. First edition. 704 pp., 6 x 9. Illustrated by drawings and diagrams. Published by McGraw-Hill Book Co., Inc., 239 West 39th Street, New York. Price $6.

This treatise on heat engines is based on the author's twenty years of practical experience and his ten years as a teacher at Syracuse University. A good feature is the omission of the usual appendix tables which are found in all handbooks and which are generally superfluous in a book of this kind. The inclusion of the reciprocating steam engine, the steam turbine and the internal combustion engine in one volume has naturally resulted in some abridgement of the treatment of each one, but on the whole the information is sufficient for all ordinary requirements.

The book is somewhat marred by unedited "engineers'" English and the usual first edition proofreader's errors are present.

The following general headings are taken up: Part 1—The Heat Engine; Part 2—Thermodynamics; Part 3—Friction and Lubrication; Part 4—Power and Thrust; Part 5—Mechanics; Part 6—Machine Design.

Problems of Labor. By Daniel Bloomfield, Partner, Bloomfield and Bloomfield Boston. The Handbook Series, XXI and 436 pages, 5 x 7½ in., cloth board covers, $1.80. Published by the H. W. Wilson Co., New York City.

In this volume are assembled and reprinted some of the best things that have been recently published upon the following subjects related to labor: Causes of Friction and Unrest, Cost of Living, Methods of Compensation, Hours of Work, Tenure of Employment, Trade Unionism, Labor Disputes and Adjustment, Limitation of Output, Industrial Insurance, Methods of Promoting Industrial Peace, Occupational Hygiene, and Women in Industry. The articles are written by such experts as Louis F. Post, Frank W. Taussing, John A. Fitch, Lord Leverhulme, and Samuel Gompers, thus giving a wide range of view point. All phases of the labor problem are ably and concisely treated. The book is well indexed and a bibliography, classified according to the subjects covered by the reprinted articles, is provided.

The Engineering Index for 1919. Compiled and published by the American Society of Mechanical Engineers, 29 West 39th St., N. Y. 528 pages; 9¼ x 6¼ in.; cloth board covers.

The American Society of Mechanical Engineers acquired the Engineering Index at the close of 1918, and since that time has published it monthly in the Society's publication, *Mechanical Engineering*. The book under consideration is the first bound volume of the index brought out by the A. S. M. E., and it differs somewhat from the former editions. The arrangement of the topics is entirely alphabetical, there being no grouping of items under the different divisions of engineering, as was formerly done. Besides the information descriptive of each article indexed, such as the name, author, and the periodical in which it appeared, each item contains a brief note summarizing the article.

The Index contains over 12,000 items referring to articles in nearly 700 engineering and allied technical publications, and the staff of the Society has "endeavored to make it the most complete and comprehensive work of its kind ever published."

Catalogs Wanted

The United States High Speed Steel and Tool Corporation, Plant No. 2, Green Island, N. Y., would be pleased to receive catalogs from manufacturers of machinery in order to complete its files.

Trade Catalogs

Dyehouse and Bleachery Ventilation. Buffalo Forge Co., Buffalo, N. Y. Catalog No. 721, 8½ x 11 in. This company has studied and experimented carefully the problem of dyehouse and bleachery ventilation and is presenting to the public an illustrated catalog on this subject.

Insulating Materials and Supplies. Westinghouse Electric and Manufacturing Co., East Pittsburgh, Pa. Catalog 5-A-1, pp. 24, 4 x 7 in. This catalog gives a complete list of all insulating materials and supplies manufactured by this company. Included in the list of products described are: mica micarta and bakelite plates and tubing, treated and untreated cloths and papers, insulating and soldering compounds, insulating oils and tapes.

Welding and Cutting Equipment. Davis-Bournonville Co., Jersey City, N. J. Catalog, pp. 15, 3¼ x 6¼ in. This catalog describes briefly its oxy-acetylene and oxy-hydrogen equipment, portable outfits, acetylene, oxygen and hydrogen production, regulating and reducing valves, welding torches and tips, cutting torches and tips, welding and cutting machines, and oxygen and hydrogen plants.

How to Judge Engines. Witte Engine Works, Kansas City, Mo. Booklet, pp. 36, 10 x 12¾ in. This booklet has been written by Ed H. Witte, president of the Witte Engine Works, and gives a general description of engine construction and engine selling. The first few pages describe the Witte engine in the various sizes and styles, and the last half of the book covers in detail not only the construction of the Witte engine, but various other engines.

Measuring Machines. The Golden Co., manufacturers' representative, 405 Lexington Ave., New York. Catalog No. 234, 5¾ x 8¾ in. This catalog describes and illustrates the universal measuring machine which is used for the checking and control of standards and scales of every form. This machine is made by Société Genevoise d'Instrumens de Phvsique.

Sheffield and the Manufacture of Steel. City of Sheffield, England. This short pamphlet is designed to give information about Sheffield and its industries upon which its prosperity and facilities depend.

Hacksaws. L. S. Starrett Co. Athol, Mass. Booklet, pp. 63, 4¾ x 7 in. This booklet is written for the large class of men to whom a hacksaw is merely a hacksaw; a tool whose proper use is not understood because they have not had the opportunity to learn, and this information is very valuable to machine-shop men. It covers experiences of all hacksaw manufacturers.

Tumbling Mills. Whiting Foundry Equipment Co., Harvey, Ill. Catalog No. 153, pp. 27, 6 x 9 in. The advantage of cleaning castings; description of operation on water cinder mills and the table of sizes is given in this catalog. Several different types of mills in some large machine shops are also shown. A copy of this catalog will be sent upon request.

Appliances for the Mechanical Transmission of Power. Fairbanks Co., New York City. Catalog No. 935, 7¾ x 10¾ in., 251 pages printed on excellent coated stock and clothboard covers, and replete with illustrations. This catalog supersedes all previous issues and covers completely the many lines handled by the Fairbanks Co.'s transmission. Tables and specifications have been worked out with care and precision to assist the purchaser to determine his transmission requirements. All in all, this catalog is one of the best that we have seen.

Oxy-Acetylene. Davis-Bournonville Co., Jersey City, N. J. Catalog, pp. 16, 6 x 9 in. This company has issued a temporary catalog of the Davis-Bournonville acetylene generators, welding and cutting torches, pressure regulators, portable outfits and supplies.

Bearing Alloy. The Ajax Metal Co., Philadelphia, Pa. Circular, 3¾ x 6¼ in. This circular gives several reasons why some industrial concerns have adopted Ajax ball-bearing alloy.

Gisholt Products. Gisholt Machine Co., Madison, Wis. Booklet, G. P. E., pp. 24, 5¾ x 7¾ in. This booklet illustrates only its various products such as turret lathes, vertical boring and turning mills, universal tool finders, drilling machines, toolpost holders, reamers, boring bars and chucks.

Automatic Chucking Machines, Automatic Screw Machines, Tractors, etc. The New Britain Machine Co., New Britain, Conn. Folder, 8½ x 11 in. This folder describes some of the automatic labor-saving machinery made by the New Britain Machine Co.

Sandblasts. Pangborn Corporation, Hagerstown, Md. Catalog, 4 x 9 in. This catalog is printed in Italian describing Pangborn sandblasts and allied equipment.

Export Opportunities

The Bureau of Foreign and Domestic Commerce, Department of Commerce, Washington, D. C., has inquiries for the agencies of machinery and machine tools. Any information desired regarding these opportunities can be secured from the above address by referring to the number following each item.

An importing firm in Syria desires to be placed in touch with exporters of agricultural implements, trucks, machine tools, hand tools. No. 32,900.

A firm in Spain desires to purchase from manufacturers and export firms machine tools, lathes, etc. Quotations should be c.i.f. Bilboa. Correspondence should be in Spanish. References. No. 33,147.

A manufacturer in Belgium desires to secure an agency with stock of goods for the sale of machine tools, such as taps for gas and water, elevating apparatus, steel, files, bolts, screws, rivets, cotters, vise, anvils, ventilators and mortar engine. Correspondence and catalogs in French. No. 32,958.

A firm of engineers in Scotland desires to secure agencies for the sale of raw material such as pig iron, copper, zinc and tin; tools, lathes, drilling and milling machines. Quotations should be given c.i.f. Scottish port. Reference. No. 33,048.

Forthcoming Meetings

The International Railway Master Blacksmiths' Association will hold its next annual convention at Tutwiler Hotel, Birmingham, Ala., on Aug. 17, 18 and 19. The secretary of the association is A. L. Woodworth, Lima, Ohio.

The American Steel Treaters' Society and the Steel Treating Research Society will hold their second annual convention and exhibition at the Commercial Museum, Philadelphia, Pa., on Sept. 14 to 18, inclusive. J. A. Pollak, of the Pollak Steel Co., Cincinnati, Ohio, is secretary of the former society.

The American Foundrymen's Asssociation will hold its annual convention and exhibit at Columbus, Ohio, on Oct. 4 to 9. C. E. Hoyt, 1401 Harris Trust Building, Chicago, Ill., is secretary.

An exposition of U. S. manufacturers at Buenos Aires, Argentine Republic, S. A., has been arranged for the month beginning Nov. 15. Information can be obtained from the American National Exhibition, Inc., Bush Terminal Sales Building, 132 West 42nd St., New York.

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Wickes Crankshaft Line-Bearing and Flange-Turning Lathe

By J. V. HUNTER
Western Editor, *American Machinist*

Production of automotive crankshafts in large quantities requires highly specialized machinery. Such machinery, embodying the ideas of many designers, has been built from time to time only to be superseded by some later design better adapted to the work—and the end is not yet.

WITH the idea that high-duty production requires an exceptionally rugged machine tool, Wickes Brothers, Saginaw, Mich., has developed a line of lathes especially adapted to turning the line bearings and flanges on automotive crankshafts. To obtain the highest quality and rate of production from machines of this class it is required that the tooling be designed by a specialist and consequently all these machines are built complete with the tooling for the jobs upon which they will be used.

These lathes are built only in one size of 20-in. swing. It is optional with the buyer whether they shall be of the belt-driven type as shown in Fig. 1, or furnished with motor drive, as shown in the cheek-turning lathe in Fig. 2.

The bed is of deep, heavy box-type construction and has a single V in front and a flat way on the back upon which the carriage rides. The tailstock is of heavy-duty standard construction and is carried on a separate set of ways of the same construction as those for the carriage.

The headstock is back-geared, the ratio being arranged to suit the job. The back-gear shaft is provided with ring oilers.

The spindle is made of 0.40 to 0.50 carbon steel with a collar on the work end forged integrally and all bearings are ground to size. It is equipped with ball-thrust bearings on the rear end. The cone pulley is bronze bushed and has three steps. A Hilliard multiple-disk type clutch is used for transmitting the power. The brake band is made in two parts and is lined with high-grade brake lining. The spindle bearings have sight-feed oilers. It will be noted that there are six spindle speeds, but as a double-speed countershaft always is furnished with the machine, twelve speeds are available.

The transmission between the main spindle and the quick-change gear-box is by spur gears. The gear-box has eight feeds, four from the quick-change box and four for an auxiliary box operated by a lever which controls a split-feed. The initial feeds are $\frac{1}{8}$, $\frac{1}{16}$, $\frac{1}{32}$ and $\frac{1}{64}$ in. The split feed halves the difference be-

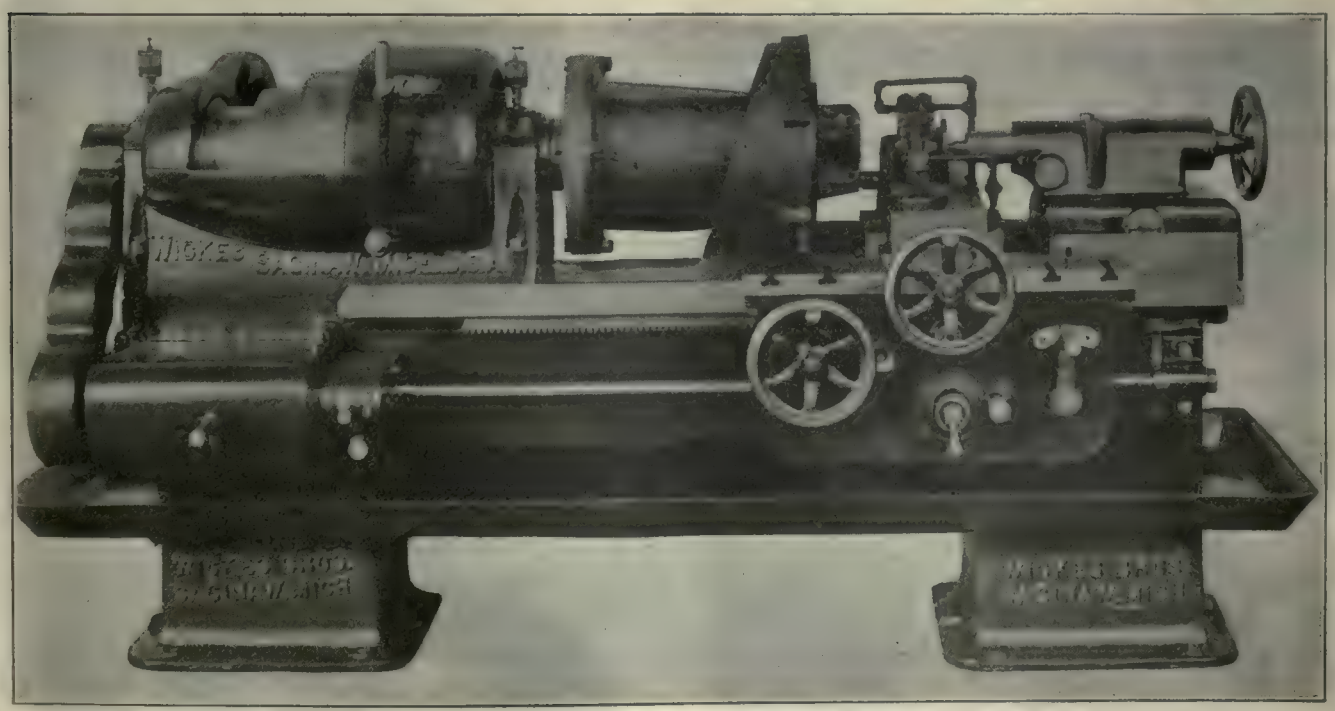


FIG. 1. WICKES BELT-DRIVEN CRANKSHAFT LINE-BEARING AND FLANGE-TURNING LATHE

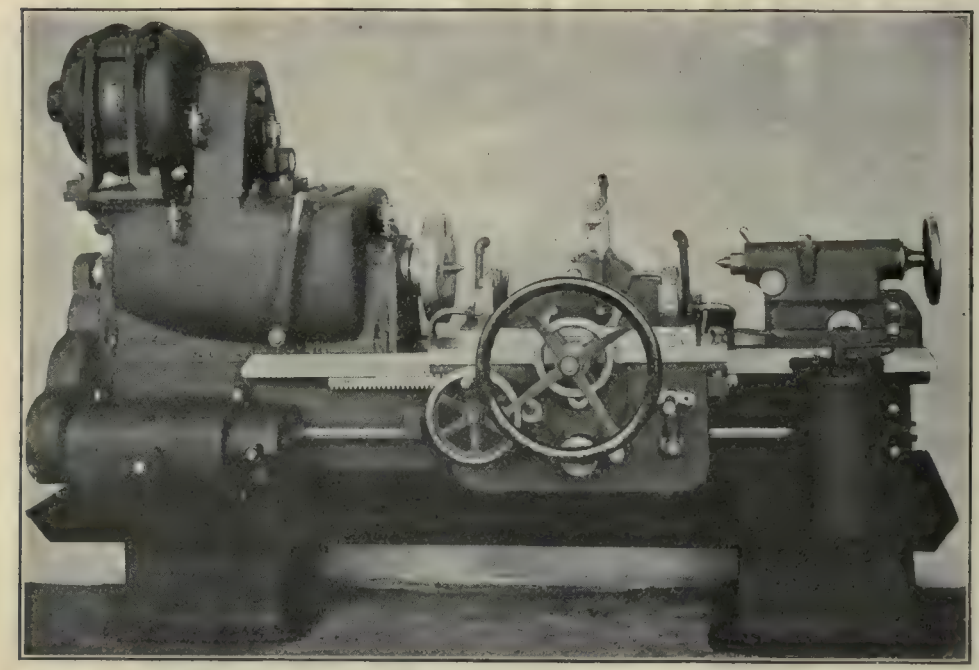


FIG. 2. MOTOR-DRIVEN CRANKSHAFT CHEEK-TURNING LATHE

tween the regular feeds, thus adding the additional four feeds of $\frac{3}{32}$, $\frac{3}{64}$, $\frac{3}{128}$ and $\frac{3}{256}$ in.

An advantage claimed for the split-feed arrangement is that the operator can start the machine at a slower feed for the larger diameter of work, on such as facing flanges, and as the diameter decreases he can throw in the split-feed in order to obtain a higher rate of feed for the decreasing diameter.

The carriage is of heavy construction for carrying the heavy tool loads imposed, and is taper gibbed both back and front.

The apron is provided with friction-drive for both longitudinal and cross feeds. The frictions are engaged by a device allowing quick action and ease of adjustment. It may be controlled with either hand or by the knee when the hands are busy. The handle for this friction will be noted on the apron, in Fig. 1, in the position usually occupied by the knob commonly used for this purpose.

The regular equipment of the carriage includes a double tool block which is held down by taper gibs and provided with additional gibs on each side at the rear to take the upward thrust of the back tools. Cast-steel multiple or single toolholders, shown in Fig. 3, are provided, the design of which admits of supporting the tools close to the cutting point, thus insuring a minimum overhang. The toolholder bolts go clear through into the tool-block, insuring rigidity. The toolholder clamp is used as a carrier for feeding the coolant to the cutting point of the tool. In Fig. 4 it will be noted that the coolant pipe *A* is tapped directly into the toolholder clamp *B*. The latter is drilled through lengthwise, the hole connecting with that tapped for the pipe. The coolant is delivered at *C* and flows over the cutting edge of the tool.

A pot-chuck is provided to support the work rigidly and prevent chattering. Its use also avoids the necessity of turning a spot on the work for a steadyrest. The pot-chuck is so designed that the crankshaft is supported close to the point where the work is done, thus minimizing a tendency of the work to twist.

The pot-chuck is of cast steel and is supported by a steadyrest at the outboard end. The bronze shoes of the steadyrest are wide enough to overspan the slot cast in the top of the pot-chuck to permit ready placing and removal of the crankshafts. Each pot-chuck is designed especially for a particular crankshaft.

As previously mentioned, the lathe can be furnished either belt or motor driven. The latter type of drive uses either a multi-speed a.c. motor, or a variable-speed d.c. motor. When constant-speed motor equipment is required a selective geared headstock is furnished which provides 12 speeds. The size of the motor ranges from 3½ to 5 hp., depending upon the service required. The drive is through a rawhide gear placed between the steel motor pinion and the driven gear, thus insuring quietness of operation.

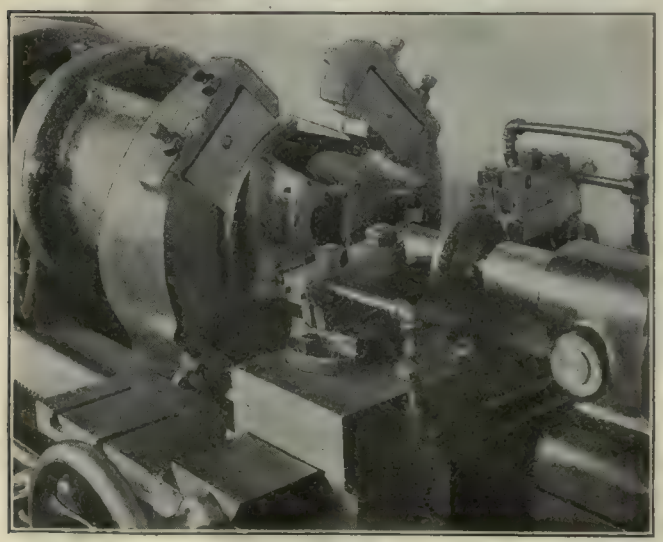


FIG. 3. SHOWING POT-CHUCK AND TOOL EQUIPMENT

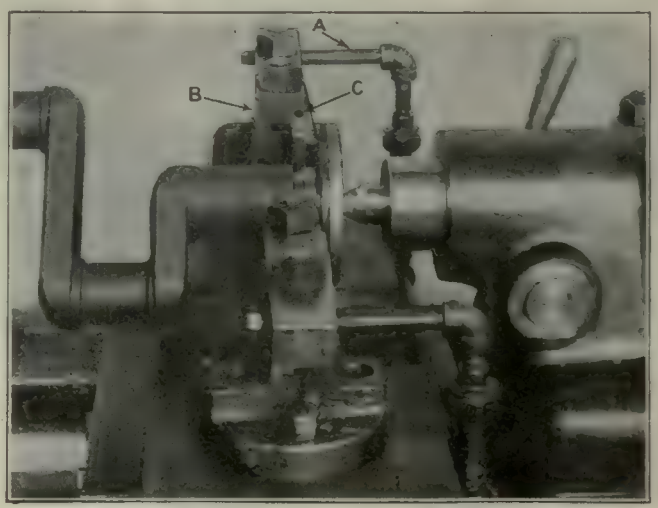


FIG. 4. TOOLING FOR FLANGE TURNING

How Do You Regulate Materials?—II

By HENRY H. FARQUHAR

The functions with which the present paper deals center in the receiving and storing of materials after they come into our posession. The authority by which they come in is, of course, the purchase order, and no goods must be received except upon this authority.

(Part I was published in our June 24 issue.)

The Receipt, Storage and Records

THE preceding article in this series dealt with some of the more important considerations in the regulation of supply, outlining certain principles and rules by which one may secure a constant and almost automatic flow of suitable articles to the point of use. Five planks of the material platform were laid down, the gist of the five being: (1) Centralization of authority and responsibility, and (2) regulation of replenishment according to use rather than the whims of individuals or other accidental factors. From these principles there were formulated five rules:

I. Replenishment of materials should be governed strictly by requirements for production during a reasonable future period.

II. There must be predetermined specifications for each article purchased.

III. All replenishment orders shall be in writing and may be issued only by specified persons.

IV. All replenishment orders shall be approved before they may be honored by the purchasing agent.

V. All purchase orders shall be in writing and must be systematically followed up.

The guiding principle in the receipt and storage of material is unified authority and responsibility; hence the following most obviously successful rule may be formulated:

VI. All Persons Concerned Directly in the Transaction Shall Receive a Copy of the Purchase Order

By following this rule we obtain an effectual check against material being dumped on us which we did not order and do not want. We also make collusion more difficult and establish checks against forgetfulness, against useless inquiries as to when orders were placed, against delivery to the wrong person or place, and so on.

Although it is bad practice, this step is sometimes omitted even in the case of the receiving clerk. Much additional and unnecessary work is thereby thrown upon him in checking up when materials arrive.

Opinions differ as to whether the receiving clerk should be told how much of any item is expected, or whether he should (by means of a short carbon) be informed simply that goods of a certain kind are due from a certain dealer. Each method has its advantages and disadvantages, and the matter is not ordinarily one of great importance. If sufficient checks against carelessness and dishonesty be instituted, there is no objection in practice to telling the receiving clerk exactly how many parts are expected, and his work is considerably expedited.

As a check on the actual execution of orders placed a second rule for control of material once purchased logically follows:

VII. There Must Be a Careful Count and Inspection of All Goods Received Before They May Be Stored or Released for Use

Some very surprising occurrences sometimes take place within the walls of a factory. One would think from the very nature of the case that materials would be considered of a value at least equal to their value in money. Such, however, is seldom the case. If you will analyze the subject carefully, I believe you cannot escape the conclusion that materials are very much more important than an equivalent sum of money. They should be as carefully looked after, and the modern material system should resemble the modern banking system to a large extent.

It is folly therefore to do as one manufacturer of my acquaintance did up to a short time ago. He had worked up excellent specifications, but under existing receiving methods he might as well have saved himself this expense, for when goods arrived he allowed them to go to the storeroom in blissful faith that the dealer had done exactly as he was expected to do. The awakening was sad but salutary.

A safe rule to follow in inspecting is to put as much care into the inspection as was put into the specifications. This means that in some cases a count is all that is necessary, while in others a very careful analysis must be made. Rejects should be immediately disposed of and cleared out of the way.

To connect the effects of this rule with those of the preceding one and check receipts against the outstanding copies of the order a wise rule is:

VIII. Notice of Receipt of Materials Shall Be Given Immediately

A case occurred recently in which a purchase order was sent out in a great hurry, with instructions to "rush delivery." The materials, it was found later, came in as ordered; but only after a week's delay and after insistence of the dealer that he had shipped the order, were the goods finally located in a corner of the receiving room. Production had meanwhile

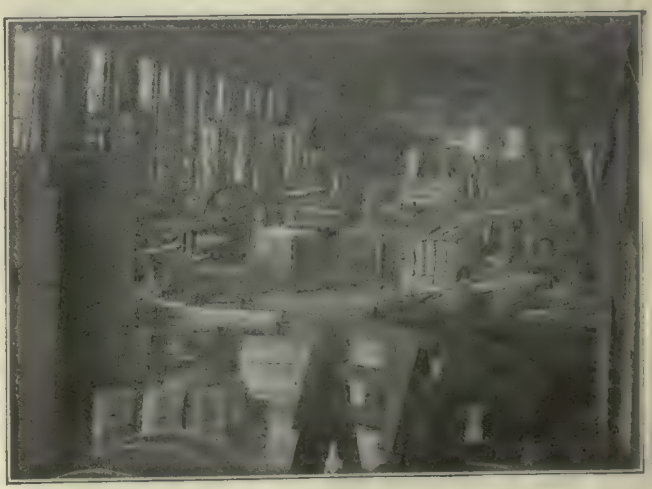


FIG. 3. WORKING SPACE USED FOR STORAGE IN VIOLATION OF RULE X

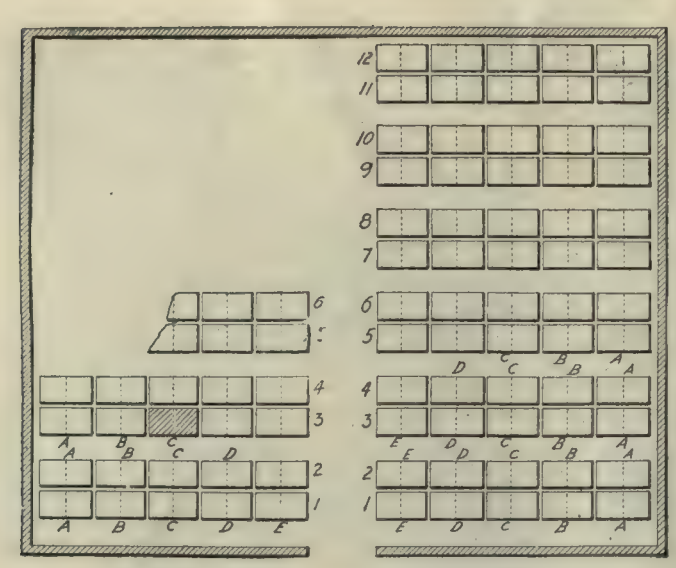


FIG. 4. METHOD OF INDEXING RACKS AND BINS

been held up. Since in the balance sheet is centered all information as to the state of materials, to the balance clerk immediately upon receipt must be sent a notification of arrival. The same notice may then serve the purchasing agent and the auditor.

Looking next at the question of storage, it must be clear that on the adequacy of the administrative and physical arrangements in this respect depends the effectiveness in practice of all preceding rules. The storeroom, to a greater extent than many realize, determines the accuracy with which we may govern materials, and as a consequence several important rules may be issued for its regulation:

IX. Responsibility for Storage and Issue Must Be Centralized

The mistake is often made in the medium-sized plant of failing to centralize storeroom responsibility, under the assumption that because we must have de-centralized storage we must therefore have de-centralized responsibility. Personally, I advocate the central storeroom where it seems at all practicable (among other reasons because it tends to force anticipation of needs) but many cases occur where it is out of the question. In such cases, however, there may and should be central responsibility for receipt, for storage, for issue, and for the regulation of policy and procedure.

X. Storage Other Than in the Storerooms Should Be Reduced to a Minimum

Upward of 55,000 lb. of scrap metal, the catch of a thorough housecleaning, was sold from one department of a New England machine shop. It was unearthed from around machines, under benches, in the aisles and corners, and consisted of both raw materials and partly worked parts which had become permanently sidetracked. The policy until that time had been to let the foreman arbitrate between the sales manager and the other production foremen of the plant as to when any given job should be processed. As a result, jobs were frequently broken down to please one or another of these officials, and the work thenceforth became neglected. Were not this an actual and a recent case, it would appear too ridiculous to cite. It is not an uncommon policy even today, as may be seen in Fig. 3.

Another potent cause of loss in many plants is the policy in handling departmental supplies. It is always a little difficult to draw the line as between what may be held in the shop, and what must be stored in and issued from the storeroom. In general, however, it may be accepted that when a job in process is interrupted for what will probably be more than a few hours. all parts in process should be turned over to the storeroom accompanied by proper notations of the fact; and that departmental supplies (such as bolts, screws, etc.) should be issued to the work place and charged off at once to the proper expense account in quantities sufficient to last only a few days, the main source of supply remaining under the custody of the storekeeper and controlled through the regular routine.

XI. The Storerooms Must Be Accessible Only to Authorized Persons

The success with which so many plant activities may be controlled hinges at many points on the accuracy of the inventory. Consequences have at times been very distressing when we thought we had 100 pieces on hand when there were actually only 85. Our accounting statements furthermore are misleading unless our inventories of materials and work in process be correct. Primarily, in order that we may maintain any semblance of control, therefore, and only secondarily because some among us have the habit of pocketing what does not belong to us, we must have a locked storeroom. The psychological effect furthermore is excellent. I told one manager the other day: "You have no more right in this storeroom without permission of the storekeeper than the humblest workman." The strange part of this story is the fact that he smiled and agreed with me.

XII. Materials Shall Be Stored and Indexed According to a Systematic Scheme

It is not an uncommon occurrence in many storerooms to be put to considerable inconvenience and delay simply because a needed article cannot be quickly located. The knowledge of the whereabouts of any item should not be confined to any one's head, for heads are sometimes unavoidably lost in times of greatest need.

Where a good system of stores and worked materials



Courtesy Universal Winding Co.

FIG. 5. RACKS WITH INTERCHANGEABLE STORAGE UNITS

symbols is in use, the most satisfactory method of storage by all means is alphabetically by symbol. With standard interchangeable racks and bins such arrangement, particularly in the metal-working storeroom, is easily maintained, and aside from the symbols which should be on each bin, no other indexing system is ordinarily needed. Such a systematic arrangement by symbol is not always possible for all items, however, and in such cases, or where such symbols are not in use, the rows of racks, the individual racks themselves, and the separate bins within each rack must be numbered and lettered according to a definite plan, with a cross index to show just where each item is to be found.

Fig. 4 illustrates a satisfactory method of indexing storage racks and bins in accordance with Rule XII. The method here followed is similar to that used in numbering houses in a city. The shaded area represents plan of one standard rack four stories high, into each compartment of which fit interchangeable bins (see Fig. 5) of suitable dimensions. The complete rack is designated B 3 C, and the location of an article in a bin in the second story from the bottom would be B 3 C 2.

Where materials may be stored according to symbol, such a method of indexing is of course unnecessary.

XIII. Movable, Interchangeable Storage Units Should Be Used as Far as Possible

Continual rearrangements, particularly in individual racks and bins where other than bulk goods are stored, but also frequently in the whole layout, are desirable in most storerooms. All equipment, therefore, should lend itself readily to such changes. Racks and bins should very seldom be built-in, and they should, so far as possible, be absolutely interchangeable. Standard bins of various appropriate sizes should fit interchangeably into any racks throughout the storeroom, so that, with the expanding and contracting requirements of different articles, an easy rearrangement will prevent "over-flow" bins, keep all of any one item together, and provide maximum space utilization.

Somewhat akin to this subject is that of attention to labor-saving devices in general—a subject which will repay much time and investment. There are many little wrinkles and facilities which may be utilized in counting, storing, and especially in transporting materials, and which in the aggregate will save many hours' work in the average storeroom.

XIV. Double Binning Should Be Used Wherever Possible

Double binning, by which one bin is used for all incoming material of any kind and its brother for all issuing, the process being reversed when the latter becomes empty, serves many uses in connection with material control which can be only hinted at. For instance, I have seen iron washers dumped from the bottom of a bin so rusted and caked together as to be almost unrecognizable. They had lain there for months undisturbed during the putting in and taking out of those above them.

Double binning would have aided materially in preventing such occurrences. It would, moreover, have furnished incidentally numerous checks on amount in keeping perpetual inventory. Fortunately, double binning, or double piling, adds on the average probably not over 33 per cent to the amount of space required over single bins or single piles. This additional space may ordinarily be provided in the average storeroom through attention to a more effective arrangement and a better space utilization. Double binning may be seen in the rack in Fig. 5.



Courtesy Universal Winding Co.

FIG. 6. RACK FOR BARS AND PLATES (NOTE METHOD OF DESIGNATING INDIVIDUAL BINS)

Finally, all transactions in materials must be covered by adequate records. The more important records covering replenishment were touched upon in the preceding paper, and, as there explained, the balance sheet constitutes the running history of most of the transactions which it is necessary to have covering materials. In order that this history may continuously serve the needs of production, two rules should be enforced:

XV. A Perpetual Inventory Should Be Maintained on All Goods

Periodic inventories (annual, semi-annual, quarterly) are fortunately rapidly becoming things of the past. Modern business cannot wait for periodic stock-taking —the information of amounts on hand must be available constantly and immediately for day-to-day planning and accounting.

I do not propose to go into a discussion of the merits of the perpetual inventory and the demerits of any other kind, but I simply wish to say that the manufacturing industry is yet to be found where the perpetual inventory is not perfectly applicable, more accurate, cheaper, and of infinitely greater utility than is the periodic. It is simple to install, easy to operate, and, with proper checks, accurate even beyond practical requirements.

XVI. Balances of Materials Must Be Kept on Bin Tags and on Balance Sheets, With Constant Independent Checks Between Them

Neither the bin tag nor the balance sheet alone is sufficient—one is a complement to the other and should be so used.

In one case which I recently had the pleasure of looking into, the manager rather prided himself on his "stores system." "Just see," he said, "we have our balances on hand for each item, kept on cards in the storekeeper's office. All he has to do is to make the proper entry on the proper card after receiving or issuing, then the stores issue slips go right up to my office where the balance clerk makes a corresponding entry on the balance sheet. There is not much chance for any mistake, because we get a double check." As a matter of fact, individual amounts as shown in the bin, the storekeeper's card, and the balance sheet varied on different articles all the way from 0 to 700 per cent.

The final result of a careful round-up of all items showed actual figures as follows:

[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]

There was, moreover, a tremendous surplus above any reasonable future needs on some articles, while the balance on others was dangerously low.

An analysis of the causes of this state of affairs revealed that:

(1) The storeroom was not locked.

(2) Responsibilities for receiving, storing, issuing and record-keeping were scattered among several persons.

(3) Tags were kept at the desk instead of at the bin or pile. This resulted in delayed, and then hurried or neglected entries; entries on wrong cards, entries of wrong amounts in cases where amount originally called for could not be found, and the stores card was not accurately changed; and a lack of the quick and easy check as between bin contents and tag balance which is possible only when they are together.

(4) The issuing of goods on verbal requests.

(5) The absence of a properly conducted perpetual inventory.

(6) The absence of automatic minimum checks with the balance sheets.

The aim in this case were nearly all those of automation. By increasing the money reserve, at the additional clerical expense (because of concentration in work and more logical routine), a satisfactory perpetual inventory was put into effect which checked with a later (the last complete) physical inventory within a fraction of one per cent.

A consideration of these eleven rules will, I trust, leave no doubt that careful attention to the receipt, inspection, and adequate safeguarding and recording of materials is of quite as great importance as is the strict regulation of their replenishment. The third phase of material administration, the issue, classification and segregation, will be discussed in a succeeding paper.

Chamber of Commerce of the United States Votes on Elimination of Strikes by Public Service Employees

Organization members of the Chamber of Commerce of the United States were asked today to vote on five recommendations submitted by the Chamber's Committee on Public Utilities. These recommendations are that:

1. Strikes by employees of all public service corporations performing public service essential to the lives, health, well being and comfort of the people should be expressly prohibited by law.

2. Suitable tribunals should be created by the law to adjudicate differences between employees of public service corporations and their employers, and decisions of such tribunals should be final and binding upon both parties.

The subject came before the Chamber from the Merchants Association of New York and the presidents of the principal business organizations of New York City. The communication, dated April 18, said in part:

"For several weeks past the economic and social life of this nation has been crippled, and in part paralyzed, by the enforced cessation of the function of transportation.

"Whatever may be said regarding the rights of the employees in ordinary industrial operation, we are strongly of the conviction that the arbitrary cessation of labor by the employees of public utilities is a wrongful attack on the rights of the entire people, and that such arbitrary cessation should be made impossible by the enactment of proper restrictive laws.

"The undersigned chief executive officials of the principal business organizations of the City of New York, respectfully request that the Chamber of Commerce of the United States give immediate consideration to this subject with a view to formulating and declaring the rights of the public, and to promoting legislation suitable to protect the public, and to prevent further destructive invasion of its rights."

The communication was signed by Alfred E. Marling, president of the Chamber of Commerce of the State of New York; William Fellows Morgan, president, and Lewis E. Pierson, vice president of the Merchants Association; J. Sherlock Davis, president of the Brooklyn Chamber of Commerce; H. Perkins Williams, president of the Chamber of Commerce of Queens, and James Brockunridge, president of the Bronx Board of Trade.

In recommending the proposals for a referendum, the chamber's Committee on Public Utilities expressed its belief in the following set of principles:

"No corporation or person, individually or collectively, may lawfully or rightfully obstruct or impede the performance of any duty or obligation of the State or of any agency created by the state for the performance of a public service.

"The state is sovereign. Its will is expressed through the Government created by it. That will cannot be given effect if the servants of the Government refuse to obey its behests. Therefore, no servant of the Government has either moral or legal right to obstruct the lawful processes of the Government. If such assumed right were successfully asserted, the will of the servant would over-ride the will of the people, the Government would be subverted and the servants would become the masters. It is the obligation of the State to protect the lives, health, security, rights and property of all its people.

"These depend upon the uninterrupted operation of the agencies which provide transportation, water, light, heat, power, and means of communication. It is therefore the right of the people that such uninterrupted operation be guaranteed by the power of the state.

"These agencies are created by the state for the performance of services of a public character; they are devoted exclusively to the service of the public; they operate by virtue of public powers delegated to them by the state; and they are thereby public agencies by the state to perform public services indispensable to the well being, comfort, security, and often to the health and lives of all the people. The state is, therefore, bound so to exert its powers as to enable these agencies and instrumentalities fully and effectively to perform the public purposes which have been delegated to them.

"The immediate result of a strike is to compel the suspension of the industry against which the strike is directed. When directed against a public utility it is an invasion of that which is indispensable to the community.

"The object of a dental appointment is to relieve pain, but the unfortunate individual, anticipating the pain to be inflicted, suffers more than the actual operation. It often happens that the dentist is unable to relieve pain, and the patient is compelled to suffer. The dentist is not to blame for this, but the patient is to blame for not having the tooth extracted before the pain began."

"The object of the dentist is to relieve pain, but the patient is to blame for not having the tooth extracted before the pain began."

"The dentist is to blame for not having the tooth extracted before the pain began."

"The dentist is to blame for not having the tooth extracted before the pain began."

Recent Patent Deeds

By A. A. Hopkins

In the January, 1899, issue of the American Machinist, A. A. Hopkins, A. M., Ph.D., published a list of patents issued by the Patent Office for the month of December, 1898. The list was compiled from the records of the Patent Office, and includes all patents issued during the month of December, 1898, which were of interest to the mechanical engineer. The list is arranged in the order of the dates of the patents, and includes the name of the patentee, the title of the patent, and a brief description of the invention. The list is also arranged in the order of the dates of the patents, and includes the name of the patentee, the title of the patent, and a brief description of the invention.

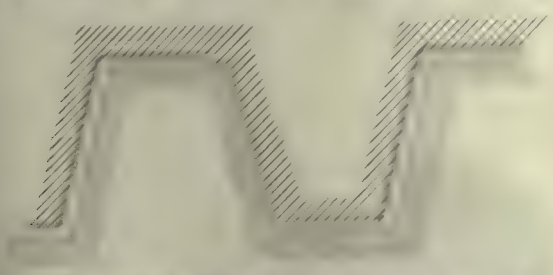


Fig. 1. [illegible]

The object of the dentist is to relieve pain, but the patient is to blame for not having the tooth extracted before the pain began.

The dentist is to blame for not having the tooth extracted before the pain began.

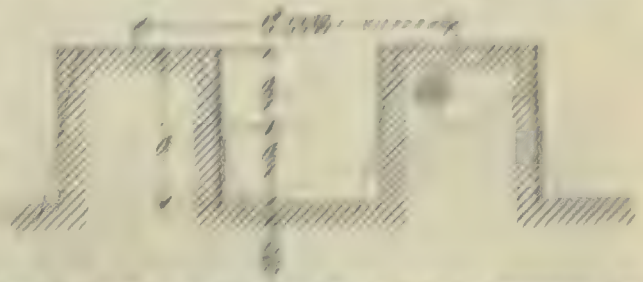


Fig. 2. [illegible]

The dentist is to blame for not having the tooth extracted before the pain began.

an allowance of 0.02 was called for in the nut over the maximum major diameter of the screw. This is clearly shown in Fig. 3. The dimensions on the nut are in accordance with tables for Acme threads as given in

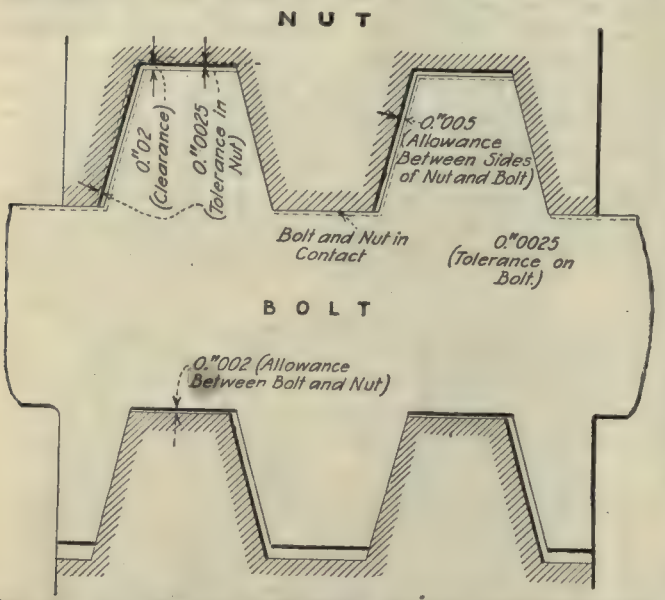


FIG. 3. ALLOWANCE BETWEEN MATING MEMBERS FOR TIGHT AND LOOSE FITS

the "American Machinist Handbook" with the exception of the 0.005-in. tolerance on the diameter.

Fig. 4 shows a nut and bolt drawn in accordance with the tables given in the handbooks and a study will show that the parts cannot go together as every touching surface of the bolt is the exact dimensions of its mating part in the nut; therefore, some allowance should be determined to permit the parts to assemble without seizing. A difference of 5 to 10 min. in the angle might also give good results, but a change in the angle for a fit other than tolerances is not recommended.

In conclusion it is earnestly hoped that some of our leading engineering societies such as the A. S. M. E.

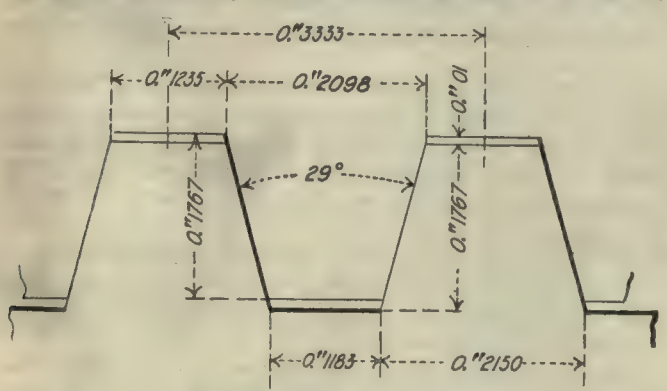


FIG. 4. NUT AND BOLT DRAWN IN ACCORDANCE WITH PUBLISHED TABLES

and the S. A. E. will establish a series of allowances and tolerances for this very practical kind of thread. The questions of the ratio of the thread to the diameter, minimum-hole basic, maximum-screw basic; the allowance per diameter for number of threads per inch and permissible error in lead per foot are questions that can be answered later; but, as I said before, let someone come forward and give data, if only for one pitch, for loose and tight fits between mating parts of Acme threads.

What Is a Machine Tool?

BY A. L. DE LEEUW

To give a definition of a subject is to express in words what we understand the subject to be, expressing it in such a way that everything which meets the definition should be included, and everything which does not meet the definition should be excluded. For instance, the definition of a circle is given in such a way that any figure that answers is really a circle, and any figure that does not entirely answer the definition would not be considered a circle by any intelligent being. This can be so because we ourselves are well agreed as to what a circle is, but when there is no agreement between ourselves as to the nature of the subject of discussion, then there is no possibility of a satisfactory definition. This is where the trouble lies with the definition of machine tools. It is not that we cannot express what we know, but that we are not agreed on the subject. If I should try to give a definition of a machine tool, I would do more than merely *define* the subject; I would really be laying down the law as to what the world must accept as machine tools.

However, I will give here a reasonable definition of *what I consider* to be a machine tool, permitting, of course, anybody or everybody to disagree with me:

> "A machine tool is a machine for the removal of material from a piece of work, and containing means for holding, guiding and controlling the work, or tool, or both."

According to this definition, a punch press is a machine tool; so is a woodworker's lathe or any other woodworking machine. For those who believe that machine tools should be confined to metal-working machinery, the definition might be modified thus:

> "A machine tool is a metal-working machine for the removal of material from a piece of work, and containing means for holding, guiding and controlling the work, or tool, or both."

This definition has the disadvantage that it would not include well-defined machine tools when they are used on materials other than metals, for instance, a gear-cutting machine ceases to be a machine tool when it cuts rawhide pinions. It might be said that the gear-cutting machine was intended as a metal-working machine, but I do not believe in embodying anybody's intentions in a definition which may have to be used later on for classification. In order to overcome this objection, the definition might be modified as follows:

> "A machine tool is a machine *capable* of removing metal from a piece of work, and containing means for holding, guiding and controlling the work, or tool, or both."

This again has a disadvantage, in so far that any woodworking lathe would be *capable* of removing metal from a piece of work. Personally, I do not think it necessary to distinguish between woodworking and metal-working machines, as they merge into each other, and for that reason I believe that the definition as originally given is the broadest and most nearly accurate.

In my opinion, a punch press or a shear is decidedly a machine tool. After all, I believe that a machine becomes a machine tool when it has a certain degree of refinement in the means of guiding tool and work, and that the question as to whether the metal is removed as chips or as punchings is not of much importance.

The Optical Flat - A Practical Measuring Tool

By H. L. VAN KEUREN
Consulting Mechanical Engineer, Boston, Mass.

When one has occasion to purchase a yard of cloth, he demands that the yard he pays for be somewhere near a yard, at least within one inch over or under a yard. In other words, the inch is a practical every-day unit for measuring a yard of common commodities. However, if the transaction involves a tract of land, say of 1,000 acres, an inch is of little consequence and the foot is therefore used as a convenient unit.

IN PRESENT-DAY production of machine parts, dimensions are specified in thousandths of an inch. Are these thousandths measured by a gage or micrometer accurate to only a thousandth of an inch? No, indeed, a finer unit must be used; namely, the ten-thousandth. So therefore, in the purchase of micrometers, gages, and other measuring tools, and, in fact, production tools, the accuracy is specified in ten-thousandths of an inch. But how is the maker of tools, micrometers and gages to determine his ten-thousandths of an inch? Necessarily, he must have a still finer unit. Today, as a result of the application of scientific principles (known in the science of Optics for many years) to a war necessity, an accomplishment of our National Bureau of Standards, the workman can take a most practical unit, the hundred-thousandth of an inch (0.00001 in.) out of the sky or from an electric light bulb. Furthermore, it is just as easy to subdivide this unit into tenths, thus securing the millionth of an inch (0.000001 in.), as it is to read tenths of a thousandth on an ordinary micrometer.



FIG. 1. VERIFYING THE FLATNESS OF AN OPTICAL FLAT TO MILLIONTHS OF AN INCH BY THE STRAIGHTNESS OF DARK INTERFERENCE BANDS, USING A MONOCHROMATIC LIGHT

To many, who have heard the recent discussion on "Millionths of an Inch" and "Measurement by the Interference of Light Waves," the whole subject seemed far fetched and too scientific to be adapted to real work. In fact, while the basic details are scientific, as is the case in any real development of the present age, the essential facts involved in the every-day use of this most recent development, the optical flat as a measuring tool, can be acquired in a very short time by any modern workman, and the advantages to be gained are of considerable practical importance.

Thus, deliberately and with the intention of explaining to the workman, the mechanic and the toolmaker, the every-day uses of light waves as a measuring unit, the relatively unimportant theoretical and mathematical phases of the subject have been eliminated in the following discussion. There have been included only the really important fundamental facts and the essential characteristics and meaning of interference bands in every-day measuring work.

What Is an Optical Flat?

Everyone is familiar with the magnifying glass. Good magnifiers and lenses are made of a clear white glass known as optical glass, and the surfaces are parts of spheres, accurately ground and polished. Now, the optical flat is really a special form of lens, known in optics as a plano lens. For measuring work only one commercial plano lens need be flat. Both sides should be polished, or clear, so as to be able to see through the flat. The side to be used is made very accurately flat. In fact, the ordinary commercial plano lens is not at all suited for measuring work. An optical flat, while it is a special form of lens, has, in the ordinary sense, no magnifying power; that is, it does not enlarge an object viewed through it. However, this simple tool, having a very accurate flat test-surface, enables us to detect with the eye the occurrence of errors or differences as small as one or two millionths of an inch.

Flatness Tests

One of the best ways to test the flatness of a lapped steel or other polished surface is with the optical flat. Not only can the exact nature of the surface being tested be seen at a glance but the test is very rapid, requiring only the time it takes to lay the flat on the surface being tested and to look at the condition revealed. The exact character of every part of the surface becomes known at once. Would you not like

to see, with your own eyes, the high points and the low points, for instance, on the anvil or spindle of your micrometer—or on the flat lapped parts of built-up fixtures, gages, precision blocks and the like? This is shown by the optical flat.

Referring directly to the matter of size blocks and precision gages, the optical flat is a necessity in their manufacture. Moreover, it furnishes the only available means for the purchaser to compare their actual accuracy with the specifications under which they were bought. It is also of equal importance to watch the effect of wear as regards flatness and size.

Length Measurements

The comparison of the length of a flat gage block or combination of gage blocks with a known standard is easily and most accurately made with the aid of two optical flats. Not only this, but at a glance it can be determined whether the surfaces of the two blocks are parallel, or how much they are out of parallel.

While the use of glass flats for optical measurements is most easily applicable for measuring lengths established by flat surfaces, it is possible to measure quite accurately the diameters of cylindrical plugs and balls.

Thus, knowing the nature of this new measuring tool and its important applications, the simple procedure of its use will be explained, first by calling attention to the essential fundamental facts regarding light, which furnishes the unit of measurement.

Light Is a Wave Motion

In moving along a straight path from one point to another, light travels in the form of a wave motion. These waves have a certain length, a certain height or amplitude, and travel at a given speed or velocity. Different colors of light have different wave lengths.

In ordinary measuring work we are concerned not with the amplitude or velocity, but with the length of the wave of the particular color of light used. These wave lengths are perfectly definite quantities which have been very accurately determined and which can be duplicated at any time anywhere in the world. They are therefore an ideal measuring unit.

The average wave lengths of the different colors of light are as follows:

Red	0.0000268	inch
Orange	0.0000248	"
Yellow	0.0000228	"
Green	0.0000208	"
Blue	0.0000189	"
Violet	0.0000169	"

Daylight

Daylight, which is sometimes known as white light, contains all of the colors and their wave lengths. The ordinary modern electric-light bulb gives off practically white light or the equal of daylight. As can be seen from the above, the average wave length for daylight is approximatly two one hundred-thousandths (0.000020 in.) or 20 millionths of an inch.

Monochromatic Light

Light which is composed of waves of only one length, or in which one particular wave length predominates, is known as monochromatic light or light of one color. Such a light is given off when a particle of common salt is held in a gas flame, in which case there results the yellow sodium light.

If a troop of soldiers marching across a bridge are in step the added effect of the vibrations or waves produced in the bridge by the timed blow of each man's foot may cause the bridge to vibrate dangerously, while if they are out of step the waves from the different men interfere or counteract each other and the bridge does not vibrate appreciable. Likewise, it is possible to have two light waves from a given source come together and be in step, thus causing a wave twice as big, or they may be out of step, thus counteracting or interfering with each other resulting in a mixture of light or no light (darkness).

Interference Between Glass Plates

When two pieces of nearly flat plate glass are placed together, care being taken to remove particles of dirt and dust so that the film of air between the plates is very thin, a series of colored interference fringes or bands are seen in daylight. These colored bands are due to the fact that the light reflected from one of the surfaces interferes with the light reflected from the other surface. An every-day example is cited in the colors which often occur after washing windows with water containing kerosene. The interference of the light reflected from the surface of the window with that reflected from the thin film of kerosene cause the colors.

Now, the interference resulting between two plates, when viewed in monochromatic light or light of one color, is a series of alternate light and dark spaces, rather than a series of colors as is the case with daylight. For simplicity, therefore, the explanations which follow will be made with reference to the use of a monochromatic light having a wave length 0.00002 in. The light and dark spaces resulting from interference with monochromatic light are known as interference fringes or bands. For our purpose the dark bands will be referred to in most cases. It is with these bands that we are concerned. They locate the occurrence of our unit of measurement, the hundred thousandth of an inch, and they tell the whole story.

Straight Bands Mean Flat Surface

In Fig. 1, which shows a source of monochromatic light, the operation of verifying the flatness of a 2-in. diameter optical flat is shown. The large bottom glass is an 8-in. master flat—one which has been previously tested by checking three surfaces together as is the procedure with ordinary cast-iron surface plates. The fact that the bands seen in Fig. 1 are straight indicates that the contacting surface of the 2-in. glass is optically flat. This important fact, that—"straight bands mean a flat surface" is simply a matter of geometry is quite evident when it is known just how the bands occur.

Dark Bands Indicate Steps of 0.00001 In.

As previously stated, the average wave length of light is 0.00002 in., and it is a proved scientific fact that the dark interference bands between two nearly flat and parallel contacting surfaces occur when the distance between the two surfaces is ½, 1, 1½, 2, 2½, 3, or an even number of half-wave lengths. Therefore the dark interference bands show vertical distances between the two surfaces of 0.00001 in., 0.00002 in., 0.00003 in., 0.00004 in., 0.00005 in., 0.00006 in. and so on, each dark band locating a step of one hundredth-thousandths or 10 millionths of an inch. This is strictly true when

looking directly down on the surfaces and practically true when viewed at a slight angle.

Thus the contacting or under surface of the 2-in. flat in Fig. 1 is not parallel to the upper surface of the 8-in. master flat. In fact, it is in contact at but one point; namely, at the right, and the wedge of air between the two surfaces is sloping upward to the left. This wedge of air is as many units of 0.00001 in. thick at the left as we can count bands starting from point of contact at the right. Thus, counting about 14 bands in the photograph, there is approximately 0.00014 in. vertical distance at the thickest part of the wedge of air.

Bands Run Perpendicular to Direction of Wedge

When a series of straight interference bands occur between two flat contacting surfaces these surfaces are not parallel, but there is always a wedge of air between them. This wedge of air may be made to slope in any direction desired, by applying pressure where it is desired to have the point of the wedge. Thus the bands may be made to run in any desired direction, but always at right angles or perpendicular to the direction of the slope of the wedge.

Number of Bands Show Steepness of Wedge

The number of bands which occur between two *flat* surfaces has nothing to do with the accuracy of these surfaces. In fact, the bands may be made as close together as desired simply by lifting or raising the upper glass opposite the point of contact. This is simply opening up the wedge of air, making more steps of

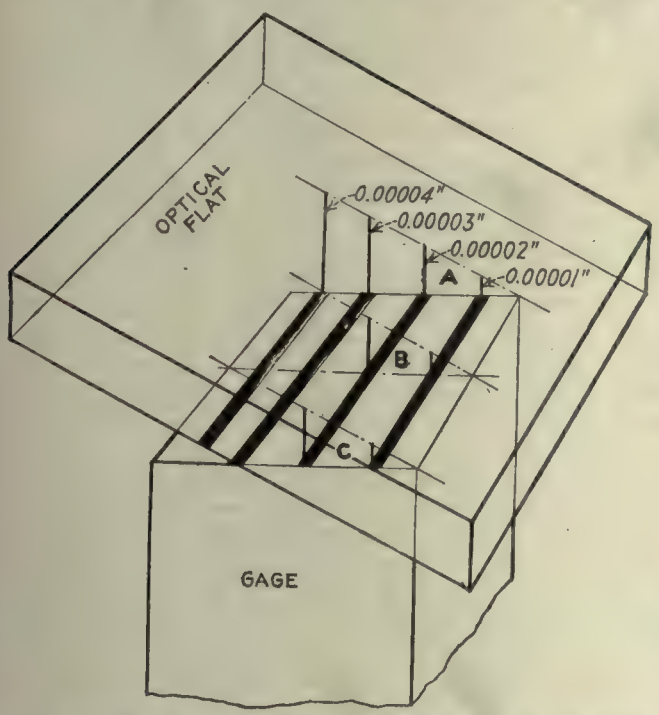


FIG. 2. EXAGGERATED CONDITION SHOWING OPTICAL FLAT MAKING ANGULAR CONTACT WITH FLAT GAGE BLOCK. STRAIGHT INTERFERENCE BANDS INDICATE FLAT GAGE SURFACES. BANDS LOCATE VERTICAL STEPS OF 0.00001 IN. BETWEEN CONTACTING SURFACES

0.00001 in., and consequently more bands occur. Conversely, by applying a downward pressure both at the point of contact and at the thick part of the wedge, it is made thinner and the steps, as located by the bands, become farther apart.

If the surfaces are accurately flat, they can be brought together so close that the distance at any point is less than 0.00001 in., and the bands disappear. Thus, when a flat gage block is wrung on a glass flat, it is generally in intimate contact, being held on the flat by a very thin film of moisture or grease within two or three millionths of an inch. If both surfaces are flat, no bands or colors will appear when viewed in monochromatic light or in daylight.

While the flatness of two surfaces can be determined by the lack of bands or interference colors when wrung together, this test is not as sensitive as determining the flatness by the straightness of the bands, inasmuch as the force exerted by the film of moisture or other liquid causing them to adhere will warp either the gage block, the optical flat or both, thus giving the appearance of perfect flatness when such is not the case. For the sake of further explanation the perspective sketch in Fig. 2 shows, greatly exaggerated, the condition which exists when a series of interference bands occurs between two flat surfaces. For simplicity in drawing there is shown a square optical flat in contact with one edge of a square gage block, and the angle or wedge between the glass and the gage is very much too large.



FIG. 3. A GAGE THAT IS FLAT WITHIN A MILLIONTH OF AN INCH

In Fig. 2 there is indicated the vertical distance of 0.00001 in., which is detected by the first band, and similarly the vertical distance of 0.00002 in. corresponding to the second band. Inasmuch as the test glass is flat, and as every point on the first band is the same distance from the contacting edge all of the little triangles *A*, *B* and *C* are equal. Thus it follows by geometry that "straight bands mean a flat surface," as these triangles could be equal only if the surface of the gage was flat.

The Bands Are Not Light Waves

At this point the reader will be cautioned against an occasional misunderstanding sometimes obtained in following an explanation on light wave measurement. Remembering that the light wave is a very small quantity (0.00002 in.), it is evident that the bands, which are a very noticeable distance apart, say ½ or ¼ in., are *not* the light waves. The bands simply show the places where interference occurs at distances between the two surfaces of ½-wave length intervals or multiples thereof.

Flat Within a Millionth

In Fig. 3 there are shown the bands occurring in the flatness test of a precision gage block produced by the writer. The bands are practically straight and uniform to within $\frac{1}{10}$ of the distance betwen the center line of any two adjacent bands. The gage in question is

therefore flat to within $\frac{1}{10}$ of our unit of measurement, the half-wave length (0.000010 in.), or within 0.000001 in. (one millionth of an inch).

Complete Flatness Test

The expert can tell, with one setting, if a surface being tested is flat, but even then it is more dependable to place the glass test-flat on the gage twice, causing the bands in the second test to run at right angles to their direction in the first test.

This is done because, if the surface being tested is very slightly cylindrical, and by chance the bands were first made to run in the same direction as the axis of the cylinder, straight bands having an uneven spacing would occur, and this unevenness in spacing might pass unnoticed. However, when the bands are made to run at right angles to the axis of the cylinder they show the exact amount of curvature of this cylindrical surface.

Curved Bands Show Curved Surface

It follows, of course, that if straight bands show a flat surface, that curved bands show a curved surface. Not only is this statement true, but in addition the curvature and shape of the bands show at a glance the exact nature of the surface, whether it be convex, concave, cylindrical, spherical or irregular, and, moreover, the amount of error is easily determined.

Anyone familiar with the meaning of a profile or contour map of a hill can realize an exact analogy of the meaning of interference bands occurring between two surfaces. The only difference is that in the case of the contour map the irregularly shaped lines, which indicate a change of elevation or height of the ground at the points on the contour lines, represent steps of 100 or 1,000 ft., depending on the scale of the map; while the interference bands show differences of elevation of only 0.00001 in. See Fig. 5, at *E*.



FIG. 4. A GAGE THAT IS NOT FLAT. CURVED BANDS SHOW THAT NEAR AND FAR EDGES ARE LOWER THAN THE MIDDLE BY ONE BAND INDICATING A UNIT OF 0.00001 IN.

The gage shown in Fig. 4, as determined from the curvature of the bands and the location of the point of contact is convex, being high in the center and low at the edges. The glass flat rests on the gage in contact with the right-hand edge and is sloping upward from the gage toward the left. The point of contact is located on the same side of the bands as the center of curvature of the bands. Thus the following rule applies:



FIG. 6. A REJECTED GAGE BLOCK. THE NEAR RIGHT-HAND CORNER IS LOW

When the point of contact, between the test glass and the surface being tested, is located on the same side of the curved bands as their center of curvature, the surface is convex. In the same way, with the points of contact remaining the same as in Fig. 4, and with bands having just the reverse of the curvature shown, the surface would be low in the center and high on the edges, or a concave surface. Thus we have the rule applying to a concave surface:

When the points of contact, between the test glass and the surface being tested, are located on the opposite side of the bands from their center of curvature, the surface is concave.

Most surfaces produced supposedly as flat are found, when in error, to be convex rather than concave. This is due to the difficulty in holding the edges of a surface in a true plane.

Amount of Flatness Error

Knowing that curved bands indicate a curved surface and the nature of the curvature, it is of importance to know just how much the surface is in error. Referring again to Fig. 4, it will be noted that the bands curve just about the distance between the center lines of any two bands. Now, as previously explained, each band indicates a vertical step of 0.00001 in. between the two surfaces, and since the bands curve the distance between them, the edge is lower than the center by one band or one unit of 0.00001 in. or ten millionths of an inch.

Another way of presenting the condition is as follows: In Fig. 4 the glass makes contact at the right-hand edge of the gage, and is sloping upward to the left 0.00001 in. per band. Now, looking at the second dark band, it is found that this band occurs in the middle of the gage, which is high, about $\frac{1}{4}$ in. from the contacting edge, while at the front and back edges, which are low, the second band occurs sooner, or about $\frac{1}{8}$ in. from the

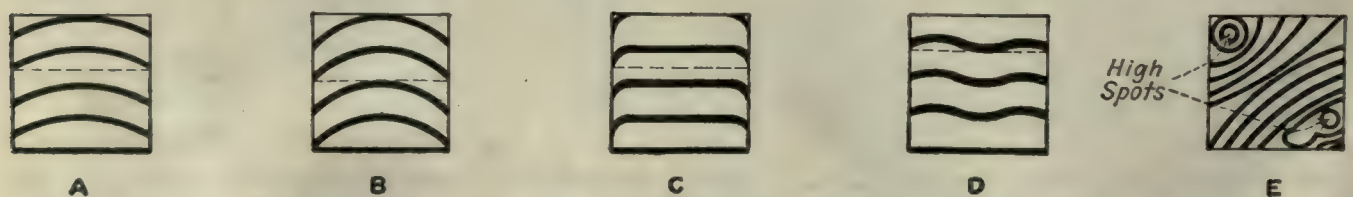


FIG. 5. DIFFERENT CONDITIONS AND DEGREES OF SURFACE ERROR. HEAVY LINES INDICATE EDGE IN CONTACT WITH FLAT

A, Convex surface—side edges low 5 millionths. B, Convex surface—Side edges low 10 millionths. C, Nearly flat—Side edges low or rounded 5 millionths. D, Surface both convex and concave—Hollow in center, higher each side of center and lower at side edges. Error 3 millionths. E, Note 2 high spots with 12 bands between, indicating a valley 6 bands or 60 millionths deep.

contacting edge. The bands being ½ in. apart, the front and back edges are therefore low by one unit or 0.00001 in.

Fig. 5 shows different conditions and degrees of surface error at *A*, *B*, *C*, etc.

The rejected gage block shown in Fig. 6 is an example of an irregular surface. The point of contact in this case is on the near edge of the gage but is confined near the left-hand corner, and the glass is sloping upward toward the far edge or back of the gage. Note that the gage is convex and that the curvature at the right near corner of the gage is very pronounced. This particular corner is 2½ bands or 0.000025 in. lower than the left near corner. Halfway back the bands do not curve more than the distance between them, and the edges are therefore lower than the center of the gage by not more than 0.00001 in. or ten millionths of an inch.



FIG. 7. COMPARING LENGTHS OF TWO GAGES. GAGE AT LEFT IS THE SHORTER BY ½ BAND OR 5 MILLIONTHS OF AN INCH

Counting Millionths

In practice it is usually most convenient to estimate the variations in the surface in tenths of a band. These tenths of a band, when the wave length used is 0.00002 in., correspond to millionths of an inch. If a wave length is used which is appreciably different it is necessary to multiply the variations of tenths of a band by a factor in order to get the result in millionths. However, the use of an even equivalent of 10 millionths of an inch per band is quite satisfactory for every-day purposes. Thus errors of ½ band are recorded as 5, one band as 10, 2 bands as 20, and 5 bands as 50 millionths of an inch.

Length Measurements

In comparing the length of a flat-end measure or gage, or a combination of gage blocks, with a known standard of the same nominal length, the process is quite as simple as that of testing flatness. This operation is shown in Fig. 7.

The block to be tested and the known standard are wrung on a glass flat side by side. They can thus come very close to being at the same temperature. A second optical flat is then laid on top of the two gages. In this case, consider the gage at the right as the standard and the one at the left as the unknown or the one being tested for length. Now, as shown in the illustration, the glass is in contact with the standard at a point near the observer and is sloping upward to the further edge of the gages. The pronounced light spots near the observer on the gages indicate contact. Note further that the bands on the unknown gage, at the left, occur about ½ a band lower down on the wedge than those on the standard gage.

It is quite evident that if the two gages, shown wrung on a lower glass flat, were both of exact and uniform thickness, that the upper surface of one gage would simply be a continuation of the surface of the other gage. Then any bands which might occur on one gage would occur exactly the same way on the other. Thus, with the upper flat in contact with both gages the bands are made to cross both gages, if they match each other, the gages are the same thickness or length.

The Shorter Gage

The shorter gage is easily identified, as its point of contact with the upper optical flat will be located lower down on the slope of the wedge than the point of contact of the longer gage. Also, if the upper surfaces of the two gages are parallel, each succeeding band from the point of contact of the shorter gage with the upper flat, will be located an equal distance lower down on the wedge than the corresponding bands on the longer gage.

Thus, referring to Fig. 7, the bands on the unknown gage at the left, occur about ½ band lower down on the wedge than the corresponding band (take in each case first, second, third, etc., band from the point of contact) on the standard. The gage at the left is therefore 5 millionths of an inch shorter than the standard.

It is well to establish the practice of always determining the amount one gage is shorter than the other. This procedure avoids confusion. Thus, if the unknown gage is shorter than the standard, its error is directly determined; and if the standard is shorter than the unknown gage, it is known at once that the unknown gage is that much too long.

Determining an Error on Several Bands

In comparing two pieces which differ by as much as one ten thousandth of an inch or ten bands, no particular difficulty is encountered. When such a difference exists, this difference is determined by counting from the point of contact on the shorter gage, the number of bands to the point of contact on the longer gage. The same difference (providing that the upper surfaces of the two gages are parallel) can be found by referring to the first band from the point of contact on each gage, the second band on each gage, or the third, etc.

The procedure is illustrated in Fig. 8. The upper flat is brought in contact with both gages. As shown, the upper flat is making contact with the right-hand corner of each gage, and is sloping upward toward the further left-hand corners. Thus, in the top view, it will be noted that 3½ bands occur from the point of contact on the shorter gage to the point of contact on the unknown gage. Therefore the standard gage is 3½

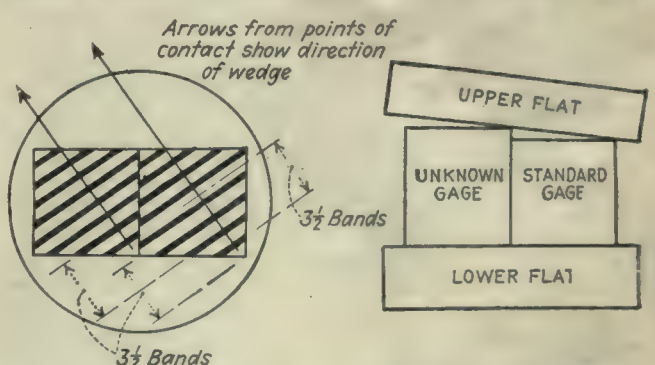


FIG. 8. COMPARING TWO GAGES WHOSE DIFFERENCE IN LENGTH IS SEVERAL BANDS. THE STANDARD GAGE IS 3½ BANDS OR 35 MILLIONTHS OF AN INCH SHORTER THAN THE UNKNOWN GAGE

bands shorter than the unknown gage, which consequently is 0.000035 in. long.

When the bands on one gage run parallel to those on the other, as is the case in Figs. 7 and 8, it means that both upper surfaces of the gages, as they are wrung on the lower glass flat, are parallel. It is evident that lack of parallelism would in reality be due to the fact that a gage was thinner at one edge than at the other. Thus the bands would tend to bend toward the point of contact at the edge of the gage, which happened to be the thinner. For a complete test of parallelism, it is necessary to make the test twice, turning one gage in the second test 90 deg. or at a right angle to its position in the first test.

Testing Separately Flatness, Length and Parallelism

If we had a mechanical means of testing the thickness of a flat gage block at several places, when all the measurements and records had been made, we would have on paper a mass of figures. From these figures it would be difficult indeed to determine which, if either, of the two surfaces was curved, or whether the thickness of the piece simply varied at the point measured. However, with the optical flat we can extend our vision, use our eyes, so to speak, ascertain and separate the errors of flatness, thickness or length, and parallelism at a glance. This separation of errors is in itself a valuable asset.

Measuring Plugs and Balls

While the detailed explanation of the procedure for measuring the diameters of plugs and balls, will not be included in the present discussion, these measurements can be quite effectively and accurately made with the aid of two optical flats. Briefly, the method involves the use of a flat standard gage block of the same nominal length as the plug or ball to be measured. By placing both the block and plug, or ball, between the two glass flats, there can be determined, by the slope of the glasses, as shown by the interference bands on the flat gage block, the difference between the diameter of the plug, or ball, and the thickness of the gage block.

Important Rules

It is believed that the following rules, summarizing the foregoing explanations, will be helpful in gaining experience and proficiency in the use of the optical flat for shop measurements:

1. If at all possible use monochromatic light or light of one color. In the absence of other information use the average value of the wave length as given above for the light chosen. Remember that each band corresponds to ½ wave length.

2. Daylight can be used quite satisfactorily for flatness tests. Estimate bands from color to color and use the approximation of one band per 10 millionths of an inch.

3. Straight bands mean a flat surface, and conversely, curved bands mean a curved surface.

4. Ordinarily when a series of bands occurs between two flat surfaces, there is always a wedge of air between them.

5. The bands always run at right angles to the direction of the center-line of the wedge.

6. The number of bands indicate the steepness of the wedge, which increases in thickness from the point of contact, an amount of ½ wave length per band.

7. The bands are not light waves but simply show the points where the light waves interfere. With monochromatic light the dark bands are the result of interfering waves, and the light spaces are the result of reinforcing light waves.

8. Be sure in flatness tests to Inspect surfaces twice—the second time making the bands run at right angles to their direction in the first test.

9. On a convex surface the point of contact, between the test glass and the surface being tested, is located on the same side of the curved bands as the center of curvature. In practice, a pronounced light spot will indicate the point of contact.

10. On a concave surface the point of contact between the test glass and the surface being tested, is located on the opposite side of the bands from the center of curvature.

11. In recording variations or errors estimate tenths of the distance between the center lines of adjacent bands.

12. If two gages which are wrung on a bottom glass flat are both of equal and uniform thickness or length, the bands seen through the top flat crossing both gages will be parallel and exactly match up. The upper flat should, of course, make contact with both gages.

13. In comparing lengths always determine which is the shorter gage. On this gage the point of contact and each succeeding band will occur lower down on the wedge than those on the longer gage.

14. The lack of parallelism of the upper surfaces of two gages which have been wrung on a lower flat is detected by lack of parallelism of the bands on the two surfaces.

15. The complete test for parallelism of two gages requires two tests, the second test being made with one of the gages turned 90 deg. or at a right angle to its position in the first test.

16. If two surfaces are properly wrung together, they are held in intimate contact by a very thin film of liquid within 2 or 3 millionths of an inch, and are too close for bands to occur if the surfaces are flat.

17. The presence of interference colors sometimes seen between a glass flat and a gage which is wrung on the flat, indicates that the wringing is not perfect or that the gage surface is not flat. This test is not recommended as the tension of the liquid which causes the two surfaces to wring, distorts either the gage or the glass flat or both.

Thus it can be said that, with the optical flat, a very simple measuring tool, we are literally and figuratively not working in the dark, but in reality are using light as a standard of measurement in a most accurate, rapid and practical manner.

When we can measure a piece we can duplicate it, and thus, by the application of these essential facts resulting from scientific endeavor, we have increased our ability to improve manufactured products—from the original reference standard to the crankshaft of an automobile. Is this not, therefore, a step forward in the world's industrial progress?

Standard Sizes for Shafting

The desirability of reducing the number of sizes of shafting and in consequence the number of parts of power-transmission equipment that must be carried in stock has long been recognized. It remained for the conditions of the war, however, to bring about definite action in this regard, from the standpoint of the conservation of materials. The activities of the Committee of the American Society of Mechanical Engineers on War Industries Readjustment brought to light the fact that an immense amount of steel is continuously tied up in manufacturers' and dealers' stocks of shafting and that a corresponding amount of cast iron is also held in stock in the form of hangers, bearings, couplings, collars, bushings, pulleys, etc. At the suggestion of the chairman of the Committee on War Industries Read-

justment, therefore, a committee was formed to investigate the subject of the standardization of shafting sizes. The personnel of this committee is as follows:

Cloyd M. Chapman, chairman; Hunter Morrison, Russell E. Nelles, George N. Van Derhoef, Louis W. Williams.

This committee was confronted with two distinct but closely related problems, viz., the standardization of the diameters of shafting used for the transmission of power, such as lineshafts, countershafts, etc., and the standardization of the diameters of shafting used by machinery manufacturers in making up their product. The first of these problems seemed to be the simpler of the two. While a large number of sizes of transmission shafting are now listed and stocked, it was believed that a comparatively few of these are in extensive general use. Accordingly, a letter was sent to thirty-six of the largest manufacturers and dealers in transmission shafting asking for statistics on the consumption of each size of shafting handled by them. Some twenty of the largest concerns in the industry furnished complete statements of their sales over periods of time chosen by themselves. These data were reduced by the committee to a uniform basis of percentages. The amount of each size sold was expressed as a percentage of the total sales, both on a weight basis and on a lineal foot basis. From these data plotted in the form of a diagram, it was very evident which of the sizes were popular and generally used and which were more rarely called for. A tentative list of twelve sizes was prepared from this diagram and sent to forty-six dealers in transmission shafting and shafting supplies from whom twenty replies were received.

In the letters to these firms, the committee expressed the opinion that the custom of using shafting $\frac{1}{8}$ in. under the unit sizes is so firmly and so nearly universally established in this country, that it would be unwise to attempt to adopt sizes in even inches and fractions as standard. It was pointed out, also, that certain sizes stand out preëminently as "popular sizes" and that others are sold in relatively small quantities. It seemed very feasible to select a series of standard sizes which would meet the popular demand and give a sufficient selection of sizes for general purposes and at the same time reduce the number of sizes now listed by the trade from some fifty or sixty down to twelve or fifteen.

The response to these letters was hearty and practically unanimous in opinions. The transmission-shafting users and dealers, almost to the last one, approved the plan of standardization and the sizes suggested were very generally approved except that the diameters $1\frac{1}{8}$ in. and $2\frac{7}{8}$ in. were in many cases requested to be included. After due consideration the committee decided to include these two sizes in the original list, making 14 sizes now adopted as standard.

The second problem was a more intricate one. The number of sizes now produced by the rolling mills for use in machinery is very large. Almost every sixty-fourth of every inch up to three inches is drawn. This means excessive equipment at the mills and large stocks in the warehouses. If a reasonable number of these sizes could be eliminated or classed as "Specials" and a comparatively few sizes selected as standard or stock sizes a great saving would thus be effected and a valuable service performed.

In order to get the opinions of leading consumers of shafting for machinery purposes, the committee decided to lay the plan before some 225 large consumers of this material and invite their comment upon its desirability or feasibility and their advice as to the size interval between standard diameters which should be considered. It was explained that it was not intended that the adoption of certain sizes as standard should make it impossible to secure any other size required on special order; but that the general elimination of a great number of the sizes now in use and the consequent greatly increased production of the standard sizes could only tend to a reduction of mill costs and capital invested in manufacturers' equipment and in stocks in warehouses. Both of these savings should have a lowering effect upon the price to the consumer and the problem was, therefore, truly one of conservation.

In the case of machinery shafting the users were equally unanimous in their approval of the plan to standardize sizes, but recommendations as to size interval varied greatly. However, these recommendations, in so far as they were definite and specific enough, were tabulated and a diagram constructed showing the relative popularity of the various size increments for each inch of diameter.

With these data accumulated and sifted down to usable form the committee felt that it was in a position to present its information and preliminary deductions to representatives of other interested organizations. Accordingly, invitations were issued to twelve societies and associations requesting them to consider the proposed lists of standard sizes and to appoint representatives to confer with the committee before its report was finally formulated. The seven organizations listed below responded and the standard sizes which follow have the unanimous approval of these representatives and, as far as can be learned, of their associations.

American Hardware Manufacturers' Association.
American Railway Engineering Association.
American Supply and Machinery Manufacturers' Association.
National Association of Manufacturers of the U. S. A.
National Association of Purchasing Agents.
National Machine Tool Builders' Association.
Southern Supply and Machinery Dealers' Association.

The committee then considered that it had completed the first part of the work to which it had been assigned, so on January 14 submitted to the council a progress report in which it recommended the approval and adoption of the following lists of sizes as standard:

Transmission Shafting:

$\frac{1}{8}$ in.; $1\frac{7}{8}$ in.; $1\frac{7}{8}$ in.; $1\frac{1}{8}$ in.; $1\frac{1}{8}$ in.; $2\frac{7}{8}$ in.; $2\frac{7}{8}$ in.; $2\frac{1}{8}$ in.; $3\frac{7}{8}$ in.; $3\frac{1}{8}$ in.; $4\frac{7}{8}$ in.; $4\frac{1}{8}$ in.; $5\frac{7}{8}$ in.; and $5\frac{1}{8}$ in.

Machinery Shafting:

Size intervals extending to $2\frac{1}{2}$ in., by sixteenth inches; from $2\frac{1}{2}$ in., to 4 in., inclusive, by eighth inches; from 4 in., to 6 in., by quarter inches.

The Council approved the report and accepted the recommendations.

In the opinion of the committee the adoption of standard sizes of shafting will mean that in the future there will be a gradual elimination of odd sizes from makers' lists and from dealers' stocks, and for new construction only standard sizes would be selected.

Before undertaking the standardization of the shafting formulas and the dimensions of shafting keys and keyways the committee plans to reorganize itself and add to its membership.—*Mechanical Engineering.*

A Grinding Attachment for a Milling Machine

BY JACK FINLAY
Toolroom Foreman, Commonwealth Small Arms Factory, Lithgow, New South Wales, Australia

This article describes a special grinding attachment for use on a milling machine, it being designed for accurate toolroom work on gages. Because of the wide range of utility of the device, a complete set of drawings for its construction are here given.

IN MAKING gages for rifle manufacture, many cases arise in which it is necessary to grind holes in pieces that are too long to swing in either a universal grinder or lathe, or so unwieldly that the time required for setting up is long in comparison with that taken for grinding. In order to care for this circumstance the device described here was developed in the toolroom of a small-arms factory and it has proven itself to be very useful.

Fig. 1 shows the grinding attachment in use, it being designed to fit a Brown & Sharpe No. 2 plain milling machine. The part *A*, which is held in a vise on the milling machine table while it is being ground, is a gage used on the front end of the trigger-guard seating of a rifle. In this particular case, the attachment is very handy, as it is possible to apply the reference gage to the gage being made, indicate by the reference gage and then remove it and grind the hole in the new gage, which is held in the vise. It is an easy matter to "indicate" a job with this arrangement by means of the vertical and longitudinal movements of the milling machine table.

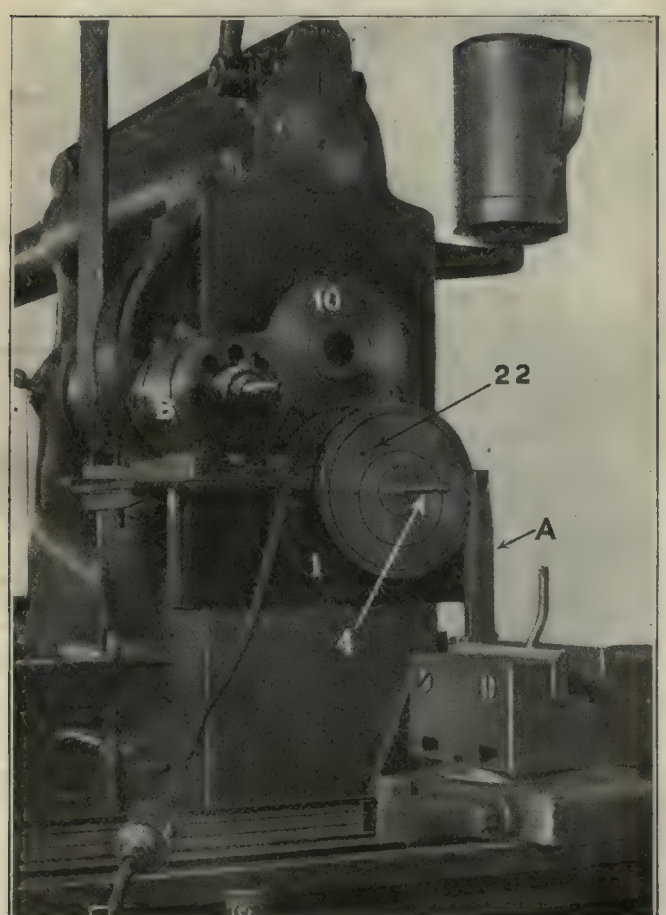


FIG. 1. FRONT VIEW OF THE ATTACHMENT IN USE

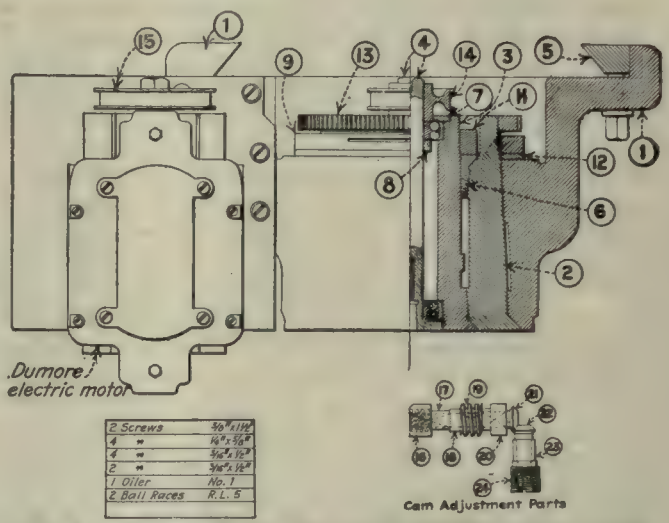


FIG. 3. ASSEMBLY OF THE ATTACHMENT, PLAN VIEW

CONSTRUCTION OF THE FIXTURE

While Fig. 1 shows a front elevation of the attachment, Fig. 2 is an assembly drawing of it, showing the plan view, and Fig. 3 gives the dimensioned details of all parts. These parts are numbered the same in each figure, and hence will be referred to by the numbers indicated in the cuts.

During grinding the power feed of the saddle is used to give a reciprocating motion to the work. The spindle *4* carrying the grinding wheel is run by the motor *B*, and it is also caused to rotate eccentrically in order to provide the feed for the grinding wheel. This latter motion is imparted from the spindle of the milling machine by the gear *10*, as will be explained later.

Part *1* is a casting which clamps on the face of the column of the milling machine by means of gib *5* and forms the housing in which Part *2* revolves, a running fit being made. At the rear end of *2* is fitted a fiber thrust washer *12* and a split nut *9*, by means of which wear can be taken up. At the extreme end of *2* is fitted gear *13*, which is driven by gear *10* on the spindle of the miller. The bushes *2* and *3* are both bored out with an eccentricity of $\frac{1}{4}$ in., *3* fitting inside of *2*. The cone bushing *6* fits on the rear end of *3*, any wear being taken up by the adjusting nut *11*.

THE ECCENTRIC MOTION

On the outside of *3* is cut a straight-toothed worm-wheel, with which the worm *19* meshes. The worm is keyed to the miter-gear shaft *21*, which runs in the bushes *20* and *17*. Bushes *20* and *16* fit in the hole drilled at right angles to the main axis of *2*, *16* being secured in place by a setscrew. Since *17* is threaded in *16* it is possible to adjust the position of the bevel gear *21* by turning bush *17*. Referring to Fig. 2, it can be seen that miter gear *21* engages miter gear *22*, on the

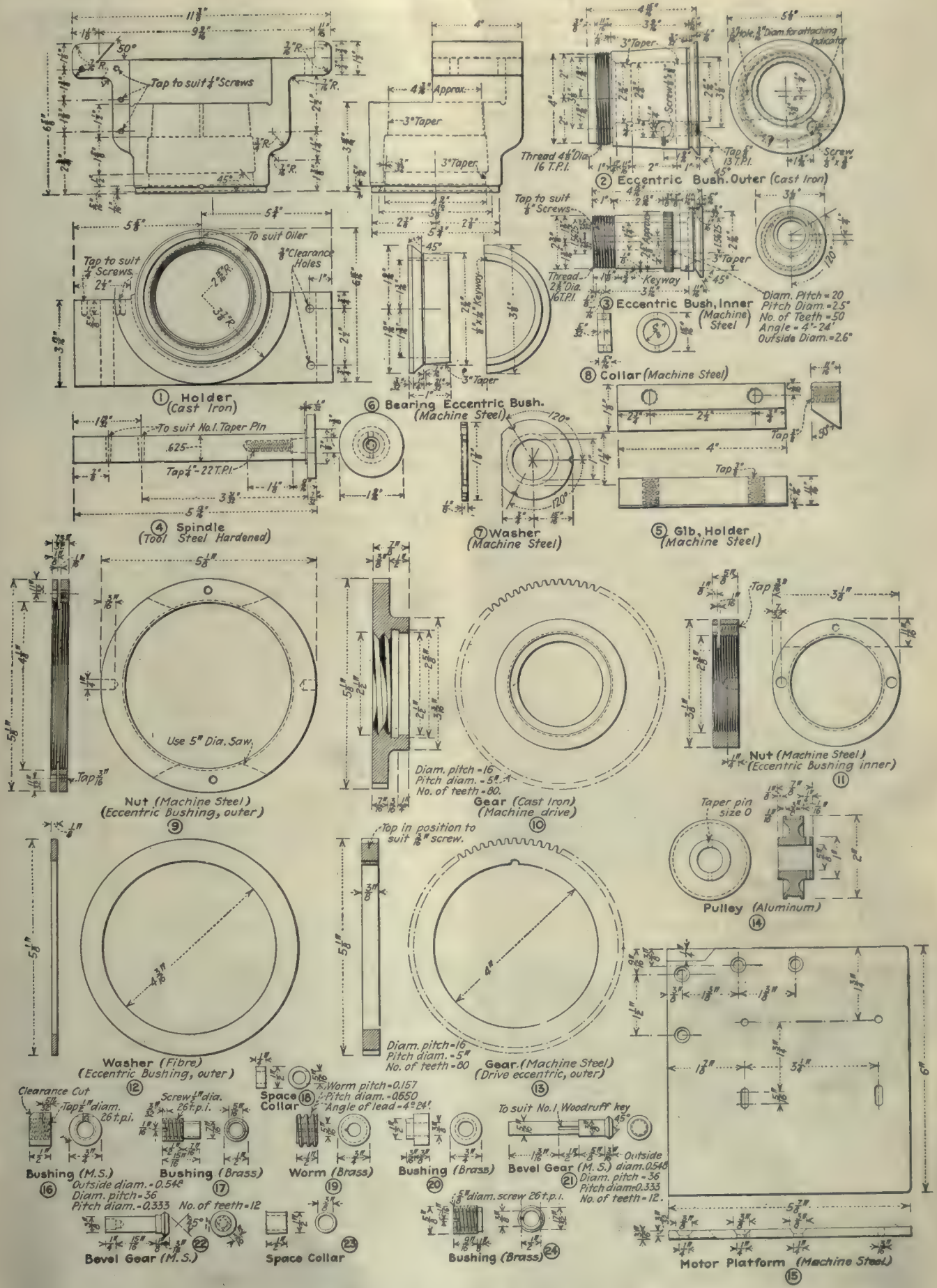


FIG. 3. DIMENSIONED DETAIL DRAWINGS OF THE PARTS OF A GRINDING ATTACHMENT FOR A NO. 2 B. & S. MILLING MACHINE

shaft of which the space collar *23* and the bush *24* fit. Bush *24* is screwed into the front face of *2* and secured in the proper position by a setscrew. When shaft *22*, see Fig. 1, is turned by means of an internal wrench, bush *3* is caused to revolve slowly in bush *2*, thus making it possible to vary the eccentricity of the spindle from zero to ½ in.

In each end of *3* an S.K.F. ball bearing, size R.L.5, is fitted, the spindle *4* running on these and the rear bearing being held in place by the washer *7*. End thrust is taken by the rear ball race, which is held in place by means of the collar *8* on one side of it and the aluminum driving pulley *14* on the other. The front end of spindle *4* is ground out to a No. 3 Jarno taper and is threaded also, so that arbors hold by screwing in and pulling up on the taper.

The Drive

The spindle is driven by a small Dumore electric motor, a rubber driving belt, which accommodates itself to the eccentric movement of the spindle, being used between pulleys *14* and *15*. Thus the drive of the spindle and its feed, or eccentric rotation, are entirely independent, and any speed of the milling machine may be used to revolve *2*. To vary the amount of eccentric rotation it is necessary to stop the drive of the milling machine and to turn shaft *22*, as before explained, although the motor *B*, may continue to run.

With this attachment, grinding jobs which were really quite awkward have been done with ease, due largely to the wide range of movements of the miller table and knee.

Hardening Teeth in Flywheels

By Fred H. Colvin
Editor, *American Machinist*

The advent of the electric starter has introduced new problems in motor manufacture, one of these being the wear and breakage of the gear teeth cut in the flywheel where this type of starter is used. Various methods of overcoming this difficulty are used by different manufacturers, including the fastening of a separate steel ring-gear on the flywheel, both for the purpose of taking the wear and allowing renewal should it ever become necessary. Repair men usually find the maximum wear at two opposite points on a four-cylinder engine, and at three points on a six-cylinder engine, this being due to the fact that the engine normally stops at these points due to the compression in the cylinders.

The Pierce-Arrow Method

A few builders are using cast-steel flywheels, the harder material presenting greater resistance to wear than cast iron. The Pierce-Arrow company goes this one better by using a cast-steel wheel and hardening the teeth as shown in Figs. 1 and 2. The complete apparatus is shown in Fig. 1, this consisting of a watertight tank in which the flywheel *A* is mounted as shown. The oxy-acetylene torch *B* heats the teeth locally. After the teeth are heated sufficiently for hardening, the wheel is turned in the direction of the arrow by a ratchet *C*, this being operated by the small electric motor *D*. This arrangement heats and hardens the teeth as they pass the torch and has been found more satisfactory than any other method. It does not seem to distort the flywheel as might be supposed, and has proved to be a very satisfactory arrangement.

Fig. 2 shows the position of the heating torch with relation to the teeth, the flame being applied very close to the surface of the water.

Drilling Out 88 Cu.In. of Cast Iron Per Minute

The Cleveland Twist Drill Co., during its drilling exhibitions at Atlantic City in connection with the exhibit of the Railway Supply Manufacturers Association, held on Young's Pier, June 9 to 16, accomplished the following wonderful drilling: With a 1¼-in. diameter milled high-speed drill they attained a drilling speed of 72 in. per minute in cast iron. The peripheral speed was 235 ft. per minute and the feed 0.10 in. per revolution. The drill stood up for a total of 15 in. This means that the metal was being removed at the rate of 88 cu.in., or 23 lb. per minute.

In tests on machinery steel with the same kind and size of drill, the maximum rate attained was 24.54 cu.in., or 7 lb. per minute. A depth of 3 in. was drilled.

Such rates of drilling cannot be practiced in commercial work, and are noteworthy chiefly in that they demonstrate the ultimate possibilities of these high-speed drills, and indicate that drilling practice has not reached the highest efficiency in many plants.

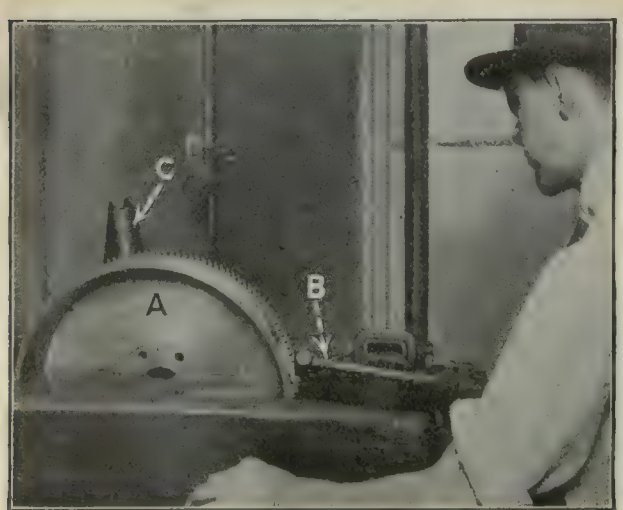


FIG. 1. THE FLYWHEEL-HARDENING OUTFIT

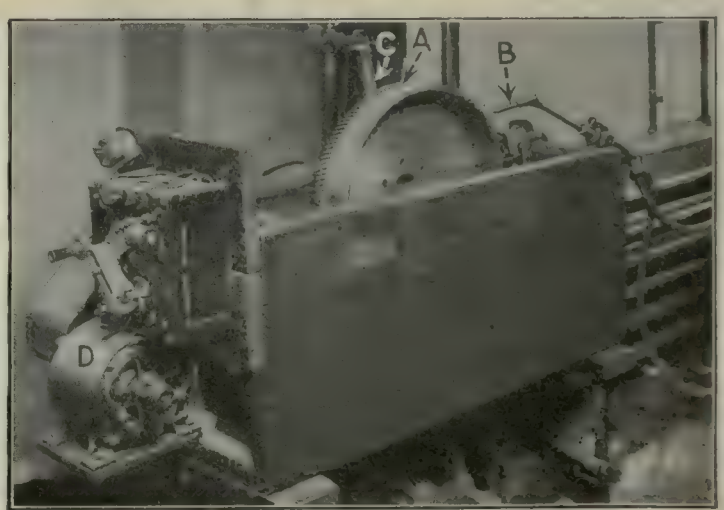
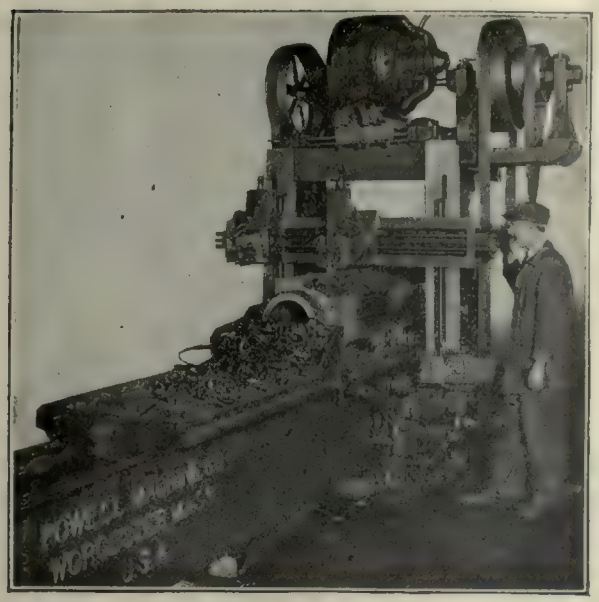


FIG. 2. SHOWING POSITION OF BURNER



POWELL "Hy-Speed-Cut" PLANING MACHINES

By E. L. Dunn
ASSOCIATE EDITOR, AMERICAN MACHINIST

About forty years ago a small planing machine was exhibited at the Mechanics Institute, Boston, and a little later a similar machine was installed at Girard College, Philadelphia, where it is still in use. These machines were the first of a type that has been manufactured continuously, passing through many developments and culminating in the present-day design that is here described.

ALTHOUGH Powell planing machines had been manufactured for many years under different names, it was not until August, 1908, that the "Hy-speed-cut" type was introduced by the Powell Machine Co., Worcester, Mass. Prior to this date the machine was known simply as a well-built tool of good design and standard construction, but with the introduction of the patented accelerating drive feature, it attracted much favorable attention both in this country and in Europe where it was exhibited and demonstrated.

As a matter of passing interest and to illustrate the progress that has taken place, planing machines built by A. M. Powell in 1881 and 1884 are shown in Figs. 1 and 2. As a comparison Fig. 3 shows a 48 in. x 17 ft. machine of latest design, for belt drive. The accelerating drive is the logical result of a study of the difficulties of planing machine operation and is based on the theory that planing speed is limited principally because of the hammer-like blows received by the tool when starting the cut, and to the excessive power required to reverse a fast moving table.

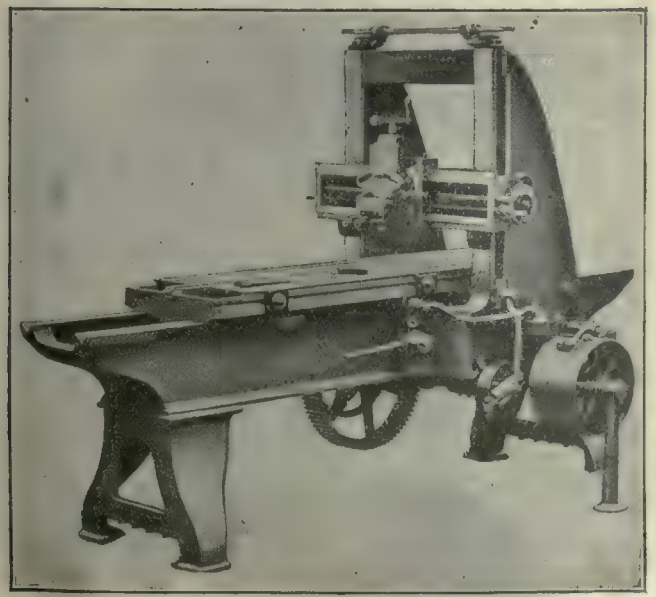


FIG. 1. THE FIRST MACHINE BUILT IN 1881

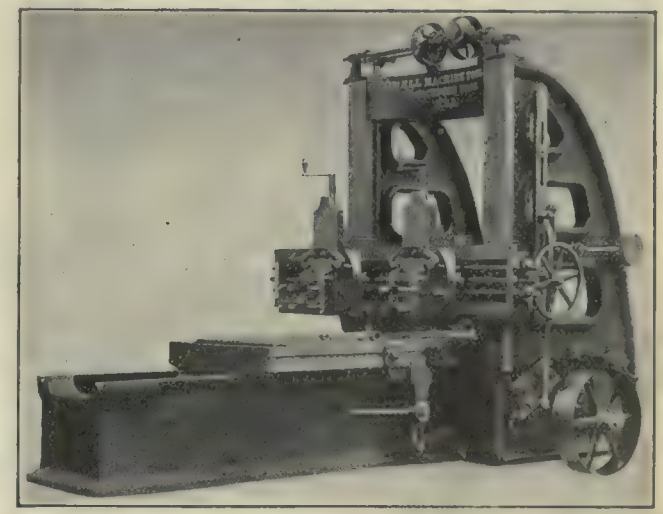


FIG. 2. ONE OF THE TYPES BUILT IN 1884

Difficulties of Planing Machine Drive

In cutting cast iron, using the best grades of high-speed steel for the cutting tools, the generally accepted economical speed varies from 30 to 50 ft. per min., while for some other metals the speed may be increased to 60 ft. or more. The density of hardness of the material to be cut determines very materially the proper cutting speed. At these higher speeds the blow which the tool receives when entering the work shortly dulls its cutting edge, as the intensity of the blow varies according to the square of the velocity.

As the return stroke of a planing machine represents practically dead loss, it is customarily operated at a greatly increased speed over that of the cutting stroke. However, a slight increase in the cutting speed is of



FIG. 3. TYPICAL "HY-SPEED-CUT" PLANING MACHINE

more relative importance as the net gain is greater. For instance, with a cutting speed of 30 ft. per min. and a return speed of 90 ft. per min. the actual time consumed in doing the work would be the same as if a continuous cutting speed of 22.5 per min. was used. To increase this speed to 25 ft. per min. the reverse speed would have to be increased 66 per cent, or 150 ft. per min., whereas the same results could be obtained by increasing the actual cutting speed 16 per cent, amounting to 35 ft. per min.

The power required to reverse a planing machine table varies, according to conditions, from three to six times the power required for the cut, this being due principally to both the flywheel effect of the pulleys and the momentum of the table. To meet the excessive power requirement due to the reverse, flywheels have sometimes been used on the continuous running overhead countershaft, and to reduce the flywheel effect of the reversing pulleys they are frequently made of aluminum.

The Powell accelerating device was designed to overcome some of the difficulties common to planing machine operation as set forth, and should not be confused with what is generally known as a variable speed drive. The accelerating feature applies only to the differential stroke of the table, which starts at slow speed, accelerating to high speed and finishing at slow speed. As a result of this variable movement the impact of the tool against the work is reduced to the minimum while the cutting speed is increased to the capacity of the tool and finally the power required for the reverse is greatly decreased.

The chart, Fig. 4, illustrates the theoretical value of the accelerated stroke in comparison with that of doubling the cutting or the return speed of a non-accelerated stroke. Fig. 5 is reproduced from a nickel steel chip made with the accelerated stroke; the roughened end, resembling teeth, indicates clearly the slow-speed effect of the cut, while the smooth body of the chip shows the paring action of the high-speed cut.

The operation of the accelerating, or "Hy-speed-cut," planing machine is similar to that of other planing machines with the following exceptions: The operating shaft that passes through the machine bed is provided with a primary or initial slow-speed pulley, a second or high-speed pulley and their mating loose pulleys. These pulleys are respectively actuated by a slow-speed drive belt and a high-speed drive belt from the overhead countershaft. The usual tight and loose pulleys are also provided for the quick return, or reverse action, belt which is likewise run from the overhead countershaft. The slow-speed or initial drive pulley is connected with the shaft by an internal roller clutch that gives connection in one direction of rotation and releases in the other; in other words, a releasable friction ratchet, similar in principle to the coaster-brake device used on a bicycle. The high-speed pulley, however, is keyed solidly to the shaft. In addition to the usual table dogs, two or more extra dogs are provided as shown in Fig. 3. When the machine is running the table dog shifts the belt in the usual way at the beginning of the stroke and the table starts forward with a slow movement. When the tool has entered the work for a distance of

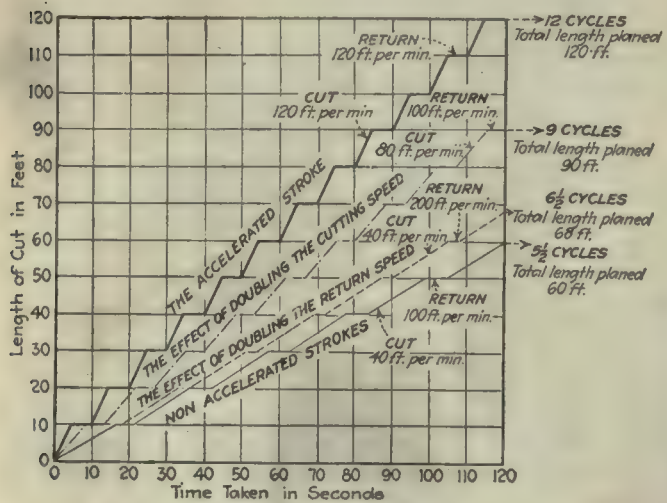


FIG. 4. CHART OF OPERATING CONDITIONS

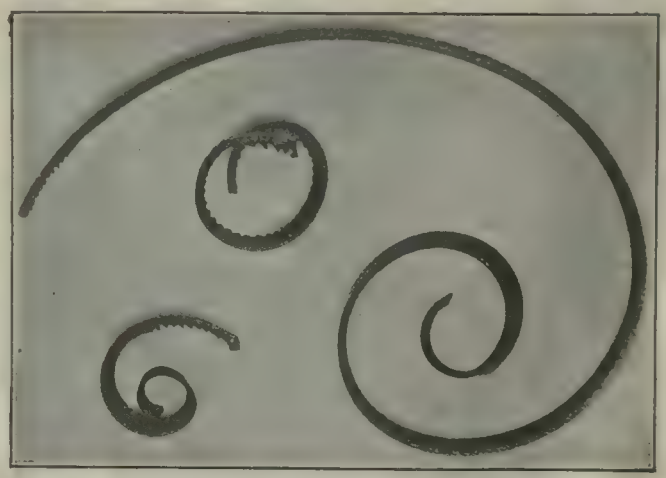


FIG. 5. NICKEL STEEL CHIPS SHOWING BY THE ROUGH ENDS THE SLOW-SPEED START AND FINISH

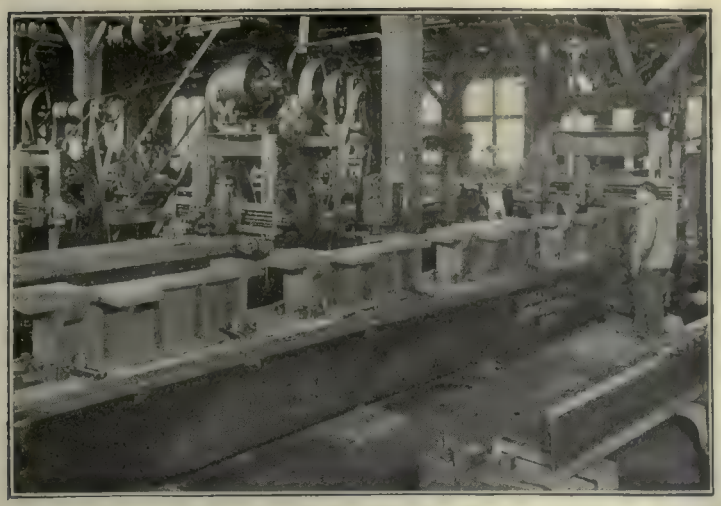


FIG. 6. ACCELERATED STROKE USED FOR JUMPING GAPS

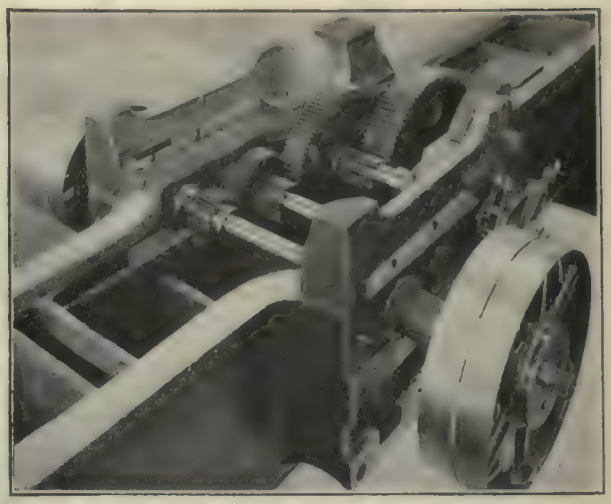


FIG. 7. GEAR TRAIN IN 30-IN. MACHINE

1 in. or less, a second table dog shifts the other driving belt to the high-speed pulley. With the shifting of the high-speed belt the speed increases and draws away from the initial drive in an increasing ratio to a point determined by the belt velocity of the high-speed drive. The table now runs at high speed until near the end of its stroke, when a third table dog shifts the high-speed belt to off position allowing the slow-speed drive to again become effective. The table, while thus running at slow speed, is reversed in the usual manner by the end dog and returns in the regular way at high speed to the starting point where the speed is again reduced. Any number of accelerating and retarding dogs may be arranged on the table for successively and repeatedly effecting the acceleration and retardation of the stroke to suit conditions, as shown in Fig. 6.

The accelerated cutting speed is usually about two and one-half times that of the slow speed, and the reverse speed never exceeds the accelerated cutting speed. The accelerating device may be put out of commission at any time by simply lifting a latch or tappet which operates the accelerating belt shifter. The machine thus arranged has practically four speeds, as the countershaft has two sets of tight and loose pulleys. The greatest efficiency of the accelerating cut is obtained on long, continuous work, but the percentage of gain is the same if the work is only one foot in length.

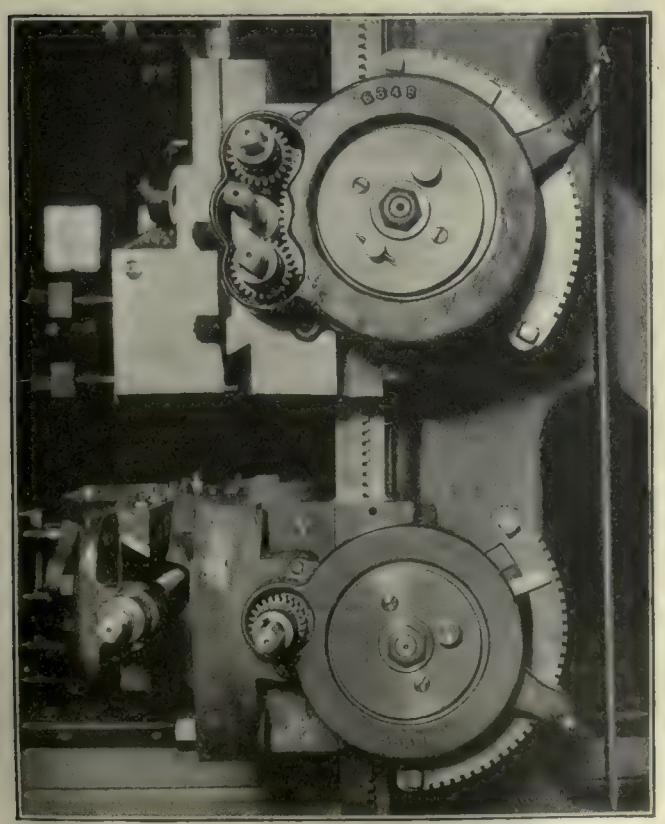


FIG. 8. FEED CHANGING DEVICE

Planing a Nickel-Steel Forging

As an example of a planing operation, a 3 per cent nickel-steel forging, having a surface of 1 ft. 4 in. x 6 ft. 6 in., was recently machined. A cut $\frac{1}{16}$ in. deep with a feed of $\frac{1}{8}$ in. was made by a Stellite No. 4 tool. The tool entered the work at a speed of 30 ft. per min., the accelerated speed being 75 ft. per min., a higher speed being impossible owing to the incapacity of the motor. Upon completion of the work the tool was found to be in excellent condition and capable of considerable additional work. The forging, which was air chilled, had been annealed for 10 hr. at 950 deg. C. (1,710 deg. F.) and had the following composition in percentage:

Carbon 0.42, manganese 0.56, phosphorus 0.031, sulphur 0.026, silicon 0.16, nickel 3.08, chromium 0.08, copper 0.05.

The accelerated cut is also used to advantage in planing work having one or more open spaces, as illustrated in Fig. 6. The planing machine shown is a 36-in. size widened to 48 in. and has a table 30 ft. long equipped with accelerating and retarding dogs. It is claimed the saving in time in this case amounted to 40 per cent or more.

Other Features of Construction

The gear-train drive, consisting of wide face steel gears, is shown in Fig. 7, and the feed changing devices for the vertical and horizontal feeds are shown in Fig. 8. The feed may be changed while the machine is in operation by shifting the handle *A* to the desired notch. The heads can be supplied with automatic horizontal feeds when required. Attention is called to the leveling blocks shown below the bed in Fig. 6. The screw and wedge arrangement has been found a great convenience for leveling the machine at the time it is installed.

Another innovation is the table slot shown in Fig. 9.

The advantages claimed for this are that the upward pull of the bolt is at a right angle to the line of contact, as indicated by the arrow, thus allowing ample strength even after the table has become thin from many sur-

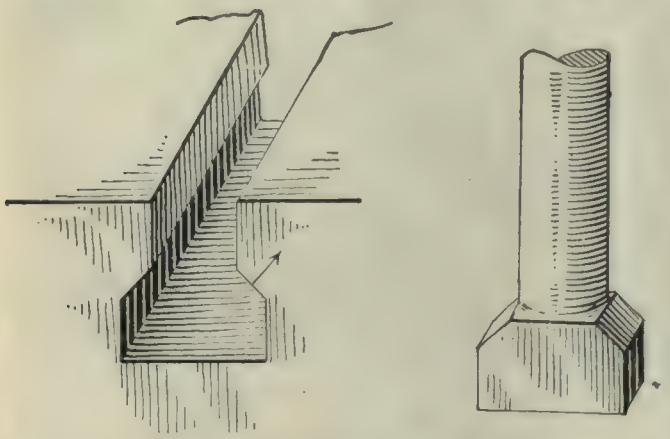


FIG. 9. TABLE SLOT AND BOLT

facing cuts. Another advantage is that the bolt head is not only much stronger, but is also positively locked against turning.

The larger size machines are furnished with either belt drive or direct motor drive as required.

Ingenuity

By John S. Watts

I have known of engineers who failed to solve problems in design, because of the lack of ingenuity, and it appears to me that the training acquired at college does not tend to develop whatever quality of ingenuity the student may have possessed. As a college can, of necessity, only teach its students that which is already known, it is doubtless unreasonable to blame the college for lack of ingenuity in its graduates. The idea I would like to bring out is that each man should himself endeavor to cultivate the ability to attack a problem on new lines when the orthodox solutions are not applicable.

Instances are common where well-eduacted and competent engineers have failed to find the solution of a problem because they considered only the regular methods and the solution has been suggested by men of much less technical knowledge, but of greater ingenuity. We have all heard the story of the "damphool" who did not know that a certain thing was impossible and so just went ahead and did it.

The habit of considering an engineering problem incapable of solution if the said problem is not amenable to common methods is a habit that has led to considerable criticism of us by our business associates in the past.

It is often the subject of adverse comment by financial men that the engineer will always say, when confronted by any problem that is a little unusual, that it cannot be done; but if pushed to it he will always find some way to do it. The result of this attitude is that the engineer loses credit while the financial man is imbued with the feeling that the credit is his, because the solution was found only upon his insistence after the engineer had said it was impossible.

My opinion is that it is much better, when confronted with a difficult and unusual problem, to say that, while it will be hard to accomplish, if there is a way to do it it will be found. There is nearly always some method by which the difficulty can be overcome or got around.

What Ingenuity Can Do

To give a few examples of what I mean by ingenuity: A smokestack was being built which on account of its being in a prominent place in the city had to be made as neat in appearance as possible. The inspection was very severe, and it was impossible to get the rivet heads exactly in alignment, when driving them in the usual way with the head of the rivet inside of the stack. In forming the head outside they would come a little out of line one way or the other and present an unsightly appearance. This was finally overcome by putting the rivet in from the outside, and heading it over on the inside. The head of the rivet that showed outside of the stack, being the original head, was necessarily concentric with the body and therefore could not help being in line.

Another example was in the case of a twenty-ton jib crane to be installed on the end of an ore loading pier. The structure was only four feet from the face of the wharf and this space had to be kept clear of all obstruction as it was used for a pathway in handling a ship at the wharf. The project was turned down as impossible by the experts because there was not space for the bull wheel at the bottom of the mast. However, a solution was insisted upon, and was finally found by placing the bull wheel on top of the mast. This, so far as I know, had never been done before and it involved a very different arrangement of the hoisting rope and sheaves.

A car plant was falling behind seriously on its schedule, due mainly to a lack of planning which had resulted in the bulldozers being overloaded with work while the hydraulic presses had not enough work to keep them going. The die designing experts claimed that as all the dies were made to suit the bulldozers the only solution of the difficulty was to design and make up new dies to do the work on the presses, which would take weeks of valuable time. The situation was saved by a newcomer to the car business, who, by various experiments, adapted a sufficient number of the bulldozer dies to the presses to enable them to take their legitimate share of work.

The desire to adhere to known and tried methods which have proved successful is in itself a laudable one, but it should not be followed to the entire exclusion of new methods. Some of the lack of ingenuity is, I believe, partly due to the way in which the older men frequently reject the designs of the younger men with contempt because they do not follow orthodox lines, thus tending to make the younger men feel that only those methods that have already been used and tried out are admissible and that, therefore, a knowledge of these old methods is all that is worth cultivating.

I believe that any idea brought forward should be seriously considered if only to inculcate the habit of ingenuity; and if the new idea is not sufficiently promising to warrant using it, the originator should be advised of the reason for its rejection and not simply given to understand that it is turned down because it is new.

The decision as to whether a new idea is worth trying out should be based upon the saving or higher efficiency that may be expected from its use, and if there is found to be no advantage in it the older method is to be preferred.

Characteristics, Treatment and Uses of High-Speed Tool Steel

THE following information has been sent out by the Division of Metallurgy of the Bureau of Standards in response to inquiry. The general importance of the subject will make the facts given of wide interest.

DEVELOPMENT. The history of the cutting of metals with steel tools is characterized by three well-defined stages each of which represents an efficiency in rapid cutting operations greatly superior to its predecessor. The first stage, that of the use of the simple carbon tool steel, ended with the discovery by Mushet (about 1870) of his air-hardening steel, which was a high carbon steel containing tungsten with manganese or chromium or both. Mushet's steel was superseded in the third and present era by a low carbon steel with a tungsten content two to three times as great and containing also chromium. This steel was developed along with the high-heat treatment discovered by Taylor and White (about 1900). Shortly after this important step (about 1905), vanadium was introduced in the steel as a relatively large addition and with a considerable increase in its efficiency. The resulting product is now called modern high-speed steel.

The principal steps in the development of the lathe tool steels up to 1906 are illustrated by the following extracts from Taylor's data given in Table I.

FUNCTION. High-speed tool steel is used, as its name implies, for cutting metals and materials at high speeds with heavy cuts usually far in excess of those possible with carbon or finishing steels. The peculiar property which makes this possible is called "red-hardness" as the cutting surface may become heated to a dull red without impairing its cutting power. Its ability to make heavy cuts at high speeds renders it invaluable for quantity production. Besides being used for roughing operations, it is used to a great extent in tools for finishing where "red-hardness" is not so important, but hardness (in the sense of resistance to wear) and capacity for uniform hardening in large pieces is very essential. In fact, the tendency to use high-speed steel for almost every kind of cutting operation is probably carried to extremes.

COMPOSITION. Modern high-speed steel is a high alloy steel, the essential alloy contents of which are within the following limits: Carbon (0.50 to 1 per cent), tungsten (12 to 20 per cent), chromium (1.5 to 6 per cent) and vanadium (0.5 to 2 per cent). Other elements are of course always present as impurities or additions. While a number of compositions within the limits mentioned will furnish equally good steels, it does not follow that any combination within those limits will. The combinations found best by experience are placed on the market by the steel makers under trade names, all of which come within limits noted above and each of which is supposed to come within certain narrower limits as to composition.

The analyses in Table II are given by Mathews as representative of well-known commercial steels with their relative efficiencies as determined by Taylor's cutting test:

TABLE II. REPRESENTATIVE ANALYSES OF COMMERCIAL STEELS WITH THEIR RELATIVE EFFICIENCIES AS DETERMINED BY TAYLOR'S TEST

Efficiency per cent	C per cent	Si per cent	Mn per cent	Cr per cent	W per cent	V per cent
100	0.63	0.27	0.31	2.99	16.87	0.51
70	0.64	0.22	0.24	5.35	18.99	0.15
66	0.61	0.19	0.36	3.34	16.28	0.40
45	0.63	0.19	0.26	4.21	13.10	0.25

They do not represent as wide a variation in carbon as is often found. The analyses made at the Bureau of two standard steels show a considerable difference in carbon as well as other elements. See Table III.

TABLE III. ANALYSES OF STEELS MADE AT THE BUREAU OF STANDARDS

	C per cent	Si per cent	Mn per cent	Cr per cent	W per cent	V per cent
..	0.77	0.47	0.25	3.47	17.8	0.74
...	0.56	0.20	0.42	2.21	13.8	0.98

From the high-tungsten and other alloy content it is apparent that the price is very high. It is therefore in the interest of the user to give this steel the most careful and effective treatment possible.

SPECIAL FEATURES. High-speed steel has several unusual characteristics peculiar to it which are intimately connected with its treatment and utility.

(1) High-Temperature Treatment. It must be heated for hardening to an excessively high temperature, such as would ruin simple steels, to obtain its best properties. This treatment necessitates somewhat special equipment for producing the desired heat-treatment conditions.

(2) Red-Hardness. After being given the high-temperature treatment, it will not lose hardness on tempering until heated above a dull red heat. This is its most valuable characteristic, and its superiority over carbon tool steel, for cutting where high temperatures will be developed, may be clearly seen from the fact that the carbon steel begins to lose hardness appreciably on tempering at 200 deg. C. (392 deg. F.), while for high-speed steel the loss begins at about 700 deg. C. (1,292 deg. F.). Such temperatures for a given

TABLE I. PRINCIPAL STEPS IN DEVELOPMENT OF LATHE TOOL STEELS UP TO 1906

Date of Test	Compostion C	Mn	Cr	W	V	Cutting Speeds: Medium Steel Forging	Hard Steel Forging	Hard Cast Iron	Remarks
1894	1.05	0.19	....	.....	....	16 ft.	6 ft.	15 ft., 6 in.	Jessop carbon steel
1898	2.40	1.90	0.49	5.62	....	26 ft.	8 ft., 6 in.	28 ft.	Mushet (self-hardening)
1906	1.43	0.23	1.86	84.0	....	61 ft.	19 ft.	39 ft.	Bethlehem (self-hardening)
1906	0.74	0.06	3.86	16.2	....	91 ft.	40 ft.	50 ft.	High-speed steel
1906	0.68	0.07	5.95	17.8	0.32	99 ft.	41 ft., 6 in.	52 ft.	High-speed steel

$\frac{1}{8}$ in depth of cut; $\frac{1}{16}$ in. feed; duration of cut 20 minutes.

loss in hardness indicate roughly the red-hardness quality.

(3) Secondary Hardening. The hardness of high-speed steel may be increased over that resulting from the high-temperature heat treatment by tempering within certain temperature limits which are relatively high. This property is made use of to obtain slightly higher lathe efficiency and to relieve hardening stresses.

(4) Self-Hardening. High-speed steel has the characteristic of hardening on cooling in air. This feature is important as it permits the uniform hardening of large tools and the use of less drastic quenching media than required for some tool steels. The chromium content is probably responsible in a large degree for this characteristic, though some of the other elements undoubtedly contribute to it.

EFFICIENCY TESTS. The test usually employed for determining the efficiency of a given tool steel is that developed by Taylor for lathe roughing tools and consists of determining the cutting speed, other variables being constant, for which the steel will fail or be ruined in 20 min. Taylor measured the time from the start until the tool was ruined, that is, the point completely worn off. Present testing practice is to take the time at which the tool fails, that is, loses its edge and a glaze appears on the metal being cut, for this gives a sharper end point, more consistent results and the tool may be more readily reground. The lathe test is often used to determine the efficiency of a steel for cutting conditions radically different from those in the lathe test and while in this case a fair estimate of its efficiency may be had, the final criterion must of course be its behavior under conditions approximating those of actual operation.

On account of the expense of the lathe or other full-size tests to destruction, experiments have been conducted to find, if possible, a relation between the cutting efficiency and some simple and quick test on the hardened steel. No such relation has been found for hardness, microstructure and magnetic properties. This is obvious from the nature of the property in question, that is, resistance to softening by tempering. Any test of this character will have to be made on the steel tempered above the secondary hardening range so that the progressive loss in hardness, or a parallel property, can be measured and compared for different steels. The value of this test is yet to be determined.

HEAT TREATMENT. It is essential to heat high-speed steel very slowly to a cherry red, about 750 deg. C. (1,382 deg. F.), before heating to a higher temperature in order to prevent cracks and checks. Above this temperature it may be heated as rapidly as desired.

Forging is best carried out at a relatively high temperature, not below 1,000 deg. C. (1,832 deg. F.). Cooling from the forging temperature should be slow enough to prevent hardening, otherwise cracking is likely to occur. Hardening (cooling in air or a faster medium) produces a maximum hardness and accompanying brittleness when starting from the forging temperature range, hence the tendency to crack. It is therefore well to cool in the heating furnace, in lime, ashes or any medium which will retard the cooling rate sufficiently. This phase deserves particular attention, as cracks formed in the process of forging are very likely to remain indistinguishable until grinding, the fault thereby being attributed to the subsequent operation.

For hardening, the heating of high-speed steels demands a very high temperature (1,200 to 1,300 deg. C. or 2,192 to 2,372 deg. F.), which is just short of fusion. The production of such temperatures requires somewhat special equipment, which, in the form of gas- and oil-fired furnaces, is placed on the market under the caption "High-Speed Steel Furnaces." These furnaces often have an accessory heating unit for preheating.

For work in which the preservation of the surface is no object, such as roughing tools, the hardening temperature is often judged by Taylor's method of heating until the surface fuses. This is, however, impossible in the case of shaped tools, and pyrometric control is then essential.

Platinum thermocouples are necessary for measuring the high temperatures involved and should be well protected by porcelain tubes. Optical and radiation pyrometers may also be used, but their inherent disadvantages must be considered in applying them to production work.

Time of holding at a given temperature is as important as the temperature, so that for efficient production the pyrometer should be supplemented by a clock, the time and temperature for a given tool and composition being specified to the hardener.

Protection of the surface is always desirable, and in some cases may effect a considerable reduction in machine work. Damage to the surface may be prevented in the furnace to a large extent by heating with a yellow flame or packing in a carbon mixture. Some oxidation will, however, occur on transference of the tool from furnace to quenching bath. Oxidation from this source may be prevented to some extent by heating in barium chloride or by covering the total with a paste such as is used by file makers. In general, slightly carburizing conditions are essential, or a very short exposure at the high temperatures.

High-speed steel is essentially an air-hardening steel when used in small sizes, but is generally quenched in oil, probably to avoid oxidation while cooling. Quenching in water at ordinary temperatures will almost invariably crack the steel, but water at 100 deg. C. (212 deg. F.) will probably give as good results as oil. Quenching directly in a lead or salt bath at the desired tempering temperature reduces the liability to quenching cracks.

It is generally recognized now that the best results are to be obtained by tempering for maximum hardness, that is, in the temperature range 550 to 620 deg. C. (1,022 to 1,148 deg. F.). The effect of tempering for secondary hardening is to increase slightly the cutting efficiency as measured by the Taylor 20-min. lathe test, but for shop cutting speeds its beneficial effect is undoubtedly magnified, initial hardness then being of greater value.

For tools requiring constancy of dimensions, tempering is necessary, as otherwise heating in service will produce changes in size.

CAST HIGH-SPEED STEEL. Many attempts have been made to avoid waste in machining by casting to shape. It is quite possible to make even intricate castings successfully, but there are several difficulties which limit its development. It is first of all necessary to refine the coarse casting structure and this is most readily done by forging or other hot working. As casting to shape precludes hot working the refining

must be done by some other method. Proper annealing will accomplish this, but whether to as satisfactory a degree as forging remains to be determined. In making castings there is always waste in the gate and risers, which non-useful metal, in the case of small castings, may be greater than the shape being cast. This method will therefore probably find its most profitable application only in the production of large or specially shaped tools.

SUBSTITUTES. The high price of high-speed steel has brought forth a host of substitutes, most of which replace tungsten with chromium or molybdenum in the presence of one or more other alloying elements. These are inappropriately called high-speed steels for their efficiency is much less than that of the high-tungsten high-speed steel, but they evidently have a field of usefulness. For finishing work or intermittent cutting where a high degree of "red-hardness" is not so essential, they may compete favorably on a price basis with the high tungsten tools which are regularly used. It must be remembered also that they may require a different and more exacting treatment than the high tungsten steels.

Besides the steel substitutes, there are non-ferrous alloys which may be considered as substitutes and are very successfully used in competition with high-speed steel for certain classes of work, particularly for cutting very hard material and for roughing. They are brittle and therefore cannot be used where subject to shock and must be used in short lengths. Tools must be ground to shape and no heat treatment is possible or necessary.

The principal alloys of this class are sold under the trade name of stellite. They are binary, ternary or quaternary alloys composed of either cobalt or nickel and metals of the chromium group, which group includes chromium, tungsten, molybdenum and uranium; the latter, however, has not been used commercially in the alloys. The stellite alloys may be broadly divided into two classes: (1) Those malleable at a red heat, and (2) those which can be worked into the desired form only by casting.

The malleable alloys are composed almost entirely of cobalt and chromium, varying from 10 to 50 per cent chromium with a corresponding cobalt composition. These alloys, which are resistant to nearly all forms of corrosion except hydrochloric, sulphuric or hydrofluoric acids, are used for tableware, surgical instruments, chemical and laboratory apparatus and jewelry. Patent specifications Nos. 873,745 and 873,746, dated Dec. 17, 1907, describe the methods of manufacture of these alloys and give the uses and properties of alloys of various compositions. Patent No. 1,150,113, dated Aug. 17, 1915, describes similar alloys using iron as a third constituent.

The cast alloys are either ternary alloys of cobalt chromium and tungsten or molybdenum; or quaternary alloys of cobalt chromium, tungsten and molybdenum. The compositions and manufacturing methods of these alloys are described in patent specifications Nos. 1,057,423 and 1,057,828, dated April 1, 1913.

Another alloy of similar type is Cooperite. The patent specifications call for the following composition: zirconium, 8 to 15 per cent; nickel, 50 per cent or more.

Sulphur in Cutting Lubricant for Monel Metal

BY JOSEPH MANCUSO

Monel metal is coming into popular use in the arts, but many automatic screw-machine operators find difficulty in machining it. The following is a description of the method used by Wallace & Tierman Co. in the manufacture of monel-metal parts with the B. & S. Automatic Screw Machine.

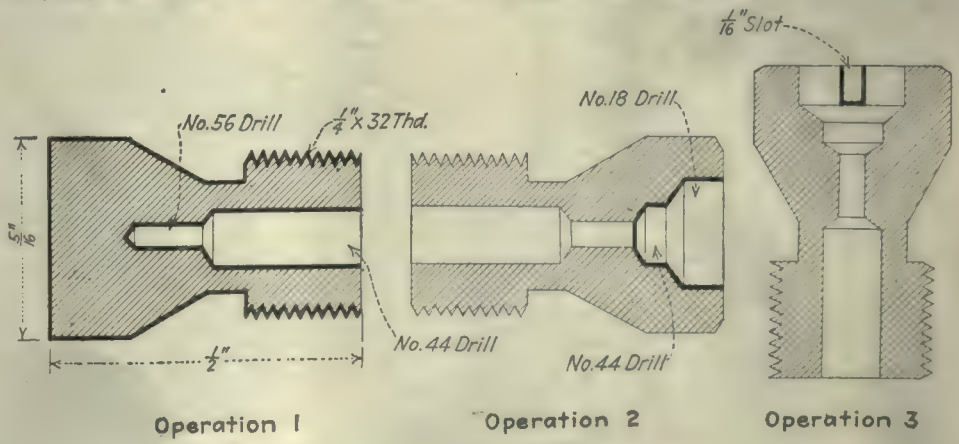
Part No. P 9 is taken as an example as it required forming, drilling and threading operations.

Operation No. 1—Automatic Screw Machine.
Operation No. 2—Hand Screw Machine.
Operation No. 3—Slot.
Spindle speed to form—1093 r.p.m.
Spindle speed to drill and cut off—1093 r.p.m.
Surface ft. per minute for forming and cutting off—89.5.
Surface ft. per minute for No. 44 drill—24.6.
Surface ft. per minute for No. 56 drill—13.3.
Spindle speed to thread—419 r.p.m.
Surface ft. per minute for threading—27.5.

Production 685 pieces per 8 hours; 675 pieces threaded without changing or sharpening die.

High-speed tools are used where possible, such as forming, turning and cutting-off tools, with carbon-steel drills and thread dies. All tools are ground with the same rake and clearance as for steel.

The cutting lubricant used is mineral cutting oil, five gallons of which is thoroughly mixed with 2 lb. of flowers of sulphur (which can be purchased at any drug store for 10c. per lb.). This mixture will give the oil a yellow color and will deposit the sulphur powder very noticeably upon the tools. The sulphur powder does not go into solution with the oil but is held in suspension and the bottom of the oil tank should be stirred every hour or so to prevent the sulphur from settling. This sulphur and oil mixture has been in use on monel-metal work for several years, without any harmful effect on any part of its machinery, except a discoloration of the bronze gibs of the tool slides and these are removed and cleaned from time to time. The whole success of this stunt is in the sulphur powder and it is necessary that the tools receive a generous supply of this mixture.



OPERATION SHEET

The Foote-Burt Piston-Turning Machines

By J. V. HUNTER
Western Editor, *American Machinist*

The machines herein described show to what an extent engine-manufacturing machinery has been developed. The particular features of this line of piston-turning machines are compactness and speed of operation.

PISTON-TURNING machines which have been especially designed for the purpose of affording large production in a relatively small floor area are among the productions of the Foote-Burt Co., Cleveland, Ohio. Each machine consists of a row of vertical spindle lathes mounted on a common base, two-spindle and four-spindle types being made. The function of the machine is to turn and groove the outside surfaces, and to face and center the upper ends of pistons. This work is performed in two operations. It is customary to use two machines on the job, one for the roughing and the other for the finishing operation. Fig. 1 shows a four-spindle, or four-column, machine with pistons in position on the spindles.

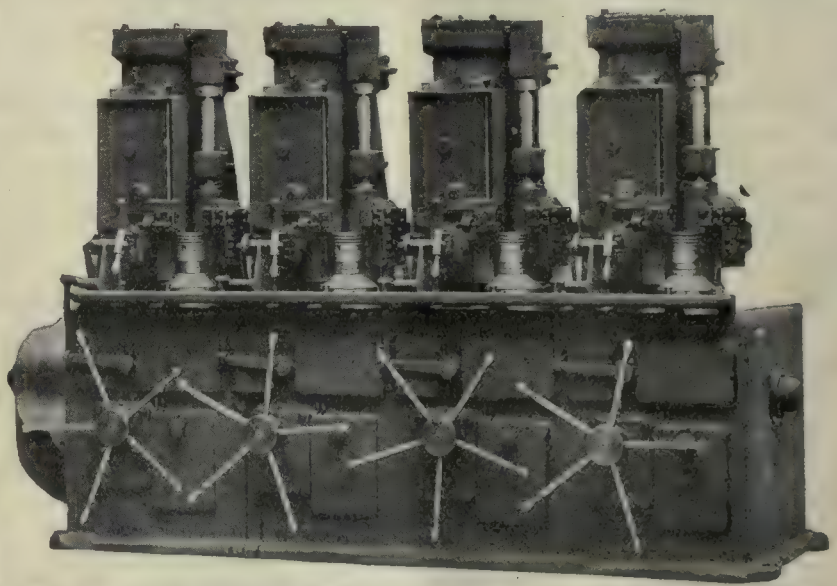


FIG. 1. FOUR-COLUMN PISTON-TURNING MACHINE FOR ROUGHING

Each spindle is entirely independent in its action, so that a delay or even a temporary shutdown at any one station, such as occurs while re-cooling, does not in any way interfere with the operation of the other spindles of the machine. The pistons are removed and replaced at each station by the operator as fast as they are completed; and, although all spindles are driven from the same power source, there is no timing connection between the different units other than the constant rate of drive, as their operating functions are all self-contained. The work-holding chucks vary somewhat with the type of piston being worked but all have draw-in bars with a loop which goes inside the piston and serves to draw down on a short pin passed through the wrist-pin hole. The draw-in bar is operated by the large pilot wheel in front of each station.

A better view of the toolposts for the roughing machine is shown in Fig. 2, although the design is not identical with that shown in the preceding illustration. The side-turning tool *A* is carried in a clapper-box *B* mounted on the slide *C*, which feeds vertically downward on the column. The clapper-box is controlled by stops

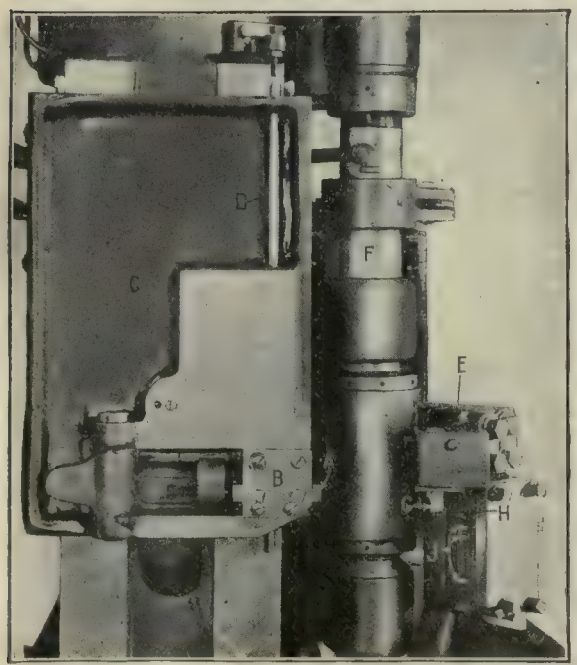


FIG. 2. DETAILS OF ROUGH-TURNING

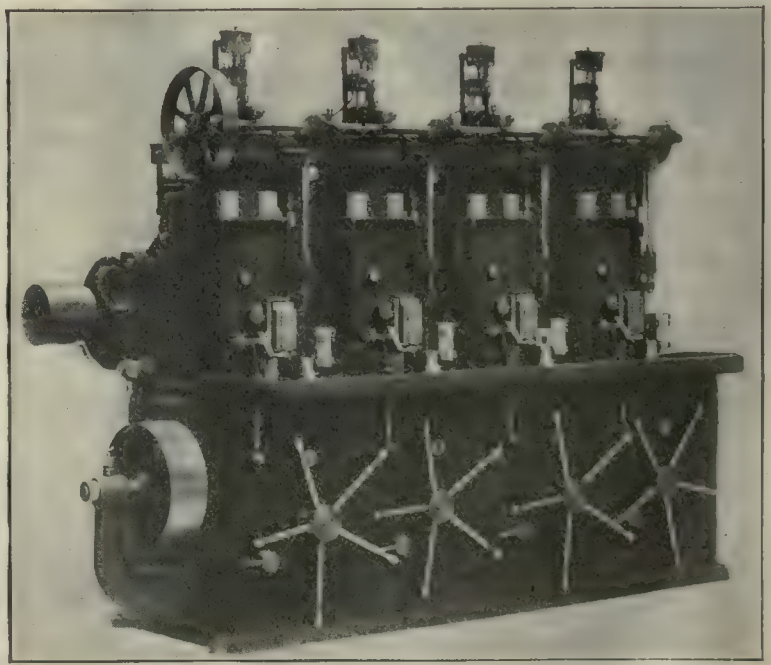


FIG. 3. FOUR-COLUMN MACHINE FOR FINISH-TURNING

on the rod *D*, and it is thrown out during the return travel of the slides so that the tool clears the work. The other tools are on a bracket arm *E* which swings about the shaft *F* and is controlled by a cam and lever motion. The tool *G* faces the top of the piston; as it nears the center, the tool *H* chamfers the upper corner, and then the grooving tools *J* enter the work.

In the roughing machine the work runs at a speed of 50 ft. per minute. The feed is controlled by a cam motion, and to provide for rapid motion of the tool through the clearance, both to and from the work, the feed is at high speed, for $\frac{7}{8}$ in. of travel. A feed of 0.035 in. per revolution is generally used, but the rate of feed is governed by what the job will stand, as the

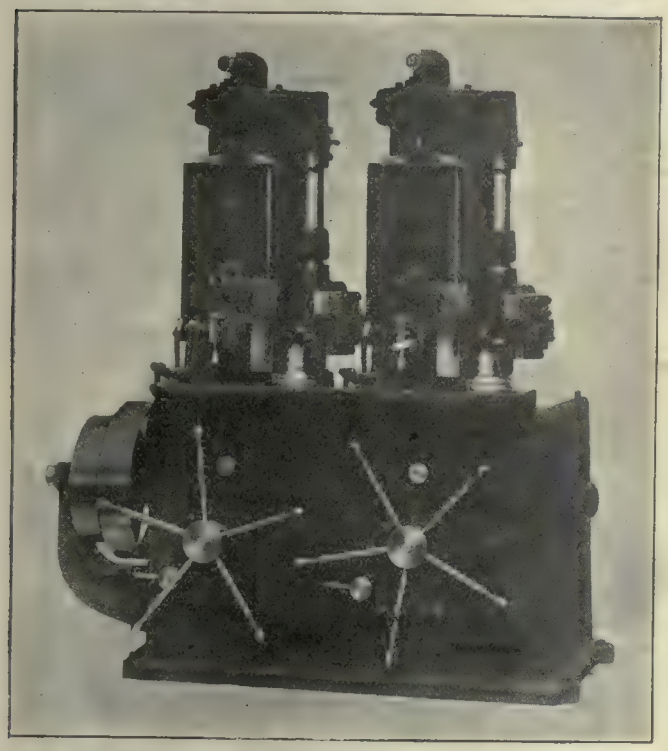


FIG. 4. TWO-COLUMN MACHINE FOR ROUGH-TURNING

tools can usually greatly exceed this rate. In some cases it is, therefore, possible to considerably increase the rate of production by speeding up the machine.

The Finishing Machine

The four-spindle finishing machine, Fig. 3, has no clapper-boxes to hold the turning tools, three of which are carried in each slide. The lowest tool finishes the body and skirt of the piston, and as it nears the bottom the two upper tools reduce the diameter of the space between the ring grooves. A cutting speed of 100 ft. per minute, with a feed of 0.035 in. per revolution, is used. The total travel of the tool is $5\frac{3}{8}$ in., and of this $\frac{7}{8}$ in. is fast feed through the clearance space and the remainder slow feed for cutting.

The operation of the swinging arm carrying the grooving tools is similar on both the finishing and the roughing machines. The finishing machine has, in addition, a light spindle which carries a centering tool, and which is driven from a cross-shaft on the top of the machine through a pair of bevel gears. This spindle slides through a splined bushing in the upper bearing, and it is guided and fed by a bracket attached to the tool slide.

The two-piston turning machine, Fig. 4, is practically the same in mechanical design as the larger machines, the one shown being intended for roughing operations. Each column has a small housing on top holding a quill, which is used to adjust the position of the vertical slide. The short-handled lever at the left of each column controls the clutch for that station of the machine, and it is arranged so that it is automatically disengaged when the slide returns to the upper end of its travel. An unturned piston may then be put in the place of the finished one.

Engineering Foundation Seeks Large Endowment

Based on the generous gifts and high purpose of Ambrose Swasey, the Engineering Foundation has, since 1915, maintained a liaison between engineers, as represented by the Founder and other societies, and scientific workers, as presented in the National Research Council. Practical means for co-operation in research have been set up so that engineers in the numerous branches of the profession may join with physicists, chemists, geologists, geographers, psychologists, doctors, biologists, educators and anthropologists, in the attack upon problems of common interest and in the exchange of knowledge.

Potential benefits for the whole nation are very great, but these benefits cannot be gained without expenditure of effort and materials. Research workers must be supported. Equipment, materials, working places and traveling facilities must be provided. Since the benefits accrue to the professions, the industries and the public in general, support in large measure should come from general funds, such as those provided by endowments. Although engineers, like other professional men as a class, are not wealthy, some individual engineers have large means. The Engineering Foundation seeks to build up its endowment to dimensions worthy of the profession. Engineers connected with industrial and financial organizations having great resources can aid by convincing proper officials of corporations that the continued prosperity of our industries depends upon continued progress of research. Since the commercial and industrial establishments of the country reap the larger proportions of the financial profits arising from scientific and technological work, these establishments should contribute liberally to the support of research.

Scientists are more largely concerned with research in pure science, the search for undiscovered knowledge for its own sake, the usefulness of which may not become apparent, in some instances, for many years. Between this most advanced line and the development of specific industrial devices or processes lies the large field of research in applied science and the industries which especially concern technologists. In this broad field there is scarcely an item of work in which the engineer, in some branch of his practice, is not directly concerned. Sooner or later the engineer uses all the results of research in science and the industries to advantage.

There are many problems relating to the materials and forces of engineering on which further knowledge is needed. Progress will be made approximately in proportion to the funds made available. But there are other kinds of problems which concern the engineer.

No longer may one declare, as did Professor J. B. Johnson, a generation ago, that "Engineering differs from all other learned professions in this—that its learning has to do only with the inanimate world, the world of dead matter and force." Many acute social and economic questions of our day need the dispassionate, impartial, patient study of scientists and technologists.

To these questions must now be applied the scientific method of collecting facts by thorough study and the engineer's capacity for planning and performing, instead of ill-considered "reforms."

Engineering works, public, corporate and private, frequently involve studies of special problems or in themselves constitute full-sized experiments, which could be made to yield important data for general technical use. Sometimes the engineers in charge do not perceive the opportunity, not having been trained in research work. More often the possibilities are realized, but means, men and time are not available because of the urgency for completing the project with a minimum expenditure, in the shortest practicable time.

Occasionally experimental work is undertaken in accordance with a well-conceived plan, as a necessary or desirable adjunct to the main operation. In such cases the exigencies of the main operation sooner or later interrupt the experimental work; the men who have it in hand leave the force; the information is gained, but never written up; the statement is buried in some report of limited circulation; or greater familiarity with research methods and a broader conception of the problem could, with small additional expense, have secured much more valuable results and have made them more generally useful.

Again, many construction or manufacturing operations might be made to yield useful data of greater value than those obtained from small-scale laboratory experiments, if only trained observers with suitable instruments were provided. Often the expense would be slight. Sometimes for lack of trained observers occurrences of scientific significance pass unnoted.

The services described in the foregoing paragraphs, and many others, could be performed by the Engineering Foundation, if adequate funds could be placed at its disposal. The Foundation does not plan to build laboratories and conduct research work directly, but rather to stimulate, co-ordinate and support research work in existing scientific and industrial laboratories, co-operating, in so far as may prove advantageous, with the National Research Council.

Mr. Charles F. Rand, of 71 Broadway, New York, past-president of the United Engineering Society, and of the American Institute of Mining and Metallurgical Engineers, was elected chairman of the Engineering Foundation, on March 19, to succeed Dr. W. F. M. Goss, resigned. With the collaboration of Mr. Swasey, Mr. Rand is actively seeking additions to the endowment fund which will swell the total to at least a million dollars in the near future. Mr. Swasey's gifts amount to $300,000.

The office of the Engineering Foundation is in the Engineering Societies Building, 29 West 39th St., New York. Further information may be had by addressing that office, or the chairman. A booklet giving an account of the Engineering Foundation and its work will be mailed upon request.

What Is a Machine Tool?

By L. L. Thwing

If I am not mistaken, Mr. Jansson's definition of a machine tool, which appeared on page 1044 of the *American Machinist*, was suggested by that journal some years ago. In any case it is on the whole the best descriptive definition we have.

If it presumes the delivery of such materials as castings, forgings, etc., it would exclude all forging, swaging, and forming (by pressure) machines, also pattern-maker's lathes and all sheet-metal machinery. And is it not true that a man who might be a skilled operative of any or all of these machines could hardly be called a machinist, while on the other hand the usual requirements for an "all-around" machinist do not include experience on any of the above machines.

It might be said that specialists such as a grinding-machine or screw-machine operators could not qualify as "all-around" machinists either, and they cannot, but they have had a definite experience in metal cutting, and that is the basis of the machinist's art.

A recent contributor has asked how many present day machinists could handle the valve of a 1,000-lb. steam hammer in a confidence-inspiring way? Probably very few, but the majority will vigorously deny that it is any part of their trade.

Since the days of ancient Greece men who have used words to indicate certain actions or certain things have disputed about their meaning, but they have generally agreed that if a word is in common and every day use by people who have frequent occasion to use such words, such use is correct, whether or not they are backed up by derivation, ancient authority, or literal exactness.

In the early days of the machine shop, such terms as turning lathes, drilling machines, and planing machines were in universal use, so that ancient authority is not lacking for those who advocate the use of these terms today; however the terms "drill" and "planer" have become a fixed part of our shop language and, despite what may be advanced against them, they will probably continue to be so used.

If, as a matter of fact, a majority of machinists and machine-tool dealers call sheet-metal machinery "machine tools," the question is definitely settled in a practical way.

An excellent example of the application of the recently suggested definition—"a machine tool is a metal-working machine whose waste is in the form of chips,"—is shown when it is applied to a machine recently advertised in this magazine. The machine is a spinning lathe with a tool for truing up and smoothing the edge before removing from the lathe. Under the above definition this is a machine tool; remove the turning fixture and it produces no chips and is therefore a metal-forming machine.

Too Much Legislation

The present campaign on the part of certain interests to bring about the adoption of the metric system by legislation brings to mind the story of the action of a certain legislature in the olden days in its efforts to simplify and improve the order of things. Having had brought to its attention the incommensurate relation of the circumference to the diameter of a circle a vote was passed to the effect that in the future, the circumference should be three and one-seventh times the diameter.



A Few Splitdorf Details—II

By S. A. HAND and K. H. CONDIT
Associate and Managing Editors, *American Machinist*

The severe conditions under which ignition magnetos must operate make rigid inspection a necessity and consequently the makers of the Aëro have developed some ingenious devices for testing the accuracy of the various sub-assemblies. These are described here and also the processes and dies used in the molding room where the insulating parts are manufactured.

(Part I was published in our last week's issue.)

As WAS stated in the first article on Splitdorf magnetos, the rotor used is entirely different in many respects from that used in most other types of high-tension instruments. Instead of the primary and secondary windings on a soft-iron frame, the Splitdorf has four drop-forged wings riveted to a brass center section into which are screwed the steel shaft ends. An assembly drawing of the rotor is given in Fig. 7. The wings are end-milled and pack-hardened, 12 pieces being set up for milling at once. Clearance holes for the shafts are then drilled and also the holes for the rivets which fasten the wings to the brass center. The various parts are assembled and the brass rivets at *A* and *B*, Fig. 8, and the iron rivets at *C* and *D* are inserted. The rotor is next put in an Eveland arc riveting machine as shown in Fig. 8. In this machine the rivet is heated by the electric current and forced into the countersunk hole in the wing by a downward movement which is operated by a lever acting through a rack and pinion. This method is quick and avoids the distortion likely in hand or machine riveting. It also fills the holes better.

The rotor is then passed through several turning, milling and keyseating operations and finally has the circumference of the wings and both ends of the shaft ground to size.

Inspection of Rotors

To facilitate the inspection of the rotors the fixture shown in Fig. 9 was made up. Perfect performance of the magneto requires that the distances between the two shaft shoulders, the two wing faces and the respective shaft shoulders and the adjacent wing faces be held to close limits. The inspection fixture has three pointers which read to thousandths of an inch, plus or minus, and give an accurate check on the various distances mentioned. The rotor rests in two supports with the left wing face against the fixed support *A*. The movable fork *D* operates the pointer *C* and indicates any error in the distance from the shaft shoulder to the wing face. The movable fork *D* operates the pointer *E* and indicates any error in the distance between the two wing faces. Similarly the fork *F* operates the pointer *G* and measures the distance from the left wing to the right shaft shoulder. If those three distances fall within allowable limits it follows that the first distances mentioned are also correct.

A Fixture for Testing Concentricity

Another ingenious inspection fixture is shown in Fig. 10. This device is used for testing the concentricity and also the distance from the face of the flange to the bottom of the recess which takes the shoulder on the rotor shaft just described, in the bearing holder assembly. A number of the finished assemblies, driving end, appear in the upper right-hand corner, and a breaker end assembly will be seen in the upper left-hand corner and in detail in Fig. 11. For smooth running the rotor shaft must be concentric with the small shoul-

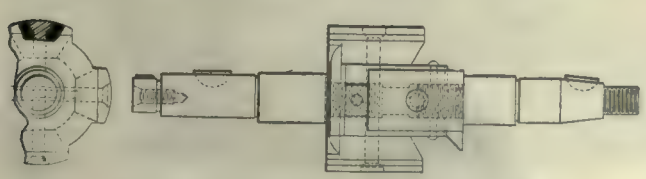


FIG. 7. MAGNETO-ROTOR ASSEMBLY

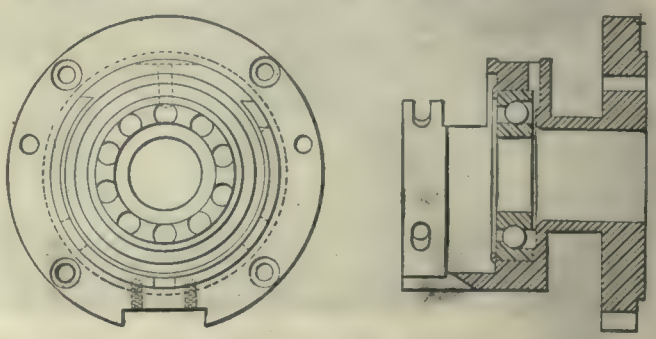


FIG. 11. BEARING-HOLDER ASSEMBLY

AUTOMOTIVE CONSTRUCTION

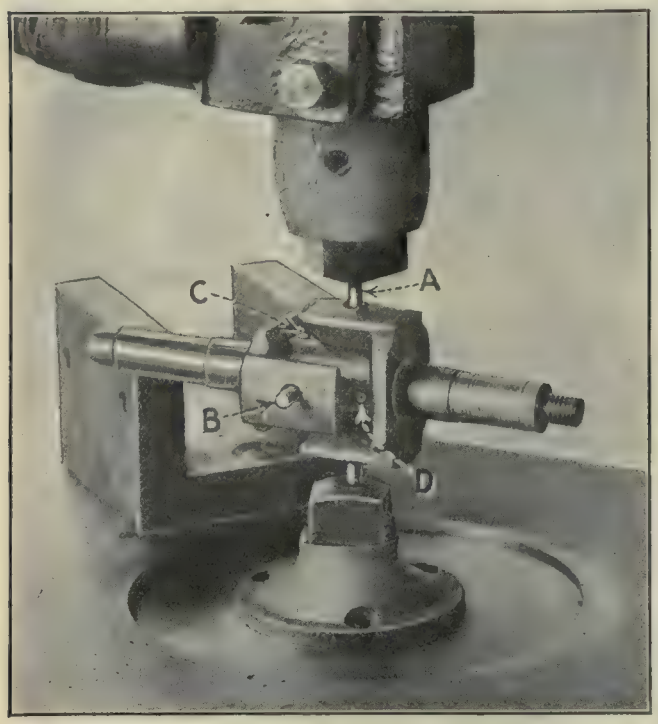


FIG. 8. RIVETING THE ROTOR WINGS

der at the right of the sectioned view in Fig. 11. Consequently, the inner ball race must also be concentric and its face must be a specified distance from the face of the shoulder.

How the Concentricity Is Determined

The bearing holder is shown in position at *A*, Fig. 10, with its flange against the upright *B* and held by the swinging clamp *C*. The hardened test plug *D* is then inserted through a hole in *B* until it enters the inner ball race up to a shoulder. The other end enters a recess in the movable upright *E* and engages the wedge-shaped block *E* which supports the "go" and "no go" levers *G* and *H* and is moved horizontally by the leved *K*.

The illustration shows a perfect holder in the block as indicated by the fact that with the block *E* moved to the right the "go" lever has dropped and the "no go" lever is supported. The concentricity is determined by spinning the test plug which is so de-

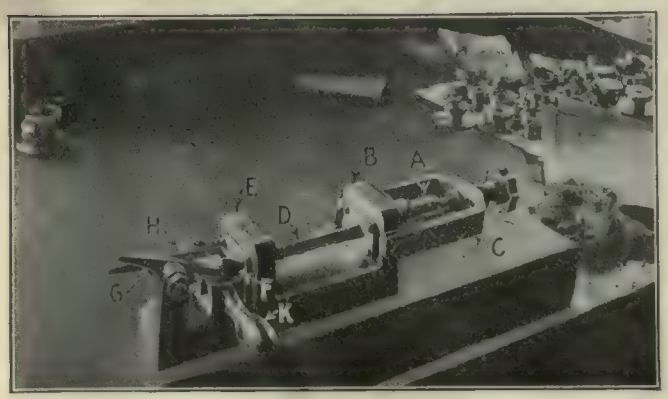


FIG. 10. BEARING-HOLDER INSPECTION FIXTURE

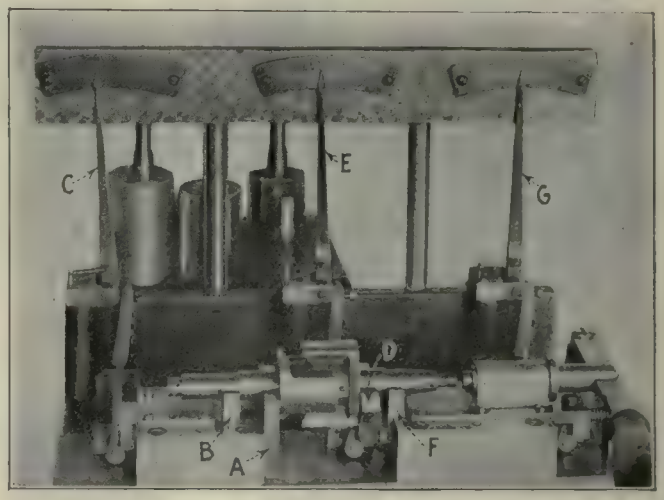


FIG. 9. ROTOR-INSPECTION FIXTURE

signed that a very slight eccentricity of the bearing will cause it to bind.

The need for extreme accuracy in this part of the magneto is apparent when one considers the use and abuse to which it is subjected. In many cases these bearings have to run for months without lubrication as a result of carelessness of the operator of the car or truck to which the instrument may be attached.

Making Cam Blanks

To get the best results out of any magneto it is essential that the break or interruption of the primary current occur exactly at the theoretically determined point in the cycle of operations. The breaker cam is the part responsible for this action and its contour must be held to very close limits. The Aëro cams are cut from a round bar of 0.20 carbon steel in an automatic screw machine which also drills and reams the central hole preparatory to the cutting of the keyway on a small Lapointe broaching machine. The cam blanks thus formed after they have been straddle-faced are strung five at a time on an arbor and rough-ground to shape in a machine with a cam-grinding attachment that feeds

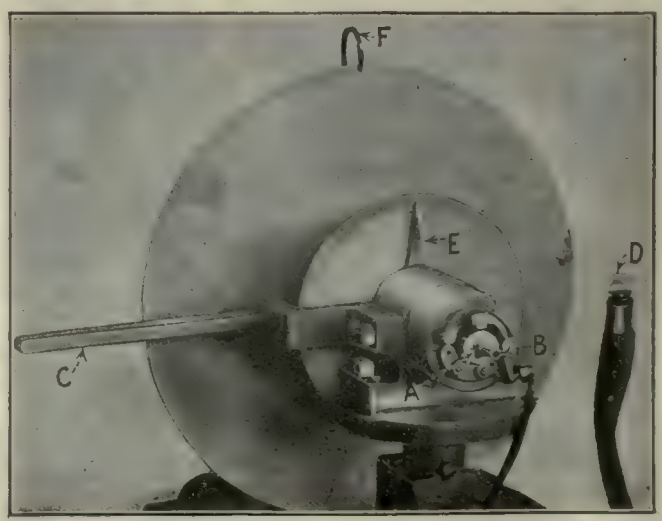


FIG. 12. CAM-INSPECTION FIXTURE

AUTOMOTIVE CONSTRUCTION

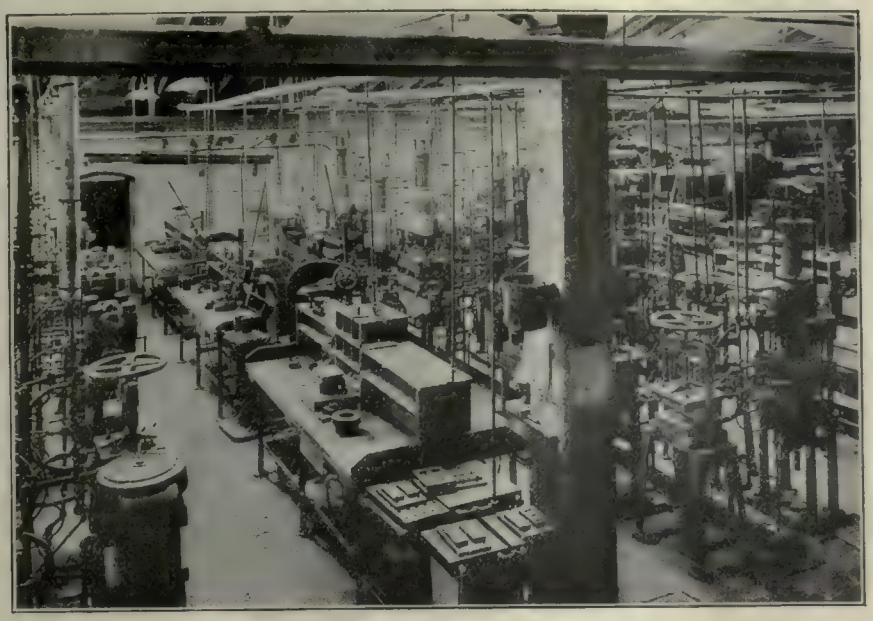
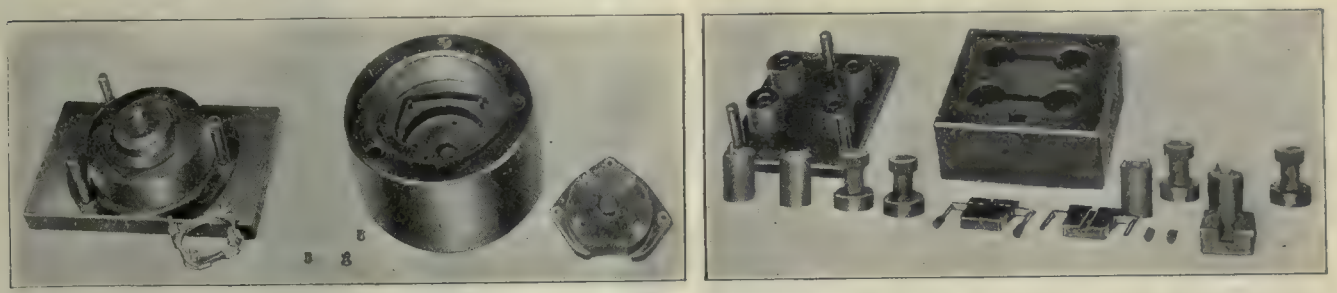


FIG. 13. GENERAL VIEW OF MOLDING ROOM

is held by a knurled nut and is readily adjustable for different tests. The indicator *F* is held by friction and can be pushed either way for adjustment. Each cam is tested for symmetry, point of break and duration of break according to the values given on the drawings.

Symmetry of the cam lobes and concentricity of the hole are determined by means of testing fixture carrying two Ames dials operated by fingers which slide on the cam surface, one near the top and the other near the bottom.

Because of the extremely high voltage of the current generated by a high-tension magneto, particular care must be exercised in the design and manufacture of the insulating material used. The Splitdorf Electrical Co. uses a good deal of Bakelite for making molded insulation, but where the



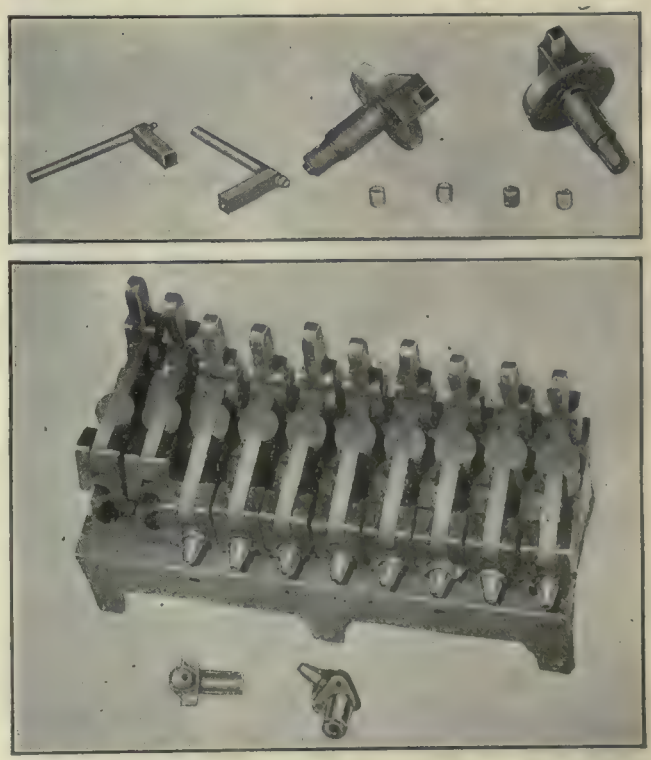
FIGS. 16 AND 17. DISTRIBUTOR PARTS AND MOLDS

the abrasive wheel directly into the work without traverse.

After rough-grinding, the cams are stamped with the proper symbol number and pack-hardened for 5 hrs. in Carbo X at a temperature of 1650 deg. F. They are drawn at 400 deg. and quenched in water. The scale is then removed on a disk-grinding machine and final grinding is done in practically the same manner as the rough-grinding except that a finer wheel is used which produces a finish almost equal to polishing. Finish-grinding limits are ± 0.001 in. on the lifting face.

Inspection of Cams

Inspection of the cams is made in the fixture shown in Fig. 12 where a motorcycle-type cam is shown in position for testing at *A*. The cam is slipped on a splined arbor *B* from which it is kicked off, after testing, by the lever *C*. A standard breaker-arm assembly is fitted to the fixture, the contact points acting as a switch in the circuit which contains the lamp *D*. Back of the fixed pointer *E* is a disk graduated in half degrees and locked to the cam arbor so that the zero point is under the pointer when the spline is vertical. The larger disk is graduated in degrees with the zero and 180-deg. points marked. Some of the divisions between 20 and 33 deg. are made longer and marked to indicate the particular cam which breaks at each one. This disk



FIGS. 14 AND 15. DISTRIBUTOR FINGER AND STRAIGHTENING FIXTURE

AUTOMOTIVE CONSTRUCTION

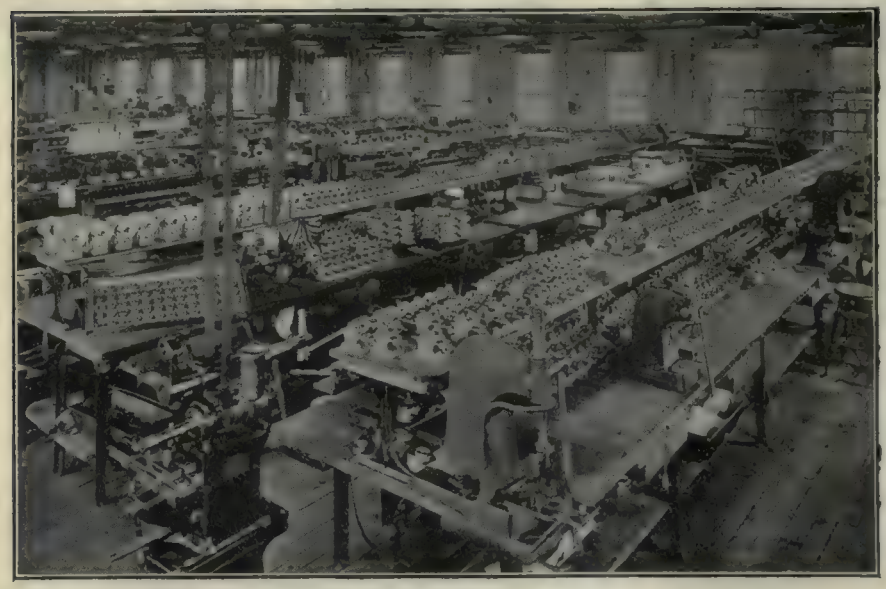


FIG. 18. CORNER OF GENERAL ASSEMBLY FLOOR

conditions are most severe it uses a compound of its own known as Americanite. This is a mixture of rubber, talc and several other ingredients which comes from the mixing rolls as a sheet of material looking not unlike dirty brown linoleum. It is used alone for certain parts and in combination with Bakelite for others, and was developed under the need arising from the cutting-off of foreign materials during the war.

A view of the molding room is given in Fig. 13 which shows the Greenard arbor presses used for stripping the molds, and the hand-operated Zeh and Hahnemann and hydraulically operated Burroughs presses for the actual molding. For this work a steam pressure of 110 lb. is used to keep the material at the required temperature (300 deg. F.) and a water pressure of 2,500 lb. for operating the power presses. The molding operation on Bakelite lasts 10 to 30 min., depending on the size of the piece, and 25 to 50 min. on Americanite. The raw Americanite stock is kept pliable on a steam plate until it is required. The molds are painted with liquid paraffin to prevent the "cookies" from sticking to the pan. Some of the molded parts with the inserts used and the molds in which they are made are illustrated in Figs. 15 and 17.

Fig. 18 shows a corner of the assembly floor where the magnetos are put together ready for testing. This gives a fair idea of the simplicity of the equipment and tools necessary for this work.

From final assembly the magnetos go to the testing jacks, Fig. 19, to undergo what is known as a "road test." Here they are run at maximum speed under conditions which simulate those of actual use as nearly as possible.

After this test the finish-inspection department puts the instrument through a rigid examination for defects of material or workmanship, checks for timing and runs the magnetos on an individual testing machine shown in Fig. 20 with gear guards removed. Here speeds of 100 to 3,000 r.p.m. are obtainable so that the spark-producing ability can be tested at any speed with facility, and a good idea can be obtained of the kind of performance to be expected from the magnetos in service.

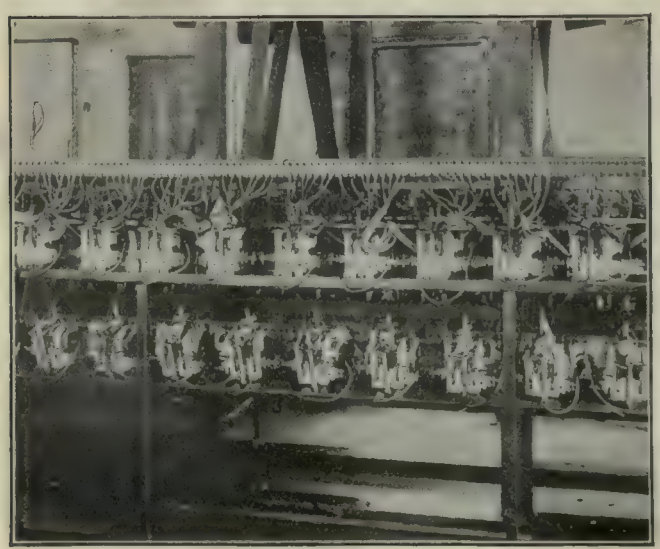


FIG. 19. "ROAD" TESTING JACKS

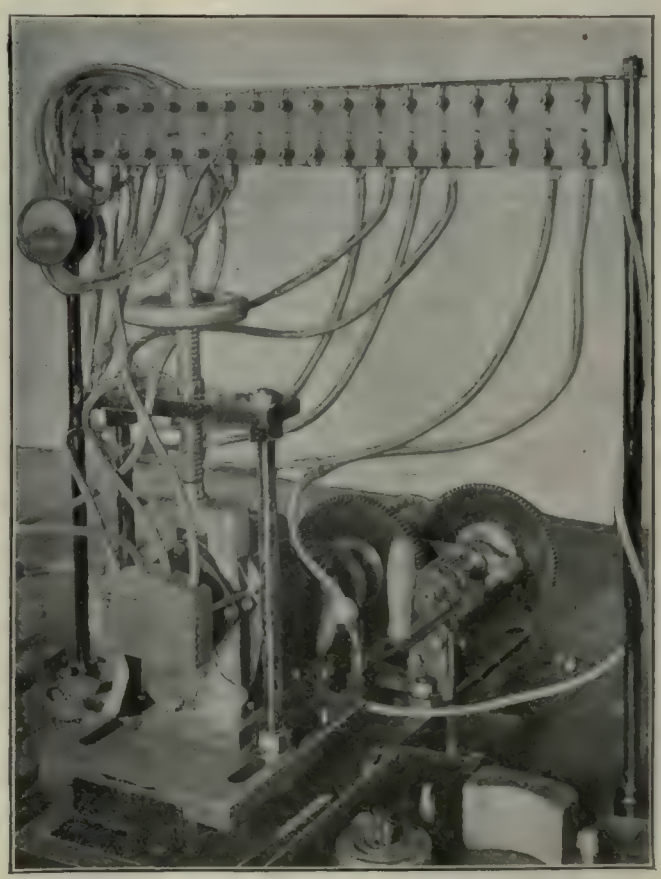


FIG. 20. FINAL-INSPECTION TESTING FIXTURE

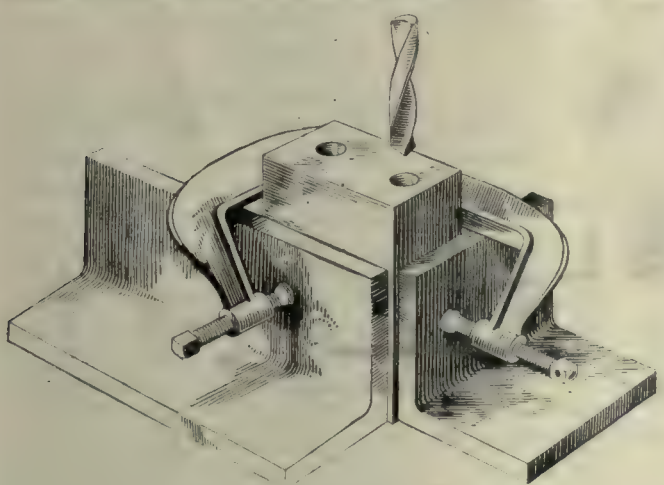


Using Two Angle Plates to Clamp Work

By H. H. Parker

While the advantage of the arrangement shown in the sketch is obvious it is not always used; instead, when setting up square, rectangular, or other work of considerable relative height, on the drill press table, a single angle plate is used to which the work is clamped and then squared up in the other direction by trial.

By using two angle plates at right angles clamped to adjacent sides of the piece, the work is bound to be



USING TWO ANGLE PLATES

perpendicular with the table if the angle plates are accurate and no chips are lodged under them. Cylindrical pieces may be clamped in the same manner.

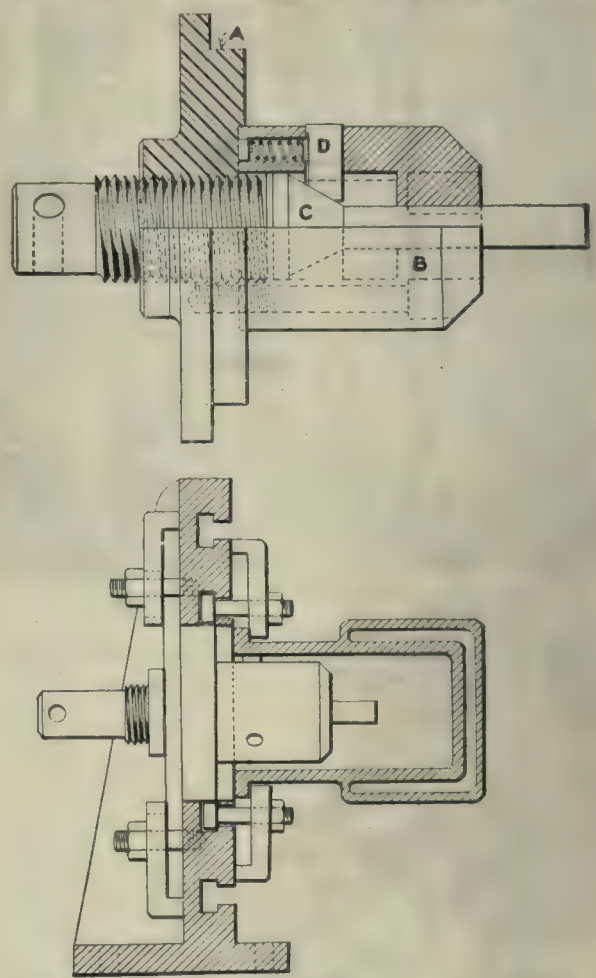
Whether the drill spindle is square with the table is another matter. The writer recalls one large shop where great precautions were taken to level up work on the drill press table but no steps were taken to ascertain if the drill spindle was perpendicular to the table —and generally it was not.

A Device for Centering Cylinders Preparatory to Grinding

By Roy F. Leighton

The illustration shows a device for locating an automobile engine cylinder on an angle plate in position for grinding. The angle plate is attached to the carriage of a large lathe and the boring and grinding attachments screw on to the spindle nose. This device will true up the cylinder at once and hold it in position while the block is being clamped to the plate.

The shoulder of the disk *A* fits the hole in the angle plate and the device is clamped to the latter with the nose piece *B* projecting through. A block is then swung



CENTERING DEVICE FOR BORING AUTOMOBILE CYLINDERS

into place with the cylinder fitting over *B* and the central screw of the device tightened by means of a pin in the cross-hole at the exposed end. Turning in this screw causes the tapered part *C* to expand the three hardened steel jaws *D* thus centering the cylinder and holding it until clamps have been applied. A coil spring and fiber disk pressing against a flat spot on each jaw prevent the lower ones from dropping of their

own weight and interfering with the locating of the cylinder. The nose piece *B* is held to the disk by long fillister-head screws and several sizes are provided to cover a range of cylinder bores.

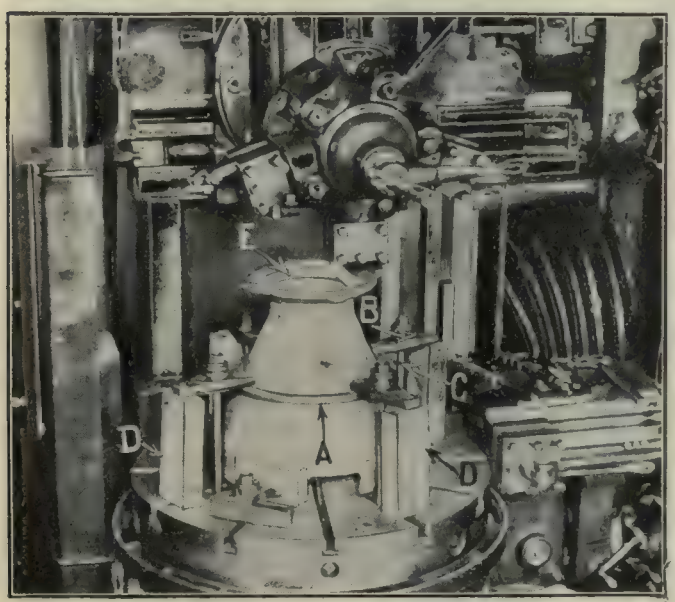
Clamping a Difficult Job on the Boring Mill

By E. A. Dixie

The illustration shows one of a number of conical hoppers which were to be turned and bored on a vertical boring mill. A job of this shape is not the easiest one to clamp securely on any machine but the method of holding it, as shown herewith, not only assures rigid clamping, but is simple and inexpensive.

The ring *A* was made by the blacksmith. Four straps *B* and bolts *C* are used in conjunction with the wooden packing pieces *D* to strap the hoppers securely to the table.

Another interesting feature in connection with this job is that the 45-deg. surface *E* was turned by throwing



CLAMPING CONES ON THE BORING MILL

in both the cross and the down feeds simultaneously, The machine used is a Niles vertical boring and turning machine.

Disk-Grinding Friction Rolls

By W. Burr Bennett

The cost of turning the outside diameter of a 3½- x 3-in. friction roll or pulley was considered to be too high, so it was decided to try a process of disk grinding. The latter method seemed doubly attractive, inasmuch as a more or less roughened surface was desirable to hold the cement used in securing the leather friction cover on the face. After some study it was decided to make a fixture such that the roll or pulley would be held at an angle on the face of the grinding disk, and a Gardner disk grinder with an 18-in. disk was selected as the proper machine. This machine has a table that can be swung in an arc across the face of the disk, thus distributing the wear on the cutting face, and it is also provided with a micrometer feed, which permits of close sizing.



ARRANGEMENT USED FOR DISK-GRINDING FRICTION PULLEYS

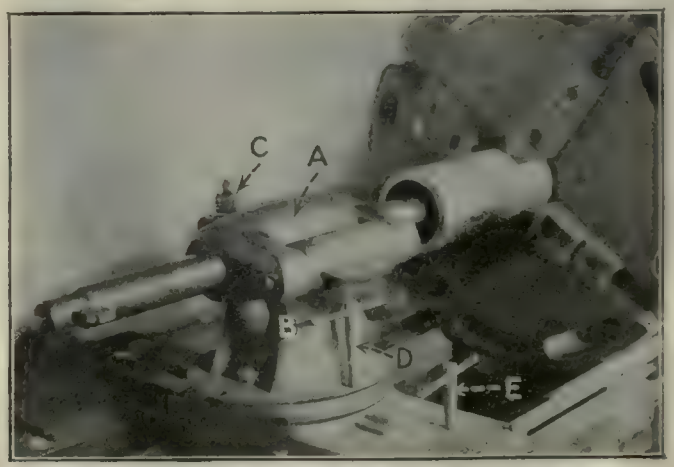
The shaft holes in the rolls are previously drilled and reamed. During the grinding operation the roll is kept in place by a collar, which is held on the extension of the shaft of the fixture by a loose pin. The work in place on the fixture is shown very well in the accompanying illustration. The average continuous production time on this operation is three rolls per minute, which is quite a contrast to the previous turning time of three to four minutes each.

Holder for Boring Bars

By J. H. Vincent

The device shown in the illustration is one which is in frequent use for holding boring bars in the shops of the Minneapolis Threshing Machine Co. The top plate *A* is hinged to the base *B*, so that by releasing the bolt *C* the bar can be quickly removed and turned end for end in the holder. The bar carries the roughing tool in one end and the finishing tool in the other.

The pin *D* is used in order to insure that the bore of the fixture will always be parallel to the ways of the lathe bed, although as originally built it was intended to use this pin for locating the positions of the bracket *B* when indexing it upon the cross slide as is done with a turret. In the latter case the second pin *E* would serve to fix the tool slide in a central position. The present method of operation has been found to be quicker and equally satisfactory for the class of work on which it is used.



LATHE FIXTURE FOR HOLDING DOUBLE-ENDED BORING BARS

WHAT to READ
—for the man in a hurry



Suggested by the Managing Editor

LEADING space this week is devoted to a brief description of a Wickes Brothers special purpose lathe which has just come on the market. This machine was designed for machining crankshaft line-bearings and flanges at a rate commensurate with modern automotive production practice. This brings to mind a letter which arrived in our office shortly after the publication in our European edition of the description of another Wickes crankshaft lathe which you may remember some months back in the *American Machinist*. The letter was from an incredulous Scot who apparently was not familiar with American production methods for he could not believe the output figures which were given for the machine and asked us to explain. He was charitable enough to suggest a possible typographical error for "he had operated one of the best British crankshaft machines and it took as long to set up the work for each cut as the time given in the article for the whole job."

What to read was not a difficult matter to decide two hundred years ago when books were few and magazines unheard of. It is far different now when so much reading matter is offered to pass the time pleasantly or profitably as the reader chooses. We are doing our utmost to make the "American Machinist" not only profitable but indispensable as a clearing house of ideas and news of the machinery world. This page is the editors' advertisement of their section of the paper. It gives the high spots.

A letter from us to the maker brought sworn production figures from one of the automobile factories which we took great pleasure in forwarding to the skeptic. We have heard nothing further from him.

Part II of Mr. Farquhar's "How Do You Regulate Materials?" begins on page 101 and deals with receipt, storage and records. The author goes the Ten Commandments six better by prescribing sixteen rules which are well worth considering even if you decide not to accept all of them.

Engineers and designers are offered an unusually good assortment of technical articles in this issue, even if we do say it ourselves. On page 105 A. J. Schwartz digs back twenty-five years into the files of the *American Machinist* and resurrects a controversy over the acme thread. He closes his short article with some sensible suggestions. Following this on page 107 is a somewhat popularized description of that invaluable measuring tool, the optical flat. Written by H. S. Van Keuren, an old Bureau of Standards man and a recognized expert in gage work, it gives an easily understandable account of the principles underlying the use of the optical flat and some carefully worked out rules for the guidance of the novice in its use. Don't miss this for we have another article along the same lines from the Bureau of Standards which goes much further into the science of the matter and which will be published very shortly. Immediately after Mr. Van Keuren's article, on page 112, we reprint the suggested standards for line and machinery shafting adopted by the committee of the A. S. M. E., appointed for this purpose. It represents another forward step in mechanical engineering economics. One more reference to the Bureau of Standards and we have done for this week. Pages 121, 122 and 123 give the "Characteristics, Treatment and Uses of High-Speed Steel" from the point of view of the Bureau's Division of Metallurgy. If you use high-speed steel you will want this information.

Another special automotive machine tool is described on page 124, the Foote-Burt Piston-turning machine. It is made both as a roughing and as a finishing machine.

Two more definitions of a machine tool appear on pages 106 and 126, one by A. L. De Leeuw and the other by L. L. Thwing, two of our regular contributors. Do you agree with either of them?

There is still another tool description outside of the Shop Equipment Section in this issue. It starts on page 117 and takes up the development of the Powell planer.

We are going a little light on automotive material again this week for we have only the short concluding article on the manufacture of the Splitdorf magneto. We have more of Fred Colvin's comparative articles in the mill, however, and they will appear very shortly. He has more cylinder data and also some additional information on piston manufacture which will round out our series on those important parts. There is also a picture story on making wristpins which is novel and valuable.

The letter from our London correspondent, page 142, is unusually interesting this week. It shows that the cost of living and the output per man in the shops are just as serious questions in England as they are here.

EDITORIALS

What Production Engineering Should Mean

NARROW viewpoints have been responsible for much of our industrial troubles. They have prevented us from securing many of the benefits which we might have otherwise obtained: When the so-called scientific management failed it was because those who installed it were blinded by a lot of rules and forms which prevented them from seeing more than one side of the problem.

The same handicap is being found in the efforts of the production engineer to secure maximum production. As with the old "speed boss" of earlier days, he is often the "best hated" man in the shop, when in reality, he should be the most popular, if things were properly managed. Maximum production should bring the greatest returns to both employer and employee, without of course resulting in undue exertion or fatigue, and the man who accomplishes this should earn the gratitude of both sides.

The difficulty appears to be that too many employers and production engineers seem to think that their duties begin and end with the taking of time studies and the setting of piece or bonus rates. In reality they should include, or be in close touch with, all that goes to make up production. The production engineer should maintain close contact with the employment department and with those who look after industrial relations, not forgetting the education of apprentices and the up-grading of older men. He should be on the most friendly terms with the tool designers and the department foremen, and the closer his contact with the workers themselves, the better results he will secure.

One of the most important studies for a production engineer is that of psychology. It has far more to do with real production than time study or motion study. A knowledge as to how the human element will react under different conditions is invaluable in securing the best results.

We have been too prone to consider only the physical and mechanical side of the question, to think of machinery rather than of the surroundings. In many large hand-made cigar factories there are readers, who read by the hour as the men roll the cigars. In other classes of work music has been found to aid in maintaining interest and increasing the production.

Neither of these methods will apply in machine-shop work, but there are possibly other things which might be used. Clean shops, well painted machines, and even flower beds outside affect most men favorably whether they realize it or not. Whatever will add permanently to a worker's energy and well-being is part of the production engineer's job. If red geraniums in yellow boxes will add 2 per cent to the output they are just as much a part of his work as a similar expenditure for tools and fixtures. If good photographs of work sent out, or of current events, will add to the output, by all means let them be posted.

Production engineering is a much broader profession than we have been apt to think. It is most honorable because increased production adds, or should add, to the welfare of the community and of the country. Production engineers should aim to see that it means this and nothing less.

F. H. C.

Exhibits of American Products in Argentina

TO THE manufacturers of the United States has come an unusual opportunity for the establishment or the augmentation of trade with South America. This is due, of course, indirectly to the conditions existing as a result of the war, but the preceding statement was prompted by a fact entirely apart from these conditions.

In the June 17 issue of the *American Machinist*, an exposition of United States manufactures at Buenos Aires, Argentina, was announced. The date of this exposition has been changed, so that it will begin on March 15, 1921, and continue for at least 30 days. The object is to introduce American manufactures, on a large scale, to the business men and to the general public of Argentina and the surrounding countries.

The need of developing trade with South America is not thoroughly appreciated by many manufacturers, simply because they have plenty of domestic orders to keep them busy at present. Everyone has heard of the fellow who left his roof in bad repair because, when it rained, he could not fix it and, when the weather was nice, there was no need of fixing it. The viewpoint of American manufacturers is the same, as a rule. They have little permanent foreign trade because, when they really feel the need of a foreign market, it is too late to develop it and, when there are plenty of domestic orders to go around, there is no use in bothering with other countries.

Manufacturers in other countries do not view this matter in the same light. Great Britain and Germany controlled a large percentage of the South American market before the war. These nations are now busy rebuilding and recuperating at home. The injury which we received in the war is hardly comparable to that which they have endured. Also, the post-war efforts made by the manufacturers of our country and those of Europe to obtain the South American trade are not comparable. The United States receives the worst of this comparison, however. While we are letting this market in our own hemisphere go unexploited, European nations are right now sending what goods they can to this section and also getting large blanket orders without even promising delivery dates, in order to exclude us.

If this market is so valuable to Europe, it is even more valuable to us, and some of our big manufacturing concerns fully realize it. Too bad that they are in the minority. Although we can do without this market right now, we are going to need it soon. Now, however, not then, is the time to develop it.

Here is the point to the discussion. European coun-

tries will not be on a normal production basis and fully entrenched in the South American trade before about two years. The manufacturing facilities of our country are at the present time greatly enlarged. At this time when the markets of the world are open to us with very little competition offered, why not enter them? It can never be any easier than it is now. Once established, the worth of our products should secure a permanent trade. The exposition previously mentioned offers a means of putting goods from the United States before the buyers of South America. It is a much more effective method than the use of catalogs and agents, for seeing is believing.

A word about this exhibit. It is conducted by the American National Expositions, Inc., with offices in the Bush Terminal Sales Building, New York City. This organization plans to give expositions in foreign countries of our products, and it has the approval of the United States Government.

Buenos Aires was chosen as the location of the first exposition because of the richness of the field about Argentina and the large import trade of that country. Think of the publicity that can be given to American goods by having some 500 manufacturers exhibiting and selling. Particularly as it is the opinion of the promoters that practically all of Argentina's business men will attend the show.

Besides the actual business which the exposition will create, the friendly feeling which will arise from increased intercourse between the countries will be of value to both of us. What is of more moment just at present, we can get started before European trade is too strongly entrenched.

Don't wait until it rains before you think of repairing the roof. C. J. P.

The Child Labor Laws and Apprentices

By R. P. Deane

I have been interested in reading, from time to time, articles about the scarcity of boys who want to learn a trade.

I think that one cause, in some states at least, for so few boys being interested in serving an apprenticeship may be attributed to the Child Labor Law. Now, I do not want any one to get the impression that I do not think that each one should have as good an education as his circumstances will permit, for there is nothing so useful to a man as a good education, but my criticism of the labor laws is their limiting the things that a boy is permitted to do, until he is so old that he thinks he is a man. In Massachusetts it is against the law to use boys under sixteen for practically any machine-shop work other than pushing a broom—and there isn't much to be learned at that.

Of course I do not believe in boys being engaged in hazardous work, but I do not think that any fair-minded man would say that running a small lathe, drilling machine, shaper, or milling machine, is really hazardous. These laws seem to be directed more to limiting the number of boys who can afford to learn a trade, and as such they are very effective.

Few shop owners or manufacturers feel that they can afford to teach boys a trade and pay them high wages at the same time, and a boy of sixteen or over requires quite a little money for running expenses now. Most of his friends probably make good pay and he feels that he should make as much as they do. His parents, particularly if they have several more coming along, think that the boy must be self-supporting, or more. Starting to learn a trade at sixteen means that he does not begin to get the good pay until he is nineteen or twenty, at which time some begin to think about marriage and homes of their own.

I believe it is generally considered that a boy serving a three-year apprenticeship is a loss the first year, about an even break the second, while he may produce a slight profit the third. After the third year the chances are that he will try another shop, so the employer really has nothing to show for his trouble in teaching the boy.

Let us take the case of a boy who begins work other than a trade at fourteen. If he is bright and willing he will probably increase in value by the time he is sixteen until he will earn about double what he can get for the first year in learning a trade. He does not take kindly to having his wages cut in half by becoming an apprentice; neither do the parents think he should have to begin at the bottom again, so he keeps on at what will very likely prove a dead-end job.

This is doubly true at the present time, when many men, with no real knowledge of any trade, are making as much—and often much more—as machine operators, than the real mechanics make. What is not realized is that the chance of stepping out of the shop and into a responsible position is good for the real mechanic, but is practically impossible for the operator.

I have had men ask me many times to teach their boys the trade, but when told what wages they could expect, they immediately lost interest. Others have asked me to take in boys who were too young, and were very much disappointed to learn that it was against the law to use boys of that age on practically any shop work. Yet I believe that these same men would raise an awful howl about boys doing men's work, if any number of them were permitted to work at their own respective trades.

It seems like a very short-sighted policy to make laws which practically bar the children of comparatively poor people from having trades and then wonder why fewer of them each year try to learn trades. If the labor laws could be amended to allow boys of fourteen to use tools which are not really hazardous, I believe that there would be no scarcity of boys who would serve apprenticeships, or of manufacturers who would take care of them.

Impromptu Key for Milling Cutter

By Charles D. Folsom, Jr.

Every milling-machine hand knows how easily a narrow cutter, such as a slitting saw, will shear off a cold-rolled steel key used to hold it on the arbor. The remedy for this trouble is to use tool steel, but the extra work of filing a key from a round piece of drill rod very often causes a man to use cold rolled and "take it easy." However, one day when I was in a hurry and had just sheared a key, I happened to see an old file on the bench; in about five minutes I had filed up the end of the tang, broken it off in the vise, and put it in place on the arbor. The tang of a file is soft enough to file, yet not thoroughly soft, as it would be if it had been annealed, so it is just about right for a key.

Summer Meeting of National Safety Council

THE Engineering Section of the National Safety Council held its summer meeting in Chicago, on June 24, 1920. This section is composed of engineers engaged or interested in accident prevention and has done some important work in connection with the development of uniform safety standards.

The meetings were under the direction of Chairman C. P. Tolman, chief engineer of the National Lead Co.; Vice Chairman L. A. De Blois, manager of the safety department of the E. I. Dupont de Nemours Co., and Secretary Sidney J. Williams, secretary and chief engineer of the National Safety Council, Chicago. The Western Society of Engineers co-operated in arranging the meetings and loaned the use of its rooms. The morning session was devoted to the reports of a number of committees who have been conducting investigations in various lines of safety work. H. A. Schultz, of the U. S. Steel Corporation, reported for the committee on "Safeguarding Machinery at its Source," which has considered the problems of dealing directly with machinery manufacturers to urge them to properly safeguard their products instead of leaving this work to the purchaser. In part the report was as follows:



L. A. DE BLOIS



S. J. WILLIAMS

OFFICERS OF THE NATIONAL SAFETY COUNCIL SUMMER MEETING

"Some three years ago the National Safety Council appointed a committee with the same title as that of this committee. Probably the most important feature of its work was in paving the way with the Machine Tool Builders' Association and with the American Society of Mechanical Engineers. To see that this work was in a measure successful we have but to turn to the advertising pages of the mechanical publications, where page after page show machines pictured with hazardous points guarded. It is true that the guarding is not always adequate, and also that the manufacturer sometimes fails to guard all of the hazardous points, but on the other hand think of these machines as illustrated 10 or 15 years ago! In those days the gears, power transmission, etc., were devoid of any covering.

"It is perfectly obvious that the best time to plan the safeguarding of the machine is while it is being designed. Then only can we hope to incorporate the features essential to safety and obtain the kind of a job that is pleasing to the eye and satisfactory to the critical inspection of the engineer inspector and the plant manager. Too often the guards that are installed, after the machine is in its working position in the shop, are frail, unsightly and inadequate.

"Safety specifications should be based upon practical recognized safety standards and should be drawn up in a form so that they may be included and used as a whole, or in part, for any contract for construction work, or for purchase and installation of machinery and equipment. A set of safety specifications should be attached to, or embodied in, general specifications when originally submitted to contractors or manufacturers for bids. . . .

"If we begin with our own companies we may feel reasonably certain that later such demands will be made by the purchasing departments of all companies—in fact many of them have already begun, as you know. Always, we should emphasize the fact that manufacturers of machines that are adequately guarded have an advantage over their competitors whose machines are not guarded because the sales engineer can truthfully state that the machine, as delivered, will comply with the requirements of the safe practice inspection department of the State Industrial Commission and also the requirements of the various insurance companies."

The dangers incident to shifting belts on cone pulleys was the study of a committee under the chairmanship of H. E. Somes, of the Chevrolet Motor Co. In his report he said:

"At the last meeting of the Engineering Section of the National Safety Council, I volunteered to obtain time studies on mechanical belt shifters for cone pulley belts and on the hand method. After going through a number of large machine shops, I was very much surprised to find that with the exception of an isolated instance, belt shifting devices for cone pulley belts were not used; and due to that fact, and also the short period of time left to investigate this subject, I have been unable as yet to obtain the time studies. One of our factory managers, who has a successful belt shifter installed, expressed it as his opinion that a green workman can shift cone pulley belts by means of the belt shifter as rapidly as an experienced workman can shift them by hand—with the additional advantage that in doing so he is safeguarded from injury. However, I have been convinced of the fact that mechanical belt shifters can be or already are developed that will shift belts on cone pulleys more rapidly than by hand—much more safely and efficiently and without serious injury to the belt itself.

"The problem seems to be, where should cone pulley belt shifters be required. A shifter has its maximum value when it is installed on a machine where belts are shifted many times per day. Where a saving can be realized in the workman's time due t an improved method of shifting belts and the machine itself gains a greater capacity, these advantages will become more apparent, in proportion to the number of belt changes. Usually the advantages become of lesser importance as the number of shiftings decreases.

"Among installations where cone pulley belt shifting devices are desirable are the toolroom, and maintenance and repair shops.

"Considering the modern manufacturing machine shop, such as the automobile plant, we are struck at once by the fact that belt shifting is very uncommon, and in fact in many cases, if the manufacturer could obtain them, single

purpose machines would be purchased. In the production machine shop an individual machine is tooled up for a single job and frequently this machine runs several years without any change in the method of manufacture, speed or feed.

"As an illustration of this point: Recently I went to the Chevrolet Motor Co.'s manufacturing plant in Flint, to see a screw machine which had been fitted with a mechanical belt shifter. I asked the operator what he thought of the shifter and how much it aided him. He replied that he thought the belt shifter was satisfactory but that he had been employed on that particular job for approximately eight months and in that time had never used it to shift belts except to satisfy himself that it would work. This condition exists throughout that entire plant.

"The field for greater service of the belt shifter undoubtedly would be in shops not engaged in production manufacturing, but where, on account of the special nature of the different jobs, wide variations in the spindle speeds are necessary. This also applies to drill press operations where the step cone pulleys are exposed within 12 or 18 in. of the floor. Drill presses, excepting where they are used over long periods of time on a single operation, require a large number of belt changes throughout the working day, owing to the different sizes of drills which may be used.

"While observing a belt shifter at Flint, I noticed that it seemed to be satisfactory in shifting from high to low; but in shifting from low to high speeds the belt curled and caused difficulty. The plant engineer advised that the shifter had been thoroughly satisfactory until the belt became oil soaked from long use.

"In order, however, that we may obtain accurate information as to the advantage of using mechanical belt shifters over the hand shifting method, and also to ascertain whether a satisfactory shifter has been developed, the Chevrolet Motor Co. has arranged to conduct a test on several types of shifters. This test will be strictly impartial, and we hope to learn if the belt is injured by using a mechanical shifter and whether or not the shifters are satisfactory after the belt has become thoroughly oil-soaked and very pliable."

Safety Educational Work

A committee headed by Bruce W. Benedict, manager of the shop laboratory, University of Illinois, has considered the questions connected with the promotion of educational work. This report was presented by W. D. Keefer, who said in part:

"Almost every one familiar with the engineering courses offered in the average technical school and university in our country agrees that our student engineers are being taugh technical subjects that fit them to solve problems where materials, machines and forces of nature are involved, but that practically nothing is taught to assist them in solving the problems involving men. . . .

"Many persons interested in safety think that a presentation of the principles of accident prevention to student engineers will assist materially in developing a proper understanding of men, and at the same time make a valuable addition to the student's engineering knowledge. They base this statement on the fact that successful safety work is the result not only of the proper application of true engineering principles but also of the ability to understand and handle men.

"The National Safety Council has in the past two years been devoting some time and money to the consideration of this problem and the following suggestions are the consensus of the comments of the committee.

"1. Safety education in enginering colleges should not be confined to preparing safety engineers. A greater effort should be made to impress all engineering students with the fact that safety is an integral part of efficiency. Such courses as machine design, shop practice, industrial management and others are particularly suitable for the inclusion of the study of safety work.

"2. Safety can be presented to the engineering educator and the engineering student, as a subject definitely related to engineering efficiency rather than as a humanitarian subject.

"3. Opportunities should be provided for engineering professors to take up summer work in the safety departments of some of the large companies.

"4. Encourage colleges to take out a $15 a year membership in the National Safety Council, which membership will make available all the Council's bulletins and other publications.

"5. Urge colleges to post safety bulletin boards in the engineering shops and keep them alive with the Council's bulletins and other literature pertaining to safety.

"6. Assist engineering colleges in establishing individual safety museums.

"7. Attempt to have the standard engineering handbooks introduce a safety section to include safety codes and principles that apply to the particular branches of engineering which the handbook covers."

Safety Code Committees

Various sub-committees have been engaged in compiling codes for standard safeguards for different classes of machinery. Their work was reported by R. H. Guerrant, safety engineer of the National Safety Council. Items worthy of note follow:

"When the Council was asked to sponsor the code on power presses we at once set about organizing a committee of representative men to formulate this code. Various engineering societies and organizations, including the National Association of Machine Tool Builders, the Bureau of Standards and all State Industrial Boards were invited to appoint representatives on the committee. . . .

"In the preparation of this code we already have as reference some very valuable pamphlets on the subject. Among these I might mention the 'Safe Practices' pamphlet on power presses issued by the National Safety Council, a bulletin on 'Safety Devices Used by Members of the Sheet Metal Ware Association,' bulletin on 'Stamping and Punching Presses,' issued by the Utica Mutual Insurance Co. and other similar publications, together with the codes of various states, some of which contain provisions relating to safety in punch press operations.

"As soon as the committee has been formed the work of actually producing the code will be started. This work will likely be handled largely from the National Safety Council offices, and the code in tentative form will be forwarded to the various members of the committee for their action.

"A similar course was followed in the handling of the paper and pulp safety code. State boards were invited to name representatives to serve on the committee as were the several organizations of paper and pulp mill men."

During the afternoon session F. J. Littel, president of the F. J. Littel Machine Co., spoke on "Automatic Feed for Power Presses." He described the different types of automatic feeding devices which have been successfully applied to power-press operation, including both the roll-feed and dial-feed methods of handling the work to and from the dies. He also described new developments in the line of magazine feed together with automatic sorting and loading devices that make the operation of the power press almost independent of the attention of a workman. Mr. Littel was followed by A. L. Kaems, safety engineer of the Simmons Co., Kenosha, Wis., who spoke on "How We Increased Production by Safeguarding Power-Press Operation.".

A dinner meeting in the evening concluded the program. H. G. Ellerd, president of the National Safety Council, presided. The addresses included: "The Engineer and Production," by W. G. Nichols, president of the American Manganese Steel Co.; "Safety and Production," by George A. Hart, superintendent of the Melrose Park plant of the National Malleable Castings Co.; and "Safety and Engineering Efficiency," by Sidney J. Williams, of the National Safety Council.

SHOP EQUIPMENT NEWS

-Edited By-
E. L. DUNN and S. A. HAND

SHOP EQUIPMENT • NEWS •
A weekly review of modern designs and • equipment •

Descriptions of shop equipment in this section constitute editorial service for which there is no charge. To be eligible for presentation, the article must not have been on the market more than six months and must not have been advertised in this or any previous issue. Owing to the news character of these descriptions it will be impossible to submit them to the manufacturer for approval.

• CONDENSED • CLIPPING INDEX
A continuous record of modern designs • and equipment •

Cincinnati 16-In. Gear Hobbing Machine

WITHIN the past few months several Cincinnati 16-in. gear hobbing machines have been placed in production service by their maker, the Cincinnati Goar Cutting Machine Co., subsidiary of the Cincinnati Shaper Co., of Cincinnati, Ohio.

The capacity of the machine ranges up to a maximum gear diameter of 17¼ in. with 12-in. face. It will cut spur gears of 3 D.P. in cast iron or steel; and helical gears of 3 D.P. in cast iron or 3½ D.P. in steel. Gears with either right or left helix may be cut, up to 45 deg. of angularity. The machine is regularly equipped with standard parts and change gears for cutting spur gears only. If helical gears are to be cut, proper data must be furnished the maker so that the proper gears may be supplied.

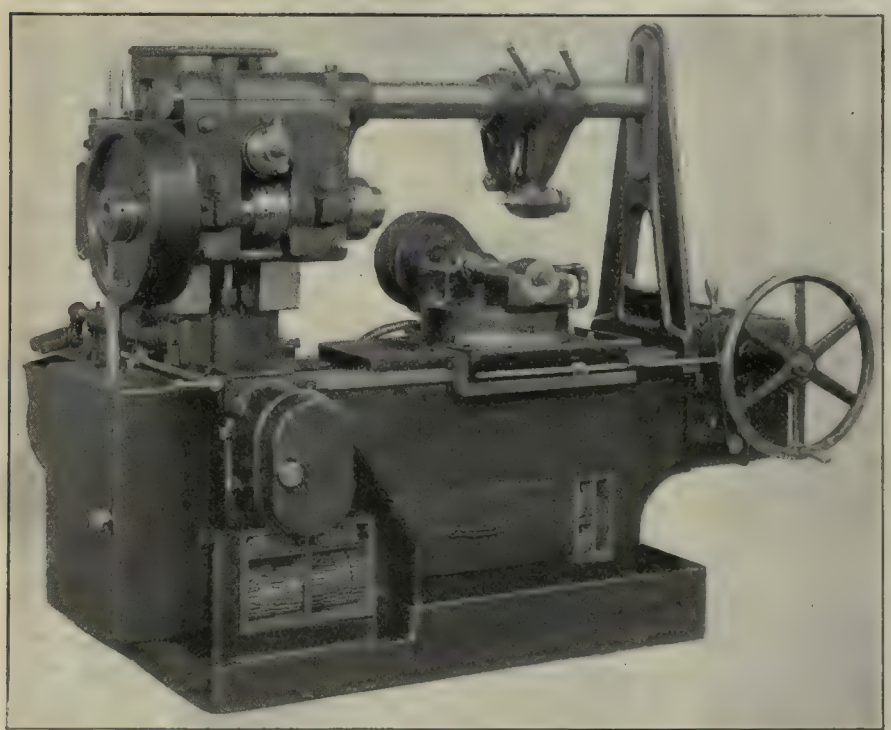


FIG. 1. CINCINNATI 16-IN. BELT-DRIVEN GEAR HOBBING MACHINE

Specifications: Rated capacity, diameter, 16 in.; face, 12 in. Actual maximum gear diameter, 17¼ in. Rated capacity, spur gears, 3 D.P.; cast-iron helical gears, 3 D.P.; steel helical gears, 3½ D.P. Maximum distance center of hob to nose of spindle, 19½ in. Maximum diameter of hob, 4½ in. Diameter hob arbor, 1¼ in. Taper hole in work spindle, No. 12 B. & S. Hob speed, 8 changes, ranging from 50 to 200 r.p.m. Hob feeds, 26 changes, ranging from 0.015 to 0.250 in. per rev. of work. Driving pulley, 15 x 3¼ in.; speed, 400 r.p.m. Over-all dimensions; covers closed, 52 in. x 82 in.; covers open, 56 in. x 103 in. Net weight of machine with electrical equipment, 5,600 lb.; domestic shipping weight, 5,900 lb.; export shipping weight, 6,600 lb. Contents boxed for export, 210 cu.ft.

The bed and housing are of box construction, heavily ribbed to secure rigidity. The column at the left side of the machine has a flat top on which the driving motor may be mounted, as shown in Fig. 2, or which may be used, in the case of a belt-driven machine, Fig. 1, to support an extra tool pan. A noticeable feature of the construction is that hollow-head screws have been used almost exclusively for assembling the main parts of the machine, giving it a smooth external finish.

Finished ways on the side of the column carry the work-spindle saddle which is taper-gibbed to long and narrow guides to prevent any sagging when the clamping bolts are loosened. The saddle is raised or lowered by a crank so it can be set for depth of cut or size of gear. The quill is fitted with a graduated dial reading to 0.001 in.

The indexing mechanism consists of a steel double-thread worm and cast-iron worm gear which are entirely inclosed and run in a bath of oil. Adjustments of the worm may be made for wear. The change gears for indexing are placed on the left end of the machine, Fig. 1, and are inclosed by the gear box cover.

The work spindle is horizontal and is rigidly supported by two long bronze-bushed bearings; the front bearing is tapered for adjustment to offset wear. The thrust bearings are alternate steel and bronze washers. The spindles are of hammered forged steel, bored to 1⅛ in. diameter and have No. 12 B. & S. taper. Spindle lubrication is secured through two sight-feed oil cups.

The work arbor is supported by a bracket carried on an over-arm 3¾ in. in diameter and provided with an outboard support bracket or A-frame. A double over-arm bracket is provided, only one portion of which is released for removing the work arbor. This bracket carries a center which insures the accurate and quick return of the work arbor to its proper position after reloading.

The ways which guide the hob carriage are square and extend the length of the bed. Taper gibs are used to adjust the carriage to the ways. The carriage may be swiveled through 50 deg. in either direction,

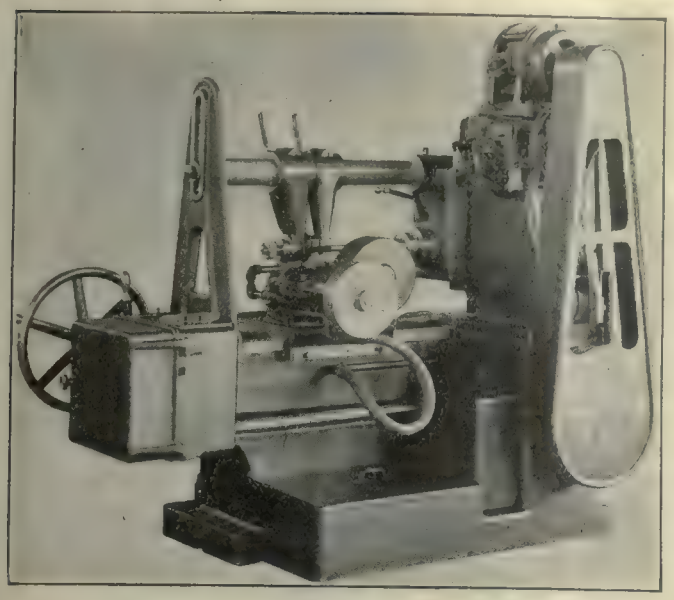


FIG. 2. REAR OF MOTOR-DRIVEN GEAR HOBBING MACHINE

and may be accurately set by a vernier reading to 5 min. Movement of the carriage is controlled by a handwheel located at the right front of the machine.

The hob spindle is driven by helical gears to insure smooth running. It is provided with bronze bushings and a taper bearing for making adjustment for wear. The bearing boxes are scraped into the saddle for perfect alignment and are capable of endwise adjustment. Almost all hobs are made with several more teeth than are in use at one time, and the work is started at one end of the hob, which, as it dulls, is shifted endwise until the entire hob is dulled. On account of its being possible to adjust the hob spindle endwise, it is not necessary to reset the hob on its arbor.

The speed box for the hob spindle is inclosed in the case on the front of the machine. There are eight standard changes of hob speed. The feed change gears for the carriage are in a case at the right end of the machine and give twenty-six changes of feed ranging from 0.015 in. to 0.250 in. per revolution of the work. The gearing for the feed is driven through a worm and worm gear, and is provided with a trip to stop the feed mechanism only.

The machine may be entirely controlled from the operator's position in front. If motor driven the motor control switch is located on the front; if belt-driven the machine is controlled by the clutch-operating handle located back of the hob-slide handwheel.

Automatic knockout is provided for stopping the machine at the conclusion of a cut; adjustable dogs either cut off the motor current or shift the belt clutch depending upon the type of drive.

A copious supply of coolant is an essential for successful results on gear hobbing machines and careful attention has been given to providing for this. The coolant is contained in an ample reservoir in the bed, into which it drains from a steel chip pan that receives chips and coolant through an opening in the carriage. A belt-driven centrifugal pump inclosed in the housing on the back of the machine furnishes the supply to the hob through flexible pipe which can be adjusted to suit the requirements of the work.

Mery Stampograph

The rotary stamping machine shown in Figs. 1 and 2 is designed to stamp letters, characters, etc., in metal or other material while it is in a soft or plastic condition. The machine is manufactured by Julius Mery, 2,842 North Maplewood Ave., Chicago, Ill., and is ordinarily furnished for hand operation, but can be arranged for power operation when required. The machine is self-contained and has a stamping capacity of thirty-five characters, as indicated on the face of the dial. Provision is made, however, for changing the size of the characters to suit the work being stamped. This feature can be better understood by reference to Fig. 2. Between the two large disks are pivoted thirty-five pinions, one for each character. Each pinion carries a hardened steel die on which different sized characters are cut and by rotating the pinions the desired sizes may be brought into indexing position. The pinions are rotated simultaneously by means of the knob *A* on the face of the dial, Fig. 1, and when set are locked by the nut *B*. Adjustment for work of different thickness is accomplished by means of the ball crank at the top of the machine and incidentally this regulates the depth of the impression which is set to the graduated scale shown at *A*, Fig. 2. The spacing for the different sized characters is automatically regulated and the machine is said to

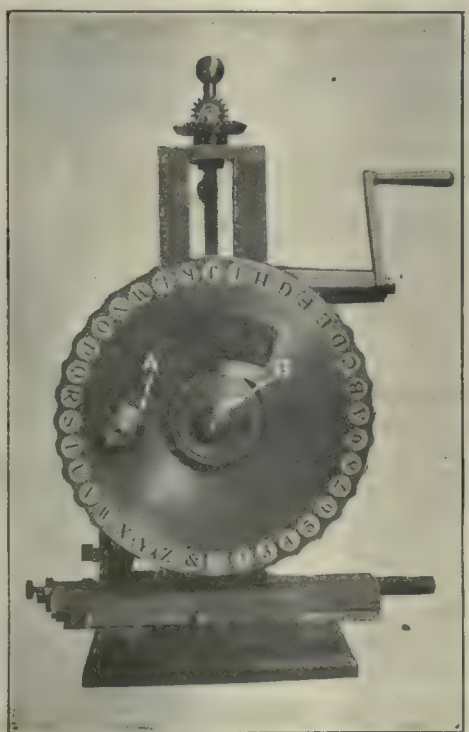


FIG. 1. STAMPOGRAPH, FRONT VIEW

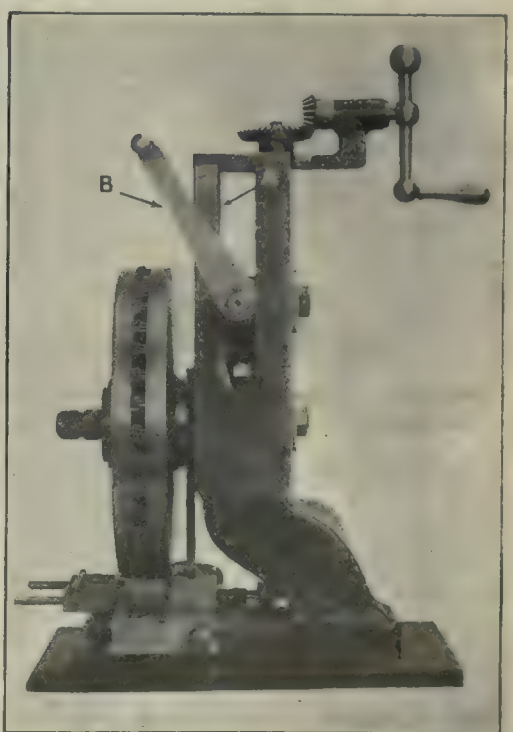
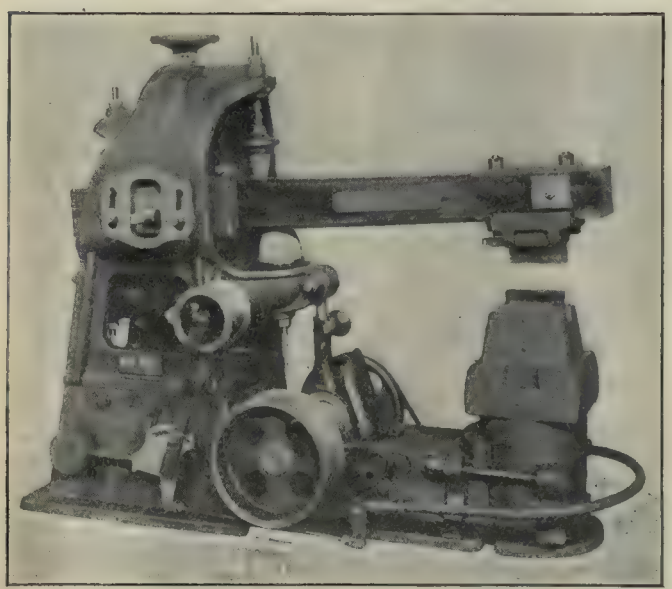


FIG. 2. STAMPOGRAPH, SIDE VIEW

space evenly and with good alignment. The impression is obtained by means of the crank *B*, Fig. 2, and provision is made against breakage should the metal be too hard. The hand-power machine weighs about 200 lb. The power-operated machine weighs 350 lb. and occupies a bench space about two feet square.

"American" Rubber-Cushioned Helve Hammer

Rubber-cushioned helve hammers of improved design, as illustrated, are being manufactured by the Long & Allstatter Co., Hamilton, Ohio. The hammers are made in five sizes, ranging from 25 to 100 lb. capacity. It is claimed that all connections and parts that have a tendency to work loose are carefully protected against such trouble. The treadle is arranged to prevent lost motion between it and the belt-tightener and is said to be sensitive and smooth acting in regulating the force and rapidity of the blows. The steel brake-band with its friction lining passes almost entirely around the brake wheel and, owing to its greater area of friction surface, assures quick stopping of the hammer with the helve in the "up" position when the treadle is released.



"AMERICAN" RUBBER-CUSHIONED HELVE HAMMER

A pair of ordinary dies having faces partly flat and partly round is furnished as part of the regular equipment.

Lovejoy Turret Toolpost

The turret toolpost illustrated herewith is a recent addition to the line of the Lovejoy Tool Co., Inc., Springfield, Vt.

One movement of the binding lever releases the turret, accurately indexes it to the next tool position and again rigidly clamps it to the base.

The turrets are made of hardened steel and are interchangeable with any base. This feature permits the use of a number of turrets carrying tool combinations for various jobs so that a job can be changed without changing the tool set-up. Two types of turrets are regularly made, one for outside turning and the other for boring.

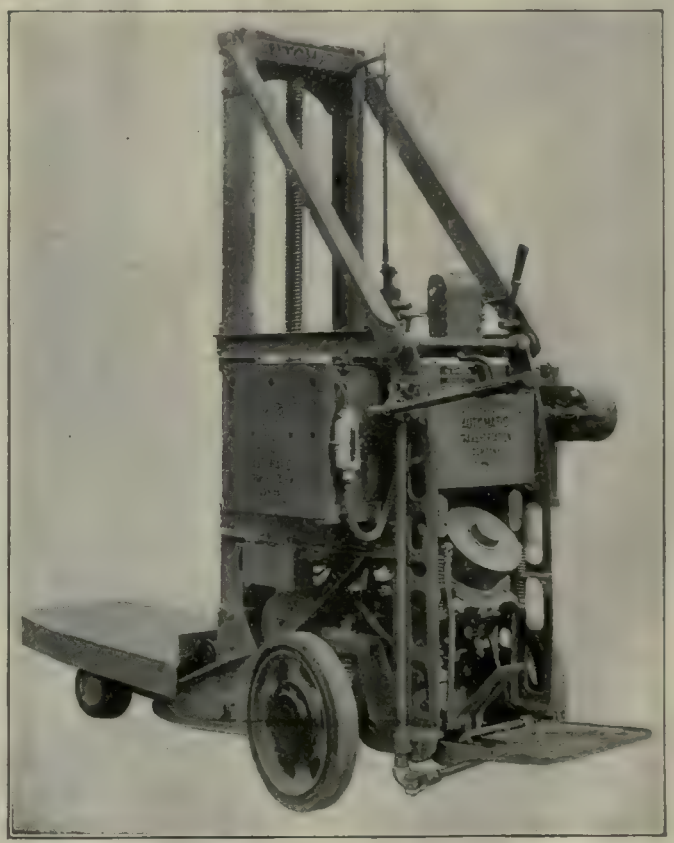
The turning tools have shanks 1 in. in diameter and are fitted with $\frac{13}{32}$-in. high-speed steel cutters. The round shanks permit the holders to be rotated to give side clearance to the tools. The boring bars are 1 in. in diameter and will cut to the bottoms of holes that are only slightly larger than the bars. Bars of other sizes with bushings to fit holes in turrets can be furnished to order. The turrets can be used on lathes having a center distance above the tool block as small as $1\frac{3}{8}$ inches.



LOVEJOY TURRET TOOLPOSTS FOR OUTSIDE AND INSIDE WORK

"Automatic" Lifting and Tiering Truck

A lifting and tiering truck of the type shown has recently been placed on the market by the Automatic Transportation Co., Buffalo, N. Y. The function of this truck is to pick up and elevate loads with its own power, to suitable heights for placing material in box cars, on trucks, wagons, etc., without rehandling. It has a capacity to lift a load of 4,000 lb. any distance from 1 in. to 6 ft., and at the rate of 1 ft. in 15 seconds. The overhanging platform is supported on two sturdy uprights. It is provided with substantial guide rollers, and is raised and lowered by a single screw of large size re-



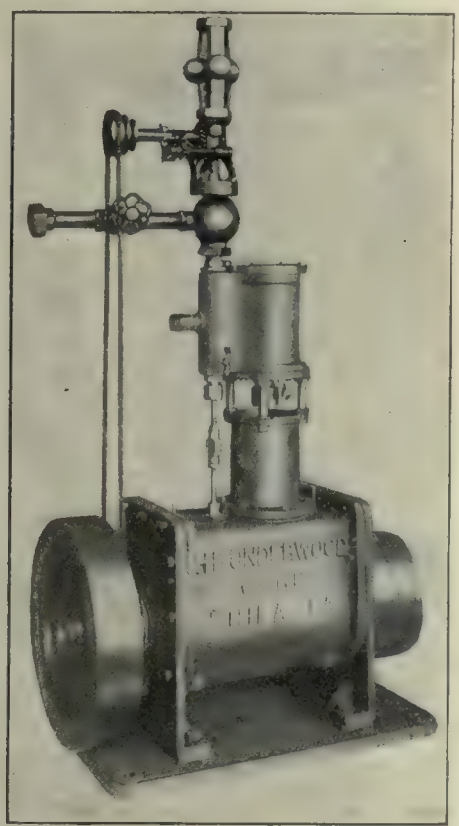
"AUTOMATIC" LIFTING AND TIERING TRUCK

volving in a heavy bronze nut carried in a trunnion. An oil reservoir furnishes ample lubrication to the screw. The motor may be started and stopped at any point in its travel, and is provided with automatic limit cutouts to prevent overrun of the platform at either extreme. Platforms or skids of standard heights, designed for use with electric lifting trucks, may be used with this machine.

Underwood Steam or Air Engine

H. B. Underwood Corporation, 1015-25 Hamilton St., Philadelphia, Pa., has added to its line the small engine, shown in the illustration, which can be driven by either steam or compressed air. The engine is built in both a 3- and a 5-hp. size, and is designed for driving portable tools such as boring bars and drilling machines.

The cylinder of the 3-hp. engine is 3½ in. in diameter and that of the 5-hp. is 4½ in. in diameter, both engines

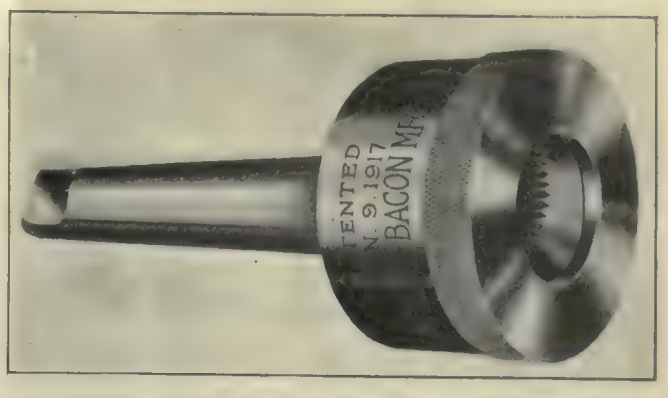


UNDERWOOD STEAM OR AIR ENGINE

having a 3½-in. stroke. The working parts are inclosed in an oil-tight case which is formed in the base of the engine and serves to exclude dirt. The crankshaft is a steel forging with a 1½-in. finished diameter. A piston valve is used, and the engine is fitted with a governor on the supply line. The engine runs at 250 r.p.m. with 70 to 125 lb. supply pressure. The floor space required is 12 x 21 in., and the height to the top of the governor is 46 in. Net weight, 270 lb.

Gustin-Bacon Reversible Driving Chuck

The chuck shown in the illustration has recently been placed on the market by the Gustin-Bacon Manufacturing Co., 1416-18 West Twelfth St., Kansas City, Mo. The chuck grips when driven in either direction, being especially designed for service where it is desir-



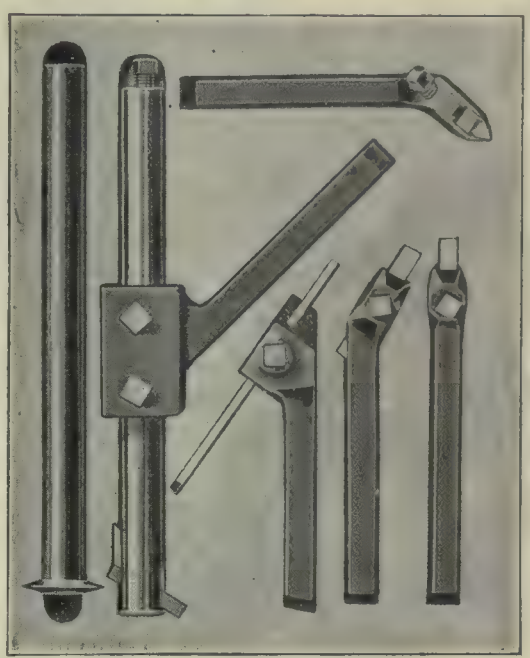
GUSTIN-BACON REVERSIBLE DRIVING CHUCK

able to reverse the direction of rotation, as in running staybolts in fire boxes and in driving straight-shank taps.

The jaws shown are used for holding round bars; one size, suitable for accommodating bolts from ⅛ to 1¼ in., being carried in stock, while other sizes can be furnished upon order. Jaws for holding square heads can be furnished, the stock size accommodating square heads from ⅝ to ⅞ in. The jaws are tool steel, and can be easily replaced when worn out. It is claimed that the chuck grips the bolt centrally, so that it runs true. The base of the chuck shank is squared to 1¼ in., so as to permit the setting of a staybolt with a wrench when desired.

"Ready" Garage Lathe-Tool Set

The Ready Tool Co., of Bridgeport, Conn., has placed on the market a set of lathe tools for small machine shops and garages, as illustrated herewith. The set



"READY" GARAGE LATHE-TOOL SET

comprises tools for both inside and outside turning and threading. Also a cutting-off tool. The tool board furnished with the tools has a place routed out for each individual tool, making it easy to keep the tools in their proper places and to note whether any are missing.

Business Conditions In England

FROM OUR LONDON CORRESPONDENT

THE prophets of impending doom grow more numerous and observers are not wanting who predict that a crisis is actually at hand. For one thing it is felt that prices have just about reached their limit. But this feeling has been experienced more than once since the European war was ended. Certain it is that on the part of capitalists, hesitation is being shown. Possibly the fear of a tax imposed on war wealth, or of a levy raised on capital, may lately have been the predominant item in the mental outlook.

Certainly, some branches of engineering are experiencing a decline in the actual receipt of orders, but most have work in hand to last them for months. The motor-car (that is, the pleasure car) industry and, to a lesser extent, the machine-tool trades, may be included. Speculators in pleasure cars, people who ordered simply that they might sell at a profit as soon as the car was actually delivered, are cancelling orders, and the statement has been made that "a wave of economy is sweeping over the motor trade just as much as in other trades." There are, in fact, rumors that one or two small firms are going out of the business, while it has long been asserted that several remain in existance simply on the strength of deposits paid by intending purchasers. The automobile industry of Great Britain has been in a peculiar position, for, unlike other branches of engineering, it has actually been financed in advance to a considerable extent by its own customers. By the way, the Austin Motor Co., will, according to present plans, export one-third of its production of motor cars and one-half of its motor tractors.

WORKERS PRESSING FOR 44-HOUR WEEK

Meanwhile engineering workpeople seem determined to press for the 44-hour week. Some time ago it was agreed that this demand should be withdrawn temporarily (that is, until the result of an inquiry into the present economic conditions in engineering and shipbuilding, both in Great Britain and other nations, was made known), the purpose, of course, being to find out the effect of the 47-hour week as compared with the 53-hour week, and some organized workmen have been growing restive.

This joint inquiry has not yet been held. Instead, statements, both public and private, have been made showing considerable decrease in output. For example, D. B. Morison has been saying that the average hours actually being worked in the shop with which he is concerned, after making allowances for absence for various reasons, are now but 44; the net decrease in hours, as compared with pre-war conditions, is 9 hours, or about 17 per cent. Further, in the works of Richardsons, Westgarth and Co., Ltd., marine engineers, of Hartlepool, Sunderland and Middlesbrough, "the actual time now taken to complete a given amount of work is, on an average, nearly half as long again as it was before the war." Consequently, it seems the output in a given week must be but 55 per cent of that obtained in pre-war times. "Fortunately," adds Mr. Morison, "there are indications of an appreciation of the undoubted fact that the costs of production are now so extravagantly high that, if the continuous demands for still higher wages are persisted in, commercial success will ultimately become impossible. Demand will then cease and a slump, and unemployment, must inevitably follow. The desideratum at the moment is the restoration of at least pre-war output per man per hour. There are already distinct signs of a slackening demand for ships."

BAD TIME-KEEPING, ETC., BEING INVESTIGATED

Reference to want of production, bad time-keeping, etc., is being made all over Great Britain. At a launching of a cable-laying and repairing vessel at Fairfield it was stated that delay had been caused not simply by the natural difficulty of changing over from war to peace, but also by lack of steel and by restrictions imposed on labor by trade unions. On the other hand, it is but fair to say that at the launching in the same district of the latest Cunarder, Sir W. Beardmore mentioned that, while in 1913 the average time lost in the Dalmuir yard was 13 per cent; in 1919, partly due to the later morning start and also to the increasing interest in production, the loss was but 6.4 per cent. This still seems a fair-sized amount.

It will be noticed that, speaking of the Northeast Coast of England, D. B. Morison mentioned distinct signs of a slackening demand for ships. A report from Glasgow, relating to the Clyde area, of course, is to much the same effect. But in all the districts a considerable amount of re-conditioning is on the way and in fact the yards are full and orders are in hand for further ships. At the moment not much misgiving need therefore be felt. Nevertheless, with a decline in certain freights, ship owners are more anxious and inquiries have been made as to the possibility of cancelling orders.

LITTLE EXPECTED IN THE WAY OF WARSHIP CONSTRUCTION

Little is expected in the way of warship construction; in fact Armstrong, Whitworth & Co., Ltd., when launching the light cruiser "Emerald" at its Armstrong yard, suggested that special mention might be made of the fact, as this "will probably prove to be the last war vessel to be constructed in a private contractor's yard for several years to come." The firm named has made further developments, and is to build water turbines in the works of the associated firm, Armstrongs & Main, Glasgow.

It has long been known in Great Britain, and the fact has been publicly pointed out, that the home supply of engineers with special training and experience in hydro-electrics is somewhat scant, and a party of about a dozen Cambridge engineering students was recently formed to visit Norwegian power plants of this kind. Some of them will, it is expected, also receive further training in Norway.

The workpeople concerned in shipbuilding at any rate do not view the immediate future of employment with misgiving. They have proposed to claim a further shilling an hour in the Clyde district. Alternatively, it is suggested that a number of the trades shall combine in a rather more modest claim; that is, 6d. an hour, or 23s. 6d. a week. It is possible that the engineering workpeople will join in, but before this the new engineering trade union amalgamation (a dozen or so of smaller unions, but dominated by the Amalgamated Society of Engineers) may have its own say.

Neither are engineers the only class of workpeople demanding the 44-hour week. Gas workers all over the country have recently taken a ballot, and 96 per cent of those employed at the present time voted in favor of a strike to enforce not only a 10s. increase in weekly wages, but also the 44-hour working week, with double pay on Sundays and holidays, and a fortnight's annual holiday. Notices to leave work on June 26 are being prepared, but further negotiations are anticipated. As to the premium bonus system, the few thousand London pianoforte workers still remain on strike.

TWO JOBS BEING HELD BY ONE MAN BEING PROTESTED

While some men are thus agitating for a shorter week in their own trades, others are protesting against the performance of two jobs by one man. The boot trades have been meeting. They noted the tendency of organized workpeople who both agitate for shorter hours and also close the door of their own trade against outsiders, but yet are willing to occupy their spare time in competition with traders and others. The government therefore is asked to license all traders, and further to insert in their proposed 48-hour working-week bill a clause which will make it illegal for any regularly employed person, male or female, to do work of any describtion for personal gain after that period had been worked.

The railwaymen have not obtained the additional £1 a week claimed, but, on the other hand, increases have been awarded by the wages board set up, the increases ranging from 7s. 6d. a week to 4s. a week in London and industrial areas, and half these rates for country districts. A further advance in fares is foreshadowed, though not necessarily quite to the extent of 110 per cent on pre-war fares which would have been necessary if the whole of the workers' demand had been met. Apart from the effect of the new concessions, it had been estimated that an increase of 80 per cent on pre-war rates would be needed. The figures given suggest the possibility of fares being simply at double pre-war rates for the future.

Lack of Castings Felt

Complaint of lack of castings is made from practically every engineering center, especially perhaps by makers of machine tools. Up and down the country a number of foundries are being built, but this may only accentuate the evidence of shortage of skilled labor. Lack of raw material, too, has held up both shipbuilding yards and engineering shops on the Clyde. Pig iron in the district is particularly scarce, and although many people in the automobile industry have received the impression that their requirements have been neglected and shipyards favored, a shortage of steel plates has been reported from Glasgow. In fact, some 1,500 tons were recently obtained from South Wales, and this is said to be a record. In pig iron so pronounced is the difference between supply and demand that it was suggested recently in the House of Commons that the Scottish iron-founding industry is faced with a crisis. The increase in the cost of coal has caused pig iron to rise in price, and in London recently Stafford crown iron bars, previously quoted at £31 10s. from the works, were raised to £33 10s., which means practically an increase of 33 per cent over the price in 1920.

Iron Castings Also Scarce

The scarcity of steel castings is no less pronounced than that of iron castings, and railway congestion is again alleged as the cause of delay in the supply of rails, plates, etc.

While America is understood to be accepting orders for structural steel for delivery from July to September, on the other hand, at the market named it was mentioned that January orders were only just being delivered. Some iron and steel firms have been insisting on payment by their customers of advances on material already manufactured but not delivered, and a committee of manufacturers and merchants in London have been considering the subject. The material is that which has been left in the yards owing to railway congestion and therefore not delivered and consequently not paid for. The claim for the advances arises because the banks, who were willing some time ago to give credit on material sold in such conditions, now simply suggest loan accounts.

Machine-Tool Prices Being Raised

An increase in engineering time wages of 3s. a week has just been made, in accordance with the last agreement; consequently some machine tools are being raised in price by 5 per cent, and others by smaller amounts.

The subscription list has been opened in connection with the formation of William Asquith (1920), Ltd., high-speed radial drilling machine manufacturer, capital £600,000, divided into 300,000 8 per cent cumulative participating preference shares of £1 each and £300,000 ordinary shares of £1 each. Apparently, the vendors take 150,000 ordinary shares as part of the purchase price. The Halifax business, it is shown, was founded in 1865 by William Asquith, and the area for works, etc., is more than 12 acres, with 650 workpeople. The prospectus states that the consideration fixed by the vendor company, William Asquith (1919), Ltd., for the sale of its assets and undertaking is £484,000. The assets have been valued at about £598,353, including £402,-359 for land and freehold property, fixed and loose plant, fixtures and office furniture, etc.; £25,000 for motor cars, wagons, etc., patterns, molding boxes, drawings, designs and jigs; £166,994 for stock-in-trade; plus £4,000 invested in Associated British Machine Tool Makers, Ltd. The effect of the molders' strike is shown in the estimated profits. For the six months ending with September 30, 1919, these were put at £60,971; but for the whole year ending with March last the estimate is £76,000, subject to audit. The profits for the year ending with March, 1913, were £15,329, and the highest profits, £96,404, appear to have been made in the year ending March 31, 1918.

New Issues of Capital Reach High Figures

New issues of capital reached high figures during April but were relatively few toward the end of May. Taking the present year so far the total reaches more than £213,000,000. According to a statement issued by a London bank, in the full year ending with May last the capital issues amounted to £387,738,000, of which almost exactly one-sixth was in the nature of overseas investment and five-sixths was for home purposes. Before the war it was a complaint that capital was not invested in British industries, etc., or rather that it was insufficiently invested at home, and it would probably not be difficult to find a year in which the proportions given above for home and foreign investment were reversed.

Regarding amalgamation, it is understood that Bolckow, Vaughan & Co. have acquired a controlling interest in the Darlington Rolling Mills Co., Ltd., the capital of the first-named firm being about £5,000,000. Statements have been made that Baldwins, Ltd., who have large iron and steel and coal interests in South Wales, and include some seven companies, will be acquiring an undertaking connected with steel in the Midlands of England.

Household Coal Supply To Be Unrationed

From now on, the supply of household coal for Great Britain is to be unrationed and purchasers will be able to deal with any merchant from whom they can get supplies, registration being dropped. Nobody anticipates that a fall in price will result. Although in theory competition between merchants will come into play, this section of business is probably just as well ringed as any other. In order to allow for decontrol, the amount of coal allotted to export has been reduced; it will be 1,750,000 tons a month instead of 2,000,000 tons. The Profiteering Act, which has been amended, is to be relied on to prevent excessive charges. The government controls the price at the pit head, wholesale and retail prices being otherwise unrestricted. The weekly output of coal from the mines continues unsatisfactory, still failing to reach the hoped-for 5,000,000-ton figure.

A Home Office return relating to mines under the Coal Mines Act shows, as compared with pre-war figures, an increase of 5.6 per cent in the number of persons employed in this industry, with a decrease of about 20 per cent in the output. The average output per person employed underground was 332 tons in 1913 and 253 tons in 1919; or regarding persons employed both under and above ground the output figures respectively were 267 tons and 201 tons. It may be mentioned that the present London price for best Derby coal is about 57s. a ton as against 27s. in 1913. The respective pit head prices are 33s. 5d. and 13s.

Lapointe Machine Tool Co., Ltd., Starting a Small Works

The Lapointe Machine Tool Co., Ltd., is starting a small works at Edgeware, to the north of London, which will shortly employ between 50 and 60 men. The building was already in existence. The plant is entirely American and as closely as possible the technical and commercial methods of the Hudson organization will be followed. Some few American workers are already engaged. It is not the intention to build machines or even standard broaching tools. All the tools made, according to the present program, will be special.

The buildings cover some 16,000 sq.ft. of floor space but at present only about 9,000 sq.ft. are in use. Further land available will double the existing works area. J. L. Owens is in charge (he is at present leaving for the United States) and with him is associated Mr. Coleman.

SPARKS FROM THE WORK

Valentine Francis

Foreign-Trade Development Cruise Offers Bid for "Von Steuben"

Ford Eggena, of New York, representing the foreign-trade development cruise, was the sole bidder on the steamship "Von Steuben," recently offered for sale by the Shipping Board. Mr. Eggena, whose bid was received and opened on July 7, offered $1,500,000 for the vessel, the amount to be covered in monthly payments up to Dec. 20, 1920.

The Board did not take action on the bid, reserving time to go into its details. Mr. Eggena's proposal was in the form of a letter directed to the Shipping Board. The letter, which contains all the terms of the bid, follows:

Referring to your letter of the 1st inst. and my letter of the 24th of June to the manager of ship sales, I beg herewith to submit to you my bid for the purchase of the above-named vessel.

1. Purchase price—$1,500,000 (one million five hundred thousand only).

2. Terms—A. Certified check for the sum of $150,000 (one hundred and fifty thousand only) 10 (ten) days from the date the U. S. Shipping Board approves of said sale and the purposes to which the vessel is to be put, in writing.

B. Vessel at the option of the Shipping Board to be taken over to the Morse Dry Dock and Repair Co., Brooklyn, N. Y., at once at my expense and reconditioning started immediately, entirely at my risk and expense or transfer to said docks not to take place until certified check is deposited, viz., within 10 days as per par. A.

(C) Vessel to be fully covered by insurance immediately.

(D) Balance to be paid in the following installments free of any and all interest: Aug. 20, 1920, $150,000; Oct. 20, 1920, $250,000; Nov. 20, 1920, $350,000; Dec. 20, 1920, $600,000; Total, $1,350,000; previous paid 10 days $150,000; total purchase price, $1,500,000.

3. Vessel to be reconditioned for the round the world commercial cruise to build up and stimulate our foreign trade and which will at the same time be the greatest advertising medium for our merchant marine.

Accommodation, first class only, and vessel to be refitted with the best of everything, no expense being spared to make her the finest vessel afloat.

4. We will convert said vessel into an oil burner provided that the Shipping Board will guarantee the supply of fuel oil at the various ports of call on this cruise, entering into an agreement as to price and supply of said fuel oil.

5. Reconditioning of vessel to be carefully carried on so that she can be put into first-class passenger service at any time.

6. At the termination of the first world cruise, which will take about one year, if deemed advisable, the vessel will continue on another cruise of this nature; if not, she can be put into pasenger service, such service and route to be agreed upon between the U. S. Shipping Board and the Foreign Trade Development Cruise management.

7. We desire the full co-operation of the U. S. Shipping Board and need their moral support, together with that of the Department of Commerce, which we have.

8. Fullest details of the entire enterprise and the many advantages it offers, not only to our foreign commerce, but to our merchant marine, will be gladly supplied and if given the opportunity to present the facts to the Board in person, I feel that the result would be satisfactory to all. It is our earnest desire to co-operate to the fullest extent with the U. S. Shipping Board.

Auction Sale of Machine Tools and Belting

An indication of the trend of prices of Government machinery, when sold at auction, is given by such a sale held in New York City, July 8 and 9. This machinery was not under belt and consequently did not bring as high prices as might have been the case if the buyers could have seen it in operation. In general, the prices ran over 50 per cent of catalog list. A few of the sale prices follow:

Becker milling machine rotary vises	$36
7½-in. universal geared scroll chucks.	19.50
9-in. universal geared scroll chucks.	22
10½-in. universal geared scroll chucks	25
12-in. three-jaw universal geared scroll chucks	30
Waterbury grinding machine	60
Rivett No. 205 hand-operated radial grinding machine	350
Rivett No. 106 automatic internal grinding machine	750
No. 2A Becker vertical milling machine	475
No. 4B Becker vertical milling machine	950
No. 3A universal horizontal boring machine	3150
Snyder 36-in. heavy-duty upright drilling machine	600

Professor Breckenridge Appointed Chairman of Advisory Board

Professor L. B. Breckenridge, head of the department of mechanical engineering of Yale University, has been appointed by the Secretary of the Interior as chairman of the advisory board which is being formed in connection with the survey being made of the power resources of the north Atlantic seaboard. The work is being done under an appropriation granted at the last session of Congress.

Summer School for Foreign Trades

A summer school of Pan-American and Foreign Commerce is to be held in Washington, from July 19 to Aug. 21, for the purpose of spreading information as to the problems of export business and the way in which they may be solved.

The main object of the course is evidently to promote Pan-American commerce, but it will also extend to other countries. In view of the fact that our commerce with the Americas has increased 450 per cent in the last fifteen years, attention is called to the possibilities in this direction and the necessity for retaining and increasing this business.

Further information can be obtained from Clarence J. Owens, Executive Director, 1000 Vermont Ave., Washington, D. C.

War Plants to Manufacture Small Motors and Wiring Devices

The General Electric Co., which recently acquired the vast war plant of the Remington Arms Co., at Bridgeport, Conn., will use the plant for the manufacture of small motors and wiring devices. It has recently announced the following appointments for the Bridgeport plant: W. S. Clarke, as general manager; J. P. Catlin, manager of production in motor department; Herbert A. Hagadorn, superintendent of maintenance of grounds and buildings; C. W. Collins, director of industrial relations.

Mr. Clark was formerly connected with the assistant manager's office at Schenectady; Mr. Catlin was formerly engineer of the motor division at the Pittsfield, Mass., plant, and Mr. Hagadorn and Mr. Collins come from the Schenectady plant.

The Bridgeport plant contains thirteen five-story brick and steel and concrete factories, each 240 x 80 ft. Connecting buildings make these one vast factory. The plant has a complete boiler plant and power plant.

New Motor Truck Plant, Fort Wayne, Indiana

The International Harvester Co. of America, Inc., with general offices in Chicago, has purchased a 140-acre tract of land just east of the city limits of Fort Wayne, Ind., and will erect thereon a plant for the manufacture and assembling of motor trucks.

The first unit of the plant will be an assembling unit and will cover an area of twelve acres. It will consist of an L-shaped, three-story, reinforced concrete building to house the carpenter shops and shipping department, also a number of standard one-story steel buildings of the monitor type, adapted to progressive assembly.

The company plans to start the erection of the first unit early this coming fall and to have it completed within twelve months. The ultimate development of the entire plant as now planned will extend over a period of three years and will require an expenditure of about four million dollars.

Incidental to the construction of the plant proper, will be the development of a number of transportation and civic projects; including a railway connecting the several steam railroads entering Fort Wayne from the east, the extension of streets, street railway lines, sewers, water, electric light, gas and telephone services, and the construction of about one thousand homes for future employees.

LD'S INDUSTRIAL FORGE
News Editor

French Commerce Chamber Has Catalog-File System

The American Chamber of Commerce in France has inaugurated a catalog-file system, the object of which is to place catalogs of American firms before important and reliable French buyers. Under this system preliminary correspondence can be abolished. French buyers come to this Chamber and, from an inspection of the catalogs, choose the articles they desire, without loss of time. They can then communicate immediately with the seller without having to wait two months or more to receive trade literature.

Catalogs can thus serve the purpose of a representative in France. The catalog file has been given extensive publicity and is under the direction of courteous and experienced personnel.

A nominal fee is charged by the Chamber to cover expenses incurred. This fee entitles each subscriber to have catalogs on file for the period of one year and also entitles the subscriber to ten different headings in the catalog card index. If the subscriber desires to be listed under additional headings an additional fee is charged.

Upon receipt of catalogs, address cards are filled out, showing name and number assigned to the catalog. These cards are systematically filed under the headings given by the subscriber. The catalogs are placed in individual file boxes, each box being given a number. This number is placed on each of the file cards.

For further details and for the catalog file entry blank, write to the American Chamber of Commerce in France.

New Uses for Stainless Steel

(Consul W. J. Grace, Sheffield, England.)

It is the writer's opinion that the use of stainless steel will become absolutely necessary in many articles and machinery exported from the United States. While he was stationed at Aden, Arabia, captains of ships, users of automobiles, and others complained that iron and steel parts rusted very quickly. The climate seemed really to "eat" into these metals. The life of the automobile was considerably shortened by corrosion of its metal parts. The manufacturer who first produces and places on the market in Eastern and tropical countries an automobile, the metal parts of which are of stainless steel, ought easily to capture these markets. Machinery parts, golf-club ends, clocks and watches, made wholly or partly of stainless steel, will be in great demand in the East and in tropical countries.

Fred. A. Bigelow Elected President of Carpenter Steel Co.

The Carpenter Steel Co., Reading, Pa., on July 1 announced the election of Fred. A. Bigelow as president of the company, succeeding N. B. Kunhardt, who is now chairman of the board of directors.

Mr. Bigelow was born in Paxton, Mass., on Jan. 31, 1868. His people moved to Worcester when he was eight years old and it was there that he was educated. He graduated from the Worcester Polytechnic Institute in 1891.

The following year he obtained employment from Spaulding & Jennings Co. (later part of the Crucible Steel Co. of America) as chemist, and in 1900 was sent to Providence, R. I., as manager of the Providence warehouse for the Crucible Steel Co. of America.

Mr. Bigelow entered the employ of the Carpenter Steel Co. in 1904 as New England salesman and in 1910 was transferred to the Cleveland warehouse of the company as Western sales manager. In May, 1915, he was transferred to Reading as general sales manager.

Report Martens Contract

A contract was reported to have been signed on June 25 by Ludwig C. A. K. Martens, unrecognized Russian Soviet "ambassador," and Boyer, Sloan & Co., Canadian and English manufacturers' agents, Montreal, for several million dollars worth of Canadian machinery.

Stanley Works Holds Sale Conference

The annual sales conference of the sales force of the Stanley Works was held recently. Yearly the men who are engaged in furthering the sales of the corporation gather in New Britain to discuss the year's growth, sales results, and to gather any suggestions from the various sales agents which might tend to add to the efficiency of the selling force.

The Stanley Works this year met jointly with the Stanley Rule and Level Co., so that the salesmen who were in session far outnumber any gathering of past years. This was the first gathering of men of the two companies in a joint session for discussion of business matters.

While no salesmen from the Japanese branch were present, the same was represented by men from the San Francisco branch, which cares for Oriental business. A total of sixty-four sales agents were registered at the conference.

International Chamber of Commerce Urges Reciprocal Trade Treaties

Restoration of international credit, based on the fixing of the amount and the conditions of payment for the debts of all countries, whether Allies or enemies, was urged at the first meeting of the International Chamber of Commerce in Paris, according to cabled reports to the Chamber of Commerce of the United States. The first comprehensive summary received here also gave the measures recommended by the conference to clear the financial situation.

The new organization was created in Paris by the 500 delegates from the five countries which last fall participated in the International Trade Conference at Atlantic City. These were Belgium, France, Great Britain, Italy and the United States. Business interests in other countries will be taken in later. Among other policies urged at the Paris conference, as made public by the Chamber of Commerce here, were the following: It was resolved that all allied states should agree also as soon as possible to fix definitely the amount and conditions of payments according to the stipulations in the treaty.

There should be an avoidance of duplicate taxation of wealth on individuals or organizations in more than one country.

Extension of credits, uniform banking laws and war damages were dealt with.

Reciprocal international treaties relative to import and export taxes were advocated.

An international credit bureau was planned.

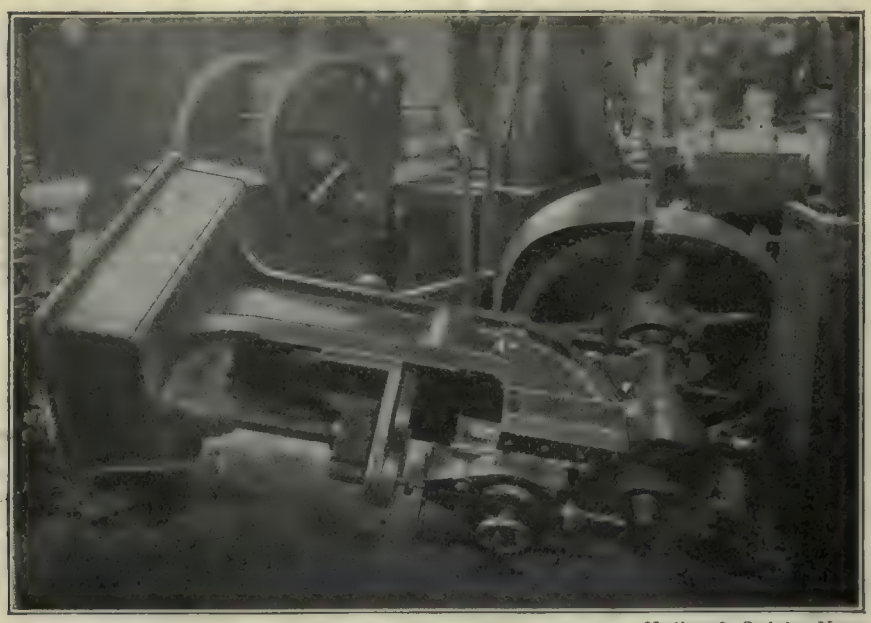
National and local chambers of commerce were requested to co-operate with their governments to reduce national and local governmental expenditures.

Governments and banking, commercial and industrial associations in all countries were urged to co-operate with the international chambers and with each other to reduce importation of non-essentials by countries whose exchanges are depreciated and to increase exportations from such countries.

There should be an endeavor to obtain the co-operation of labor to prevent delay in the turn around of ships, delay between ships and trains, and delay in transportation by rail.

There should be restriction as far as possible upon countries whose exchanges are depreciated issuing foreign loans.

There should be a reconstruction



National Safety News

WHEN IS A GUARD NOT A GUARD?

The belt slipped off the driving pulley of this punch press, caught in the guard and pulled the press over.

special committee to study the exchange situation.

There should be inducement of foreign investments in home countries.

It is desirable to furnish raw material and credits.

There should be facilities and simplification of passport procedure.

A committee was proposed to investigate the mischievous use of trade names and of misleading indications.

Common nomenclature was proposed for customs tariffs of the Allied nations.

Revocation of import and export prohibitions was urged as soon as international conditions of each country will allow.

A resolution petitions the board of directors to establish a central bureau for international statistics covering production, with forecast of output and probable needs of each country.

The world's stock of fuel was discussed.

A resolution urges hastening of utilization of hydro-electric power, development of measures for the use of mineral fuel scientifically and economically, and development to the utmost of research in the extraction of coal and oil resources of the world.

The full meeting expressed an opinion that Germany had not demonstrated an intention to fulfill its obligations to the Allies, as agreed in the treaty of Versailles. Allied governments were urged to tolerate no further delay in the carrying out of the treaty agreements.

The next meeting of the international chamber will be held in London next June. Temporary headquarters have been established in Paris. The location of the permanent headquarters is left to the board of directors.

The chamber elected the following officers: President, Etienne Clementel, former Minister of Commerce in France and member of the Supreme Economic Council. Vice Presidents, A. C. Bedford, New York city; Baron Edouard Empain, Belgian banker; A. J. Hobson, Sheffield, England; Vitorio Rolandi Ricci, Italy.

Directors for the United States: John H. Fahey, formerly president Chamber of Commerce of the United States; Willis H. Booth, vice president Guaranty Trust Company, New York, and formerly vice president Chamber of Commerce of the United States; Edward A. Filene, president William Filene Sons' Company, Boston, and formerly a director in the Chamber of Commerce of the United States.

Reed-Prentice, Becker and Whitcomb-Blaisdell Form Combination

The Reed-Prentice Co., Worcester, Mass., Becker Milling Machine Co., Hyde Park, Mass., and Whitcomb-Blaisdell Machine Tool Co., Worcester, Mass., have formed a combination of their sales, purchasing, accounting and executive departments.

This combination took place about a week ago and the main offices are now permanently located at 53 Franklin St., Boston, Mass. This arrangement has been contemplated for several months and is in line with the modern method of doing business, wherein several concerns owned by one interest can work to better advantage through one main office and sales department.

The various agents throughout the United States that formerly handled the products of these facories are now displaced by direct factory branches in the various machine-tool centers of the United States.

These three companies now have combined sales branches in Boston, Worcester, New York, Detroit, Chicago, Cleveland and Indianapolis. The personnel and the location of the various offices of the three companies follow:

Boston—executive office—53 Franklin St.: A. H. Wood, president; Graydon Stetson, vice president; J. W. Lund treasurer; J. P. Ilsley, sales manager; F. W. McIntyre, sales manager; V. A. Campbell, sales department; F. E. Rhodes, sales department; G. S. Haven, sales department; F. H. Palmer, purchasing agent; S. L. Crawford, advertising manager.

Worcester — Reed-Prentice Co., Cambridge St.; A. E. Newton, vice president and general manager, and F. L. Hendrickson, engineering department. Whitcomb-Blaisdell Machine Tool Co., 134 Gold St.: Charles Hildreth, president and general manager, and F. H. Seng, sales department.

Hyde Park, Boston—Becker Milling Machine Co.: Scott Taylor, works manager; H. S. Sawyer, manager cutter department; A. S. Morse, salesman cutter department, and A. MacDonald, salesman cutter department.

New York—5th Floor, Grand Central Palace: P. K. Dayton, New York sales manager, and P. A. Dyer.

Chicago—temporary office, 621 Washington Blvd., c/o R. E. Ellis Engineering Co. About Aug. 1 or 15—26-28 North Clinton St.: W. D. Creider, Chicago sales manager; F. C. Herman, and J. L. Stone.

Detroit—408 Kerr Building, corner Fort and Beaubien Sts.; A. J. Strong, Detroit sales manager, and W. B. Ashley.

Cleveland—408 Frankfort Ave.; C. A. Severin, Cleveland sales manager, and Charles Brandhill.

Indianapolis—940 Lemcke Annex: T. C. McDonald, Indianapolis sales manager.

Standardization of Plain Limit Gages

A sectional committee of the American Engineering Standards Committee, 29 West 39th St., New York City, has just been organized to undertake the standardization of plain cylindrical gages for general engineering work, under the sponsorship of the American Society of Mechanical Engineers. The immediate occasion for undertaking the work was a request of the British Engineering Standards Association for cooperation on the subject. The committee held its organization meeting on June 11. It is understood that this committee will recommend to the American Engineering Standards Committee that the scope of the work should be broadened so as to cover all plain limit gages for general engineering work.

The present personnel of the committee is as follows:

E. C. Peck, chairman, general superintendent, Cleveland Twist Drill Co.;

L. D. Burlingame, vice chairman, industrial superintendent, Brown & Sharpe Manufacturing Co.;

H. W. Bearce, secretary, gage department, Bureau of Standards, secretary, National Screw Thread Commission;

P. W. Abbott, Lincoln Motor Co.;

John Bath, president, John Bath & Co., Inc.;

Earle Buckingham, engineer of standards, Pratt & Whitney Co.;

Fred H. Colvin, editor, *American Machinist;*

W. A. Gabriel, chairman, draftsman and designer, Elgin National Watch Co.;

F. O. Hoagland, vice president and works manager, the Bilton Machine Tool Co.;

Edward H. Ingram, works manager, the Cleveland Drilling Machine Co.;

J. O. Johnson, office of Chief of Ordnance, War Department;

A. W. Schoof, gage engineer, Greenfield Tap and Die Corporation;

G. T. Trundle, consulting engineer, Engineers Building, Cleveland, Ohio;

H. L. Van Keuren, the Van Keuren Co.

A dispatch from Clarksburg, W. Va., announces that a syndicate of manufacturers of diversified interests has purchased coal mines and undeveloped coal land valued at $12,000,000.

Condensed-Clipping Index of Equipment

Patented Aug. 20, 1918

Shearing Machine, Plate, 7-Ft.

Regent Shears, Ltd., Wakefield, England.

"American Machinist," English Edition, May 29, 1920



The machine is designed for cutting plates up to ¼ in. thick and 7 ft. long; and gaps are provided in the side standards, so that the ragged edges of plates of any length may be trimmed. The plates are held down by a toggle lever arrangement operated automatically by a cam on the crankshaft. A micrometer adjustment is provided for raising the bottom blade after grinding. The machine is equipped with a mechanical brake, which does not engage during that part of the stroke where no braking is required and which prevents rebounding of the crank. The drive is through cut gears, a 10-hp. motor being required. The overall size of the machine is 14 ft. 3 in. x 9 ft. 6 in., and the weight is about 8,600 lb.

Drilling Machine, Multiple Spindle D-12

Fox Machine Co., Jackson, Mich.

"American Machinist," June 24, 1920

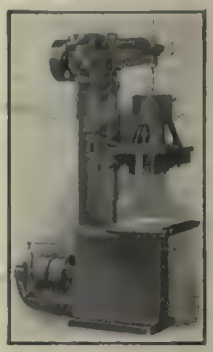


Table and column are bolted to base which contains the reservoir for coolant. Column is of box section and houses counterweight for the spindle head. Gear box, mounted on column, contains the spindle change-gears, shafts for which are mounted on Hyatt bearings. The feed gears are contained in a box at side and are controlled by levers on outside of box. Feed is engaged by a quick-acting clutch operated by a lever.

Specifications: Head; travel, 15 in.; drilling surface (rectangular) 8 x 14 in., (round) 12 in. Center of head to face of column, 12 in. Table; working surface, 17 x 22 in.; height from floor, 2 in. Number of spindles, 10 to 16. Clutch pulley, 14 x 4½ in.; speed, 450 r.p.m. Power required, 10 hp. Floor space, 28 x 36½ in. Height, 105 in. Weight; net, 2,250 lb.; crated, 2,500 lb.; boxed for export, 2,900 lb. Export box, 96 cu.ft.

Clamp, Force Universal

Burwin Co., Inc., 87 Warren St., New York City.

(Made by the Black Rock Manufacturing Co., Bridgeport, Conn.)

"American Machinist," June 24, 1920

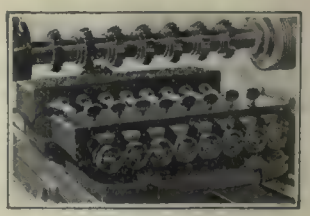


The accompanying illustration shows one style of the clamp for general use. The clamp is designed for holding work on machine tools, being particularly adapted to clamping irregularly shaped pieces, straddling bosses, or fitting different angles by means of the swivel adjusting device. The clamp is made of hardened steel and in a wide range of sizes.

Dividing Head, Multiple-Spindle

Scully-Jones Co., 80 East Jackson Blvd., Chicago, Ill.

"American Machinist," June 24, 1920



The spindles are all driven from an index plate located at the opposite end of the machine from that shown in the illustration. The work drivers are somewhat flexible so that they may be adjusted to suit work that is off center. Both the index plate and the work drivers are made to suit the needs of the user of the tool. All parts of the device are interchangeable. The dividing heads are built in six sizes with 2, 4, 6, 8, 10 or 12 spindles, as may be required. The device may also be arranged for cutting either spur or helical gears.

Transformers, MTQ Auto

General Electric Co., Schenectady, N. Y.

"American Machinist," June 24, 1920



Built as standard equipment with 1:1 ratio, principal application being to adapt polyphase moters to any circuit. Made in the following sizes: 1, 3, 5, 7, 10, 15, 20 and 25 kva. one of which is shown in the accompanying illustration. These transformers are air cooled, suitable for indoor or outdoor use, and are for service on 220-volt circuits having frequencies between 50 and 140 cycles per second. They are designed for deriving 3-phase current from 2-phase, 4-wire service, and vice versa; and they cannot be used either for 2-phase, 3-wire service, or for operating motors with inter-connected phase.

Gage, Drill Grinding

Crowther & Crowther, 3 Green Lane, Tue Brook, Liverpool, England.

"American Machinist," (English Edition), May 22, 1920



Gage provides means whereby the angle points of twist drills may be tested for accuracy against light. A bronze stamping or right-angle form is provided, the twist drill being held in the corner thus formed and gaged against the outline presented by a projecting piece which is cut and formed from the sheet metal. Gage is made in three sizes and is said to show an error of 0.001 in. Each gage is set to a master template. The three sizes are suitable respectively for drills up to ¼, ⅝ and 1 1½ in. diameter.

Drill, Pneumatic, Five Piston

Desoutter Brothers, Ltd., 51 Baker St., London W., England.

"American Machinist" (English Edition), May 22, 1920



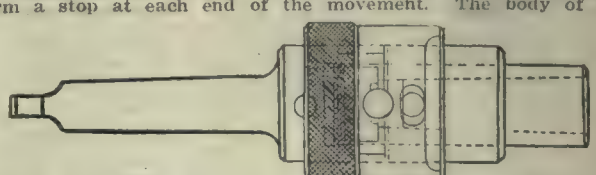
The pressure is controlled by a push button in the head of the casing. The machine weighs only 30 oz. and takes drills up to ¼ in. The tool is grasped in the palm of the hand and the air supply is controlled by a press button in the head of the drill. Essentially, it consists of casing, control, actuating mechanism, bearing and drill chuck, the parts being assembled within a casing of steel tube, knurled for convenience of handling. The motor is of unusual form, a block of five cylinders ⅞ in. bore and 1½ in. stroke being arranged symmetrically round a central axis with the bores parallel.

Chuck, Drill, Quick-Change

Alfred Herbert, Ltd., Coventry, England.

"American Machinist" (English Edition), May 22, 1920

All parts of the chuck are hardened and ground, two grooves one in the body and one in the outer sleeve form an annular recess for a row of balls. The groove in the body is wider than the balls, so as to allow movement. The balls themselves form a stop at each end of the movement. The body of the



chuck is provided with a pair of ball plungers which hold the sleeve in operating position, thus enabling chuck to be used on a horizontal spindle, or a spindle which points upward. The actual gripping of collet is effected by a pair of larger balls contained in two holes in chuck body entering recesses milled in and running around the collet. Collets are bored to Morse standard tapers, and special collets can be made for special drills.

Clip, paste on 3 x 5-in. cards and file as desired

Importers of Machine Belting in South Africa

South Africa furnishes a good market for machine belting. Imports of this kind were valued at $97,350 in 1916 and $154,555 in 1917. The mines are the principal users. Consul Fred D. Fisher, of Johannesburg, Transvaal, has furnished a list of importers of belting in the Johannesburg consular district of South Africa, which can be obtained from the Bureau of Foreign and Domestic Commerce or its district and co-operative offices by referring to file No. 120347.

It is reported that many steel plants in the Pittsburgh district are depending on motor trucks to keep their yards sufficiently clear of finished material to allow them to maintain operation, some of the plants shipping over two-thirds of their daily output in this manner.

Personals

ARTHUR H. WEED is now president of the Reed-Prentice Co., Worcester, Mass., manufacturer of machine tools. ROBERT F. HERRICK, Milton, Mass., recently resigned from this office because of the pressure of other work.

ALFRED P. WILKES has been appointed employment manager at the Meriden, Conn., plant "D" of the New Departure Manufacturing Co., of Bristol, Conn. Mr. Wilkes was formerly connected with the Manning, Bowman Co., of Meriden, and was also with S. Sternau & Co., of Brooklyn, N. Y., for a period of twelve years.

FRANK MARON has been selected as superintendent of industrial relations at the Meriden, Conn., plant of the New Departure Manufacturing Co., of Brisatol, Conn. Mr. Maron was formerly connected with the Aberthaw Construction Co., of Boston; the Winchester Repeating Arms Co., New Haven; International Silver Co., Meriden; Chas. Parker Co., of Meriden, and at the Meriden post office.

Trade Catalogs

Thread Milling Machine. Hall Planetary Thread Milling Machine Co., Bridesburg, Philadelphia, Pa. Catalog, 9¼ x 11¾ in. This catalog describes and illustrates its machine for milling external and internal threads. Specifications are also included.

Turret Lathes in Railroad Shops. Warner & Swasey Co., Cleveland, Ohio. Catalog, pp. 31, 9 x 6 in. This catalog has been prepared to illustrate and describe turret lathe "set ups" of many actual railroad installations, it also shows a list of railroad parts finished on the company's turret lathes.

Pulley Covers. Smith & Serrel, Central Ave. at Halsey St., Newark, N. J. Bulletin No. 201, pp. 11, 6 x 9 in. This bulletin describes how to decrease belt slippage, and to increase efficiency of belt drives. Directions for installing, and list prices are also given. It contains two line cuts, illustrating Pullmore pulley tread covers.

Grinding Wheels. Norton Co., Worcester, Mass. Catalog, pp. 10, 3¾ x 6¾ in. A small catalog describing commercial diamonds for truing grinding wheels.

Business Items

Riddell Brothers, of Atlanta, Ga., will shortly move its machine shop into a new building being constructed for it at 340 Whitehall St. The new shop will be one of the most modern of its kind in the Southeast. At present the company's shop is at 16 East Mitchell St.

The Delaware Engineering Co., Wilminton, Del., manufacturer of special machinery for domestic trade, reports enough contracts ahead to carry the plant at its present capacity for more than two years. In consequence of that the management is preparing to make extensive plant additions.

Worthington Pump and Machinery Corporation, New York, has purchased from the Platt Iron Works, of Dayton, Ohio, its drawings, patterns, jigs, templates, special tools, good-will and name.

The Foster Machine Co., of Elkhart, Ind., manufacturer of turret lathes and screw machines, has recently opened a New York office at the Grand Central Palace, in charge of L. S. Devos.

The New London Broaching Machine and Tool Co., of New London, Conn., has recently been organized to deal in broaching machines, etc., with a plant at New London. The officers of the new company are M. E. Infiorati, Jr., president, and Edward L. Streeter, Jr., secretary and treasurer. Both are experienced in the broaching business. The capital of the company is $25,000.

The C. J. Root Co., of Bristol, Conn., manufacturer of automatic counters, metal stampings, wrought brass hinges, etc., has issued $25,000 additional stock, divided into 250 shares at $100 par.

The O. B. Herlth Manufacturing Co., Inc., of Hartford, Conn., has been incorporated with a capital of $50,000, to make and deal in tools, machinery, etc. It has taken over the present O. B. Herlth Manufacturing Co., of 90 John St., Hartford, Conn. The incorporators of the company are O. B. Herlth, of Hartford, and W. C. Herlth, of Brooklyn, N. Y.

The American Chain Co., of Bridgeport, Conn., has recently added four more large plants to its seven. The new plants acquired are: The Highland Iron and Steel Co., with factories at Terre Haute, Ind., and West Pullman, Ill.; the Reading Steel Castings Co., of Reading, Pa., and the Page Steel and Wire Co., of Adrian, Mich., with a billet plant located at Monessen, Pa. The American Chain Co. has not escaped the problems of keeping up production in the past two years and making deliveries in the face of a shortage of raw material, and therefore plans to use the new plants to relieve its many production problems.

For the purpose of more closely cooperating with the industries of Philadelphia and vicinity, the Norton Co., Worcester, Mass., has opened a branch office for the grinding machine division at No. 324 Bulletin Building, under the direction of Paul Hoffman, district manager. The establishment of this branch office will in no way affect the distribution of Norton grinding wheels. This will be handled as in the past by Powell, Clouds & Co., No. 602 Arch St.

The Diefendorf Gear Corporation, Syracuse, N. Y., has been granted a license by the Westinghouse Electric and Manufacturing Co., to manufacture gears from Bakelite Micarta. The company has also leased larger quarters, due to growing business, and about Aug. 1 will be located at 324 Pearl St., Syracuse, with double its floor space.

The Trumbull Electric Co., Plainville, Conn., following the example of various other factories, will publish a factory magazine which will be called "Within the Circle." The magazine will be published once a month and will contain news of interest concerning the doings of the shop employes.

Export Opportunities

The Bureau of Foreign and Domestic Commerce, Department of Commerce, Washington, D. C., has inquiries for the agencies of machinery and machine tools. Any information desired regarding these opportunities can be secured from the above address by referring to the number following each item.

A merchant company in Argentina desires to secure agencies for the sale of all kinds of automobile accessories, hardware, mechanics' and carpenters' tools, and machine tools. Correspondence may be in English. References. No. 33201.

An agency is desired by a man in Germany for the sale of hardware, machinery, iron, steel, and metal products, foodstuffs, and cotton. References. No. 33208.

An importing company in Switzerland desires to secure an agency for the sale of grinding machines, plain and universal, for cylindrical grinding, and surface grinding, also crankshaft grinding. The largest possible range is required in all types from 10 by 24 to the largest machines. Quotations should be given c.i.f. or f.o.b. the most convenient port. Payment will be made by draft. References. No. 32,970.

Forthcoming Meetings

The International Railway Master Blacksmiths' Association will hold its next annual convention at Tutwiler Hotel, Birmingham, Ala., on Aug. 17, 18 and 19. The secretary of the association is A. L. Woodworth, Lima, Ohio.

The American Steel Treaters' Society and the Steel Treating Research Society will hold their second annual convention and exhibition at the Commercial Museum, Philadelphia, Pa., on Sept. 14 to 18, inclusive. J. A. Pollak, of the Pollak Steel Co., Cincinnati, Ohio, is secretary of the former society.

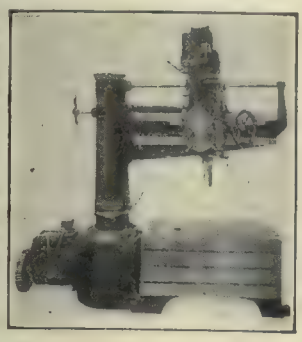
The American Foundrymen's Asssociation will hold its annual convention and exhibit at Columbus, Ohio, on Oct. 4 to 9. C. E. Hoyt, 1401 Harris Trust Building, Chicago, Ill., is secretary.

An exposition of U. S. manufacturers at Buenos Aires, Argentine Republic, S. A., has been arranged for the month beginning Nov. 15. Information can be obtained from the American National Exhibition, Inc., Bush Terminal Sales Building, 132 West 42nd St., New York.

Condensed-Clipping Index of Equipment

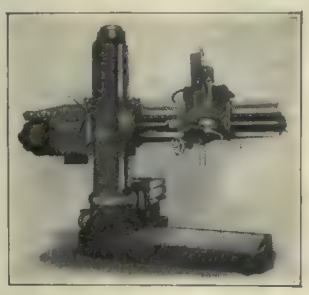
Patented Aug. 20, 1918

Drilling Machine, Radial, 4-Ft.
Scott Brothers, Ltd., Halifax, England.
"American Machinist," (English Edition), June 12, 1920



The chain drive is by 5-hp. electric motor. Gear box gives 6 speeds operated by two levers, which in combination with the double gears, give 12 spindle speeds from 30 to 420 r.p.m. Spindle has ball thrust washers, the arm also revolving on ball bearings. The 3 gear-driven feeds are 145, 97, and 64 cuts per inch; they are engaged by friction clutch. Cross handle at top of pillar allows for an arm elevation of 7 in. The pillar is 8½ in. in diameter. Spindle is 2¾ in. in diameter in the driving part and has a traverse of 14 in.; it is bored out No. 4 Morse taper. The maximum height from spindle nose to table is 24 in. Top surface of the T-slotted worktable is 43 x 22 in. Approximate weight, 1,350 lb.

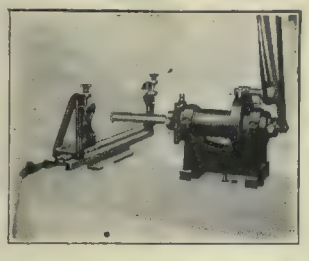
Drilling Machine, "Right-Line" Radial
Niles-Bement-Pond Co., 111 Broadway, New York City.
"American Machinist," July 1, 1920



A noteworthy feature is embodied in the design of column. All controls operated from the head, and the column clamp is electrically operated. The base of machine has an extension which carries a table back of the column and at a right angle to the main working surface.

Specifications: Distance under spindle to base: minimum, 12 in.; maximum, 68 in. Base: working surface, 5 ft. 11 in. x 3 ft. 6 in. Table: top, 23 x 27 in.; height, 30 in. Spindle traverse, 18 in. Feeds: number, 8; amount, 0.006 to 0.06 in. per rev. Hp. of driving motor, 10. Spindle speeds: number, 28; amount, 20 to 400 r.p.m. Height, 11 ft. 6 in. Diameter of floor space required, 15 ft. 5 in.

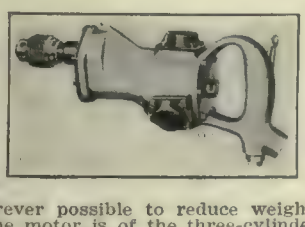
Grinding Machine, Cylinder Boring and
Sunderland Machine Shop, Omaha, Neb.
"American Machinist," July 1, 1920



The attachment is intended for garage and repair-shop work and it is designed to fit a standard lathe, being independent of the lathe-headstock. The base of the grinding head can be adjusted to suit different distances between the lathe Vs. The table upon which the cylinder blocks rest is fastened to carriage of lathe. The brackets can be adjusted to hold cylinder blocks of various sizes, and a micrometer cross-feed is provided for bringing different cylinders into alignment with the spindle.

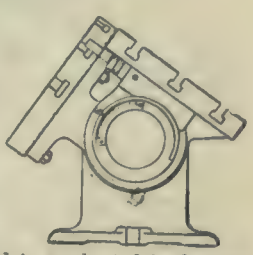
Specifications: Size; to fit lathes of 14- to 24-in. swing; to hold blocks of 1 to 6 cylinders; to bore and grind cylinders of 2½ in. diameter and larger. Swing; over ways, 22 in. Length of spindle, 15¾ in. Weight, boxed, 500 lb.

Drills, "Little David" Nos. 6 and 600 Pneumatic
Ingersoll-Rand Co., 11 Broadway, New York City.
"American Machinist," July 1, 1920



The Nos. 6 and 600 drills are intended for twist trills up to ⅝ in. diameter. The free speed at 90 lb. air pressure is about 2,000 r.p.m. The two machines differ only in handle construction, the motors being the same. No. 6 has the pistol-grip handle, while No. 600 is furnished with breast plate and rolling throttle handle. Aluminum reinforced with steel bushings is used wherever possible to reduce weight, the No. 6 weighing only 9 lb. The motor is of the three-cylinder type, and the cylinders are separate iron castings, easily accessible, renewable and interchangeable. The bearings are all either ball or roller type.

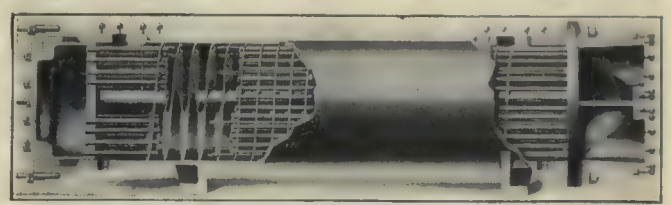
Table, Drilling Duplex Universal
Machinery and Engineering Equipment Co., Bradford, England.
"American Machinist," (English Edition), June 12, 1920



Large range is obtained by having revolving member on top of tilting member instead of at the base. Circular table is 12 in. in diameter and has three planed T-slots. It is graduated in degrees and can be secured in any position by two bolts. The auxiliary T-slotted rectangular table at a right angle to circular table is 18 in. long by 12 in. wide; it is intended for handling work of larger dimensions, where an extensive range of angles is unnecessary. The tilting member is adjusted to any desired angle through worm gear and handle. The tube on which it revolves is of large diameter and is graduated in degrees. The complete table 18 in. long, 14 in. wide and 14 in. deep overall. Weight, 500 lb.

Cooler, "Multiwhirl" Oil
Griscom-Russell Co., 90 West St., New York City.
"American Machinist," July 1, 1920

Designed for cooling oil used in lubrication of turbine bearings and reduction gears, or quenching oil in the heat treating of steel. The oil is constantly circulated through the cooler, and kept at



a constant temperature permitting both the continued use of the original quantity of oil and its maintenance at the proper viscosity for efficient results. The whirling path of the oil is accomplished by the use of a helical baffle, which directs the oil in its flow.

Drill, "Little David" No. 8 Pneumatic
Ingersoll-Rand Co., 11 Broadway, New York City.
"American Machinist," July 1, 1920

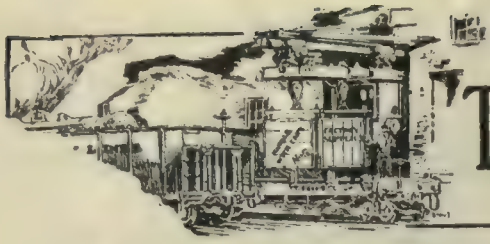


The No. 8 close-quarter drill is a machine for use close to a wall or corner. This machine runs at 250 r.p.m. without load, and will handle drilling, reaming or tapping up to 1¼ in. diameter. The spindle which turns the drill is operated by three rocking levers connected directly to the pistons through connecting rods. The motor is of the three-cylinder type with pistons acting at right angles to the levers.

Grinders, "Little David" Nos. 601 and 602 Pneumatic
Ingersoll-Rand Co., 11 Broadway, New York City.
"American Machinist," July 1, 1920



The Nos. 601 and 602 grinders are light-weight tools, running with a free speed of 4,200 r.p.m., and are suitable for grinding, buffing or polishing work. Both machines have the same type of motor but are equipped with different throttles and handles, the 601 having the closed type of inside trigger handle, while the No. 602 is fitted with the rolling types of throttle handle. The three-cylinder motor runs in a bath of oil. The valve is integral with the crankshaft, and ball and roller bearings are used throughout. The removal of a few screws enables the handle to be lifted off exposing the entire mechanism to view.



THE WEEKLY PRICE GUIDE

IRON AND STEEL

PIG IRON—Quotations compiled by The Matthew Addy Co.:

	Current	One Year Ago
CINCINNATI		
No. 2 Southern	$45.60	$29.80
Northern Basic	42.80	27.55
Southern Ohio No. 2	46.80	28.55
NEW YORK—TIDEWATER DELIVERY		
2X Virginia (Silicon 2.25 to 2.75)	49.65	31.90
Southern No. 2 (Silicon 2.25 to 2.75)	49.70	33.95
BIRMINGHAM		
No. 2 Foundry	42.00@44.00	25.75
PHILADELPHIA		
Eastern Pa., No. 2x, 2.25–2.75 sil.	46@48.25*	30.65
Virginia No. 2	45.00*	30.85
Basic	44.50†	29.90
Grey Forge	43.50*	29.90
CHICAGO		
No. 2 Foundry local	44.25	27.25
No. 2 Foundry, Southern	47.00	31.75
PITTSBURGH, INCLUDING FREIGHT CHARGE FROM VALLEY		
No. 2 Foundry	45.65	28.15
Basic	44.40	27.15
Bessemer	44.90	29.35
MONTREAL		
Silicon 2.25 to 2.75%	43.25	.....

* F.o.b. furnace. † Delivered.

STEEL SHAPES—The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses at the cities named:

	New York			Cleveland		Chicago	
	Current	One Month Ago	One Year Ago	Current	One Year Ago	Current	One Year Ago
Structural shapes	$4.47	$3.97	$3.47	$5.50	$3.37	$3.97	$3.47
Soft steel bars	4.62	4.12	3.37	5.00	3.27	3.87	3.37
Soft steel bar shapes	4.62	4.12	3.37	....	3.27	3.87	3.37
Soft steel bands	5.82	5.32	4.07	6.25	....	....	....
Plates, ¼ to 1 in. thick	4.67	4.17	3.67	5.00	3.57	4.17	3.67

BAR IRON—Prices per 100 lb. at the places named are as follows:

	Current	One Year Ago
Mill, Pittsburgh	$4.25	$2.75
Warehouse, New York	4.57	3.37
Warehouse, Cleveland	3.52	3.22
Warehouse, Chicago	3.75	3.37

SHEETS—Quotations are in cents per pound in various cities from warehouse; also the base quotations from mill:

Blue Annealed	Large Mill Lots Pittsburgh	New York Current	New York One Year Ago	Cleveland	Chicago
No. 10	3.55–6.00	7.12@8.00	4.57	7.55	7.02
No. 12	3.60–6.05	7.17@8.05	4.62	7.65	7.07
No. 14	3.65–6.10	7.22@8.10	4.67	7.70	7.12
No. 16	3.75–6.20	7.32@8.20	4.77	7.80	7.22
Black					
Nos. 18 and 20	4.15–6.30	8.50@9.50	5.17	8.20	7.80
Nos. 22 and 24	4.20–6.35	8.55@9.55	5.22	8.25	7.85
No. 26	4.25–6.40	8.60@9.60	5.27	8.30	7.90
No. 28	4.35–6.50	8.70@9.70	5.37	8.40	8.00
Galvanized					
No. 10	4.70–7.50	9.75@11.00	5.50	8.50	8.15
No. 12	4.80–7.60	9.85@11.00	5.55	8.60	8.20
No. 14	4.80–7.60	9.85@11.10	5.60	8.60	8.35
Nos. 18 and 20	5.10–7.90	10.10@11.40	5.90	8.90	8.65
Nos. 22 and 24	5.25–8.02	10.25@11.55	6.05	9.05	9.05
No. 26	5.40–8.20	10.40@11.70	6.20	9.20	9.20
No. 28	5.70–8.50	10.70@12.00	6.50	9.50	9.50

Acute scarcity in sheets, particularly black, galvanized and No. 16 blue enameled.

Automobile sheets are unavailable except in fugitive instances, when prices are 9.45c per lb. for No. 16; 9.50 for Nos. 18 and 20, and 9.55c for Nos. 22 and 24.

COLD FINISHED STEEL—Warehouse prices are as follows:

	New York	Chicago	Cleveland
Round shafting or screw stock, per 100 lb. base	$6.25	$5.80	$6.00
Flats, square and hexagons, per 100 lb. base	6.75	6.30	6.50

DRILL ROD—Discounts from list price are as follows at the places named:

	Per Cent.
New York	50
Cleveland	50
Chicago	50

SWEDISH (NORWAY) IRON—The average price per 100 lb., in ton lots is:

	Current	One Year Ago
New York	$20.00	$25.50–30.00
Cleveland	20.00	20.00
Chicago	21.00	16.50

In coils an advance of 50c. usually is charged.
Domestic iron (Swedish analysis) is selling at 12c. per lb.

WELDING MATERIAL (SWEDISH)—These prices are the best we have been able to obtain for Swedish welding materials, of which it is reported that very little are on the market.

Welding Wire		Cast-Iron Welding Rods	
1/16, 3/32, 7/64, 1/8, 9/32, 5/16, No. 8, 3/8 and No. 10	$21.00 to 30.00	1/4 by 12 in. long	14.00
1/4		1/4 by 19 in. long	12.00
No. 12		3/8 by 19 in. long	10.00
7/32, No. 14 and 1/16		1/2 by 21 in. long	10.00
No. 18		Special Welding Wire, Coated	
No. 20		1/4	33.00
		5/32	30.00

Domestic—Welding wire in 100-lb. lots sells as follows, f. o. b. New York: 5/32, 8½c. per lb.; 1/4, 8c.; 5/16 to 1/2, 7½c.

MISCELLANEOUS STEEL—The following quotations in cents per pound are from warehouse at the places named:

	New York Current	Cleveland Current	Chicago Current
Openhearth spring steel (heavy)	7.00	8.00	9.00
Spring steel (light)	10.00	11.00	12.25
Coppered bessemer rods	9.00	8.00	6.75
Hoop steel	6.07	6.50	5.32
Cold-rolled strip steel	12.50	8.25	10.75
Floor plates	6.80	6.00	6.77

PIPE—The following discounts are to jobbers for carload lots on the Pittsburgh basing card, discounts on steel pipe, applying as from January 14, 1920, and on iron pipe from January 7, 1920.

Inches	Steel Black	Steel Galvanized	Inches	Iron Black	Iron Galvanized
BUTT WELD					
1/8, 1/4 and 3/8	47%	20½%	3/4 to 1½	34½%	18½%
1/2	51%	36½%			
3/4 to 3	54%	41½%			
LAP WELD					
2	47%	34½%	2	28½%	14½%
2½ to 6	50%	37½%	2½ to 6	30½%	17½%
BUTT WELD, EXTRA STRONG PLAIN ENDS					
1/8, 1/4 and 3/8	43%	25½%	3/4 to 1	34½%	19½%
1/2	48%	35½%			
3/4 to 1½	52%	39½%			
LAP WELD, EXTRA STRONG PLAIN ENDS					
2	45%	33½%	2	29½%	16½%
2½ to 4	48%	36½%	2½ to 4	31½%	19½%
4½ to 6	47%	35½%	4½ to 6	30½%	18½%

Stock discounts in cities named are as follows:

	New York Black	New York Galv.	Cleveland Black	Cleveland Galv.	Chicago Black	Chicago Galv.
¾ to 3 in. steel butt welded	40%	24%	40%	31%	54@40%	40½@30%
2½ to 6 in. steel lap welded	35%	20%	42%	27%	50@40%	37½@27½%

Malleable fittings. Class B and C, banded, from New York stock sell at plus 32%. Cast iron, standard sizes, net.

METALS

MISCELLANEOUS METALS—Present and past New York quotations in cents per pound, in carload lots:

	Current	Month Ago	Year Ago
Copper, electrolytic	18@19	19.25	19.75
Tin in 5-ton lots	48.00	61.50	70.50
Lead	8.00	9.00	5.40
Spelter	7.75	8.70	7.50
ST. LOUIS			
Lead	7.75	8.87½	5.15
Spelter	7.50	8.37½	7.15

At the places named, the following prices in cents per pound prevail, for 1 ton or more:

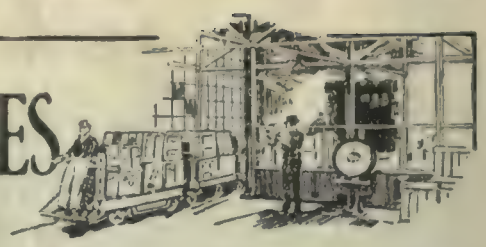
	New York Current	New York Month Ago	New York Year Ago	Cleveland Current	Cleveland Year Ago	Chicago April 8 Current	Chicago April 8 Year Ago
Copper sheets, base	33.50	33.50	27.50	32.00	28@30	36.00	27.00
Copper wire (carload lots)	31.25	31.25	24.00	29.50	26.50	27.00	23.00
Brass sheets	28.50	28.50	23.00	29.00	27.00	27.00	21.50
Brass pipe	33.00	33.00	34.00	34.00	35.00	35.00	31.00
Solder (half and half) (case lots)	33.00	33.00	45.00	40.50	41.00	38.00	39.00

Copper sheets quoted above hot rolled 16 oz., cold rolled 14 oz. and heavier, add 2c.; polished takes 5c. per sq.ft. extra for 20-in. widths and under; over 20 in., 7½c.

BRASS RODS—The following quotations are for large lots, mill. 100 lb. and over, warehouse; net extra:

	Current	One Year Ago
Mill	23.75	19.00
New York	25.00	21.50
Cleveland	27.00	24.00
Chicago	26.00	24.90

SHOP MATERIALS AND SUPPLIES



ZINC SHEETS—The following prices in cents per pound prevail:
Carload lots f.o.b. mill..... 12.00

	In Casks		Broken Lots	
	Current	One Year Ago	Current	One Year Ago
Cleveland	15.00	12.95	15.50	13.30
New York	14.00	12.00	14.50	13.00
Chicago	15.00	16.50	15.00	16.00

ANTIMONY—Chinese and Japanese brands in cents per pound, in ton lots for spot delivery, duty paid:

	Current	One Year Ago
New York	7.50@7.75	8.37½
Chicago	9.50	10.00

OLD METALS—The following are the dealers' purchasing prices in cents per pound:

	New York			
	Current	One Year Ago	Cleveland	Chicago
Copper, heavy, and crucible	16.00	16.50	16.50	16.50
Copper, heavy, and wire	15.25	15.25	16.50	15.00
Copper, light, and bottoms	13.75	13.25	15.00	14.00
Lead, heavy	7.00	4.62½	7.00	7.00
Lead, tea	5.00	3.75	5.00	6.00
Brass, heavy	10.25	9.75	12.50	16.50
Brass, light	7.50	7.75	10.00	9.50
No. 1 yellow brass turnings	8.50	8.75	10.00	10.00
Zinc	5.25	4.25	5.00	5.50

ALUMINUM—The following prices are from warehouse at places named:

	New York	Cleveland	Chicago
No. 1 aluminum, 98 to 99% pure, in ingots for remelting (1-15 ton lots), per lb	33.00	34.00c.@35.00c.	33.50

COPPER BARS—From warehouse sell as follows in cents per pound, for ton lots and over:

	Current	One Year Ago
New York (round)	38.00	25.00
Chicago	29.00	28.00
Cleveland	32.00	28.50

BABBITT METAL—Warehouse price per pound:

	New York		Cleveland		Chicago	
	Current	One Year Ago	Current	One Year Ago	Current	One Year Ago
Best grade	90.00	87.00	74.50	79.00	60.00	75.00
Commercial	50.00	42.00	21.50	17.50	15.00	15.00

SHOP SUPPLIES

NUTS—From warehouse at the places named, on fair-sized orders, the following amount is deducted from list:

	New York		Cleveland		Chicago	
	Current	One Year Ago	Current	One Year Ago	Current	One Year Ago
Hot pressed square	+$4.00	1.28	$ .75	$1.90	$.50	2.00
Hot pressed hexagon	+ 4.00	.85	.75	1.90	.50	2.00
Cold punched hexagon	+ 4.00	3.25	.75	1.90	.50	1.30
Cold punched square	+ 4.00	2.70	.75	1.90	.50	1.30

Semi-finished nuts, ⅝ and smaller, sell at the following discounts from list price:

	Current	One Year Ago
New York	30%	50–10%
Chicago	50%	50%
Cleveland	50%	60-10-10%

MACHINE BOLTS—Warehouse discounts in the following cities:

	New York	Cleveland	Chicago
½ by 4 in. and smaller	List	20%	20%
Larger and longer up to 1½ in. by 30 in.	+20%	20%	10%

WASHERS—From warehouses at the places named the following amount is deducted from list price:
For wrought-iron washers:
New York..... list Cleveland..... $3.00 Chicago..... $3.00
For cast-iron washers, ⅜ and larger, the base price per 100 lb. is as follows:
New York..... $7.00 Cleveland..... $4.50 Chicago..... $4.75

CARRIAGE BOLTS—From warehouses at the places named the following discounts from list are in effect:

	New York	Cleveland	Chicago
½ by 6 in. and smaller	10%	15%	10%
Larger and longer up to 1 in. by 30 in.	10%	10%	5%

COPPER RIVETS AND BURS sell at the following rate from warehouse:

	Rivets		Burs	
	Current	One Year Ago	Current	One Year Ago
Cleveland	20%	25%	10%	10%
Chicago	net	10%	net	10%
New York	25%	40%	net	20%

RIVETS—The following quotations are allowed for fair-sized orders from warehouse:

	New York	Cleveland	Chicago
Steel ⅞ and smaller	30%	30%	30%
Tinned	30%	30%	30%

Boiler, ¾, ⅞, 1 in. diameter by 2 to 5 in. sell as follows per 100 lb.:
New York..... $6.00 Chicago..... $5.62 Pittsburgh..... $4.72
Structural, same sizes:
New York..... $7.10 Chicago..... $5.72 Pittsburgh..... $4.82

MISCELLANEOUS

SEAMLESS DRAWN TUBING—The base price in cents per pound from warehouse in 100-lb. lots is as follows:

	New York	Cleveland	Chicago
Copper	34.00	34.00	35.00
Brass	33.00	34.00	34.00

For immediate stock shipment 3c. is usually added. The prices, of course, vary with the quantity purchased. For lots of less than 100 lb., but not less than 75 lb., the advance is 2c.; for lots of less than 75 lb., but not less than 50 lb. advance is 5c. over base (100-lb. lots); less than 50 lb., but not less than 25 lb. 10c. should be added to base price; quantities from 10-25 lb., extra is 25c.; less than 10 lb., add 35c.

Double above extras will be charged for angles, channels and sheet metal mouldings if ordered in above quantities. Above extras also apply to brass rod other than standard stock sizes—stock sizes being considered as ⅛-2 in. inclusive in rounds, and ⅛-1½ in., inclusive, in square and hexagon—all varying by thirty seconds up to 1 in. by sixteenths over 1 in. On shipments aggregating less than 100 lb., there is usually a boxing charge of $1.50.

LONG TERNE PLATE—In Chicago No. 28 primes from stock sell, nominally, for $12.50 per 100 lbs.

COTTON WASTE—The following prices are in cents per pound:

	New York			
	Current	One Year Ago	Cleveland	Chicago
White	11.00@15.50	13.00	16.00	11.00 to 14.00
Colored mixed	7.00@10.50	9.00–12.00	12.00	9.50 to 12.00

WIPING CLOTHS—Jobbers' price per 1000 is as follows:

	13½x13½	13½x20½
Cleveland	55.00	65.00
Chicago	41.00	43.50

SAL SODA sells as follows per 100 lb.:

	Current	One Month Ago	One Year Ago
New York	$3.00	$3.00	$1.75
Philadelphia	2.75	2.75	1.75
Cleveland	2.50	2.50	2.75
Chicago	2.25	2.50	2.00

ROLL SULPHUR in 360-lb. bbl. sells as follows per 100 lb.:

	Current	One Month Ago	One Year Ago
New York	$3.90	$3.90	$3.65
Philadelphia	3.65	3.65	3.62
Chicago	5.00	5.00	4.12½

COKE—The following are prices per net ton at ovens, Connellsville:

	July 8	July 1	June 24
Prompt furnace	$17.50@$18.50	$17.50@$18.50	$15.00@$16.00
Prompt foundry	18.00@19.00	18.00@19.00	16.00@17.00

FIRE CLAY—The following prices prevail:

		Current
Ottawa, bulk in carloads	Per Ton	$8.00
Cleveland	100-lb. bag	1.00

LINSEED OIL—These prices are per gallon:

	New York		Chicago	
	Current	One Year Ago	Current	One Year Ago
Raw in barrels (5 bbl. lots)	$1.58	$1.15	$2.02	$2.27
5-gal. cans (without cans)	1.60*	2.28	2.27	2.47

*To this *oil* price must be added the cost of the cans (returnable), which is $2.25 for a case of six.

WHITE AND RED LEAD—Base price per pound:

	Red				White	
	Current		One Year Ago		One Year Ago	
	Dry	In Oil	Dry	In Oil	Current Dry and In Oil	Dry and In Oil
100 lb. keg	15.50	17.00	13.00	14.50	15.50	13.00
25 and 50-lb. kegs	15.75	17.25	13.25	14.75	15.75	13.25
12½-lb. keg	16.00	17.50	13.50	15.00	16.00	13.50
5-lb. cans	18.50	20.00	15.00	16.50	18.50	15.00
1-lb. cans	20.50	22.00	16.00	17.50	20.50	16.00

500 lb. lots less 10% discount. 2000 lb. lots less 10–2½% discount.



THE WEEKLY PRICE GUIDE

IRON AND STEEL

PIG IRON—Quotations compiled by The Matthew Addy Co.:

	Current	One Year Ago
CINCINNATI		
No. 2 Southern	$45.60	$29.80
Northern Basic	42.80	27.55
Southern Ohio No. 2	46.80	28.55
NEW YORK—TIDEWATER DELIVERY		
2X Virginia (Silicon 2.25 to 2.75)	49.65	31.90
Southern No. 2 (Silicon 2.25 to 2.75)	49.70	33.95
BIRMINGHAM		
No. 2 Foundry	42.00@44.00	25.75
PHILADELPHIA		
Eastern Pa., No. 2x, 2.25–2.75 sil.	46@48.25*	30.65
Virginia No. 2	45.00*	30.85
Basic	44.50†	29.90
Grey Forge	43.50*	29.90
CHICAGO		
No. 2 Foundry local	44.25	27.25
No. 2 Foundry, Southern	47.00	31.75
PITTSBURGH, INCLUDING FREIGHT CHARGE FROM VALLEY		
No. 2 Foundry	45.65	28.15
Basic	44.40	27.15
Bessemer	44.90	29.35
MONTREAL		
Silicon 2.25 to 2.75%	43.25	.....

* F.o.b. furnace. † Delivered.

STEEL SHAPES—The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses at the cities named:

	New York			Cleveland		Chicago	
	Current	One Month Ago	One Year Ago	Current	One Year Ago	Current	One Year Ago
Structural shapes	$4.47	$3.97	$3.47	$5.50	$3.37	$3.97	$3.47
Soft steel bars	4.62	4.12	3.37	5.00	3.27	3.87	3.37
Soft steel bar shapes	4.62	4.12	3.37	.....	3.27	3.87	3.37
Soft steel bands	5.82	5.32	4.07	6.25	.....	.....	.....
Plates, ¼ to 1 in. thick	4.67	4.17	3.67	5.00	3.57	4.17	3.67

BAR IRON—Prices per 100 lb. at the places named are as follows:

	Current	One Year Ago
Mill, Pittsburgh	$4.25	$2.75
Warehouse, New York	4.57	3.37
Warehouse, Cleveland	3.52	3.22
Warehouse, Chicago	3.75	3.37

SHEETS—Quotations are in cents per pound in various cities from warehouse; also the base quotations from mill:

Blue Annealed	Large Mill Lots Pittsburgh	New York Current	New York One Year Ago	Cleveland	Chicago
No. 10	3.55–6.00	7.12@8.00	4.57	7.55	7.02
No. 12	3.60–6.05	7.17@8.05	4.62	7.65	7.07
No. 14	3.65–6.10	7.22@8.10	4.67	7.70	7.12
No. 16	3.75–6.20	7.32@8.20	4.77	7.80	7.22
Black					
Nos. 18 and 20	4.15–6.30	8.50@9.50	5.17	8.20	7.80
Nos. 22 and 24	4.20–6.35	8.55@9.55	5.22	8.25	7.85
No. 26	4.25–6.40	8.60@9.60	5.27	8.30	7.90
No. 28	4.35–6.50	8.70@9.70	5.37	8.40	8.00
Galvanized					
No. 10	4.70–7.50	9.75@11.00	5.50	8.50	8.15
No. 12	4.80–7.60	9.85@11.00	5.55	8.60	8.20
No. 14	4.80–7.60	9.85@11.10	5.60	8.60	8.35
Nos. 18 and 20	5.10–7.90	10.10@11.40	5.90	8.90	8.65
Nos. 22 and 24	5.25–8.02	10.25@11.55	6.05	9.05	9.05
No. 26	5.40–8.20	10.40@11.70	6.20	9.20	9.20
No. 28	5.70–8.50	10.70@12.00	6.50	9.50	9.50

Acute scarcity in sheets, particularly black, galvanized and No. 16 blue enameled.

Automobile sheets are unavailable except in fugitive instances, when prices are 9.45c per lb. for No. 16; 9.50 for Nos. 18 and 20, and 9.55c for Nos. 22 and 24.

COLD FINISHED STEEL—Warehouse prices are as follows:

	New York	Chicago	Cleveland
Round shafting or screw stock, per 100 lb. base	$6.25	$5.80	$6.00
Flats, square and hexagons, per 100 lb. base	6.75	6.30	6.50

DRILL ROD—Discounts from list price are as follows at the places named:

	Per Cent.
New York	50
Cleveland	50
Chicago	50

SWEDISH (NORWAY) IRON—The average price per 100 lb., in ton lots is:

	Current	One Year Ago
New York	$20.00	$25.50–30.00
Cleveland	20.00	20.00
Chicago	21.00	16.50

In coils an advance of 50c. usually is charged.
Domestic iron (Swedish analysis) is selling at 12c. per lb.

WELDING MATERIAL (SWEDISH)—These prices are the best we have been able to obtain for Swedish welding materials, of which it is reported that very little are on the market.

Welding Wire		Cast-Iron Welding Rods	
1/16, 3/32, 1/8, 5/32, 3/16, No. 8, 7/32 and No. 10	21.00 to 30.00	1/16 by 12 in. long	14.00
1/4		1/8 by 19 in. long	12.00
No. 12		1/4 by 19 in. long	10.00
5/16, No. 14 and 3/8		1/2 by 21 in. long	10.00
No. 18		Special Welding Wire, Coated	
No. 20		1/16	33.00
		1/8	30.00

Domestic—Welding wire in 100-lb. lots sells as follows, f. o. b. New York: 1/16, 8½c. per lb.; 1/8, 8c.; 5/32 to 1/4, 7½c.

MISCELLANEOUS STEEL—The following quotations in cents per pound are from warehouse at the places named:

	New York Current	Cleveland Current	Chicago Current
Openhearth spring steel (heavy)	7.00	8.00	9.00
Spring steel (light)	10.00	11.00	12.25
Coppered bessemer rods	9.00	8.00	6.75
Hoop steel	6.07	6.50	5.32
Cold-rolled strip steel	12.50	8.25	10.75
Floor plates	6.80	6.00	6.77

PIPE—The following discounts are to jobbers for carload lots on the Pittsburgh basing card, discounts on steel pipe, applying as from January 14, 1920; and on iron pipe from January 7, 1920.

	Steel Black	Steel Galvanized		Iron Black	Iron Galvanized
BUTT WELD					
Inches			Inches		
1/8, 1/4 and 3/8	47%	20½%	1/8 to 1 1/4	34½%	18½%
1/2	51%	36½%			
3/4 to 3	54%	41½%			
LAP WELD					
2	47%	34½%	2	28½%	14½%
2½ to 6	50%	37½%	2½ to 6	30½%	17½%
BUTT WELD, EXTRA STRONG PLAIN ENDS					
1/8, 1/4 and 3/8	43%	25½%	1/8 to 1/4	34½%	19½%
1/2	48%	35½%			
3/4 to 1 1/4	52%	39½%			
LAP WELD, EXTRA STRONG PLAIN ENDS					
2	45%	33½%	2	29½%	16½%
2½ to 4	48%	36½%	2½ to 4	31½%	19½%
4½ to 6	47%	35½%	4½ to 6	30½%	18½%

Stock discounts in cities named are as follows:

	New York Black	New York Galv.	Cleveland Black	Cleveland Galv.	Chicago Black	Chicago Galv.
1/8 to 3 in. steel butt welded	40%	24%	40%	31%	54@40%	40½@30%
2½ to 6 in. steel lap welded	35%	20%	42%	27%	50@40%	37½@27½%

Malleable fittings. Class B and C, banded, from New York stock sell at plus 32%. Cast iron, standard sizes, net.

METALS

MISCELLANEOUS METALS—Present and past New York quotations in cents per pound, in carload lots:

	Current	Month Ago	Year Ago
Copper, electrolytic	18@19	19.25	19.75
Tin in 5-ton lots	48.00	61.50	70.50
Lead	8.00	9.00	5.40
Spelter	7.75	8.70	7.50
ST. LOUIS			
Lead	7.75	8.87½	5.15
Spelter	7.50	8.37½	7.15

At the places named, the following prices in cents per pound prevail, for 1 ton or more:

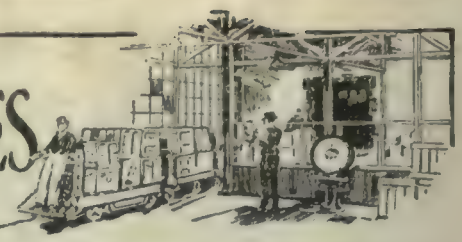
	New York Current	New York Month Ago	New York Year Ago	Cleveland Current	Cleveland Year Ago	Chicago April 8 Current	Chicago April 8 Year Ago
Copper sheets, base	33.50	33.50	27.50	32.00	28@30	36.00	27.00
Copper wire (carload lots)	31.25	31.25	24.00	29.50	26.50	27.00	23.00
Brass sheets	28.50	28.50	23.00	29.00	27.00	27.00	21.50
Brass pipe	33.00	33.00	34.00	34.00	35.00	35.00	31.00
Solder (half and half) (case lots)	33.00	33.00	45.00	40.50	41.00	38.00	39.00

Copper sheets quoted above hot rolled 16 oz., cold rolled 14 oz. and heavier, add 2c.; polished takes 5c. per sq.ft. extra for 20-in. widths and under; over 20 in., 7½c.

BRASS RODS—The following quotations are for large lots, mill. 100 lb. and over, warehouse; net extra:

	Current	One Year Ago
Mill	23.75	19.00
New York	25.00	21.50
Cleveland	27.00	24.00
Chicago	26.00	24.00

SHOP MATERIALS AND SUPPLIES



ZINC SHEETS—The following prices in cents per pound prevail:

Carload lots f.o.b. mill 12.00

	—In Casks— Current	One Year Ago	— Broken Lots — Current	One Year Ago
Cleveland	15.00	12.95	15.50	13.30
New York	14.00	12.00	14.50	13.00
Chicago	15.00	16.50	15.00	16.00

ANTIMONY—Chinese and Japanese brands in cents per pound, in ton lots for spot delivery, duty paid:

	Current	One Year Ago
New York	7.50@7.75	8.37½
Chicago	9.50	10.00

OLD METALS—The following are the dealers' purchasing prices in cents per pound:

	— New York — Current	One Year Ago	Cleveland	Chicago
Copper, heavy, and crucible	16.00	16.50	16.50	16.50
Copper, heavy, and wire	15.25	15.25	16.50	15.00
Copper, light, and bottoms	13.75	13.25	15.00	14.00
Lead, heavy	7.00	4.62½	7.00	7.00
Lead, tea	5.00	3.75	5.00	6.00
Brass, heavy	10.25	9.75	12.50	16.50
Brass, light	7.50	7.75	10.00	9.50
No. 1 yellow brass turnings	8.50	8.75	10.00	10.00
Zinc	5.25	4.25	5.00	5.50

ALUMINUM—The following prices are from warehouse at places named:

	New York	Cleveland	Chicago
No. 1 aluminum, 98 to 99% pure, in ingots for remelting (1-15 ton lots), per lb	33.00	34.00c.@35.00c.	33.50

COPPER BARS—From warehouse sell as follows in cents per pound, for ton lots and over:

	Current	One Year Ago
New York (round)	38.00	25.00
Chicago	29.00	28.00
Cleveland	32.00	28.50

BABBITT METAL—Warehouse price per pound:

	—New York— Current	One Year Ago	—Cleveland— Current	One Year Ago	— Chicago — Current	One Year Ago
Best grade	90.00	87.00	74.50	79.00	60.00	75.00
Commercial	50.00	42.00	21.50	17.50	15.00	15.00

SHOP SUPPLIES

NUTS—From warehouse at the places named, on fair-sized orders, the following amount is deducted from list:

	— New York — Current	One Year Ago	— Cleveland — Current	One Year Ago	— Chicago — Current	One Year Ago
Hot pressed square	+$4.00	1.28	$ .75	$1.90	$.50	2.00
Hot pressed hexagon	+ 4.00	.85	.75	1.90	.50	2.00
Cold punched hexagon	+ 4.00	3.25	.75	1.90	.50	1.30
Cold punched square	+ 4.00	2.70	.75	1.90	.50	1.30

Semi-finished nuts, ⅝ and smaller, sell at the following discounts from list price:

	Current	One Year Ago
New York	30%	50–10%
Chicago	50%	50%
Cleveland	50%	60-10-10%

MACHINE BOLTS—Warehouse discounts in the following cities:

	New York	Cleveland	Chicago
½ by 4 in. and smaller	list	20%	20%
Larger and longer up to 1½ in. by 30 in.	+20%	20%	10%

WASHERS—From warehouses at the places named the following amount is deducted from list price:

For wrought-iron washers:

New York ..... list Cleveland ..... $3.00 Chicago $3.00

For cast-iron washers, ⅝ and larger, the base price per 100 lb. is as follows:

New York ..... $7.00 Cleveland ..... $4.50 Chicago $4.75

CARRIAGE BOLTS—From warehouses at the places named the following discounts from list are in effect:

	New York	Cleveland	Chicago
½ by 6 in. and smaller	10%	15%	10%
Larger and longer up to 1 in. by 30 in.	10%	10%	5%

COPPER RIVETS AND BURS sell at the following rate from warehouse:

	Rivets — Current	One Year Ago	Burs — Current	One Year Ago
Cleveland	20%	25%	10%	10%
Chicago	net	10%	net	10%
New York	25%	40%	net	20%

RIVETS—The following quotations are allowed for fair-sized orders from warehouse:

	New York	Cleveland	Chicago
Steel ⅞ and smaller	30%	30%	30%
Tinned	30%	30%	30%

Boiler, ½, ⅝, 1 in. diameter by 2 to 5 in. sell as follows per 100 lb.:

New York ..... $6.00 Chicago ..... $5.62 Pittsburgh $4.72

Structural, same sizes:

New York ..... $7.10 Chicago ..... $5.72 Pittsburgh $4.82

MISCELLANEOUS

SEAMLESS DRAWN TUBING—The base price in cents per pound from warehouse in 100-lb. lots is as follows:

	New York	Cleveland	Chicago
Copper	34.00	34.00	35.00
Brass	33.00	34.00	34.00

For immediate stock shipment 3c. is usually added. The prices, of course, vary with the quantity purchased. For lots of less than 100 lb., but not less than 75 lb., the advance is 2c.; for lots of less than 75 lb., but not less than 50 lb. advance is 5c. over base (100-lb. lots); less than 50 lb., but not less than 25 lb. 10c. should be added to base price; quantities from 10-25 lb., extra is 25c.; less than 10 lb., add 35c.

Double above extras will be charged for angles, channels and sheet metal mouldings if ordered in above quantities. Above extras also apply to brass rod other than standard stock sizes—stock sizes being considered as ⅛-2 in. inclusive in rounds, and ½-1½ in., inclusive, in square and hexagon—all varying by thirty seconds up to 1 in. by sixteenths over 1 in. On shipments aggregating less than 100 lb., there is usually a boxing charge of $1.50.

LONG TERNE PLATE—In Chicago No. 28 primes from stock sell, nominally, for $12.50 per 100 lbs.

COTTON WASTE—The following prices are in cents per pound:

	— New York — Current	One Year Ago	Cleveland	Chicago
White	11.00@15.50	13.00	16.00	11.00 to 14.00
Colored mixed	7.00@10.50	9.00–12.00	12.00	9.50 to 12.00

WIPING CLOTHS—Jobbers' price per 1000 is as follows:

	13½x13½	13½x20½
Cleveland	55.00	65.00
Chicago	41.00	43.50

SAL SODA sells as follows per 100 lb.:

	Current	One Month Ago	One Year Ago
New York	$3.00	$3.00	$1.75
Philadelphia	2.75	2.75	1.75
Cleveland	2.50	2.50	2.75
Chicago	2.25	2.50	2.00

ROLL SULPHUR in 360-lb. bbl. sells as follows per 100 lb.:

	Current	One Month Ago	One Year Ago
New York	$3.90	$3.90	$3.65
Philadelphia	3.65	3.65	3.62
Chicago	5.00	5.00	4.12½

COKE—The following are prices per net ton at ovens, Connellsville:

	July 8	July 1	June 24
Prompt furnace	$17.50@$18.50	$17.50@$18.50	$15.00@$16.00
Prompt foundry	18.00@19.00	18.00@19.00	16.00@17.00

FIRE CLAY—The following prices prevail:

		Current
Ottawa, bulk in carloads	Per Ton	$8.00
Cleveland	100-lb. bag	1.00

LINSEED OIL—These prices are per gallon:

	— New York — Current	One Year Ago	— Chicago — Current	One Year Ago
Raw in barrels (5 bbl. lots)	$1.58	$1.15	$2.02	$2.27
5-gal. cans (without cans)	1.60*	2.28	2.27	2.47

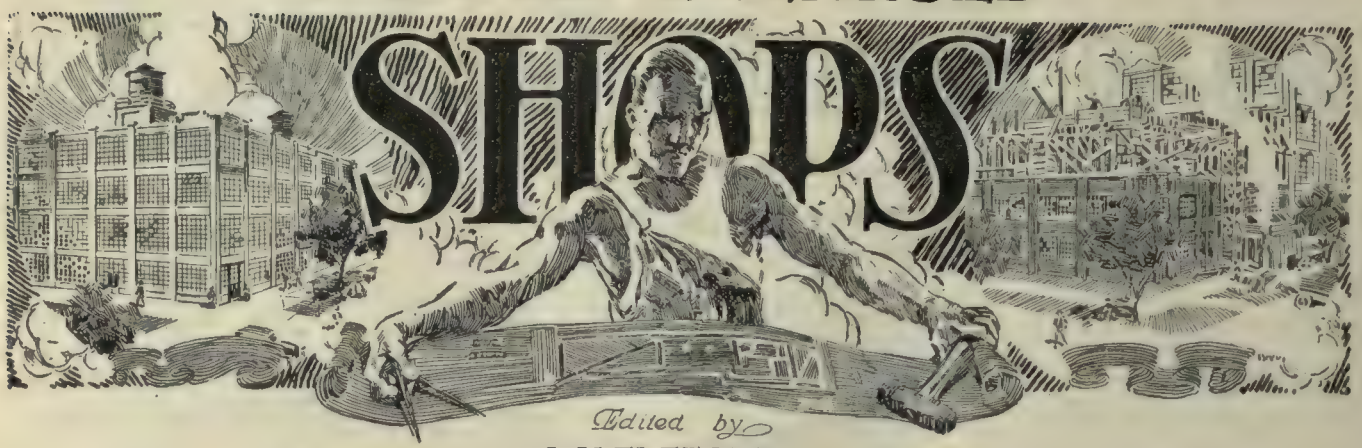
*To this *oil* price must be added the cost of the cans (returnable), which is $2.25 for a case of six.

WHITE AND RED LEAD—Base price per pound:

	Red — Current Dry	Current In Oil	One Year Ago Dry	One Year Ago In Oil	White — Current Dry and In Oil	One Year Ago Dry and In Oil
100 lb. keg	15.50	17.00	13.00	14.50	15.50	13.00
25 and 50-lb. kegs	15.75	17.25	13.25	14.75	15.75	13.25
12½-lb. keg	16.00	17.50	13.50	15.00	16.00	13.50
5-lb. cans	18.50	20.00	15.00	16.50	18.50	15.00
1-lb. cans	20.50	22.00	16.00	17.50	20.50	16.00

500 lb. lots less 10% discount. 2000 lb. lots less 10–2½% discount.

NEW and ENLARGED



Edited by
L-V-FLETCHER

Machine Tools

The following concerns are in the market for machine tools:

Conn., Bridgeport—W. Levin, 108 Reilly St.—automobile repair tools.

Mass., Boston — The Colonial Motors Corp.—miscellaneous machine tool equipment.

Mass., Greenfield — The Wells Special Mchy. Co.—low swing lathes, planers, turning lathes, cylindrical grinders and duplex milling machines.

Md., Baltimore—F. Molnaur, 531 South Ann St.—garage equipment.

Md., Sparrows Point — The Bethlehem Steel Co.—one universal and tool grinding machine with automatic feed table, B. & S. No. 13.

N. Y., Goshen—The I. H. Dexter Co., Inc.—one 40 to 50 in. x 10 or 12 ft. planing machine with 1 or 2 heads on rail and one 2½ or 3 ft. radial drill press (used).

N. Y., New York (Borough of Brooklyn)—The Intertype Corp., 50 Court St.—screw machines, lathes and other machine tools.

N. Y., New York (Borough of Manhattan)—F. T. Craven, 50 Church St.—one 500 ton and one 1,000 ton press.

N. Y., New York (Borough of Manhattan)—The Groton Iron Wks., 50 Bway.—two gate shears of ¼ in. capacity.

N. Y., New York (Borbugh of Manhattan)—The Holtrans Co., 154 Nassau St.—screw machine for use in Japan.

N. Y., New York (Borough of Manhattan)—Mayer & Lage, 120 Bway.—machine tools for export to Japan.

N. Y., Salem—The Humphrey Die and Tool Corp.—shapers, surface grinders and toolroom lathes.

N. Y., Schenectady—The General Electric Co., River Rd., A. R. Howgate, Purch. Agt.—several presses for Bridgeport, Conn., plant.

N. Y., West Albany—The New York Central R.R.—one cold saw, two turret lathes and one link grinder.

N. Y., Whitehall — The Champlain Silk Mills—one milling machine with 53 in. table traverse, and one 30 to 36 in. radial drill.

Pa., Allentown—W. H. Taylor & Co.—one 28 in. drill press with No. 4 shaper in spindle.

Pa., Chester — The Chester Shipbuilding Co.—two No. 3 Avey drills, capacity 1¼ in., and highspeed drills complete with lubricant tank, motor driven.

Pa., Philadelphia — The Ace Motorcycle Co.—automatic screw machines and milling machines.

Pa., Philadelphia—The Pennsylvania Ry., Bell Bldg.—one turret lathe, similar to No. 2A, Warner & Swasey, arranged for 220 v., d.c.

Pa., Philadelphia — The Taylor Wharton Iron and Steel Co., 25th and Washington Sts.—machine shop equipment.

Pa., Wilkes-Barre — The Lehigh and Wilkes-Barre Coal Co., Lehigh and Wilkes-Barre Blk.—miscellaneous machine tools.

La., Shreveport — The International Gas and Oil Corp.—one 2½ to 6 or 8 in. pipe cutting machine, belt driven, with or without steam engine (used).

N. C., Raleigh — The Garage Equipment Co., 809 Citizens' Bank Bldg., E. L. Moffett, Sales Mgr.—
One small vertical spindle milling machine.
One light hack saw, about 4 in. jaw.
One 24 or 28 in. upright drill press.
One 21 or 24 in. lathe with short bed.
One plain screw machine for 1 1/16 in. stock.

Ill., Chicago—The Ajax Forge Co., 2503 Blue Island Ave.—
One trimming press with side shear for 2,000 lb. steam drop hammer.
One 2,000 lb. steam drop hammer.
One 3,000 lb. steam drop hammer.
One 10 ton crane with 76 ft. span.
One 5 or 10 ton crane with 35 to 50 ft. span.
One 2 ton crane with 28 ft. span, hand operated.
One guillotine shear, capacity 3 in. rounds.
One belt driven air compressor, 500 ft. per minute, 125 lb. pressure.

Ill., Chicago—The Convex Sign Co., 162 Austin Ave.—one 16 in. x 8 ft. engine lathe.

Ill., Chicago—The Chicago, Burlington & Quincy Ry., 547 West Jackson Blvd.—chucks, as follows—
Six 15 in., iron scroll combinations.
Six 15 in., steel geared, scroll combination.
One 10½ in., iron scroll combination.
One 10½ in., steel geared scroll combination.
One 18 in., iron scroll combination.
One 18 in., steel geared scroll combination.
One 18 in., iron geared scroll combination.
Two 24 in., 4 jaw, iron independent.
Two 24 in., 4 jaw, steel independent.
One 4 in., screw type with reversible jaws.
One 18 in., 4 jaw, iron independent.
One 18 in., 4 jaw, steel independent.
Two 14 in., 4 jaw, iron independent.
Two 14 in., 4 jaw, steel independent.
One 16 in., 4 jaw, iron independent.
One 16 in., 4 jaw, steel independent.
Four 15 in., 2 jaw, round body with slip jaws.

Ill., Chicago—The Federal Metal Weather Strip Co., 1242 Fullerton Ave.—
One No. 2, one No. 3 and and one No. 4 belt driven punch press, 2½ to 4 in. stroke.
One 1,500 lb., one 1,000 lb., and one 500 lb. board drop hammer.
One 200 lb. Bradley hammer.

Ill., Chicago—H. Wissmiller, 932 Montana St.—one double spindle shaper.

Ill., Springfield—The United Supply Co.—one double action cam drawing press with stroke 5 in. or more, Bliss 69 N or similar.

Mich., Detroit — The Hayes Mchy. Co., East Larned St., A. Sprague, Purch. Agt.—large and medium sized press (used preferred).

O., Cleveland—The Bd. Educ., East 6th St. and Rockwell Ave.—manual training equipment including lathes, saws, work benches, etc.

Wis., Beloit—C. H. Besly & Co.—eight 14 in. x 6 ft. engine lathes with taper attachment.

Wis., Milwaukee—The Lisbon Ave. Motor Co., 508 54th St., A. Freiburger, Purch. Agt.—one lathe, one drill press and machinery for tire repair.

Wis., West Allis—The Warner Machine Co., 7521 Scott St., F. Gardner, Purch. Agt.—one 14 to 20 in. shaper and one heavy duty grinder.

Mo., Kansas City—The W. S. Dickey Clay Mfg. Co., New York Life Bldg.—
Four 25 x 50 in., 14 ft. gap lathes.
Two 28 or 30 in. drill presses.
Two 50 lb. power hammers.
One 10 in. high speed bench drill.
Two 2 in. bolt threading machines.
One pneumatic drill up to 2 in.
One 2½ ft. radial drill.
Three 24 in. shaping machines.
Two 20 in. x 12 ft. engine lathes.
One 24 in. x 24 in. x 8 ft. planing machine.
One 14 in. double wheel emery grinder.
One No. 2 draw cut back saw machine.
One 6 in. combination bench vise.
One 8 in. combination bench vise.

Tex., Corsicana—The Corsicana Grader and Machine Co., C. E. Kerr, Purch. Agt.—complete machine tool equipment including drill presses, lathes and trip hammer.

Machinery

The following concerns are in the market for machinery:

Md., Baltimore—The Miller Safe Co., Fremont Ave. and Briscoe St.—equipment for the manufacture of safes.

N. Y., Buffalo—The Parenti Motors Corp., 1754 Main St.—wood and metal working equipment for manufacture of automobiles.

N. Y., New York (Borough of Manhattan)—The Cunard Terminal Co., 24 State St.—one electric traveling crane for Weehawken terminal.

Pa., Philadelphia — The Chestnut Hill Hospital, 8815 Germantown St. — laundry equipment.

Va., Richmond — The Virginia Carolina Chemical Co., 12th St., J. Maxwell, Purch. Agt.—traveling cranes.

W. Va., Parkersburg—The Baldwin Tool Wks.—electric cranes.

Mich., Detroit—The Federal Bearing and Bushing Corp., 362 Trombly Ave.—miscellaneous equipment for manufacture and finishing of bearings and bushings for automobiles.

Mich., Detroit—The Michigan Grey Iron Castings Co., Harbaugh Ave. and Wabash Ry.—miscellaneous foundry equipment.

O., Cleveland—The Biggs Watterson Co., 1235 West 9th St.—one 12 in. pipe cleaning machine.

Wis., Milwaukee—The Cortsa Motors Co., 663 37th St., C. R. Kurtze, Purch. Agt.—machinery for manufacture of automobiles.

Wis., Milwaukee—R. Jeske & Bro. Co., 111 Reservoir Ave.—sheet metal working machinery.

Wis., Milwaukee—The Patton Paint Co., 213 Lake St.—special equipment for manufacture of varnish.

Wis., Milwaukee — The Tire Shop, 481 13th St.—complete vulcanizing outfit.

Wis., Oshkosh—The Three C Davenport Co., 33 Main St., O. Konrad, Purch. Agt.—woodworking machinery.

Wis., Racine—The Hamilton Beach Mfg. Co., Rapids Drive—foundry equipment.

Wis., Waukesha—The Waukesha Casting Co.—foundry equipment.

Mo., St. Louis—The Missouri Pacific Ry., Ry. Exch. Bldg., C. A. Howe, Purch. Agt.—one sand blast machine for cleaning steel work.

N. B., Doaktown—F. D. Swin—machinery for sawmill.

Ont., Arner—J. Stadden—machinery for sawmill.

Ont., Auburn—B. Marsh—machinery for a sawmill.

Ont., Ottawa—Fraser & Bryson, Ltd.—equipment for Bell River ground wood pulp mill.

Ont., Porcupine—McChesney, Ltd.—sawmill equipment.

Ont., Sudbury — The Continental Wood Products Co.—machinery for sawmill and pulpwood preparing plant.

Ont., Toronto—The Hockon Lumber Co.—planing mill equipment for West River mill.

Ont., Tottenham—McCabe Bros.—32 machines for planing mill.

Que., Brysons—J. Argue—machinery for sawmill.

Que., Nouvelle—A. Filion, Ltd.— equipment for planing and sawmill.

Metal Working

NEW ENGLAND STATES

Conn., Bridgeport — The General Motors Service and Truck Co., 554 Fairfield Ave., has awarded the contract for the construction of a 1 story, 110 x 120 ft. service station on Holland Ave. Estimated cost, $75,000.

Conn., Bridgeport—W. Levin, 108 Reilly St., will soon award the contract for the construction of a 1 story, 50 x 60 ft. garage on Pembroke St. Estimated cost, $15,000. H. E. Koerner, 164 State St., Archt.

Conn., Hartford—M. W. DeLaney, 77 Greenfield St., will soon award the contract for the construction of a 1 story, 55 x 110 ft. garage on High St. Estimated cost, $25,000. F. Walz, 407 Trumbull St., Archt.

Conn., Hartford—J. Ferringo, 174 Barbour St., will build a 1 story, 45 x 96 ft. garage. Estimated cost, $15,000.

Conn., Hartford—M. Lefsitz, 38 Kennedy St., will soon award the contract for the construction of a 1 story, 35 x 85 ft. garage on Arthur Pl. Estimated cost, $10,000.

Conn., Hartford—The A. F. Way Co., Inc., 32 Union Pl., is building a factory for the manufacture of special machinery. Estimated cost, $35,000.

Conn., South Manchester—Cheney Bros., Hartford Rd., manufacturers of silk, have awarded the contract for the construction of a 1 story, 30 x 80 ft. toolroom addition at their plant.

Mass., Brookline — D. Cerussi, 15 Exchange St., Boston, has awarded the contract for the construction of a 2 story, 100 x 270 ft. garage and salesroom on Commonwealth Ave. and St. Paul St., here. Estimated cost, $200,000.

Mass., Dorchester (Boston P. O.)—The Byrne Realty Co., 435 Geneva Ave., is having plans prepared by M. H. Maney, Archt., 16 Paisley Park, for the construction of a 1 story, 95 x 165 ft. garage on Holmes Ave. Estimated cost, $50,000.

Mass., Springfield — The Westinghouse Electric and Mfg. Co., Page Blvd., will build a 1 story, 125 x 160 ft. foundry. Estimated cost, $35,000.

Mass., Worcester — M. N. Ullman, 50 Water St., will build a 1 story, 80 x 95 ft. garage on School St. Estimated cost, $50,000.

N. H., Manchester—The Leighton Machine Co. is building a factory with 20,000 sq.ft. of floor space for the manufacture of knitting machines. Estimated cost, $40,000.

N. H., Nashua—Mercer Bros., 280 Main St., will soon award the contract for the construction of a 1 story garage. Estimated cost, $50,000. Hutchinson & French, 6 Beacon St., Boston, Archts.

Vt., Bennington—The Standard Oil Co. of New York, 26 Bway., New York City, has awarded the contract for the construction of a 1 story, 23 x 60 ft. garage and 12 x 18 ft. pumphouse, here. Estimated cost, $25,000.

Vt., Burlington—The Standard Oil Co. of New York, 26 Bway., New York City, has awarded the contract for the construction of a 1 story, 45 x 52 ft. garage, here. Estimated cost, $25,000.

MIDDLE ATLANTIC STATES

Md., Baltimore—W. C. Hipple, North Ave. and Chester St., will soon award the contract for the construction of a 1 story, 80 x 100 ft. addition to his garage. Estimated cost, $30,000.

Md., Baltimore — The Miller Safe Co., Fremont Ave. and Briscoe St., will soon award the contract for the construction of a 1 and 2 story, 123 x 400 ft. factory on Wilkens Ave. and Catherine St. Estimated cost, $350,000. Noted July 8.

Md., Baltimore—F. Molnaur, 531 South Ann St., will build a 1 story, 42 x 96 ft. garage. Estimated cost, $12,000.

Md., Baltimore—The Steinmetz Electric Motor Car Co., Inc., has acquired the 1 story, 100 x 240 ft. plant of Reus Bros. Co., on Kate Ave. along the tracks of the Western Maryland R.R., and plans to enlarge same and construct several other buildings.

N. J., Trenton—The Amer. Bridge Co., South Warren St., will build a 1 story, 79 x 200 ft. and 32 x 122 ft. addition to its plant. Estimated cost, $65,000.

N. Y., Geneva—The Standard Oil Co. of New York, 26 Bway., New York City, has awarded the contract for the construction of a 1 story, 25 x 60 ft. garage, here. Estimated cost, $20,000.

N. Y., Honeoye Falls—The Standard Oil Co. of New York, 26 Bway., New York City, has awarded the contract for the construction of a 2 story, 35 x 66 ft. garage, here. Estimated cost, $30,000.

N. Y., Macedon—The Standard Oil Co. of New York, 26 Bway., New York City, has awarded the contract for the construction of a 1 story, 33 x 55 ft. garage, here. Estimated cost, $30,000.

N. Y., New York (Borough of Brooklyn)—Havemeyer & Elder, c/o S. Millman, Archt., 26 Court St., will build a 1 story, 100 x 150 ft. garage on Atlantic Ave. and Elton St. Estimated cost, $35,000.

N. Y., New York (Borough of Brooklyn)—The M.C.K. Constr. Co., 2336 Fulton St., will build a 1 story, 80 x 150 ft. garage on Hancock St. and Cypress Ave. Estimated cost, $30,000.

N. Y., New York (Borough of Brooklyn)—M. Seidman, 1463 St. Marks Ave., will building a 1 story, 50 x 100 ft. garage on Amboy St. near Pitkin Ave. Estimated cost, $35,000.

N. Y., New York (Borough of Brooklyn)—H. Strongin, 1705 Pitkin Ave., will build a 1 story, 120 x 130 ft. garage on Coney Island Ave. near Cortelyou Rd. Estimated cost, $20,000.

N. Y., New York (Borough of Manhattan)—M. O'Dowd, Inc., c/o J. S. Maher, Archt., 431 West 14th St., will build a 3 story, 100 x 125 ft. garage at 56 North 23rd St. Estimated cost, $100,000.

N. Y., Nunda—The Standard Oil Co. of New York, 26 Bway., New York City, has awarded the contract for the construction of a 2 story, 42 x 45 ft. garage, here. Estimated cost, $40,000.

N. Y., Oneida—The Standard Oil Co. of New York, 26 Bway., New York City, has awarded the contract for the construction of a 23 x 60 ft. garage, 15 x 20 ft. boiler house, and 12 x 16 ft. pumphouse, here, each 1 story. Estimated cost, $35,000.

N. Y., Sherman—The Standard Oil Co. of New York, 26 Bway., New York City, has awarded the contract for the construction of a 2 story, 25 x 32 ft. garage here. Estimated cost, $20,000.

N. Y., Silver Springs—The Standard Oil Co. of New York, 26 Bway., New York City, has awarded the contract for the construction of a 2 story, 35 x 62 ft. garage, here. Estimated cost, $25,000.

Pa., Philadelphia—The Diesinger Motors Co., 1827 Chestnut St., has awarded the contract for the construction of a 2 story, 70 x 120 ft. sales and service building on 22nd and Chestnut Sts.

Pa., Philadelphia — The Lowry Top and Body Co., Gaul and Adams Sts., has awarded the contract for altering its factory. Estimated cost, $25,000.

Pa., Philadelphia—M. Wenger, 250 South Camac St., has awarded the contract for the construction of a 2 story, 50 x 110 ft. addition to his garage. Estimated cost, $15,000.

SOUTHERN STATES

Ky., Vine Grove—The Service Garage Co. is building a 50 x 125 ft. garage. Estimated cost, $14,000.

MIDDLE WEST

Ind., Ft. Wayne—The General Electric Co., Bway. and Pennsylvania Ry., is building a 2 and 3 story, 150 x 300 ft. lamp factory on Winter St. Estimated cost, $400,000.

Ind., Ft. Wayne—The International Harvester Co. of America, 606 South Michigan Ave., Chicago, has purchased a 140 acre site east of here, and plans to build a plant for the manufacture and assembly of motor trucks. The first unit will cover 12 acres and will include a number of 1 story buildings, also a 3 story L-shaped building to house the carpenter shops and shipping department. The ultimate development of the plant as planned will extend over a period of 3 years and cost about $4,000,000.

Mich., Ann Arbor — The Amer. Broach and Machine Co. is building a 50 x 250 ft. plant for the manufacture of broaching machines.

Mich., Grand Rapids—The Amer. Can Co., 120 Bway., New York City, will soon award the contract for the construction of a factory on 6th St., here. Estimated cost, $1,000,000. M. M. Loony, 120 Bway., New York City, Archt. and Engr.

Mich., Kalamazoo—The State Bd. Educ. will soon award the contract for the construction of a 2 story, 96 x 250 ft. manual arts building on Oakland Drive, to include a foundry and auto mechanic and woodworking shops. T. E. Johnson, Secy. H. H. Turner, 923 Michigan Trust Bldg., Grand Rapids, Archt.

O., Akron—The Portage Taxi and Baggage Co., 11 South High St., is having plans prepared for the construction of a 10 story, 66 x 132 ft. business block on South High St., the first floor to be used as a garage. Estimated cost, $200,000.

O., Akron—The S. & O. Engraving Co., 330 South High St., has awarded the contract for the construction of a 2 story, 40 x 150 ft. office and laboratory. Estimated cost, $75,000.

O., Canton — The Schlemmer & Graber Co., 12th St. N. E., has awarded the contract for the construction of a 1 and 2 story, 100 x 250 ft. garage and service building. Estimated cost, $95,000.

O., Canton—Timken Roller Bearing Co., Dueber Ave., will build a 1 story, 120 x 200 ft. factory on Harrison Ave., S.W., for the manufacture of steel. Estimated cost, $40,000.

O., Cincinnati—The Amer. Can Co., 120 Bway., New York City, has awarded the contract for the construction of a plant on Spring Grove Ave. and Fergus St., here, to consist of a 6 story, 72 x 260 ft., 4 story, 60 x 1,400 ft., 1 story, 90 x 97 ft. and 1 story, 80 x 160 ft. buildings. Estimated cost, $1,000,000. Noted April 22.

O., Cleveland—The Bd. Educ., East 6th St. and Rockwell Ave., plans to build a 1 story, 30 room, junior high school on Hopkins Ave., to include a manual training department. Estimated cost, $2,000,000.

O., Cleveland—The Chandler & Price Co., 6000 Carnegie Av., manufacturer of printing machinery, is having plans prepared by H. McGeorge, Archt. and Engr., 6000 Carnegie Ave., for the construction of a 4 story, 42 x 108 ft. factory on Cedar Ave. Estimated cost, $150,000.

O., Cleveland—The Cleveland Belting and Machine Co., 1510 University Rd., has awarded the contract for the construction of a 1 story, 112 x 140 ft. addition to its factory. Estimated cost, $100,000. W. Hartle, Pres.

O., Cleveland — The Hydraulic Pressed Steel Co., 5704 Hydraulic Ave., has awarded the contract for the construction of a 1 story, 75 x 200 ft. addition to its factory. Estimated cost, $75,000.

O., Cleveland—The Ohio Motor Vehicle Co., Nottingham Rd., has awarded the contract for the construction of a 2 story, 50 x 150 ft. factory. Estimated cost, $75,000. C. Rigler, Pres.

O., Cleveland—The Pifer Electric Repair and Mfg. Co., 1392 East 43rd St., has awarded the contract for the construction of a 1 story, 49 x 60 ft. factory. Estimated cost, $25,000.

O., Cleveland—The Superior Screw and Bolt Mfg. Co., 810 Hippodrome Bldg., has awarded the contract for the construction of a 1 story, 130 x 252 ft. factory at 2652 East 93rd St. Estimated cost, $100,000. W. J. Hayes, Treas. Noted July 1.

O., Cleveland—The Union Rolling Mills Co., 8200 Aetna Rd., has had plans prepared by W. Davis, Engr. and Archt., 892 Arcade, for the construction of a 1 story, 22 x 182 ft. addition to its rolling mill. Estimated cost, $30,000.

O., Columbus—The Atlas Brass Fdry Co., 980 South Park St., has awarded the contract for the construction of a 1 story, 80 x 100 ft. brass foundry on Stewart Ave. Estimated cost, $20,000.

O., Lakewood (Cleveland P. O.) — The Hertner Electric Co., 1900 West 112th St., has purchased a site on Elmwood Ave. and plans to build a 1 story, 60 x 250 ft. factory. Estimated cost, $100,000.

O., Massillon—The Lucius Mfg. Co. plans to build a 5 or 6 story, 100 x 200 ft. factory for the manufacture of rivetless steel gas tanks, etc.

Wis., Milwaukee—The City has awarded the contract for the construction of a 1 story, 50 x 120 ft. meter shop on Market St. Estimated cost, $55,000.

Wis., Milwaukee—The Ogden Garage Co., 529 26th Ave., has awarded the contract for the construction of a 1 story, 100 x 160 ft. garage and repair shop on Ogden Ave. Estimated cost, $60,000.

Wis., Racine—The Hamilton Beach Mfg. Co., Rapids Drive., has had plans prepared by A. L. Tlegel, Archt., Baker Blk., for the construction of a 1 story, 80 x 200 ft. foundry. Estimated cost, $60,000.

Wis., Waukesha—The Waukesha Casting Co., formerly F. C. Blair & Son, 340 Bway., is having plans prepared by the C. Kawin Co., Engrs., 431 South Dearborn St., Chicago, for the construction of a 1 story, 120 x 130 ft. foundry. Estimated cost, $50,000.

WEST OF THE MISSISSIPPI

Ark., Little Rock—The Shoemaker Bldg. Co. will soon award the contract for the construction of a 2 story, 140 x 150 ft. garage on Center St. Estimated cost, $175,000. Sanders & Ginocchio, Little Rock, Archts.

CANADA

Ont., Toronto—The Dominion Type Fdry. —equipment for Montreal, Que., plant.

Que., Montreal—The Colonial Wire Mfg. Co., Shearer St., has awarded the contract for the construction of a 3 story factory on St. Patrick St. Estimated cost, $75,000.

Que., Montreal — The Dominion Type Fdry., Ltd., Toronto, has awarded the contract for the construction of a 4 story, 51 x 122 ft. foundry on Hermine St., here. Estimated cost, $135,000.

Que., Montreal—The Sea Sled Co., Ltd., plans to build a plant. Estimated cost, $250,000.

General Manufacturing

NEW ENGLAND STATES

Conn., Bridgeport — The Amer. Specialty Co., 348 George St., has awarded the contract for the construction of a 1 story, 60 x 102 ft. factory, with 50 x 60 ft. ell, on Holland Ave. Estimated cost, $40,000.

Mass., Boston—The W. F. Schraft & Sons Corp., 160 Washington St., is having plans prepared by Haven & Crosby, Engrs. and Archts., 40 Court St., for the construction of a 3 story, 80 x 240 ft. factory on Causeway St., for the manufacture of candy. Estimated cost, $200,000.

Mass., Cambridge—The Presto-Lite Co., Inc., 30 East 42nd St., New York City, will soon award the contract for the construction of a 1 story, 25 x 100 ft. acetylene plant, here. Estimated cost, $80,000. Noted April 15.

Mass., Cambridge—The Revere Sugar Refinery, 15 Broad St., Boston, will soon award the contract for the construction of a 1 story, 90 x 200 ft. cooperage shop on 9th St., here. Estimated cost, $80,000. H. S. Adams, 100 Ames Bldg., Boston, Archt.

Mass., Holyoke—The New England Tire and Rubber Co. has purchased a site with 250 ft. of frontage on Main St. and plans to build a factory for the manufacture of "Holyoke" tires.

Mass., Rockland — The Rockland Webbing Co., Park St., has awarded the contract for the construction of a 2 story, 50 x 175 ft. addition to its factory. Estimated cost, $30,000. Noted June 24.

R. I., Woonsocket—The Alsace Worsted Co., School St., has awarded the contract for the construction of a 1 story, 60 x 140 ft. addition to its factory. Estimated cost, $35,000.

MIDDLE ATLANTIC STATES

N. J., Asbury Park—The Hill Bakery Co., North Stockton St., Trenton, plans to build a bakery on Main St., here. Estimated cost, $150,000.

N. J., Clifton—The Pennsylvania Textile Co., 449 4th Ave., New York City, has awarded the contract for the construction of a plant here. Estimated cost, $200,000.

N. Y., Buffalo—The F. F. Dally Co. of New York, 227 Military Rd., has had plans prepared for the construction of a 1 story, 28 x 127 ft. addition to its plant for the manufacture of blacking. Estimated cost, $6,000.

N. Y., Buffalo—The University of Buffalo, 24 High St., is having plans prepared by McKim, Mead & Wihte, Engrs. and Archts., 101 Park Ave., New York City, for the construction of a 3 story chemical laboratory. Estimated cost, $300,000.

N. Y., New York (Borough of Brooklyn) —The Sheldon Foster Supply Co., c/o L. Allmendinger, Archt. and Engr., 20 Palmetto St., will soon award the contract for the construction of a laundry on DeKalb Ave. Estimatd cost, $200,000.

N. Y., New York (Borough of Manhattan) —The Rigaud Perfume Co., 75 Barrow St., is having plans prepared by Sommerfeld & Steckler, Archts. and Engrs., 31 Union Sq., for the construction of a 7 story, 50 x 50 ft. factory.

N. Y., Syracuse—The Atmospheric Nitrogen Corp., Milton Ave., has awarded the contract for the construction of a 1 story plant on Willis Ave. Estimated cost, $5,00,000. Noted July 1.

Pa., Horrell (Canoe Creek P. O.)—The Standard Powder Co., Philadelphia, will build a 1 story plant here to consist of 25 buildings, including a keg factory. Estimated cost, $1,000,000.

Pa., Jeanette—The Amer. Window Glass Co., Farmers' Bank Bldg., has awarded the contract for the construction of a 1 and 2 story furnace building. Estimated cost, $300,000.

Pa., Oakmont—The Urschel Bates Valve Mfg. Co., 3444 Summit St., Toledo, is building a 4 story factory here. Estimated cost, $250,000.

Pa., Philadelphia — The Chestnut Hill Hospital, 8815 Germantown St., is having plans prepared by Willing & Sims, Archts., 1627 Sansom St., for the construction of a 2 story, 30 x 75 ft. laundry on Chestnut Hill. Estimated cost, $20,000.

Pa., Philadelphia—The Presto-Lite Co., Inc., 30 East 42nd St., will soon award the contract for the construction of a 1 story, 25 x 100 ft. acetylene plant. Estimated cost, $80,000. Noted April 15.

SOUTHERN STATES

Ga., LaGrange—Swift & Co., U. S. Stock Yards, Chicago, has awarded the contract for the construction of a 1 story, 200 x 350 ft. fertilizer plant, here. Estimated cost, including equipment, $250,000.

Ky., Louisville—The Dixie Belle Refining Co., 701 Inter-Saw Bldg., plans to build a refinery on Western Parkway.

Ky., Louisville—The Union Paper Products Co., which has recently been organized with a capital stock of $300,000, has acquired a site on Colapessa, Bernadotte, Alexander and Lowerline Sts., and plans to build a factory for the manufacture of corrugated paper boxes. S. Ohnstein, Pres.

N. C., Charlotte—The Charlotte Spinning Mill Co. is having plans prepared by the Watson Eng. Co., Archts. and Engrs., Hippodrome Bldg., Cleveland, for the construction of a 3 story, 100 x 300 ft. spinning mill and boiler house. Estimated cost, $300,000.

N. C., Hickory—The United Mills Co. has been organized with a capital stock of $500,000, and plans to build a mill for the manufacture of cotton yarn. Estimated cost, $50,000. R. C. Biberstein, Charlotte, Engr.

Va., Richmond—The Baughman Stationery Co., 1320 Broad St., W., is having plans prepared by Carneal & Johnson, Archts. Chamber of Commerce Bldg., for the construction of a 2 story, 173 x 227 ft. factory on Marshal and Graham Sts. Estimated cost, $200,000.

Va., Richmond — The Virginia Carolina Chemical Co., 12th St., has had plans prepared for the construction of a 5 story plant. Estimated cost, $250,000.

W. Va., Martinsburg — The Natl. Shale Brick Co. will soon award the contract for the construction of a plant. Estimated cost, $250,000.

MIDDLE WEST

Ind., Syracuse—The Wawasee Tire and Rubber Co. is having plans prepared by R. L. Simmins, Archt., Elkhart, for the construction of a 3 story, 50 x 175 ft. plant, here.

O., Chagrin Falls—The Adams Bag Co. is having plans prepared by E. McGeorge, Archt. and Engr., 1900 Euclid Ave., Cleveland, for the construction of a 3 story addition to its paper mill. Estimated cost, $100,000.

O., Cleveland—The Mendelsohn Co., 2110 Woodand Ave., manufacturer of cigars, has awarded the contract for remodeling its 3 story, 70 x 100 ft. factory on East 27th St. and Woodand Ave. Estimated cost, $60,000. Noted June 10.

O., Cleveland—The Pavelka Bros., East 37th St. and Bway., dealers in smoked meats, will soon award the contract for the construction of a 2 story, 57 x 65 ft. addition to their factory. Estimated cost, $60,000.

Wis., Milwaukee—The Patton Paint Co., 213 Lake St., will soon award the contract for the construction of a 2 story, 70 x 100 ft. varnish factory and a 2 story, 60 x 112 ft. warehouse.

Wis., Milwaukee—The Carpenter Baking Co., 102 7th St., will soon award the contract for the construction of a 3 story, 35 x 160 ft. addition to its bakery. Noted May 27.

WEST OF THE MISSISSIPPI

Ia., Muscatine — Muscatine Packing Co. has awarded the contract for the construction of a packing plant to include a 5 story, 50 x 100 ft. manufacturing building, 5 story, 100 x 200 ft. cold storage building, 5 story, 70 x 85 ft. abattoir, 4 story, 54 x 64 ft. fertilizer building and 1 story, 50 x 100 ft power house.

Mo., St. Louis—The Surety Tire and Rubber Co., 2100 Krenlin Ave., plans to build a 1 story, 30 x 175 ft. and 35 x 40 ft. factory. Estimated cost, $40,000.

CANADA

N. B., Doaktown—F. D. Swin is having plans prepared for a saw mill.

Ont., Arner—J. Stadden plans to build an addition to his saw mill.

Ont., Auburn—B. Marsh will build a saw mill.

Ont., Bell River—The Fraser & Bryson Ltd., Ottawa, will soon award the contract for the construction of a ground wood pulp mill, here. Estimated cost, $300,000.

Ont., Porcupine—McCheyney Ltd. will soon award the contract for the construction of a saw mill. Estimated cost, $100,000.

Ont., Sudbury — The Continental Wood Products Co., a subsidiary of the Continental Pulp, Paper and Bag Co., 48 Fermanagh Ave., Toronto, will build a saw mill and plant, here, for the preparation of pulp wood. Estimated cost, $500,000.

Ont., Tillbury—The Tillbury Brick and Tile Co. has awarded the contract for the construction of a 1 story plant, to replace the one which was destroyed by fire. Estimated cost, $30,000.

Ont., Tottenham—McCabe Bros. will soon award the contract for the construction of a planing mill.

Ont., West River—The Hockon Lumber Co., Ltd., Toronto, will build a planing mill here.

Que., Brysons—J. Argue is having plans prepared for a saw mill.

Que., Chelsea—The Royal Securities Co., 164th and James Sts., Montreal, will soon award the contract for the construction of a pulp and paper plant here, for McEdwards & Co., Ottawa.

NEED COMPETENT MEN?
SEE THE SEARCHLIGHT SECTION
Pages 314 to 346 Pages 314 to 346

July 22, 1920 American Machinist Vol. 53, No. 4

The Moline Duplex Drilling Machine

By J. V. HUNTER
Western Editor, *American Machinist*

The machines herein described are designed to give rapid production on drilling work. All of them are of the two-head type, but they vary considerably in the method of operation, in order to suit the requirements of different classes of work. An examination of this article will show that the opposed-spindle method of drilling, which is becoming quite important, is well developed.

THE Moline Machinery Co., Moline, Ill., has developed a line of duplex drilling machines, in order to meet the demand for machines to drill holes simultaneously in opposite sides of work by means of opposed spindles. Machines of this type are necessarily somewhat special, as each is designed to meet the requirements of a particular job; but, at the same time, there is a certain amount of uniformity in their construction, as shown by the accompanying illustrations.

In addition to their use for opposed drilling, these machines are in some cases built to use one set of spindles for drilling and the opposite set for reaming. Or, drills and reamers can be held in the same head, and the work table shifted from the drilling position across the bed in order to align the work with the spindles for the reaming operation. An important feature of the design of such machines is the arrangement which permits the drilling and reaming spindles to be run at different speeds. The No. 7 duplex machine is shown in Fig. 1. The drive is from the three-step cone-pulley at the left through a central driving shaft, and from this through suitable gearing in the carriages or sliding heads. The gears can be changed so as to run the spindles on one carriage faster than those on the other, if desired. The spindles are driven from a long helical gear extending across the carriages, and the

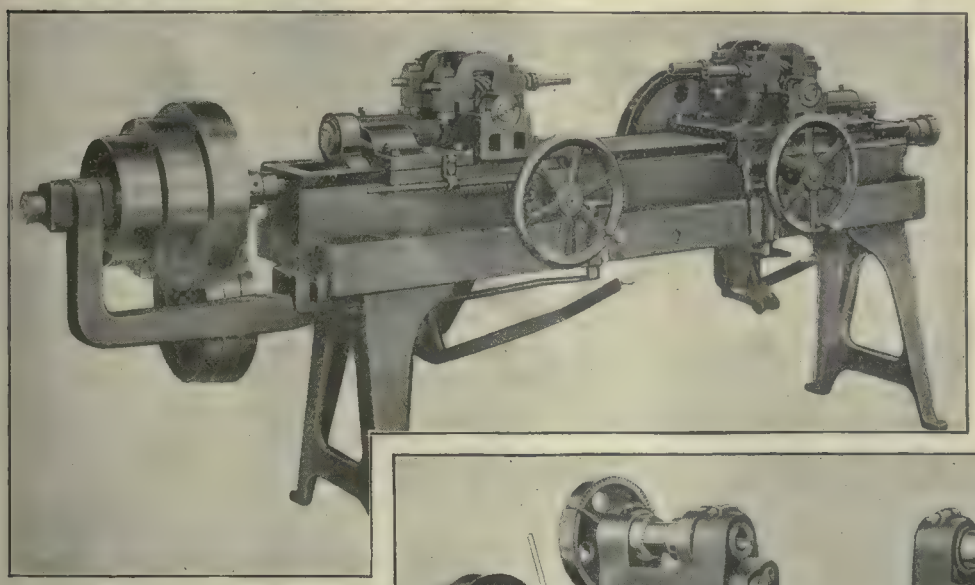


FIG. 1. NO. 7 POWER-FEED DUPLEX DRILLING MACHINE

Specifications: Length of bed, 7 ft. Width of bed, 10 in. Distance between spindle ends; minimum, 4 in.; maximum, 30 in. Hole in spindles, No. 4 Morse taper. Distance from spindle to bed, 8 in. Capacity, up to 1¼-in. drill. Each carriage has three feeds.

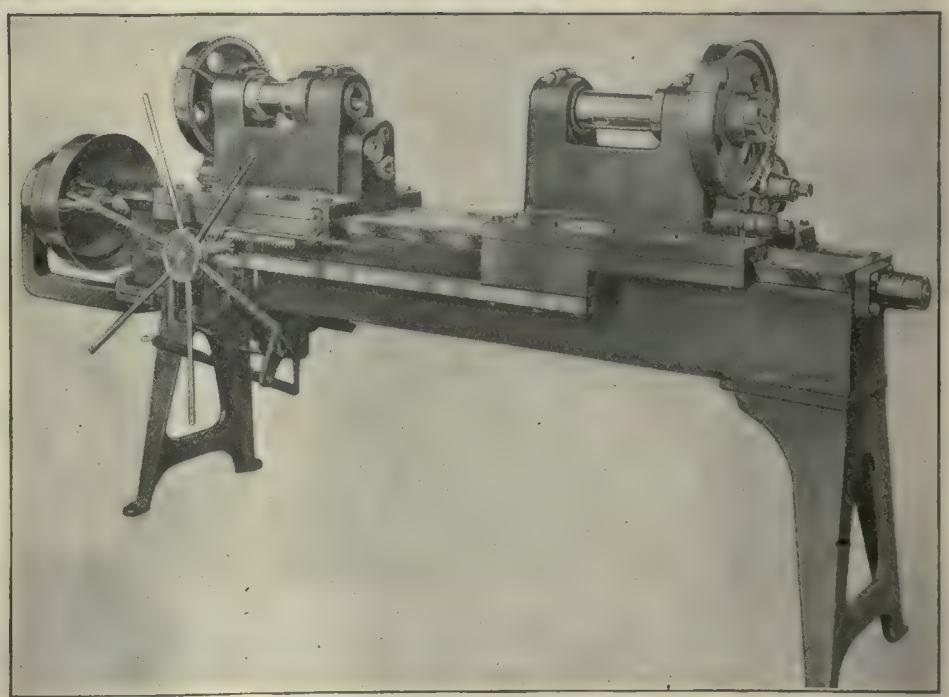


FIG. 2. NO. 8 HAND-FEED DUPLEX DRILLING MACHINE

Specifications: Length of bed, 7 ft. 8 in. Width of bed, 12 in. Distance between splindles; minimum, 10 in.; maximum, 40 in. Hole in spindles, No. 4 or 5 Morse taper. Distance from spindle to bed, 8 in. Capacity, up to 1⅜-in. drill.

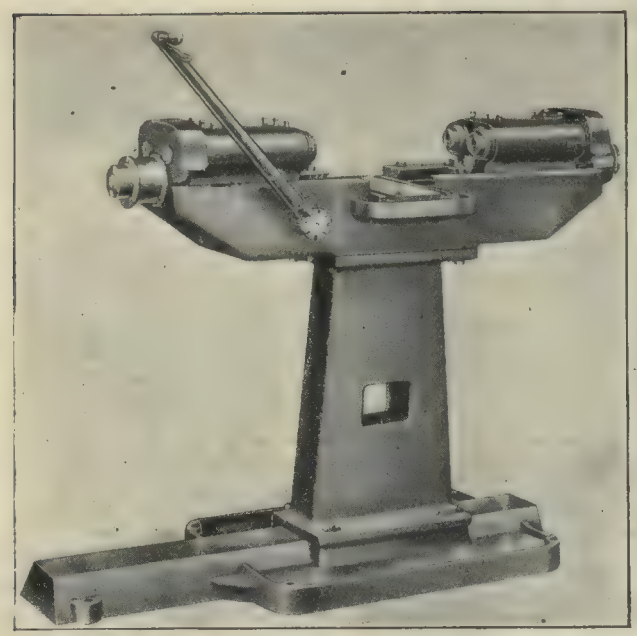


FIG. 3. NO. 9 HAND-FEED DUPLEX DRILLING AND REAMING MACHINE

Specifications: Dimensions of table, 7 x 9 in. Height of table from floor, 32 in. Distance between spindle ends; minimum, 6 in.; maximum, 16 in. Travel of each head, 5 in. Hole in spindles, No. 3 Morse taper. Capacity, four ½-in. drills in cast iron. Floor space, 24 x 40 in. Net weight, 1,000 lb.

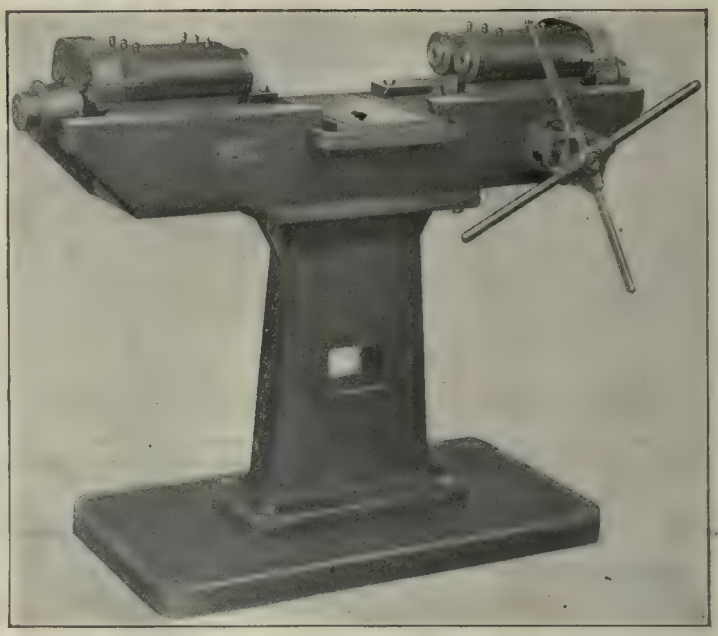


FIG. 4. NO. 10 DRILLING MACHINE WITH HEADS ARRANGED TO FEED IN SAME DIRECTION

Specifications: Dimensions of table, 7 x 12 in. Height of the table from floor, 32 in. Distance between spindle ends; minimum, 6 in.; maximum, 18 in. Travel of head, 6 in. Hole in spindles, No. 2 or 3 Morse taper. Capacity, four ½-in. drills in cast iron. Floor space, 24 x 40 in. Net weight, 1,200 lb.

heads holding the individual spindles are mounted so that they can be shifted closer together or further apart to suit the center distance required between the holes to be drilled. Each carriage is independently provided with three changes of power feed.

The bed of the machine is cast to form a coolant tank and its top is solid in the center of the machine, thus protecting the working mechanism from chips. The coolant flows down into chip troughs on both sides of the bed, and from this is drained off into the tank. A power-driven pump and the necessary piping for handling the coolant are furnished with the machine. The illustration shows the machine without a table for holding the work, as for most jobs a special jig and table are required.

The No. 8 duplex drilling machine, Fig. 2, has special spindle heads designed to meet the requirements given by a customer. This machine is similar in its general character and construction to the No. 7 duplex machine, with the exception that it is not equipped with power feed. The feed is actuated by the spoke wheel at the left through a pinion and two opposed racks, thus feeding the two spindle heads equally. An adjustable stop is located on the left-hand head, which permits regulation of travel in order to provide for drilling the holes to the proper depth and to prevent the two drills from coming in contact. The gears can be changed to drive one spindle faster than the other, if so desired.

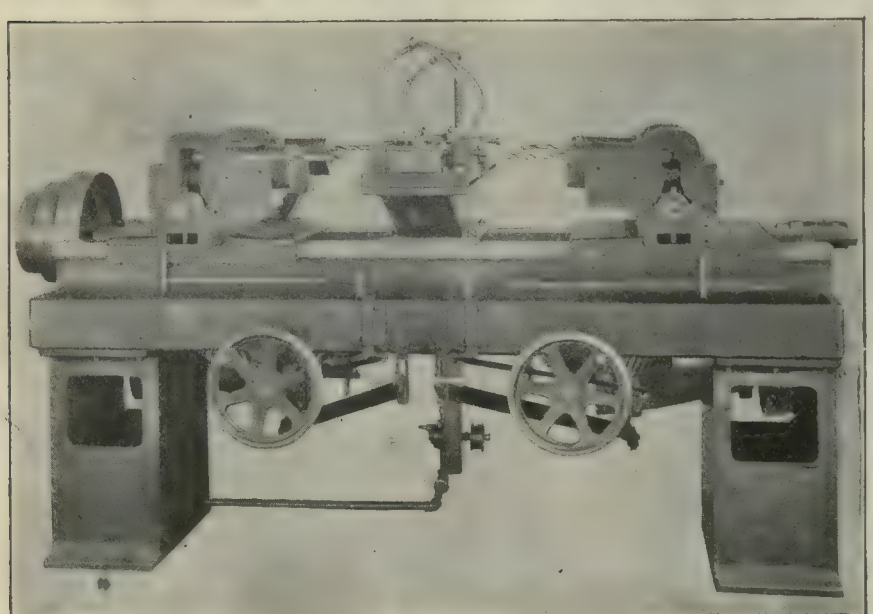


FIG. 5. NO. 12 DUPLEX DRILLING MACHINE WITH WORK TABLE AND JIG

Specifications: Distance between spindle ends; minimum, 8 in.; maximum, 44 in. Capacity, eight 1¼-in. drills in cast iron. Height of bed from floor, 40 in. Maximum center distance between end spindles on same carriage, 24 in. Floor space, 4 x 8 ft. Net weight, 5,000 lb.

Small Duplex Machines

The demand for a light, easily-operated drilling machine has been met by a size known as the No. 9, Fig. 3, which was originally designed for drilling and reaming the pin holes in the cylinder sleeves of a Knight type of gasolene engine. The two opposed spindles in front perform the drilling operation, and the two rear spindles the reaming. The machine is driven by two belts from the countershaft, one to each spindle head. It employs hand feed by rack and pinion, but power feed can be furnished if desired. The hand-feed machine is equipped with a ratchet lever and the power-feed machine with a handwheel.

The No. 10 duplex machine, Fig. 4, is similar to the No. 9 machine, except for the feed of the heads. The heads are geared to travel in the same direction, which arrangement is employed

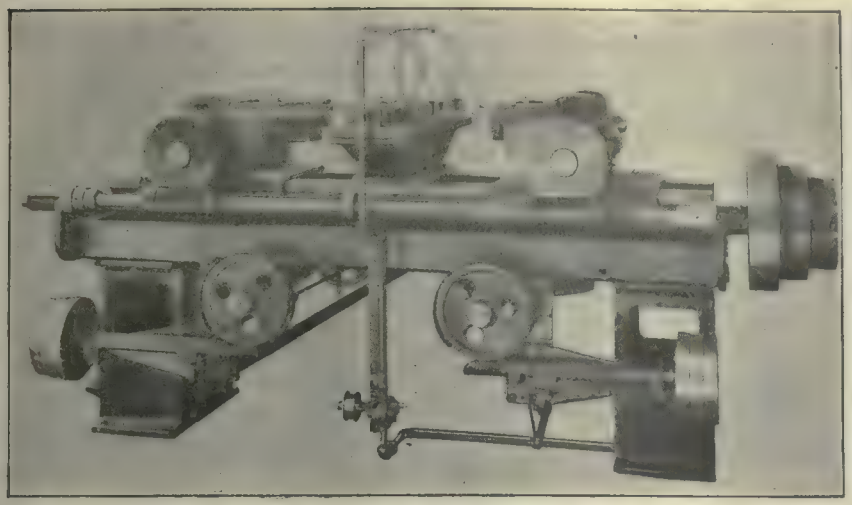


FIG. 6. REAR VIEW OF NO. 12 DUPLEX DRILLING MACHINE

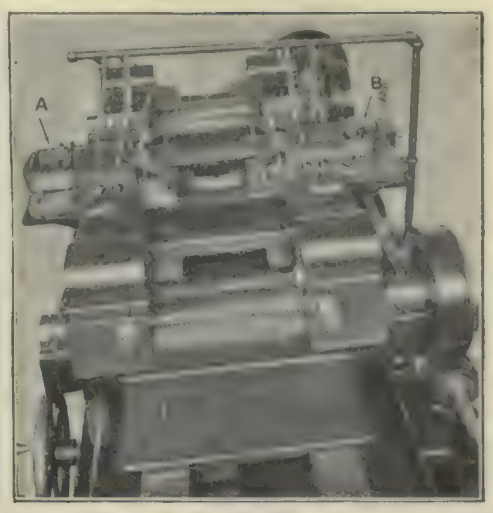


FIG. 7. TOP VIEW OF NO. 12 DRILLING MACHINE WITH WORK IN POSITION

when one head is used for drilling and the opposed head for reaming. Since special heads can be built to drill any number of holes at the same time, this feature is a desirable one, because it permits of drilling and reaming at a single setting of the work in the jig.

Duplex No. 12 Machine

The latest and most powerful of the Moline duplex drilling machines is the No. 12, which is shown complete with a work table and drilling jig in Fig. 5. The machine is provided with power feed, which can be automatically disengaged at any desired point. In addition, it has wheels for hand feeding on the front of the machine.

The power feed is driven through a worm and gear mounted on the back of the machine, Fig. 6, this being individual for each carriage and driven by a three-step cone pulley, which is, in turn, driven from the main drive-shaft of the machine.

The drive of the helical gears in the heads is effected from a shaft extending the full length of the machine along the back of the bed. This shaft is splined throughout its length for the sliding gears of the carriage, and is driven by a three-step cone pulley at one end. A power-driven coolant pump is provided, it being seen underneath the machine. It is driven from a small pulley mounted on the main drive-shaft, so that the coolant pump will be in operation only when the driving shaft is running. The coolant storage reservoir is located in one of the supporting bases, and the bed is cast with a trough along each side.

Two Heads on Each Carriage

The operation being performed with the setting shown in the illustration consists of drilling bolt holes through both ends of a built-up connecting rod for a steam pump. Fig. 7 is a view of the machine looking lengthwise along the bed, and the rod being drilled is located at *A-B*. The machine has two heads on each carriage, and each head has two spindles, making a total capacity of eight drills. Thus each of the four bolt holes is drilled from both sides at once. An adjustable stop is set on one side, so that the feed of one carriage is disengaged before the drills meet. This carriage then returns automatically to its starting position, while the other carriage continues to feed, so that its drills go past the center line of the connecting rod and join the two sets of holes. After the drilling operation is completed, one head is brought back far enough to remove the drills and insert reamers, and the four holes are reamed through from one side.

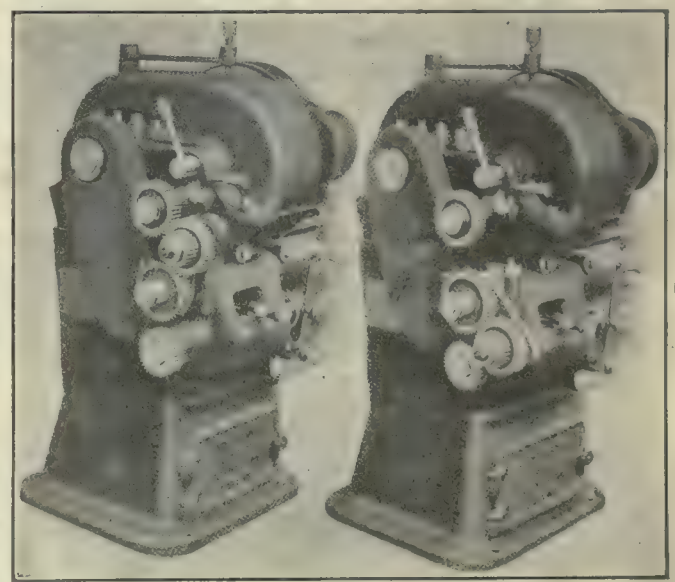
Cutting Screws of Quick Lead

By Charles Canec

Since reading the article by E. A. Dixie which appeared on page 883 of the *American Machinist*, in which he exp'ains a system of gearing up the lead screws with the cone direct instead of with the lathe spindle, when cutting coarse pitch screws on the engine lathe, the writer came across a catalog of lathes by John Lang & Sons, of Scotland.

The illustration, taken from this catalog, demonstrates a special feature which is applied to lathes having the back-gear quill in front instead of at the back. It will be seen that by swinging the idler gear to the top position, the lead screw is connected to a gear on the end of the back-gear quill, while in the lower position it is geared to the spindle direct, as is customary.

The back-gear quill is geared to the spindle by a reduction of 4 or 5 to 1, so that the strain on the change gears is correspondingly less.



A SCOTTISH LATHE WITH LEAD SCREW GEARED FROM BACK-GEAR QUILL

The pitch of the lead screw is ½ in., single, so that with equal gears connected with the back-gear quill the lead cut would be 2 in.

This scheme is a very good alternative to the one described by Mr. Dixie and might be found more practicable on some types of lathes.

The Plant Newspaper—How to Get It Read

By Entropy

For upward of two years I acted as censor of a plant newspaper which was read. It was very rarely that a copy was found around the shop the day after publication. It was not only read by the men themselves, but was taken home and read by the family. In too many instances the men to whom it was handed had to take it home to find out what was in it, because they could not read English themselves.

I have been trying to make up my mind just why this paper was read. There were probably many reasons, but first of all this paper always stuck to what was plant news. This varies with the size of the shop, its location and the kind of newspapers in the town. In a village where there is no newspaper everything is plant news that occurs in and around the shop and in the homes of the workmen expect the little that is reported to the nearest city daily which is bought by these same workers. The editor of such a paper has the easiest time of any so far as strictly editorial work is concerned. In a small town, where there is a live newspaper published once a week which acts as correspondent to a city paper and gets considerable news published there, there is a minimum of plant news, for no one cares anything about a plant newspaper which has been "scooped" by several days, or by any time at all.

What to Print

In such a place the birth of a child is news for the plant paper because the local paper does not play it up, but at the most gives it three lines. The birth of triplets, however, while much more enticing to the editor is not good plant news because it has already been published by the local newspaper and reprinted by the city daily long before the plant paper can be written and printed. However, if the triplets are so much alike that their mother can only tell them apart because Susie has a mole on the back of her neck, then it is good plant news.

A boiler explosion is not good plant news for the same reason, but the fact that some one worked all day Sunday putting in new stay bolts and so obviated a shutdown, is good news for the shop paper. In other words, anything of which the news value has been taken by a paper published oftener than the plant paper ceases to be of value, but the more intimate details of that same item may be good news to print for the very reason that the people all know each other.

Here, however, the size of the shop comes into it. In a shop of a hundred men all in one room, there is no field for a plant paper because everyone knows all about everything that happens long before the editor does. In a shop of five hundred, however, while a certain kind of news travels swiftly by shop wireless, there is much of this intimate material that does not get around at all except as it is published. As the shop gets larger and larger the kind of paper and the time between issues changes just as it does in town. For that matter a country newspaper is a very good model to follow, for it has to make the same appeal as the plant paper.

Illustrations have a great deal to do with the success of the paper. I can imagine a paper succeeding without them, but they are a great help in putting it over. Very few shops are free from men who cannot read English, but only blind men can fail to get the message of the photograph of some of his friends. Every possible excuse should be taken for making photographs, not merely of workmen, but of workmen in action. Photographs of the management should be taken in action. If the general manager can be taken unawares shovelling snow off his sidewalk, or walking on snowshoes to the office, or any other rather undignified way, by all odds put it in. If he is not a good-enough sport to see the point and laugh with the editor and all the rest of the force, fire yourself before he fires you and get a good job. Don't have these illustrations so reduced in size that there is nothing left to see but the title. Sure, bills for cuts are made out at so much per square inch, but remember that you do not have to pay so much per thousand ems for setting type if you use them. There is some offset.

Good English Unnoticed by Most People

As for English, good English is unnoticed by most people. That is, they read it without strain and without noticing that it is good. Stilted English is not good English. It is worse than an overdose of slang. There really is a limit to the amount of slang that should be interjected into a plant paper. Of course the language of the trade or of the sport which is being described should be used. A report of a baseball game in strictly correct English such as would be recognizable by use of an unabridged dictionary, would sound so stilted and snobbish that no one would read it. No one should object to the use of shop names for people as well as for things. No man has a right to object to being called "Bill" if that is the way he is called day by day in the shop and office. Unusual words should be avoided by all means. Keep the paper within the vocabulary of those whom you wish to read it. This makes it necessary to use a very limited range of words, but even the most common words can be made to tell the story that you wish to put over. It may not be easy to avoid repetition of the same words in a paragraph, but that is one of the minor faults. If nothing worse happens to the English language it is lucky. The plant paper affords the best possible chance for the management to communicate with its employees in an unofficial manner. The only danger is that some one high up in the organization may want to preach, and that is nearly the worst thing that language is used for, at least in the shop.

An editorial of two or three hundred words, expressing hope for the future of the business, telling men how they can rise in the organization or almost anything positive, is helpful and will be read. Editorials that are full of don'ts are harmful. The best little sermon I ever read was printed or lettered on one of the boards which usually say, "Keep off the grass." It was at East Aurora, and it said instead, "Why not use the path?" That is just what all these men want and need. Instructions as to what to do to get ahead. They get all the "don'ts" they need at home.

How Do You Regulate Materials?—III

BY HENRY H. FARQUHAR

The principles upon which the replenishment, and the receipt and storage of materials should be based were outlined in two preceding articles. There remain only the considerations as regards the issuing of goods from the storeroom, the classification of materials, and certain principles to be kept in mind in arranging the inter-relationships between the various officials entrusted with maintaining material control.

(Part II appeared in our last issue.)

THE one outstanding requirement to be observed in releasing goods from the storeroom is that only necessary materials be supplied to authorized persons, and that they be properly accounted for when released. The rule therefore follows:

XVII. NO MATERIALS SHALL BE ISSUED EXCEPT FOR AUTHORIZED PURPOSES, UPON WRITTEN REQUESTS SIGNED BY SPECIFIED PERSONS

This is simply equivalent to saying that we will permit only certain persons to draw against our bank account, and then only for authorized purposes and on designated blank "checks" or stores issues which may be used for accounting purposes. It does not mean, however, that we are to be parsimonious in furnishing supplies, or even that we may not adopt a liberal policy in supplying at cost such articles as the individual employees may desire. With the locked storeroom and a tight rein generally, accompanied by a judicious amount of what workmen are usually pleased to regard as "red tape," most of the needless requests will disappear of themselves, and a liberal policy in these respects may neutralize what might otherwise be considered an irksome system. Insistance must be placed, however, upon the written request, upon the approval by some responsible official, and upon seeing that the cost of each article issued is definitely "charged" to some specific account, be it personal or plant, and properly taken up in the records.

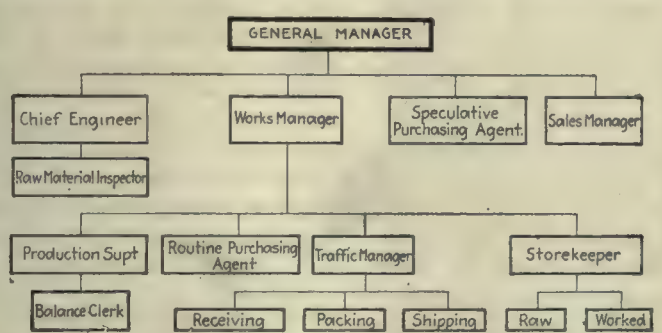


FIG. 7. TYPICAL ARRANGEMENT OF PERSONNEL CONNECTED WITH MATERIAL

It may be pointed out in passing, that through the routine of disbursing of materials a frequent check on the perpetual inventory may be secured. Thus, the balance as indicated by the bin tag may be entered on the issue slip, which, passing to the balance clerk for deduction, may be compared with the balance-sheet balance, or, when a bin tag becomes exhausted, this may be sent as a check, and so on. These are among the many ways in which the accuracy of the perpetual inventory may be maintained between the daily hand counts of a few items until, in the course of time, all items are covered.

XVIII. ALL MATERIALS (RAW, WORKED, AND FACTORY SUPPLIES) SHOULD BE CAREFULLY CLASSIFIED AND PREFERABLY MNEMONICALLY SYMBOLIZED.—This step is of course not indispensable, although if the methods be properly formulated it will contribute materially to the facility with which control may be gained and retained. The story of classification and symbolization is a very long one, and hence cannot be presented here. The bases for both the classification and the symbols should be carefully thought out, and the various components which may be conveniently incorporated—accounting charges, the product, stores, tools and machines, functions, etc., should all be tied together into a consistent and logical working system. If this be done, it will be found that a mnemonic system of symbols, based on careful classification, possesses many labor-saving and co-ordinating features in any business.

After all is said and done, we get back to the fact that rules, no matter how carefully formulated, and "system," no matter how carefully devised, cannot give us thorough control of the material situation unless we have real men entrusted with their execution working under rational relationships. I am not considering here the ever-present task of obtaining and training personnel; I am simply trying to indicate some of the more important means by which the work of that personnel may be made more effective on the job, and one of the most important features of effective control is efficient organization—the rational division of work and of responsibility between the various members of the personnel dealing with materials. The details of organization must naturally be determined after an analysis of local problems, conditions, personalities, and abilities.

It would be out of place, therefore, to attempt to formulate any specific rules as to who is to be whose boss, or as to exact distribution of functions. Again, in settling these questions, there are certain underlying considerations which must not be lost sight of, and the general rule may be stated:

XIX. ORGANIZATION FOR MATERIAL CONTROL MUST BE CAREFULLY FORMULATED

Remembering that we are dealing with values at least as important as money, and potentially (if neglected) of far greater importance, what we want is just as many independent checks and balances in responsibility and in clerical work as is consistent with speed and cost. The inter-relationships between persons has an important bearing on these questions not only in establishing necessary checks, but also in providing effective administrative control through a rational division of work.

It would seem offhand that, other things being equal, the responsibility for *quality* may logically be thrown

upon the engineering department or whoever exercises the engineering function. *Quantity* responsibility must be divided between the production department and the purchasing department, the former exercising authority in the case of routine purchasing, the latter in the case of speculative purchasing.

When I say responsibility must be "divided" I do not mean that there must be left any chance for dispute between these departments as to who is responsible for any individual article, but only that routine articles and speculative articles must be differentiated and responsibility for them definitely assigned. The *time* element must be similarly divided again between production and purchasing—the one specifying when to renew for all items as per balance sheets (production requirements), the other to be responsible for the time necessary to secure the article and for seeing that it be secured in this time. *Cost*, finally, is distinctly the purchasing agent's affair. In practically all cases which I have encountered where losses were frequent through unsystematic material procedure, the underlying cause was traceable directly to an illogical or to an ambiguous delegation of these four functions. Too often, indeed, they were all thrown upon the shoulders of one man, the purchasing agent.

Following out this suggested distribution of responsibilities, it would seem logical that in the normal case, administrative relationships may usually be blocked out according approximately to the following plan, which has proved satisfactory in numerous cases. The purchasing agent for speculative purchasing may be under the general manager; for routine purchasing under the works manager or the production superintendent. In small plants where both routine and speculative purchasing must be conducted by one man, he should, of course, usually report to the general manager. The storekeeper ordinarily should be under the works manager; or, less preferably for purposes of checks but more for speed, both the balance clerk and the storekeeper may be under a head material man who in turn is under the works manager or the production superintendent. This is the arrangement frequently found in larger plants. The inspector may be under the engineering department. The receiving clerk may be under the traffic department, which may report either to production or to sales. These relations, however, will vary with cases; they are suggestive only as an arrangement which is workable and working, and which probably furnishes maximum checks with minimum labor and routine. A skeleton administrative chart of a satisfactory arrangement of the personnel dealing most directly with materials, under typical conditions might therefore look somewhat like Fig. 7.

The list of requirements of adequate material control as outlined in this series may look somewhat fearsome to many. The satisfactory thing about the material problem, however, is the fact that it is one of those nearly inanimate phases of the work which can be systematically regulated if we will only take the trouble to go after it. This is not true of many other features of factory work, particularly those which re-act more strongly on the human element and which therefore keep forever and continuously bobbing up. This fact adds emphasis to the desirability of eliminating as far as possible the material troubles from among those confronting the manager, so that he may give undivided attention to the recurrent problems. For after all, in spite of the many factors which must be taken into account, an adequate material system is essentially a simple affair, conferring benefits entirely out of proportion to its cost.

Socialism—Communism

(Reprinted from *American Machinist*, June, 1878, when H. B. Miller and Jackson Bailey were editors.)

The whole country is just now somewhat excited upon the question of Socialism or Communism, especially since the demonstrations recently made in St. Louis and other localities by organized bands of agitators rallying under the red flag. The danger to be apprehended from this element in our body politic has doubtless been greatly exaggerated by the daily press, yet it is not altogether groundless. The inquiry is naturally raised, who are Communists and what do they aim to accomplish? The leaders will probably answer that they are workingmen who demand their rights, but as far as we can learn there are no real workingmen leading the movement, unless the keepers of gin mills and lager-beer saloons, like "citizen" Justice Schwab, of police-court notoriety, may be called workingmen.

Socialism is nothing new in this country, but judging from its aims and results, the type we are now called upon to deal with is radically different from that which we have long had in full development. For many years Communistic societies have flourished in the United States, the most prominent of which are the Shakers, the Oneida Community and the Economites, of West Pennsylvania. The members of each of these societies own considerable property in common, but, unlike the plan of the new communists, they have acquired it by industry and thrift, and have never looked to the Government for aid to compel the possessors of wealth to part with a portion of it for their benefit.

The Communism that is now striving to incite a reign of terror, is not an element of home growth, but has been transplanted from abroad. It is an offshoot from the Communism of France that rioted in blood and plunder for a brief period in Paris in 1870; from the Nihilism of Russia, so lately threatening the safety of that government, and from the Socialism of Germany, that, a short time since, came near causing the Emperor's death. Judging from their results, we can much better get along with the domestic article than with the foreign.

The new Communists parade with arms, and threaten to bring on a revolution if their demands are not complied with. They hold public meetings, and make speeches to convert others to their schemes of aggression. The old established Communists are opposed to force of arms and never start public agitations to gain legislation for their benefit. They urge no one to follow their system of life. The new declare for free rum and lager; the old have fundamental rules which exclude all intoxicating drinks. The former by the very existence of their organizations menace all peaceful government; the latter are included among the most orderly and law abiding citizens of our country.

In short, the former strives to pull down, while the latter labors to build up. The ideas and practices of the settled American Socialists do not agree with those universally accepted by the great body of our intelligent citizens, but they do not conflict with the general welfare, and form no disturbing element in our free republic. The new Communists, or rather "freebooters," should be taught a few wholesome lessons in the strength and stability of peaceful institutions.

Tight Fitting Threads For Bolts and Nuts*

By CHESTER B. LORD

"Without sacrifice of strength, without increase of rejection, without additional manufacturing costs, find a method whereby a male and female thread of the same lead and pitch diameter may be made, after repeated loosenings, to fit right without the aid of a locking device."

WHAT is the cause of our periodic dissatisfaction with threads when in general they are so satisfactory? What other machine element is so easily made or is so satisfactory as regards strength? Why are there so many different kinds of threads when all are equally satisfactory, or rather unsatisfactory? Furthermore, is the dissatisfaction founded on performance or merely upon theory? Also, is the form or angle of thread a matter of importance, or merely an excuse for mathematical gymnastics? The only answer the writer has been able to elicit in reply to these various questions is that we are looking for a better thread; which statement, however, is rather indefinite and usually simply means a thread that will pass the gage. Of course, the real object of the search has been to find a thread that will not loosen.

In the past we have attributed our troubles to the fact that our fits were not close enough—the engineer's alibi for a poor design. But fundamentals cannot be violated in mechanics any more than elsewhere in nature, and we are attempting to violate two by insisting upon our present methods of inspection: (*a*) that interchangeable manufacture is a matter of percentage which depends upon tolerance and cost; and (*b*) that a force fit is not possible between two parts the surfaces of which are complements one of the other.

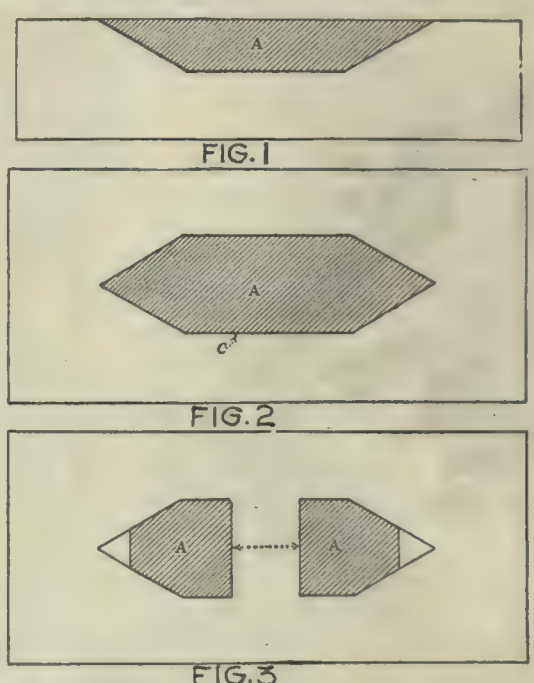
Having in mind the first fundamental, it is obvious that the chances of securing a perfect fit are limited by the cost, and the second fundamental would seem to render this entirely hopeless. It is therefore proper to conclude that a good fit is usually due to error, and that if changing both male and female threads produces no relative change, changing one thread must of necessity do so. It is the object of this paper to demonstrate that by making this latter change threads can be produced that are interchangeable practically regardless of tolerance, that will not loosen, and are cheaper to manufacture.

A physician always diagnoses a case before prescribing, so let us do likewise. The loosening of a thread fit is caused by vibration or repeated shock, the chief result of which is to flatten and burnish the parts of the thread that are in contact. This produces a slight looseness and the nut tends to follow the thread incline until it again fits. The same performance is repeated until finally the nut reaches an obstacle too large to flatten, or else the bolt and nut vibrate in unison and there is no further relative movement. This same phenomenon occurs in the case of a bolt screwed in a tapped hole.

Experiments with spring lock washers having a projection that will not allow the nut to turn without cutting the metal, and the same type of washer made without holding projections, show very little difference in their holding power; and this would seem to indicate that their function is to prevent vibration. But we also find nuts without lock washers in places where there is vibration, and still they do not loosen. The answer is that they are individually fitted.

The writer can remember in his shop days picking out and numbering nuts and bolts, and every mechanic knows that he cannot take the bolts out of a cylinder head on an engine of good make and put them back again indiscriminately. They must go back into the holes from whence they came. All have demonstrated to their satisfaction the fact that a tight thread will not loosen by vibration, and that one with tolerance will, unless it is prevented from loosening by a lock washer, or its action limited by some type of nut lock. We cannot lessen our tolerance because the tap wears small and the die wears large, and the lesser cannot contain the greater.

To gain a better conception of the problem to be solved, consider a board cut as shown in Fig. 1. We cannot obtain a forced fit between the two pieces because one surface is the complement of the other. If we apply a force to *A*, we are no better off because the pieces cease to fit the instant the pressure is released. We may therefore state as a rule that where two surfaces are complementary to one another a tight fit cannot result without some means of maintaining pressure. But if we cut the board as shown in Fig. 2, theoretically removing no material, we can replace *A* without force, and any pressure exerted will not make a tight fit unless we distort *A* or drive a wedge at *C*. This is analogous to a perfect thread, and driving the wedge at *C* is



FIGS. 1 TO 3. APPLICATION OF PRESSURE IN THREAD FITS

Fig. 1. Two complementary surfaces. Fig. 2. Surfaces analogous to two perfect threads. Fig. 3. Surfaces on which there can be maintained a forced fit.

*Presented at the Spring meeting of the American Society of Mechanical Engineers, St. Louis, Mo., May, 1920.

equivalent to introducing a slight difference in lead. If, now, we cut off the ends of *A* as shown in Fig. 3, and apply a force in the direction shown, we can obtain a forced fit because only the angles are complements and because we have a method of maintaining pressure. We can also even distort *A* because we have room for it to expand. We have only then to provide for three things: a method of making the parts in contact absolutely complementary; the introduction of sufficient metal; and a method of maintaining pressure. With our present type of thread we can only meet one of these—namely, that of partly maintaining pressure. This is demonstrated in Fig. 4, which shows in an exaggerated manner the effect of off lead.

To secure a good fit it is necessary to exert pressure on all flanks of the thread, and not on only two as we do with a standard thread. Practice demonstrates that the nut and bolt must be held by internal pressure on all flanks, and that the force maintained by screwing the face of the nut against another surface does not prevent loosening; but the writer again affirms that for practical purposes an off-hand thread is better than a perfect one, because in our present practice it is the lead or burrs that usually determine the fit.

While two slightly varying leads make a better fit, both as regards gaging and in actual use, this practice is not to be commended. Using a different lead to secure a fit is doing imperfectly on one side of the thread what the different-angle method does perfectly on both sides, because by having the leads identical and the thread supported on both sides, we secure a uniform finish instead of a distortion. Where the leads are different, the amount of distortion necessary to secure a fit increases with each thread. Thus, if the lead of a 20-thread stud is 0.05 in. and we make it 0.052 in., it will be 0.002 in. off center on the second thread and 0.018 in. on the tenth thread. This is entirely possible, and superior to a so-called perfect thread as regards fit, but a distortion, unmechanical, and unnecessary.

This is what is done with railroad fish-plate bolts where the specifications state the minimum foot-pounds at which the nut and bolt may be assembled. The impossibility of meeting these requirements in quantity production is recognized by purchasing agents and most engineers, and so the lead is slightly changed. This, however, is merely a subterfuge and really defeats the purpose of the specifications in that it permits of a poorer and weaker thread than would otherwise be possible.

We are thus confronted with this problem: Without sacrifice of strength, without increase of rejection, without additional manufacturing costs, find a method whereby a male and female thread of the same lead and pitch diameter may be made after repeated loosenings to fit tight without the aid of a locking device. This, according to specifications, calls for a full thread at contact points, pressure applied continuously on all flanks, and maximum strength at the pitch line. This means the addition of surplus metal to the male (which is the only one affected) sufficient to fill out the female threads, which would be an impossibility were it not for the ductility and elasticity of steel. If we add this surplus metal we will find that we can more than fulfill the required conditions by changing the angle of the male thread to a lesser one than that of the female, having the two intersect on the pitch line.

Theoretically, this means a smaller amount of material below the pitch line of the male, compensated for

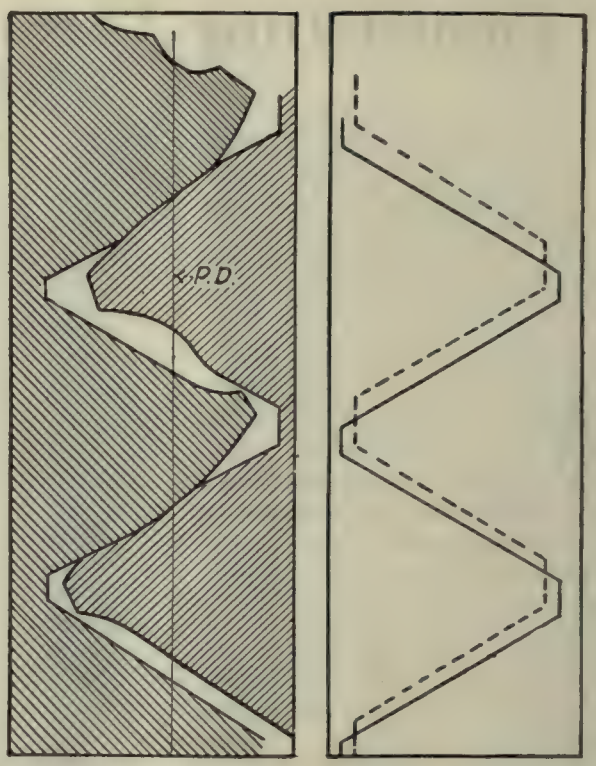


FIG. 4. THE EFFECT OF LEAD (GREATLY EXAGGERATED)

by an increased amount above the pitch line. Actually it means *more*, because we do not have to recognize as great a tolerance below the pitch line because of our lesser angle, nor above the pitch line because we can take care of a reasonable surplus and the question of initial fit need not be considered. The space below the pitch line in the male, due to difference of angle, is not as great as the tolerance usually allowed.

Every nut is bell-mouthed, and every bolt, whether cut or rolled, is tapered. This is fundamental and cannot be avoided. This being so, we have no trouble in entering, for one or two threads, a bolt of larger angular but less total displacement than the female, It is also true in practice that the first threads of either nut or bolt are weaker than the rest, because they lack support on one side and hence flow easily.

When a male thread of this type and a standard mate are screwed together, we will have transformed a male of lesser angle to one of larger angle or of wider base than the standard U. S. thread, because we have filled out the female thread tolerance as well as that of the male. We will also have uniform pressure on all flanks; the maximum possible material at the pitch line; a hard, smooth surface analogous to a case-hardened one; a fit that will remain snug despite repeated removals and that may be screwed together by ordinary means; and yet will still retain an interchangeable bolt and nut according to U. S. standards. The nut has not been changed or distorted in any way, but has simply served as a finishing roll.

The writer has stated in a previous article that, aside from threads, nowhere else in machine work do we expect micrometer limits on a roughing cut; and the question naturally arises whether an operation similar to that described would not be an effective finishing and sizing operation for commercial work. This would be the equivalent of *making* them fit the gage, and would greatly reduce the cost due to rejections. It would still have variable nuts and the necessity of sizing them.

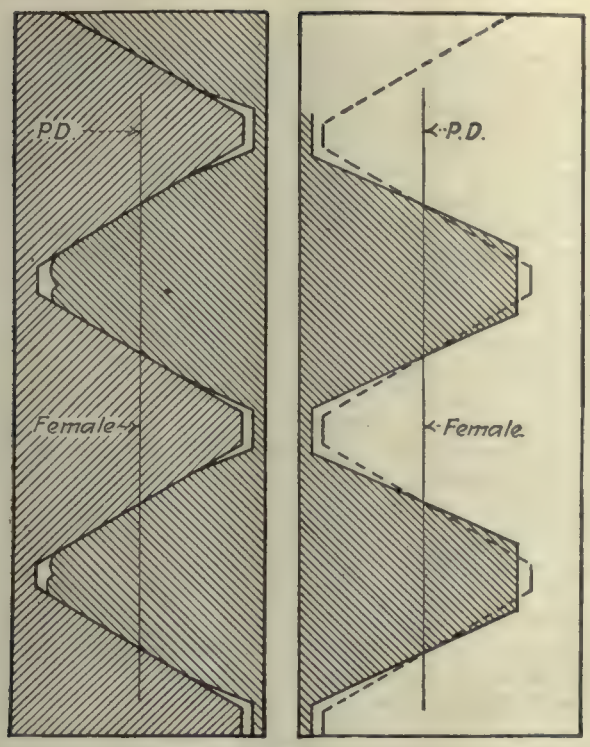


FIG. 5. DIFFERENT ANGLE THREADS (GREATLY EXAGGERATED)

Let us now see what authority and precedent we have for making so radical a departure from accepted practice. To do so, let us consider how threads are made, especially by rolling. Generally speaking, thread rolling is circular knurling, knurling being that process whereby the diameter of a part is increased at certain points by a corresponding reduction of diameter at other points, due to pressure alone. It is applicable to both flat and round surfaces, but for the purpose of this article we will consider only round surfaces.

In turning screws and bolts to size the diameter is held, generally speaking, to the pitch diameter. The displacement of metal from the root and lower flank forms the addendum under the process. Cutting a thread on a bolt with a die is a somewhat analogous operation, the similarity increasing as the die becomes duller. For a die-cut 1-in. bolt it will generally be found that with a diameter of 0.990 in. a fuller thread may be secured than with one of 1.000 in., the explanation being that with the die we secure a combined cutting and rolling operation. Due to lack of clearance, if the diameter is too large, part of the metal is pressed into the bottom of the die and with such force that it drags and is torn off, thus leaving a thread of smaller outside diameter. This same phenomenon occurs when a nut is too tight.

If we require a holding fit on a shaft, do we use tolerances that allow of the shaft being several thousandths smaller than the hole it is to fit? Quite the contrary. We not only specify the fit but also the minimum pressure allowable to assemble the two parts. and we do this both for single units and for quantity production. We might term a shaft and rotor spider a nut and bolt with microscopic threads and assembled with a right-angled instead of a helical motion. Why not fit our bolts the same way, making our tolerances plus instead of minus and using a force fit we can depend upon when it means no change in the tools necessary for assembly?

If we look at a finished commercial thread through a microscope, it will be seen that the edge is serrated and that slivers stand up all over its surface. By running a nut over it once we but slightly change its appearance, but by repeatedly doing so—always using a tight nut—we may finally burnish the thread so that it will not thereafter change its size and will have a surface somewhat comparable to a case-hardened one.

The writer has stated that the different-angle thread was practically independent of tolerance. This is self-evident on the finishing operation. Let us now see how true it is as regards the roughing operation. Excluding the ideal condition, there are six variables that may be met with, and these are caused by large and small angle on both male and female. A diagrammatic sketch will show that of six possible variations due to angle alone, the different-angle thread is usable on four, and the U. S. thread on only two. Any multiplication of these errors of angle by maximum or minimum tolerance would obviously still further favor the different-angle thread.

Fig. 5 shows diagrammatically the different-angle thread with the angles of the male greatly exaggerated to demonstrate the principle. We are complying in this case with all the conditions we have just been discussing: we are making the lesser contain the greater, angularly speaking; we are applying force from both directions, at right angles to the axis of the bolt; we have made the angles complementary—not merely two equal angles; we are securing the maximum strength at and near the pitch line, and transforming a thread with a lesser angle than that of the standard male to one with a larger angle, thus filling out the space perfectly and so doing away largely with vibration; and we are securing, whether under pressure or not, contact on all flanks, whereas the standard thread when under pressure secures contact on possibly one-half the flanks, both because it is compressible and because it does not fill the female thread. The only problem to be solved, therefore, was to find an angle of such slope that it could be formed without distortion of the nut or requiring too much force to screw home. To demonstrate this, threads as small as No. 10-32 were used, and as being of possible interest, the writer presents a brief outline of the engineers' report of the experimental work.

Results of Experimental Work

Diagrams of the different threads were first laid out on a 100 to 1 scale so as to determine approximately the most suitable angles to be tested, the Löwenherz thread with an angle of 53 deg. 8 min. being used as a basis. The nut was to have the regular Löwenherz thread with same diameter and pitch as in the 155-mm. shell adapter used by the U. S. Government.

Threads of 44 deg. and 45 deg. for the plugs seemed most favorable, and accordingly the following cold-rolled steel plugs were made up, with nuts having the same pitch diameter and lead as the plugs, but a thread angle of 53 deg. 8 min.:

1 Angle of thread 44 deg. 54 min., pitch diam. 0.8748, lead 0.0787
2 Angle of thread 45 deg. 2 min., pitch diam. 0.8748, lead 0.0787
3 Angle of thread 44 deg. 0 min., pitch diam. 0.8748, lead 0.0787

Test No. 1. Nut No. 1 and plug with thread angle of 44 deg. 54 min. were screwed together *without* a lubricant. They were started about a half a thread by hand, and then an 8-in. wrench was used for about four threads. The plug was then in so tight that a 10-in. wrench was required to turn it to full depth. After a

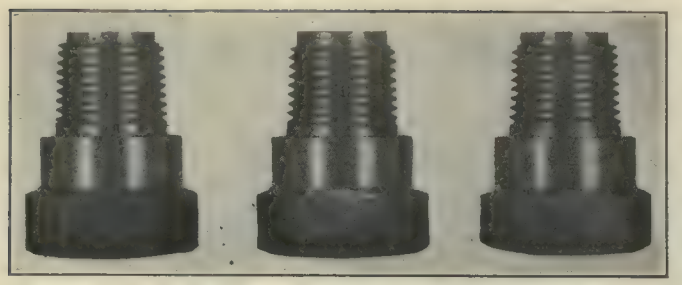


FIG. 6. THREAD USED ON SPARK PLUGS

couple of backward turns the plug stuck so tight that a 20-in. wrench would not move it. The nut was then sawed open and removed from the plug and about one-third of a thread of the plug was taken off in a piece of the nut. A magnifying glass showed that the threads in both plug and nut were drawn and cut out of shape where there was a tendency for them to overlap, due apparently to too much metal and no lubricant.

Test No. 2. Nut No. 2 and plug with thread angle of 45 deg. 2 min. were screwed together *with* a lubricant. They were started by hand for about one-half turn, then an 8-in. wrench was used for five or six threads, and a 10-in. wrench for the remainder. The plug came out slightly easier than going in. After this had been repeated three times the plug could be screwed in by hand. The maximum and minimum plug gage for the nut showed no change in the thread of the nut. Under a magnifying glass it was seen that the metal had flowed to the top of the plug thread from about the pitch diameter outward. The plugs were screwed into the nuts fifty times and there was still what could be termed a "snug fit."

Test No. 7. Plugs were tried out with commercial 1-in. nuts. The thread angle of the plugs was 58 deg., and the pitch diameter 0.9228 in., with one plug this diameter plus 0.001 in., and one minus 0.001 in. This diameter allowed the plug thread in the layout to overlap the entire thread of the nut instead of only half, as in the previous cases. The nuts used were picked out of stock for size with a standard 1-in. thread gage. The smallest plug went into the nut easily by hand. The largest two went together easily with an 8-in. wrench. After being twice screwed together with the wrench, they went together with a snug fit by hand. The magnifying glass showed that the thread from near the pitch diameter outward had been drawn and compressed slightly.

Tests with S. A. E. Threads

Test No. 9. Plugs of ½-in. diameter with pitch diameters of 0.4684 in. and 0.4699 in. (same as ½-in. S. A. E. nuts) and a thread angle of 50 deg. were tried with commercial ½-in. S. A. E. nuts. The difference in the two pitch diameters made practically no difference in the fits, as they both readily went in with an 8-in. wrench. After they had been screwed together four times, they would go together by hand, but without shake. After they had been screwed together 75 times there was still what could be termed a "snug fit."

Test No. 10. An attempt was made to compare the strength of an S. A. E. standard ½-in. thread with a 50-deg. thread of the same size. The plug with the standard thread on one end and the special thread on the other end was used with standard nuts. A pull of 14,000 lb. was gradually applied and the metal began to give way, which prevented an additional load. During this pull observations were made to determine if there was any "give" in either of the threads, but both remained the same throughout. The nuts were removed and there was no apparent distortion of the threads.

Test No. 12. In this test ¼-20 plugs with pitch diameters of 0.2165 in. and 0.2181 in. with 50-deg. angle were tried out with ¼-in. U. S. standard nuts, one being a commercial nut and the other of a standard size but made in our toolroom—the tap being 0.250 in. in diameter. Both nuts were tried with a ¼-in. standard plug gage, both being apparently the same size. The nut made in the toolroom was screwed on the maximum plug and went on about one and a half times its length and then stuck and would not go either way. It was finally removed by hammering it on the sides. The threads were rolled and torn from about the pitch diameter outward, but there was not that tendency for the metal to roll upon the outside of the thread as in the previous tests, the outside diameter being only 0.251 in. as against its original 0.250 in.

The commercial nut went on the minimum plug with an extremely tight fit, but it came off very readily with the wrench and left quite a different thread from the previous one. The thread was not torn at all but rolled out to almost a perfect V-thread with outside diameters of 0.2555 in. as against the original 0.250 in. The outside diameter of the tap for the commercial nut must have been over 0.250 in. to allow this metal to flow out to 0.2555 in. and not jam the nut. If the toolroom tap had been sharper on the flats or its outside diameter greater, there would have been room for the metal in the test plug to flow out to a larger diameter and avoid tearing the thread, and consequent jamming of the nut. Two facts are clearly demonstrated: first, necessity of room for metal to flow; second, one of the limitations of the thread gage.

Test No. 13. Plugs corresponding to standard 10-32 with 50-deg. angle were tried out with standard 10-32 nuts; pitch diameters 0.170 in. and 0.1716 in. They were a trifle too tight a fit to go together by hand, but after being screwed together once with a wrench they went together by hand snugly.

Conclusions

In conclusion it may be stated that the tests would seem to indicate the following:

a The cause of stripped threads is lack of room into which the metal can flow

b The pitch diameter should be the same in both threads

c The lead should be the same

d The thread angles should differ by not more than 10 deg.

e The limits for the inside diameter of nut need not be adhered to closely, as the inner part of the nut thread exerts very little, if any, holding power.

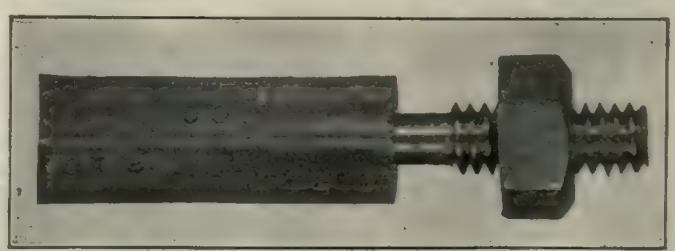


FIG. 7. DIFFERENCE IN THREAD BEFORE AND AFTER NUT HAS BEEN SCREWED ON

f The outside diameter of plug and pitch diameter of both plug and nut are important and should be adhered to fairly closely.

As might be supposed the subject of threads has brought forth considerable discussion but practically all of it favorable.

One writer suggests that the statement regarding stripped threads might cause confusion, as they are usually caused by too much room rather than by too little; incidentally this is another bad feature that the different angle thread will eliminate, for no nut can be screwed on by hand, and so there must always be sufficient material to prevent stripping because of too much tolerance, or too little material.

Another writer suggests the use of a 55-deg. Whitworth bolt and a 60-deg. Sellers nut. The only objection to this is that the Whitworth thread being rounded would not flow as readily as would the Sellers, and would not carry as much material; but it would undoubtedly make a better combination than we are using at present.

Fig. 6 shows the thread used on spark plugs to give a gas tight fit, and Fig. 7 a stud with a nut screwed partly on to show the difference in the thread before and after a nut has been on. Note the difference in the thread above and below the nut.

A Short Proof for Long Division

By Walter R. Meyers

Chief Tool Designer, R. K. LeBlond Machine Tool Co., Chincinnati, Ohio

Modern practice demands efficiency in all branches of work, and any method or idea tending to increase the production of any employee, in any capacity, increases the efficiency of the business. With this idea in mind, the writer wishes to submit the following method of proving long division, in the hope that it may give the designer, draftsman or tool engineer a short cut in his mathematics.

When I wish to positively prove a calculation, I desire to see it in plain figures, thereby eliminating mistakes on slide rules or in the use of logarithms. The advantage of this method, that of simplicity, is self-evident, as it relies on nothing but plain addition for positive proof. Being so simple, I dare say that it is not new; but to the best of my knowledge it is not generally used.

The method will be shown by the use of the following numerical example. Dividing 1.25 by 0.98362, the quotient is 1.2708, with a remainder of 15704, as can be seen by the work given later. The proof of this would be 0.98362 times 1.2708, plus the difference 0.000015704, which gives 1.25, the original dividend. But this number has already been obtained in our division, so that the terms and final remainder can be totaled, disregarding the dividend and the remainders which are shown in italics in the following example:

0.98362) *1.250000000* (1.2708
98326
266380
196724
**696560*
688534
802600
786896
15704

Proof: 1.250000000

Further explanation is unnecessary, but I may add that should there be a mistake in subtraction or multiplication it would show up in the addition and it would be in the column in which the first deviation of the sum from the dividend occurred, when reading from the right. For illustration, suppose that the remainder *696560* marked* in the example was, due to a mistake in substraction, made to read *695560*. The result would be:

.98362) *1.250000000* (1.2707
98362
266380
196724
**695560*
688534
702600
688534
14066

Proof: 1.249900000
*

The appearance of the 9 in the total indicates a mistake in the column marked by the star, and the error in subtraction can be quite easily located. The writer hopes that others may find this method as useful as he has found it.

Piston Clearance in Cylinders, and Why

By Frank C. Hudson

I have modified my opinion about automobile repair ever since talking with someone who really seems to know that a gasoline motor is more than a few holes in a chunk of cast iron with some sort of dingus wabbling around inside. I ran across one the other day in a shop where they had two Heald cylinder grinding machines, a Norton crankshaft grinding machine, other tools to match, and were running them day and night.

The head of the shop first saw the light of day in the Emerald Isle, had worked in some of the best motor shops in Great Britain, and was now the happy possessor of the afore-mentioned outfit. He had a system of fitting pistons to cylinders, which was claimed to be very successful, varying the clearance from 0.0015 to 0.003 in., according to the kind of motor.

Slow Motor Needs Liberal Clearance

According to his theory a slow-running motor does not scavenge the burnt gases well and these get down into the crankcase, dilute or otherwise injure the lubricating oil, and the pistons seize unless there is a liberal clearance. He bears this out by citing instances where a motor which will seize when run in high gear, will run perfectly if run in second or low to get higher engine speed.

Motors with scanty cooling systems, such as small radiators or restricted passages, also require more clearance, yet he gives the Franklin pistons no more clearance than most water-cooled engines because of the piston speed and oiling system used.

Piston rings were also discussed and he told of a case where a Sunbeam motor with three ¼-in. piston rings was refitted with pistons having but two rings ⅛ in. wide. With only this change the car showed over 15 per cent greater speed on the Brooklands track.

It would be interesting to know how these theories and experiences compare with those of others who really think about such matters.

The Keller Automatic Die-Sinking Machine

By S. A. HAND
Associate Editor, *American Machinist*

While the term die is both comprehensive and elastic and may be applied to a great variety of tools, it is to be understood that the machine described in this article is for sinking dies such as are used for forging, glass molding, embossing, etc., and which contain the sunken negative of the piece to be formed or decorated.

THE die requirements in this country have been greatly multiplied within the last few years and it is clear that they must continue to increase. With the ever growing scarcity of die sinkers and the increasing demand for their product it would seem that the only solution of the problem would be in the employment of a mechanical method to do the work.

Some years ago automatic machines for sinking dies were brought out by the Keller Mechanical Engraving Co., Brooklyn, N. Y., and while for many years their use was confined to ornamented die work, the vast die requirements incidental to the war were partly responsible for the development of types suited for larger and heavier work.

Fig. 1 illustrates the machine in which the master and the work are both shown in position. The master *A* and the die to be sunk, *B*, are both mounted on the upright platen *C* while the tracer *D* and the cutter *E* are carried by the latticed frame *G* on which the motor is also mounted.

For convenience in counterbalancing, the platen is arranged to travel up and down in a vertical plane, provision being made for easily regulating the amount of motion. The member carrying the cutter has a longitudinal travel, either to the right or to the left at a right angle to that of the platen. This member, in addition to its longitudinal travel, is arranged to swing on a pivot at *H* so that by weights attached near its outer edge by a chain the tracer is held against the master and the cutter against the work. The depth of the cut is regulated by the relative end positions of the tracer and the cutter in relation to the master and the work.

Both the weights for counterbalancing the work and platen and those for holding the cutter to its work can be changed in accordance with the requirements.

The cutters used are quite simple to make and are of two types—round-nosed and diamond-shaped.

Fig. 2 is a close-up view of the master and a partly completed die, the sizes of which are shown by the scale to be seen lying on top of the die. The greatest depth of this die is 2½ in.

As is plainly indicated in the illustration, the direction of the cut is vertical and the feed longitudinal while the depth is provided for by the swinging motion of the pivoted latticed-member carrying the tracer and cutter, the amplitude of the swing being entirely governed by the depth of the impression in the master.

Dies having a number of duplicate impressions on the same block may be cut from a single master by shifting the master to the right or left, up or down, a predetermined distance after each impression is finished. For work of this class a simple fixture is provided to insure accurate registering.

For producing such work as molds for bottles, it has been found convenient to equip the machine with

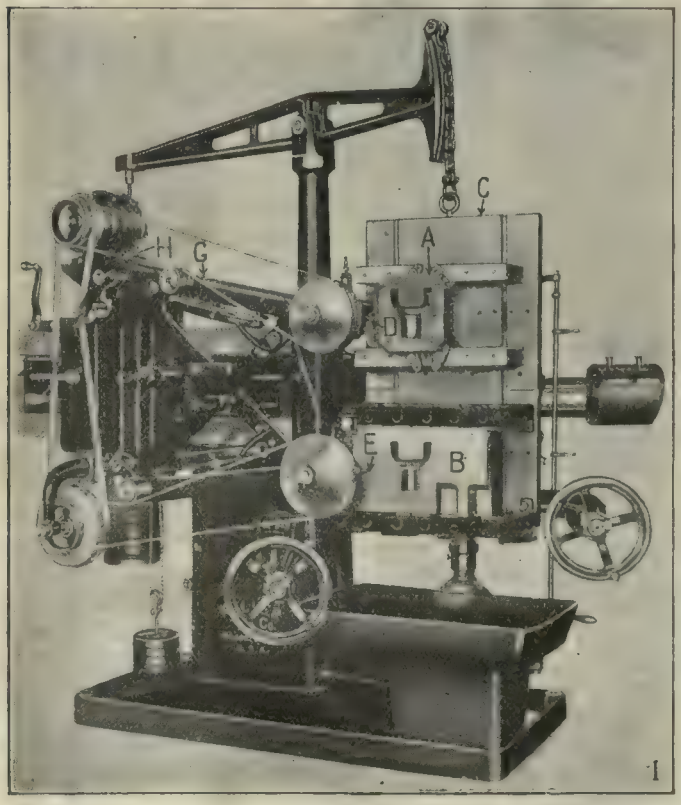


FIG. 1. KELLER AUTOMATIC DIE-SINKING MACHINE

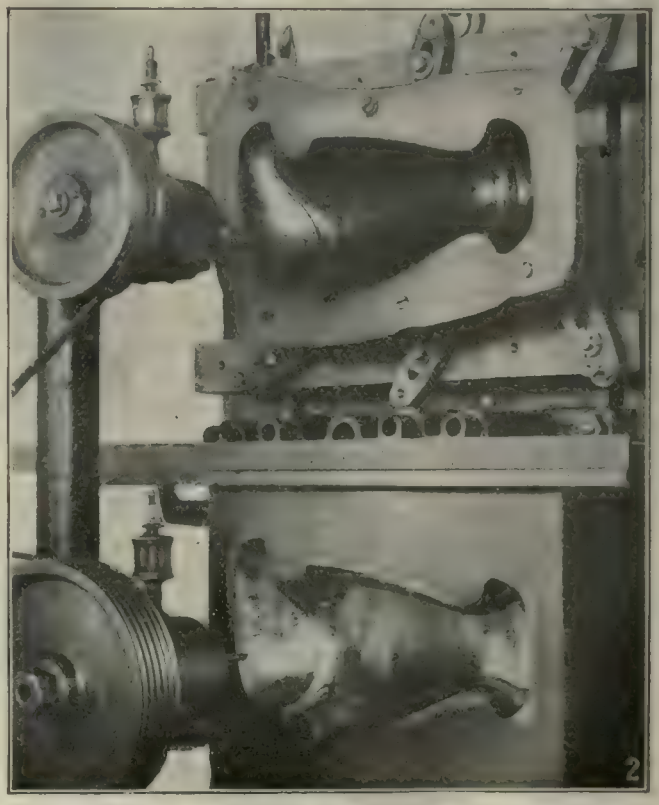


FIG. 2. SINKING A DIE FOR A METAL PITCHER

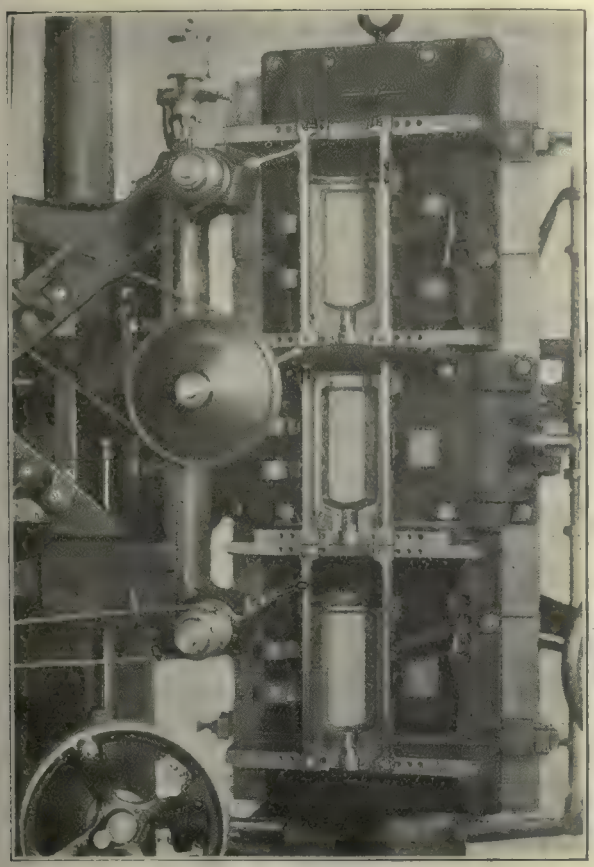


FIG. 3. SINKING BOTH HALVES OF A MOLD FROM ONE MASTER

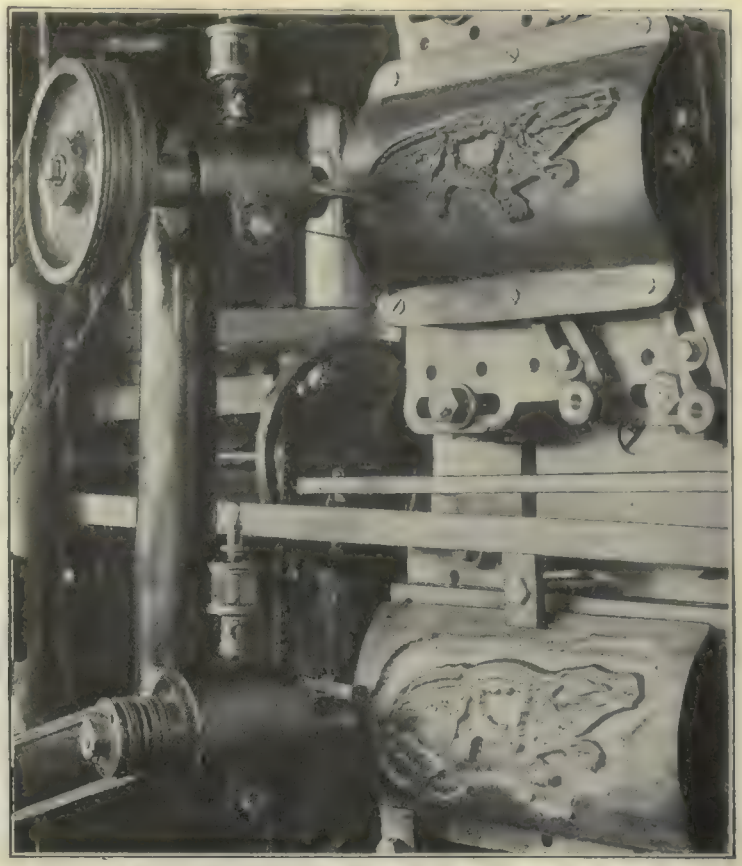


FIG. 4. METHOD OF SINKING A CURVED BRANDING DIE

two cutter spindles and to cut both halves of the mold at the same time, using a hand-cut mold section as a master. Fig. 3, illustrates a case of this kind. Here both halves of a bottle mold are being cut simultaneously. The master is shown in the center and the halves of the mold at the top and bottom respectively.

As an example of intricate work that has been done on this machine, Fig. 4 is shown. This is a close-

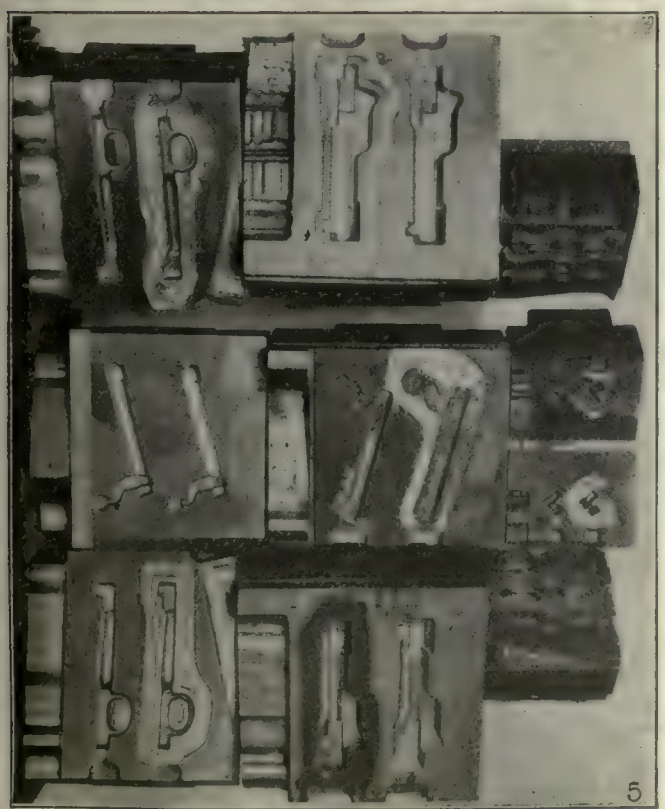


FIG. 5. GROUP OF FORGING DIES FOR RIFLE PARTS

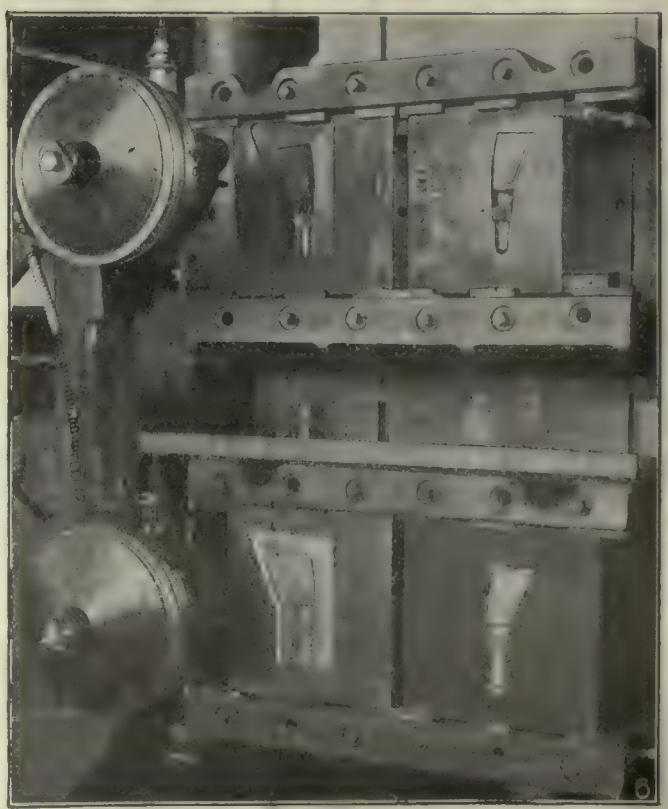


FIG. 6. FIXTURE FOR HOLDING TWO DIES AND TWO MASTERS

up view of a convex steel branding-die in the last stage of completion. Dies of this character are for use on cylinder printing presses for printing trade-marks on the tops or sides of wooden boxes.

Fig. 5 is an illustration of a number of forging dies for component parts of a military rifle, all of which were cut on this machine.

Fig. 6 illustrates a lately designed fixture in which two dies and two masters are equally and accurately clamped into position by drawing their faces forward against hardened and ground stops. Nearly all machine cut dies require a certain amount of hand finishing, though this, of course, varies with the character of the work and the individual requirements. In many cases the dies require only a little smoothing, but in any case the hand work required is relatively inexpensive and does not call for as much skill as does hand die sinking or mold cutting.

As will be noted from Fig. 1 the drive is by an electric motor through several round cotton belts running over grooved pulleys, the number of belts used depending on the power required to do the work.

The machine will accommodate a die block having a surface of 27 x 16 in. and a depth of 12 in.

For duplicating, existing dies may be used as masters while for original work, models or patterns may be made of wood or modeled in clay, plaster or wax. From such patterns permanent masters for use on the machine may be cast in iron or bronze.

The Value to Shop Students of Visits to Industrial Plants

By Victor A. Kottinger

Machine Shop Instructor, San Jose High School, San Jose, California

Class excursions of the vocational students to the leading manufacturing plants and commercial centers help to give the pupils a concrete knowledge of the industrial and commercial world. On these excursions, the boys can readily grasp some idea of the close relationship of the agricultural, industrial and commercial world. They can realize the value of invention in the progress of civilization, the relationship between labor-saving devices and competition, and the value of the organization of labor and capital.

During these industrial trips the boys are thrown in direct contact with the workers in their various occupations, and are brought to realize that an educated brain and hand have a greater economic value than mere physical force. They realize that knowledge is power, and return to their school studies with renewed interest and zeal. The dormant powers of the pupils are awakened and with this awakening comes a definite aim in life. Their eyes have been opened to a new world, in which they have an active part.

Stated briefly, the aims of the industrial excursions are (1) to give the pupils a closer connection between their regular school studies and the world of industry; (2) to awaken the dormant powers of the pupils, and thus aid them in performing the work to which they are adapted; (3) to aid the pupils to realize the value of unskilled, half-skilled, and skilled labor in the industrial and commercial world and thus enable them to recognize the importance of thorough preparation in their chosen field of labor. Upon the return of the class from industrial excursions any misunderstandings or hazy conceptions of the trip are cleared up by class discussion. These discussions are carried on in systematic and logical order, following a brief outline of the departments of the plants visited.

The pupils volunteer information which interests them most concerning that part of the department under discussion. The backward pupils are drawn out by well-directed questions, and the boys are given an opportunity to ask questions concerning any part of the department under discussion. Other pupils are encouraged to volunteer the information.

In order to find out how much knowledge has been assimilated the pupils are required to write compositions on all of the excursions. These compositions give the pupils a splendid opportunity to take notes, to make outlines of the subject, and to express their ideas in writing.

An Educational Aid in the Drafting Room

By P. A. Fredericks

It is a very difficult thing to teach beginners in drafting the value of care in minor details, and to teach a number of draftsmen to observe minor standards which have been determined upon as the correct method for that particular shop.

An aid in this direction is a bulletin board with the heading as shown in the illustration.

When the checker, or the chief, discovers an error in following out standard practice, methods of dimensioning, or any one of the hundred things which may be wrong with a drawing, the chief draftsman attaches a note of explanation to the blueprint and puts it on the bulletin board. After remaining there a week or so it is taken down and passed from man to man for direct observation; each man initials it as a record and passes it on, when it eventually reaches the files as a record.

This system supplements very effectively a book of standard practice that describes in detail the standards which are expected to be followed out, and another book of standard details that gives details of various interchangeable parts carried in stock by the firm, being therefore preferable for use on new designs.

On drawing 1 the chamfer to permit teeth of the sliding gear to engage was put on the wrong side The gear was hardened, making much extra expense

Drawing 2 shows a very common and very careless error. In retracing from the blueprint because of lost tracing the tracer filled in $1\frac{7}{8}$ in. instead of $\frac{7}{8}$ in. and failed to check even his few figures.

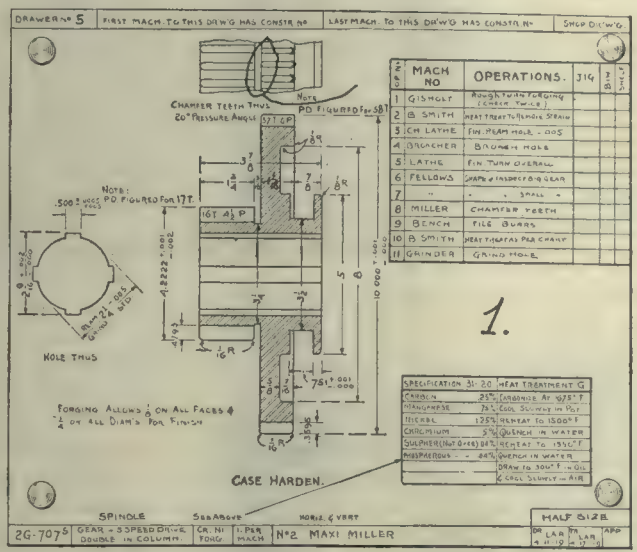
Drawing 3 is an instance of a hexagon drawn the wrong way, leaving a chance for turning the piece to $2\frac{3}{8}$ in. in diameter. It should be drawn as shown by the correction and dimensions changed to suit.

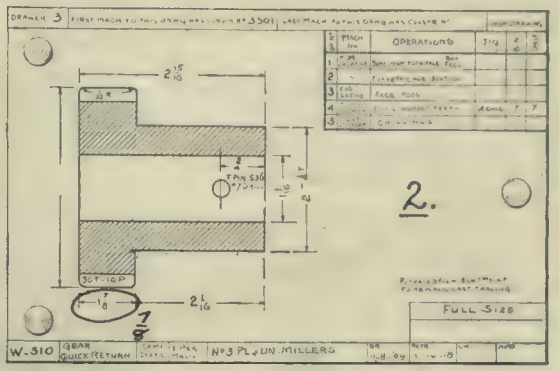
Drawing 4 caused spoiled work. The man turned the parts 1.498 in. in diameter because he did not notice the end view. It should have been drawn the other way round as per dotted lines. Similar mistakes often occur on hexagon work.

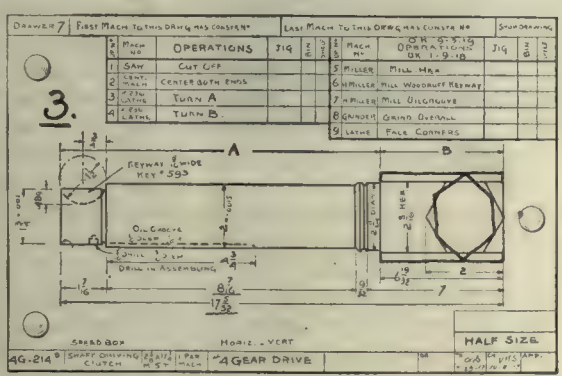
On drawing 5 the ball race is wrong side up. Since there is a force fit at *A*, revolving the shaft causes a rubbing friction at *B* and the bearing cuts either at *A* or *B*. If turned the other way up, as is intended in designing the bearing, there would be 0.005 to 0.010 in. clearance at *A* and it would work perfectly. Watch out where you put thrust faces on thrust ball races.

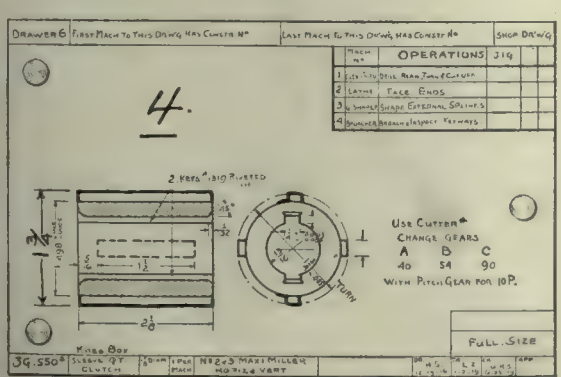
THESE DRAWINGS ARE WRONG

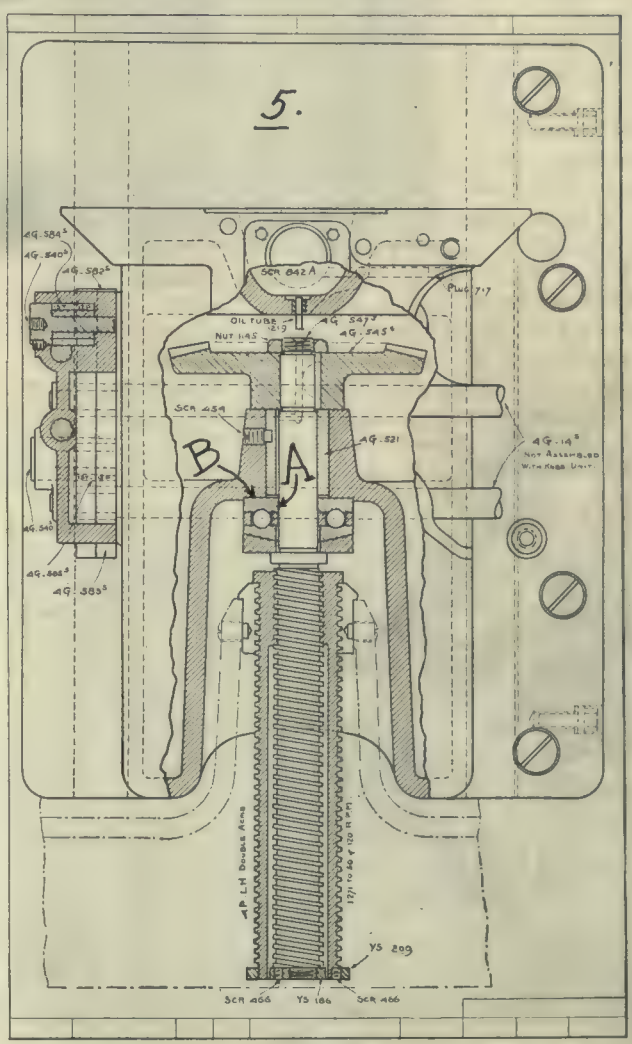
TAKE NOTE WHY AND AVOID SIMILAR ERRORS











A Machine for Boring Line Bearings

By J. V. HUNTER
Western Editor, *American Machinist*

This article describes the construction and method of operation of a machine used for boring and reaming the bearings of an automotive crankcase. The machine is typical of those used in the automotive industry, as it is designed for rapid production and can be loaded while a cut is being taken.

NUMBERS of special machines have been built for boring and reaming the line bearings of automotive engines, a good example being the machine shown in Fig. 1. This machine was made according to the specifications of the Bethlehem Motors Corp., Pottstown, Pa., in whose plant it is located. It was built by the Baush Machine Tool Co., Springfield, Mass., and equipped with special boring and reaming bars made by the Kelly Reamer Co., Cleveland, Ohio. The machine has a revolving fixture which permits the loading of a crankcase on one side of it while the boring operation is proceeding on the other. It will bore several different sizes of motor cases, a different fixture and boring bar being provided for each size. One of the cases is shown lying on top of the fixture in the illustration.

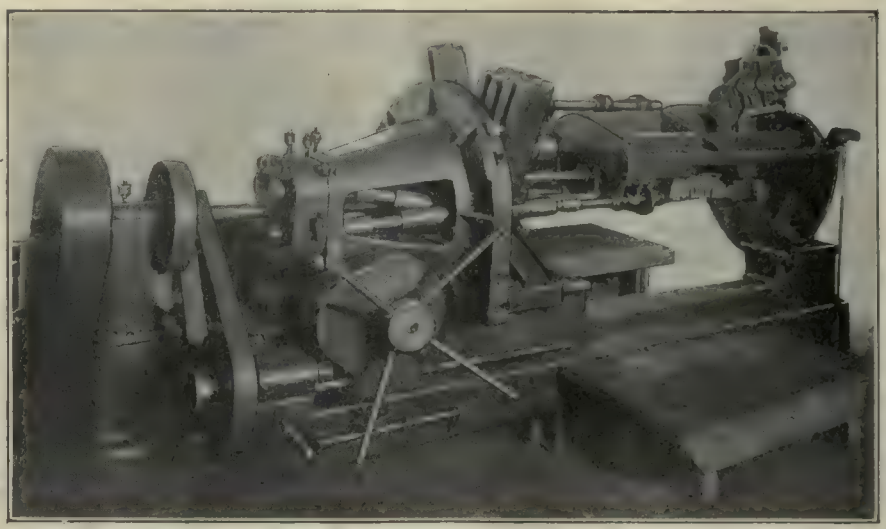


FIG. 1. SPECIAL LINE-BORING MACHINE FOR GAS-ENGINE CRANKCASES

The fixture is shown revolved 90 deg. from its working position in Fig. 2 to give a better idea of the construction and the method of operation. Fig. 3 shows the work removed and the reamer bars slipped back into position in their bearing brackets on the fixture.

The crankcases are of cast iron and two cuts are taken through them in the boring machine, finishing a case in about six minutes. The first case to be bored is placed on the fixture with the roughing cutters in place in the bars, then after it has been bored and while the case on the other side of the fixture is being roughed, the operator puts the finishing cutters in the boring bars in the case previously roughed. A similar change is made with cutters of the second crankcase while the finishing cutters are boring the first one; and thus only one setting of the work is required for both roughing and finishing.

The spindle speeds are governed by the ratios of the gears in the head driving the spindle and they range from 56 r.p.m. for the slowest bar in the 3-in. starter hole to 84 r.p.m. for the fastest bar in the 1¼-in. pump-shaft hole. The spindle speed is governed by the forward movement of the spindle head. This is so driven that it gives roughing and finishing feeds for the slowest bar of 214 and 40 rev. to 1 in. of travel respectively (0.00467 and 0.025 in. per rev.), and for the fastest bar of 320 and 60 rev. per inch of travel respectively

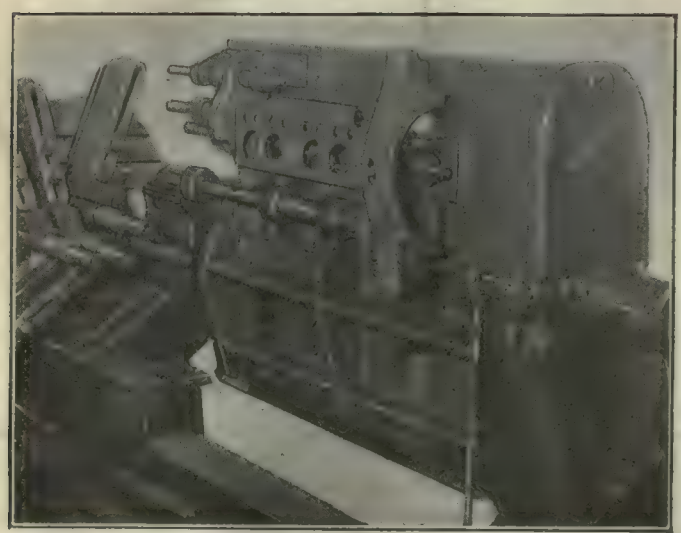


FIG. 2. SHOWING METHOD OF HOLDING THE CASES ON FIXTURE

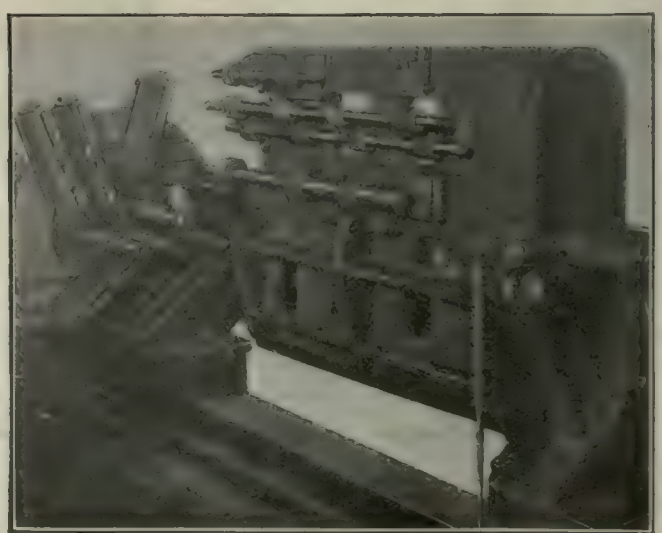


FIG. 3. FIXTURE WITH REAMING BARS IN PLACE

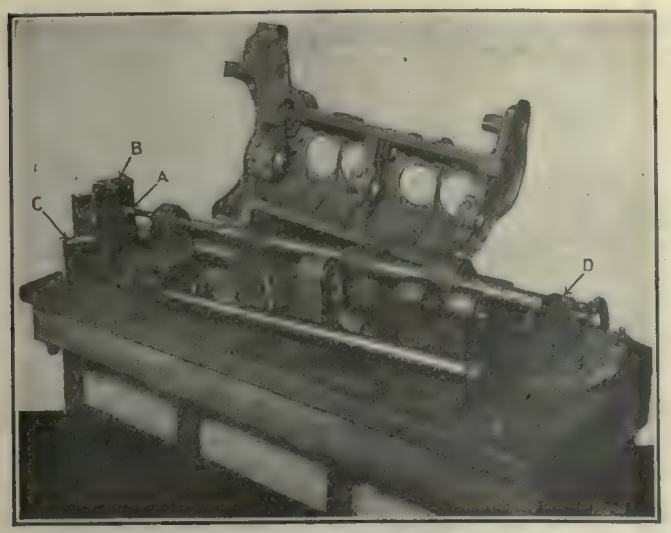


FIG. 4. SPECIAL FIXTURE FOR HAND REAMING THE BEARINGS

(0.0031 and 0.0166 in. per rev.). The bars are driven through universal joints, so that positive alignment of them with the drivers is not necessary.

A third cut is later taken through the bearings of the cases to finish them to still greater accuracy, and for this operation, which corresponds to hand reaming, the fixture shown in Fig. 4 has been devised. Special reamer bars are used for the work, they being guided in the fixture by hardened bushings in the same manner as on the power boring machine. A pneumatic drill motor is used for driving the bars. The large bars are given a uniform rate of feed, the threaded pilot-stud *A* on the forward end being inserted in the split bracket *B*, which is opened to receive the threaded section and then held close by the lever and spring *C*. A similar device *D* on the other end of the fixture feeds the other large boring bar, which is driven from the left end.

A Few Reasons Why Industrial Progress Is Slow

A splendid analysis outlining the causes for the slow progress of domestic business, is given by L. F. Loree, president of the Delaware and Hudson Co., in the Ninetieth Annual Report to Stockholders, published in the *Railway Age*, of April 30, 1920, from which the following is an extract:

The chief domestic obstacles to the resumption of progress are: (1) The extremely low purchasing power of money; (2) continued absorption of liquid capital of the Federal Government, and (3) excessive and badly adjusted taxation.

The average wholesale prices of all commodities in 1919 were 212 per cent compared with those of 1913, or an increase of 112 per cent. The total amount of money in circulation during the same periods, gold, gold certificates, silver and currency, was $3,363,738,449 and $5,960,382,866 (Jan. 1, 1920) respectively, an increase of only about 77 per cent. The statistics of bank clearings show, however, that the work done by the average monetary unit has been greatly increased, the comparison of total bank clearings being $50.48 and $71.48 for 1913 and 1919, these figures representing the average per $1 of money in circulation, which suggests the operation of an impulse toward higher prices other than the volume of money in use.

Of the total resources of the twelve Federal Reserve Banks, bills on hand on March 14, 1919, amounted to 40.94 per cent of the total resources and on March 12, 1910, they reached 47.78 per cent. Of these bills on hand there were secured, by Government war obligations, 79.23 per cent and 51.78 per cent respectively.

The foregoing shows progress mainly in the accumulation of resources and it is evident that a reduction in the year of but 10.95 per cent in the loans received by Federal war obligations is unsatisfactory. To the extent that the resources of these banks continue to be used to finance the Government they are withdrawn from the commercial field and the normal utility of the Federal Reserve system is impaired.

Taxation impinging principally upon potential saving has prevented the liquidation of a large proportion of these loans and has congealed assets that ought to be, and were intended to be, available for business purposes. Indeed, from whatever angle the present system of Federal taxation is approached, it is found to work badly, to penalize frugality and saving, to promote profligate and wasteful expenditure of capital and the normal course of industrial development. The Secretary of the Treasury of the United States has recommended changes which would relieve some of the most depressing features of the system, including the repeal of the "excess profits" tax and moderation of the surtaxes on individual incomes.

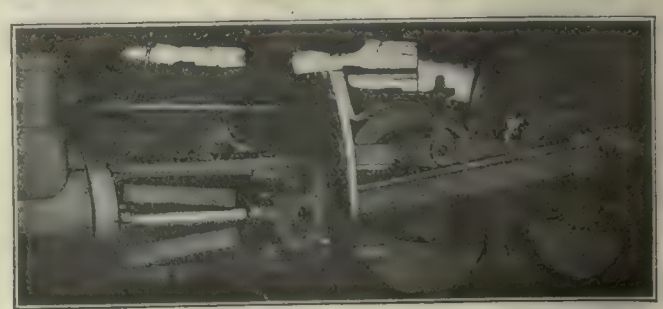
Easy Method of Disconnecting a Main Rod

By Harry Boham

Trouble is sometimes experienced in the roundhouse by reason of the front end of a locomotive main rod sticking in the crosshead when an attempt is made to disconnect it. It is caused by pieces of the sides of the rod, or of the inside of the crosshead, against which the rod oscillates, being torn off and wedged into the holes thus formed. The crosshead can not be loosened by prying or jacking or by other easily practicable means. excepting to remove the top guide bar and crosshead gib and then spread the crosshead with a wedge.

The illustration shows a method of blocking by which we are enabled to pull out the rod by steam pressure. In the engine shown the brakes are set, the reverse lever dropped into the forward motion, and the engine given a little steam; the crosshead comes out with a bang against the two hard wood blocks.

We leave about one or two inches of space between the crosshead and the blocks so there is no danger of breaking a cylinder head. This is a quick method, and is sure to bring the crosshead out.



DISCONNECTING A LOCOMOTIVE MAIN ROD BY STEAM PRESSURE

A Difficult Piece of Press Work

By FRANK A. STANLEY

The example of press work shown here is worthy of examination, as the required shape of the piece rendered its handling very awkward. The photographs show clearly the sequence of the operations and the dies used in cutting and bending.

THE sheet-steel piece, in Fig. 1 herewith, is a short tube of rectangular cross-section, but tapering from end to end and having numerous ears and flanges at various points along its contour. Several sets of press tools are required in its production, these being illustrated in Figs. 2, 4 and 5, and the flat blank produced in the dies being shown in Fig. 3.

The blank is struck from steel stock 0.062 in. thick. The dies, at the left in Fig. 2, are a set of tandem

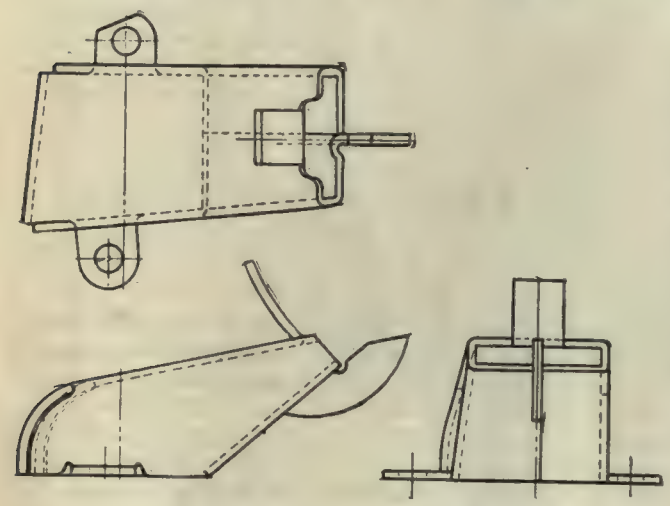


FIG. 1. DETAILS OF THE FORMED PIECE

tools, which at the first stroke pierce certain holes and openings, while the next position of the work and stroke of the press produce the blank shown in Fig. 3. The two round holes pierced by these dies are for the openings through the two small ears at the sides of the blank. In addition to the two round piercing punches there are four irregular punches for forming as many openings before blanking. These punches are really trimming tools in that they cut out the metal along the sides of the projections *A* and *B*, Fig. 3, and the adjoining surfaces in each direction, thus simplifying the work of the blanking die and assuring close accuracy at the points indicated.

The Bending Operations

The next operation is performed in the tools at the right in Fig. 2. These dies locate the blank by the important projections along its contour and at one stroke fold or bend up the ears *C* and *D*, referring to Fig. 3, and the hooked-shaped projection *E*, all of which must stand at right angles to the flat body of the blank. In this case the nest and the forming edges of the die are all made of separate blocks of steel located accurately on the die base by dowels and fastened from the upper side by fillister-head screws.

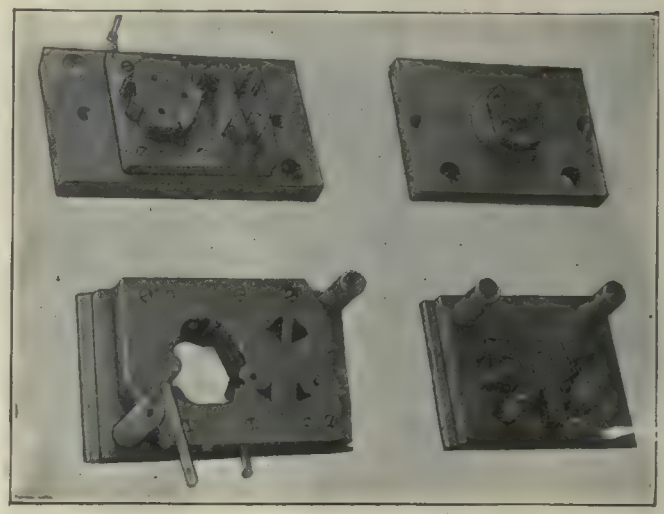


FIG. 2. THE FIRST AND SECOND OPERATION TOOLS

The next operation consists in forming along the dotted lines indicated in Fig. 3, thus throwing up the bottom walls *F* and *G* at right angles to the remaining triangular-shaped portion of the blank. The bending dies for this operation are at the left in Fig. 4, and, as there represented, are triangular in outline, with suitable nesting plates on the surface and with clearance holes in the die proper for the reception of the projections already bent up in the forming operation just completed.

The next operation, performed with the tools at the right in Fig. 4, is the forming down of the side walls and curved end at the back of the work. (See Fig. 1.) The forming punch with this set of tools is in the shape of a hook which, upon pressing the blank down into the forming-die opening, allows the work to fold up and almost completely enclose the hook punch itself, except for the shank by which it is attached to the

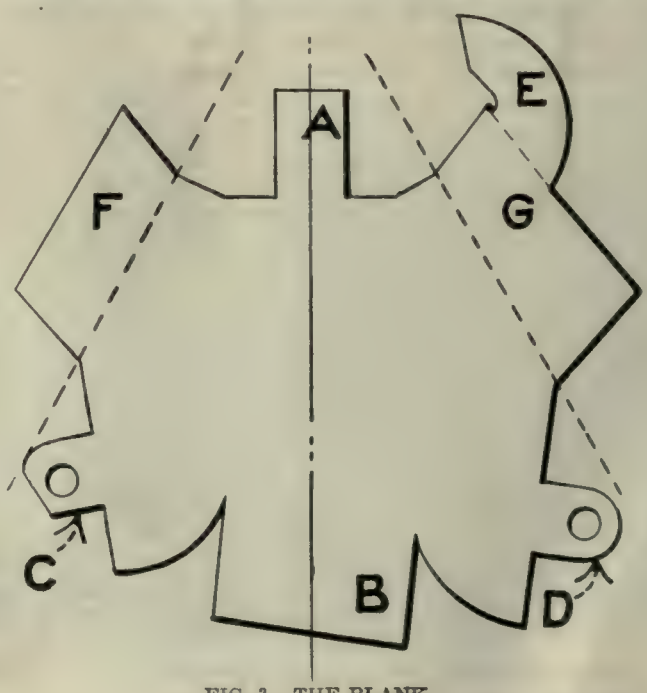


FIG. 3. THE BLANK

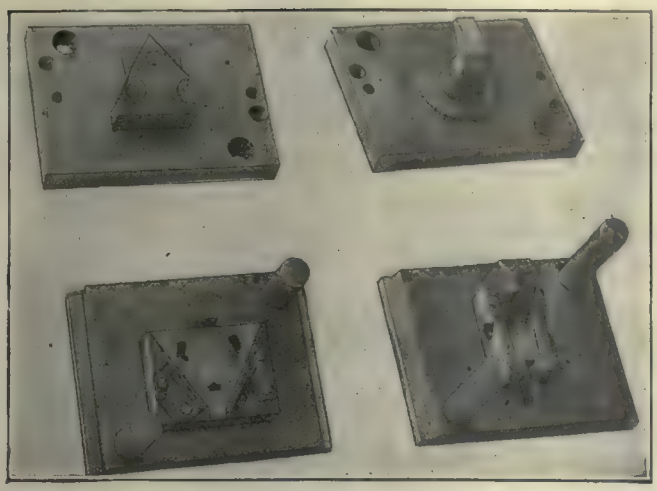


FIG. 4. TWO SETS OF FORMING AND BENDING TOOLS

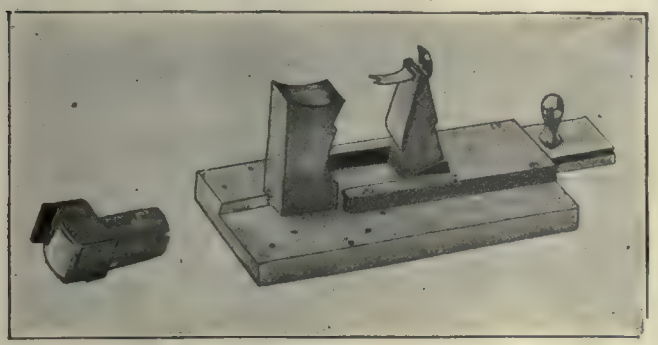


FIG. 5. THE FINISH FORMING DIES

die block. This punch, by the way, is worked down from a squared shank which is provided with a circular flange or seat by which it is fixed fast to the head.

The Final Forming Operations

This operation brings the work to a point where it is completed so far as the tapered form is concerned, but the rectangular projection *A*, Fig. 3, has still to be formed and bent to the desired angle and degree of curvature. For this operation the dies in Fig. 5 are used. The tool here shown is really a forming fixture having a movable carrier for the work, which is mounted upon a taper post, one of the pieces being shown in position. The post is attached to the carrier, which is in the form of a slide controlled by the handle at the right. This arrangement allows the operator to place the work in position and slide it under the punch without difficulty or delay. The punch is seen at the left. When it descends it bends the projection on the work down into the concave seat on the die block and sets it at the exact angle required with the walls of the work. The part made with these tools is a chute used on the coin machine manufactured by the American Coin Register Co., Oakland, Cal.

Campaign for Better Oiling

By W. Burr Bennett
President, Wayne Engineering Co., Honesdale, Pa.

Some time ago the executives of the plant under consideration realized that the repairs and replacements on their machine tools and equipment were entirely too large. An investigation showed that the lubrication was at fault. Although all machines were equipped with oil cups and holes for lubricating and oil cans and oil were plentifully provided, actually less than 10 per cent of the men gave the equipment under their charge regular and thorough oiling. It should be explained here that the maintenance department took care of all power-transmission apparatus and its lubrication, up to and including the countershafts, and that no fault was found with their attention to oiling.

Apparently, it was a case either of putting the lubrication of machinery and tools in the hands of the maintenance department, or of conducting an intensive educational campaign among the shop men. Due consideration showed the first of these solutions to be inadvisable. Accordingly a plan was outlined with the object of constantly bringing before each operator the need for attention to this matter and its direct relation to his own pay envelope.

There were four readily available ways of getting the message to the men: First, by direct coaching from the different foremen; Second, by notices posted on the machines; Third, by inserts in the pay envelope; and Fourth by notices on the bulletin boards. Supplementary to these methods, all shop papers such as time cards, shop orders, and requisitions were stamped with the legend: "Lubrication Is Important. Have You Oiled Your Machine Today?"

During the first week of the campaign, personal talks were given by the foremen and department heads to their men in order to show to them both the necessity for more care in the lubrication of machinery, and that the effect of having a machine shut down because of a dry bearing was to stop their work and thus cut the amount of their pay. It is to the credit of these foremen that they carried out their work so well that an improvement was noticed almost at once in the lubrication of equipment.

The second method was put into effect on Monday morning of the second week. When the men appeared on the job they found the following notice attached to all equipment: "STOP . . . THINK. Don't start work on this machine before you have properly oiled and carefully lubricated all parts. Don't forget to oil the jig, fixture, or vise you are using."

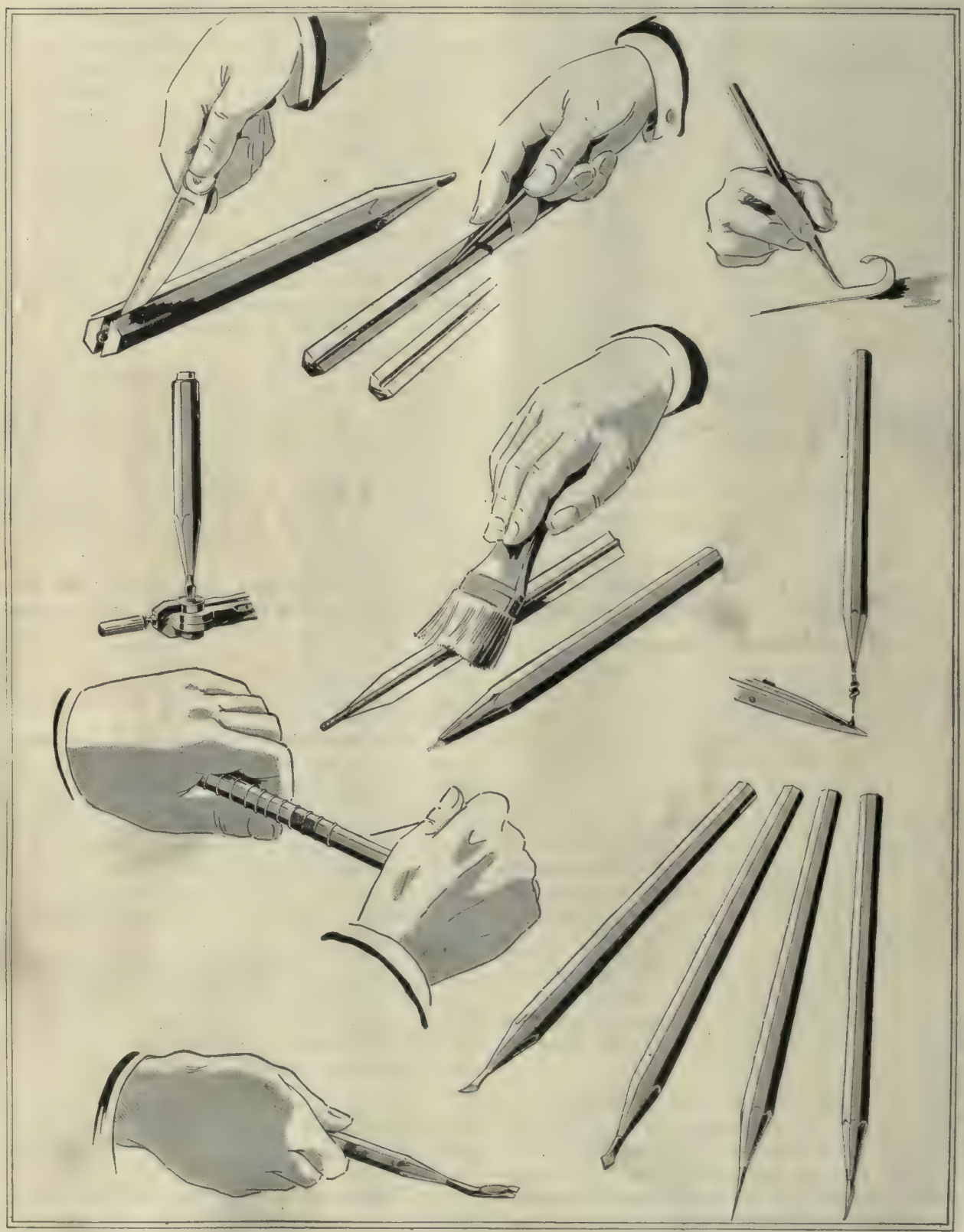
The third method was put into effect by providing inserts in the pay envelopes calling attention to the campaign that was going on and telling how much each person could help by taking proper care in lubricating his own equipment. The fourth method followed this and consisted of posting on the bulletin boards complete explanatory letters about the campaign and notices which read: "Oil Up—Lubricate Your Machine Often and Carefully. Watch both Production and Your Pay Envelope Increase."

By this time the improvement was marked and it was deemed desirable to end the campaign, with the exception of such features as periodic instructions and the use of the stamp on shop papers, which were made permanent. Therefore, the next week the men found the following note inserted in their pay envelope as a recognition of their co-operation and an acknowledgement that the results were satisfactory: "This Pay Was Made Possible by Your Careful Attention to the Oiling of Machinery. Thank You. Keep Up the Good Work."

It is interesting to note that the whole campaign required but very little effort on the part of the individuals directing it, although the results were large, dry and burnt bearings having practically disappeared. However, the consumption of oil increased about 50 per cent, but even this was cheaper than replacing metal.

FOR SMALL SHOPS *and* ALL SHOPS

By J. A. Lucas



Elements of Gage Making—IX

By C. A. MACREADY*

The accurate grinding of radii to the points of tangency is not a difficult matter if the proper fixtures are available. Such fixtures are described in this article together with instructions for their use.

(*Part VIII was published on page* 1101, *Vol.* 51.)

THE following way of grinding radii is often more convenient than by the use of a toolpost grinder or the grinding and milling attachment illustrated in Fig. 106. The plate *A* in Fig. 113 is made of ¼ x 4 in. flat ground stock, of a length which is convenient to swing the work. It is held by a screw *C* the head of which is flush with the top of the plate *A*, and a thin nut in the toolpost slot. The several different

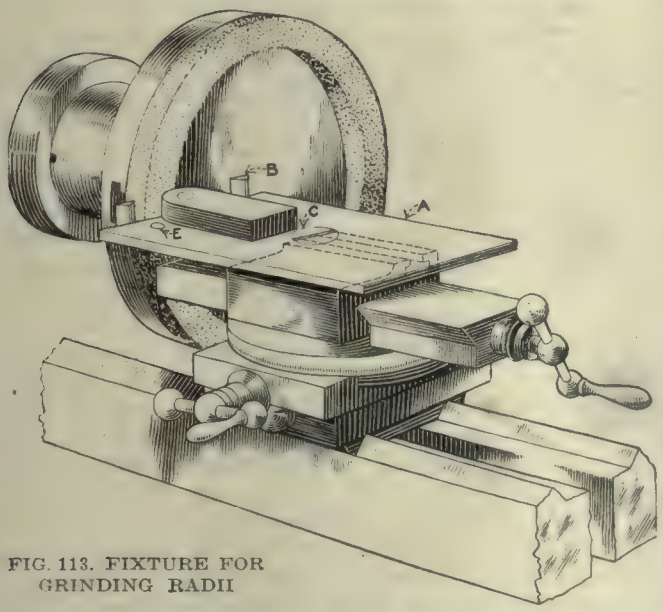


FIG. 113. FIXTURE FOR GRINDING RADII

holes *E* are placed to suit the radii wanted. The sizes of the holes will be governed by the length of the radii. They are often comparatively large as the work is frequently held by an auxiliary piece or adapter. This adapter if properly made serves as a base to check the radii. The plate *A* replacing the toolpost of a bench lathe and adjusted square vertically to the face of a cup wheel becomes a bed upon which the work is swung horizontally, using the proper hole for the center of the radius. The graduations upon the dial of the longitudinal screw are used when feeding up to the face of the cup wheel. The stops *BB* on the wheel end of the plate *A* will keep the sides of the gage from contact with the face of the wheel when grinding radii tangent to the sides of the gage. They should be nearly parallel to the face of the wheel and adjustable for different widths of gages. The following examples of the use of the plate *A*, and a few examples of adapters will make this way of grinding radii plain; Fig. 114 illustrates one of many gages that have been made by the use of this method.

*Prepared for the author's forthcoming book, Elements of Gage Making.

The gage *A*, gages two slots. It also gages a depth and two radii on the end *B*. The narrow gaging member *G* must be central with the large one *H* and parallel to it. The centers of the arcs are coincident making the required depth the difference in length of the radii. This gage provides an excellent example for study

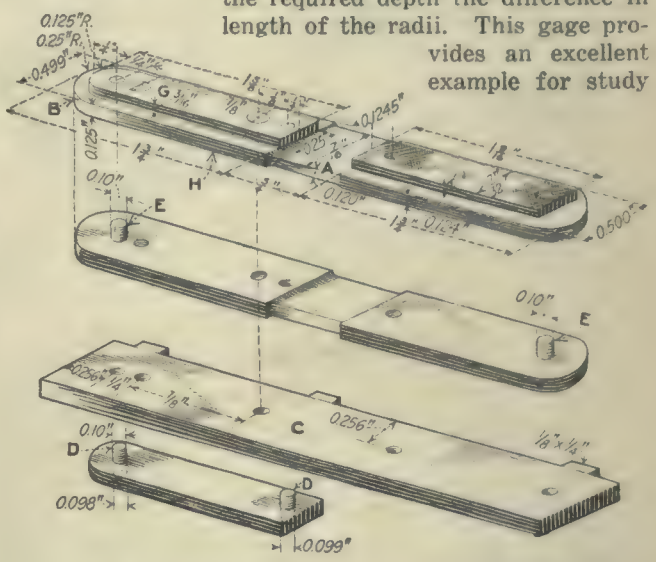
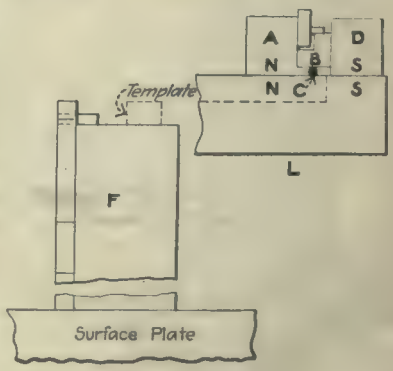


FIG. 115. A GAGE WITH THE RADIUS OFF CENTER

while determining how it should be made. The drawing shows the sides to be parallel but with a difference of 0.001 in. in width. The thickness of the broad part also differs 0.001 in., which shows that there is a maximum 0.0005 in. that is allowed for the slot in the work to be out of the center of the 0.500 in., the narrow part of the gage fitting the slot properly, as this is the important assembling point for the functioning of the parts.



As the end dowel-pin holes are the centers of the radii, they are the ones used to position the work for rough grinding the sides of the wide part of the gage, 0.500 in. Both dowel-pin holes in the 0.250 in. piece are used as locating points to equalize the sides of the piece. The checked narrow part can be ignored as it has plenty of clearance and acts as a grip when the gage is being used at the other end.

If there are more than one of these gages to be made a simple jig like *C* will save time, otherwise the holes, after being drilled in *A*,

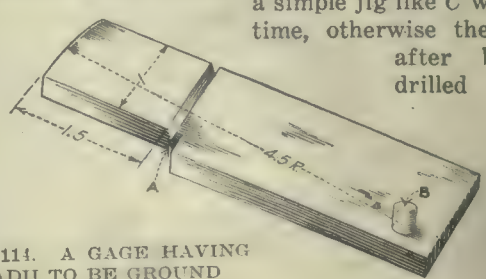


FIG. 114. A GAGE HAVING RADII TO BE GROUND

can be transferred from *A* to the top piece *G*, as it is not hardened. The holes in each hardened piece being the same center to center distance in their soft state usually will extend to their center distance when hardened. When the 0.250 in. pieces are drilled in the jig *C* the difference in their width and length from the 0.500 in.

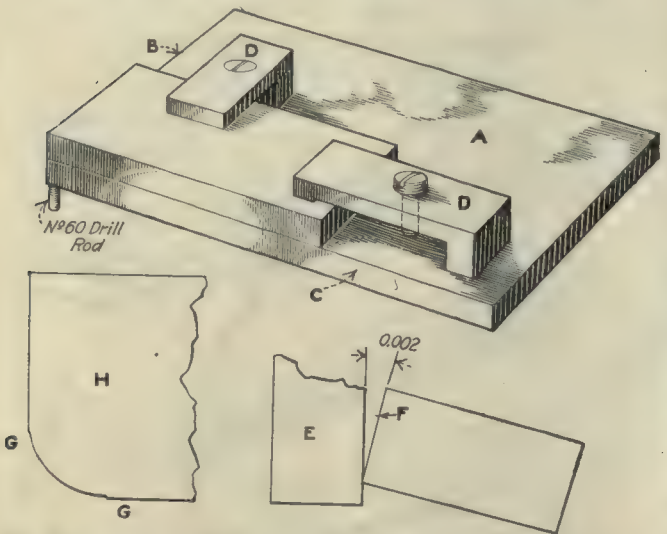


FIG. 116. ADAPTER FOR GRINDING AN OFF CENTER RADIUS WHEN THERE ARE NO HOLES IN THE WORK

pieces is made up with packing pieces. As these gages can be finished up independently of the other end, 0.012 in. on their sides and ends and 0.008 in. on their faces will be enough excess metal to leave for grinding.

After being hardened and heated sufficiently to melt soft solder they are rough ground parallel, leaving 0.001 in. for finishing on the 0.125 in. thickness. The sides of these pieces are not ground at this time. The thickness of the top pieces, given as $\frac{3}{16}$ in., not being important, they are finished. From now on they must be carried in pairs, that is, a top piece, 0.250 wide, is rough doweled to the lower gage, then attached to it with screws; the screws must be an easy fit in the thread, otherwise they will distort the thin piece or lower part of the gage, when tightened. The temporary dowels are now removed and the dowel-pin holes are lapped out using a drilling-machine spindle to rotate the lap. The use of a drilling-machine table if it is square with the spindle will usually correct the out of squareness due to grinding the pieces without wholly correcting the hardening distortions. As all the holes are lapped, one at a time, with the same size lap they will be approximately the same size. This is not necessary, but the bodies of the dowel pins which extend out from the gage should be of one size as shown in *D* and *E*. As the extending parts of these dowels are used to bed upon when grinding a surface parallel to them, the difference in their diameters will produce surfaces out of parallel an amount equal to twice the difference of their diameters. If there is a difference of 0.0002 in. the sides of the 0.25 in. piece will be out of parallel 0.0004 in. The four extending ends of the dowels which are used for the radii centers, if of one size, save readjusting the height gage when measurements are taken. Diagram *F* shows the work swinging upon the dowel pin, which rests upon an angle iron when measuring the distance from the center of the radius. The pieces with the temporary dowels in place as illustrated at *D* and *E* are now ground upon one of their sides using the principle shown in Fig. 71 and reproduced at *L*. The part *B* is the bed for the dowels to rest upon, connecting them with the S polepiece *D* and drill rod *C*. The 0.250 in. pieces are reversed and ground upon the opposite edges. This proves the diameter of the dowel pins. As the error should be slight it is corrected by lapping one side of the piece an amount equal to one-half of the error, this lapped surface was then used to bed upon the chuck when grinding the opposite side. When equalizing the sides from the dowel pins, use the dowel pin that will be used for the center of the radius in *E*, Fig. 114, as the sides of the 0.250 in. are the governing surfaces instead of the dowel pins when grinding the sides of the lower gage, to the 0.499 in. dimension, using the fixture *L*.

Before removing the dowel pins they should be used for the centers of the radii, a hole having been drilled in the plate *A* to receive them, the stops are now set to keep the sides of the gages from touching the face of the wheel. The dial is used to show the amount being removed, the correct radius is measured with a height gage, as shown at *F*, or by comparing with a templet and using an indicator.

The segments of circles are easily made with the fixture, Fig. 114. Fig. 115 shows a segment that is off center as dimensioned. A piece of flat ground stock is taken, which is long and wide enough to contain the center required. This piece of stock is nicked as shown at *A* to be broken off at this line after inspection of the radius and the location of the 1.0 in. dimension. This style of gage or templet is not machined very accurately in its soft state as it can be very easily ground after hardening to the desired dimensions by measuring from the drill rod *B* upon which it swings.

The adapter illustrated in Fig. 116, is one used when no holes are permitted in the gage. After the pivot pin, in this case No. 60 drill rod, is in place the edges *BC* of the adapter *A* are ground square to each other and the distance required from the center of the pivot for the radius. The work is placed in line with the edges *B* and *C* and held there with straps *DD*. The diagram *E* shows a plan view of the precautions taken to avoid striking the sides of the gage. The stops are adjusted to hold the work and adapter at a slight angle as shown at *F*. The face of the wheel should not be used too long in one spot as there will be a slight groove worn in it. Using different places on the face of the wheel will reduce the angle of clearance at *F* to a very small one so that the slight error shown exaggerated at *GG*, in diagram *H* can be corrected with

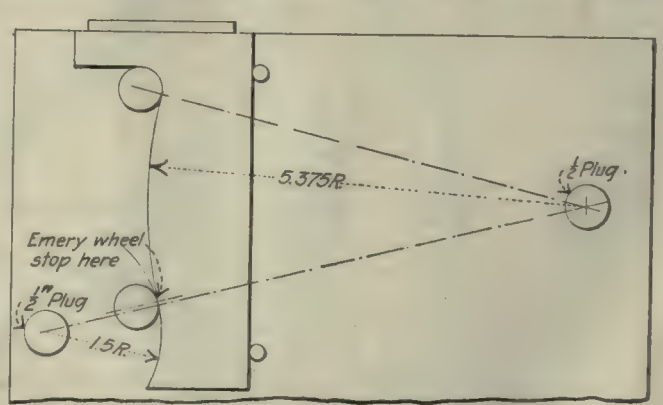


FIG. 117. DIAGRAM SHOWING DETERMINATION OF POINTS OF TANGENCY

an oilstone, or by lapping to a disk template. As all measurements are taken from a vertical point over the pivot this error will not interfere with measurements. The point of tangency if placed upon the gage when grinding radii facilitates the adjusting of the stops for the length of arc being ground. Fig. 117 illustrates a way of determining this point when the engine lathe is used to swing the work attached to the faceplate.

A line drawn through the center of the circles passes through the point of tangency and a line drawn upon the coppered surface of the gage to indicate where the wheel finishes, permits the arc-length control-stops upon the faceplate to be adjusted very accurately. This leaves very little to stone or lap for continuing the arc at each end. The male-arc templet if required can be made with the fixture illustrated in Fig. 113, and the female templet is ground out by using an internal grinding fixture in the lathe, should there be no internal grinding machine.

When lapping local spots and surfaces, which often has to be done on gages, the laps can be controlled easily with the pointed lap guide *A* in Fig. 118. The laps *B* and *C* show the controlling points, which are simply punch marks. These punch marks are placed to apply pressure where desired. Taking the depression in the gage *D* as an example, the pressure applied to a punch mark in the lap *B* or *C* will so distribute the lapping action that if only one side of the bottom requires to be lapped the pressure can be applied there and its surface caused to blend into the surface of the depression. This is made possible by locating the punch marks at varying distances from the center of the lap, wherever they are required.

This way of applying lapping pressure to gages of narrow cross section like gage *E* will overcome the rocking effect that often occurs when the gage overhangs the lap. The index finger and thumb are used merely to give the sweeping motion, the downward pressure being applied through the rod *A* held in the other hand.

When lapping parallel surfaces required in snap gages the adjustable taper wedges *F* and *G* in Fig. 119 are used. The taper wedge *F* is listed by the L. S. Starrett Co., which makes several sizes. The dotted lines indicate extensions that are soldered upon the tapered wedge, then ground parallel to each other. As these laps are only used to locate the high spots and finish-lap to size, the side overhang if not excessive will not be objectionable. When lapping snap gages that have the "Max" and "Min" on one surface, as shown at *H* in Fig. 118, the continuous surface is first finished to a plane surface using the pointed holder and laps similar to *BC*. The taper wedge is charged with abrasive upon only one of its surfaces, the other surface free from

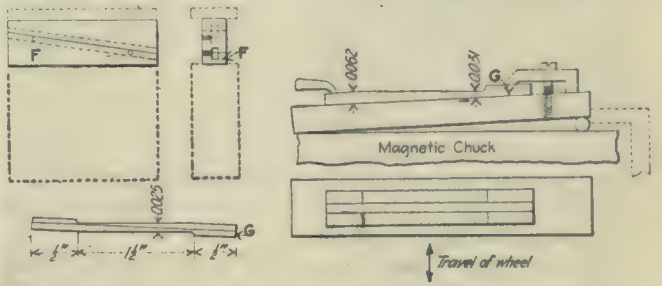


FIG. 119. TOOLS FOR LAPPING SNAP GAGES

abrasive is in contact with the finished surface of the snap gage. All lapping to size is done upon the "Max" and "Min" surfaces. When the jaws of snap gages are parallel both sides of the lap are charged with abrasive.

The taper wedge shown in *G* is made of soft sheet steel. Two strips are attached to a flat plate by straps. A piece of drill rod, of the required diameter to give the desired taper to the lap, is placed against the back pole of the magnetic chuck. The flat plate placed upon the drill rod allows the plate to be removed and the thickness of the lap measured and then replaced to the same position if more stock is required to be removed. There will be considerable distortion when rough grinding these laps but if they are stoned as described in Article VI, before the finish cuts are taken they can be produced very accurately. When using these thin laps do not try to *push* them through the slot. Always *pull* them through each way, using an up and down motion.

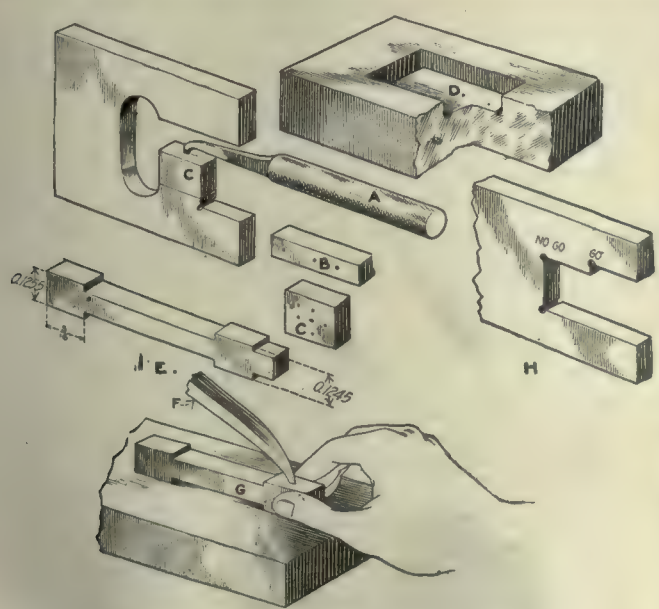


FIG. 118. METHODS OF LAPPING

What Is a High-Grade Machine?

By Francis W. Shaw
Manchester, England

How simple the question and how difficult the answer! I have thought considerably on the matter and I believe that the answer is still far off, although I seem to have no difficulty in judging to my own satisfaction the productions with which I am familiar.

The Ford car, for instance, I should never think of placing in the highest grade, or even in the moderate grade. The Rolls-Royce, however, would classify itself in the very highest grade. Yet, power for power, cost for cost, the Ford is undoubtedly the better value. For the comparative abuse it will stand, it is far ahead of the costlier car. What is it, then, that compels this grading difference? Finish, comfort, appearance? Perhaps so, but after all, surely it would be more logical to classify according to suitability to purpose. If we so classified the two cars, they would both fall into the highest grade.

Now let us consider machine tools, which are more within the writer's knowledge. Years ago I had the experience and the pleasure of operating two lathes at

the same time. One was a high-grade, so-called, English machine, the other was an American machine with a moderate reputation. Both were intended for accurate work. The English machine was heavier than the American, its price proportionately larger.

The Writer's Experience

This was my experience: On the vast majority of work the output from the American machine was far ahead of that from the English. Why? The English machine was more cumbersome to handle. To move the saddle along the bed was more fatiguing. To get the tool to the proper cutting height and in a convenient position for cutting, occupied more time, for the tool-slide was cursed with the four-stud arrangement, in which one or more studs prevented the tool from being fixed just where it would best do the job. The saddle was broader, and that often limited the traverse along the bed, making it necessary to move the tool from one side of the toolrest to the other.

Furthermore, when it came to getting metal away rapidly the English machine, though the stronger built, was out of it entirely, although had our cutting tools been of the carbon-steel variety perhaps the case would have been different. It was utterly impossible to get high spindle speeds with sufficiently fine feeds on the English lathe. Bearings ran hot at very moderate speeds. Perhaps some of the difference was due to the American lathe spindle running in babbitt-metal bearings. The makers of the English lathe seemed to make a point of the bearings being of the best phosphor-bronze—as most do even to this day. In this connection it is perhaps worth pointing out, that after several years of service, it was possible to tighten the spindle of the American lathe by a squeeze at the capscrews, but there seemed to have been no wear at all. (An English toolmaker who recently replaced bronze bearings with babbitt-steel bearings was enabled to put up the highest spindle speed from 300 r.p.m. to 500 r.p.m. after the change.)

Marks of Quality in English Machines

But there were many points which some would claim as virtues in the English machine. Materials were generally harder. One could hit the lathe bed with a spanner without bruising it. An extra pound pull at a lever or spanner would not fracture a bolt. The headstock caps were secured with large-diameter studs and nuts, whereas the American manufacturer had contented himself with small cheese-head screws. You could even clear the cuttings from a file by rapping it on the tailstock without shattering the filling and spoiling the paint. The castings themselves were smoother in the English machine and filling was therefore not so necessary for finish.

Now in the hands of English workmen accustomed to English machines the English lathe would undoubtedly have given more satisfaction than the American. The writer, however, had proved to himself the value of the high speeds and fine feeds over low speeds and coarse feeds, and as a consequence could appreciate the differences in the two machines. This is a case from which it is impossible to draw a definite conclusion. From my own experience, the characterization would be: American lathe, high-grade; English lathe, second-grade.

Many English workmen with different experience would reverse the classification.

At one time when a German woodworker's vise had just arrived in our shop our experts immediately placed it in the lowest possible category, for it was a thoroughly ram-shackle affair. Materials were rough and badly finished; there was a slackness of fit everywhere. A wire nail, bent over, formed a retainer for a spring; there was not a bit of polish anywhere and only one coat of dull gray paint. In use, however, it was a perfect tool.

Now all these points, which to our experts were deemed adverse, to the writer appeared meritorious. A wire-nail used at a point where it would not be seen when the vise was in service, since it had afforded a means of reducing the cost, constituted a feature of real merit.

Our way of securing the spring would have been by a screwed thimble or something equally expensive. Our method of setting high-gradeness—trimming, painting elaborately and polishing—would have doubled the cost and compelled the woodworker to have bought and used a far less efficient vise. Here perfection in use for the lowest cost were the features constituting high-gradeness—another example of the Ford principle.

Workmanship and Its Utility

Sloppy fits come under the ban of some engineers. Here is an instance where they improved a high-grade machine. One unit of a machine was of complex construction. Shafts ran in hollow shafts, which in turn ran in thin bronze bushes driven in position. There were numerous bearings, and all parts were made to standard limits quite suitable for most ordinary work.

Not unnaturally, when the parts were assembled, little dis-alignments here and there, the collapse of bushes in driving in, small eccentricities in cylindrical parts, together resulted in all running fits coming tight. At the running test numerous troubles were encountered. After a short run the driving belt would come off with a squeak—something had seized. The fitters then paid the machine a visit, dismantled the seized parts, often with difficulty, scraped bearings, had shafts re-ground and so on. And not infrequently, after re-assembling the trouble occurred again, sometimes several times. By degrees, not a few thousandths freedom, additional to the amount presumed correct, were obtained.

This trouble went on for several months, until some bright mind suggested that, since by correction additional play was secured, it might be as well to start out with the extra freedom. Following this hint, a different standard of running fits with larger allowances was introduced, and the trouble practically vanished. Yet, when the assemblers noted the shake of part on part, when these were being assembled, they expressed the opinion that the job was spoiled, and several thought that the proper way to a solution lay in the scraping of part to part.

Since time has proved the cure to be good, would one be justified in claiming for the machine equal perfection of grade to those formerly carefully fitted? I believe he would, yet there are many mechanics who would claim the opposite, despite the fact that the alternative would have involved the expenditure of labor to no good ultimate purpose. The whole question can only be answered by first replying to the question: "What do we mean by high-grade?" Define that term—the definition may be diverse—and the reply will be contained in the definition.

Composition of Stellite and Stainless Steel

By ELWOOD HAYNES,
President, Haynes Stellite Co.

This article treats of alloys of chromium with iron or cobalt, some facts about what appears to be the earliest experimentation with these alloys being given. Practical considerations concerning the constitution, manufacture, and uses of stellite and stainless steel are discussed.

THE THREE metals, iron, nickel, and cobalt, are termed by chemists the "metals of the iron group." The reason for classifying them thus is the fact that their respective properties are all quite similar.

1. They are all distinctly malleable.
2. They are all distinctly magnetic.
3. They possess high tensile strength and high modulus of elasticity.
4. When pure, they take a high polish and show a distinct metallic luster.

They also resemble one another in their chemical properties.

1. Each is readily soluble in nitric acid.
2. Each forms a monoxide with oxygen, as FeO, NiO, and CoO. Each also forms a sesquioxide, Fe_2O_3, Ni_2O_3, and Co_2O_3.
3. Aqueous solutions of their chlorides, when evaporated to dryness, are transformed into oxides.
4. Their oxides are all readily reduced by either carbon monoxide or hydrogen.
5. Their melting points coincide quite closely.
6. Their atomic weights are quite close together, that of iron being 56, and those of cobalt and nickel approximately 59.

When solutions of cobalt and nickel are mixed, it is difficult to separate the metals one from the other, owing to the fact that their behavior under most precipitants is practically the same.

In 1899, the writer produced an alloy consisting of practically pure nickel and pure chromium by heating their mixed oxides with aluminum. This alloy, when polished, retained its luster, even in the atmosphere of a chemical laboratory, and proved to be practically insoluble in nitric acid, even when boiling. It is also malleable when cold, and under proper annealing can be worked into sheets and wire.

Shortly afterward, an alloy of cobalt and chromium was produced, which not only showed the same untarnishable properties as the nickel-chrome alloy, but possessed much greater hardness. The alloy could not be worked to any extent cold, but was found to be malleable at a bright orange heat.

It was not until 1906 that the alloy was produced in sufficient quantity to determine its properties fully. In 1909, a cutting blade was made of the alloy, which took an edge comparable to that of tempered steel.

Later, tungsten or molybdenum was added, and the alloy thus produced was sufficiently hard to turn iron and steel on the lathe. Later experiments demonstrated that such alloys when properly formed, would scratch any steel, and would stand up under much higher speeds on the lathe than the best high-speed steel tools. This fact gave the cobalt-chromium-tungsten alloy termed stellite a field of its own, and placed it in a class by itself as a material for high-speed tools.

Generally speaking, the cobalt-chromium alloys possess three distinctive properties, namely:

1. They are untarnishable under all atmospheric conditions, and immune to nearly all chemical reagents.
2. They possess great hardness.
3. They retain their hardness up to visible redness.

Some of the stellite articles for ordinary use are formed from alloys of cobalt and chromium only. This alloy answers well for table knives, spoons, etc. The harder edge tools, such as pocket-knives, surgical instruments, etc., contain in addition to cobalt and chromium a certain amount of tungsten to give them greater hardness, while in other instances a certain amount of iron is introduced into the alloy to soften it so that it may be more readily worked. Such articles include table-knife blades, pocket-knife handles, certain dental instruments, etc. When iron is added to the alloy, the resulting mixture is termed "Festel metal," being made up from the chemical symbol for iron (Fe) and the first syllable of stellite.

This beautiful and easily workable alloy is well adapted to the manufacture of fine door latches, door-knobs, and high-class sanitary fittings for bath-rooms, lavatories, etc. It is not malleable except at a bright red heat, but when a certain portion of nickel is added it may be worked cold on the lathe or under the file. By suitable means, it can be given a beautiful stippled surface resembling that of frosted silver, and retains its luster in the most satisfactory manner.

Some of the later stellite alloys have shown most remarkable resistance to chemical reagents. One of these, possessing quite high chromium, takes a magnificent polish, resembling that of burnished silver. This alloy retains its luster perfectly in boiling aqua regia, and is not affected in the slightest degree after immersion in that liquid for a period of 14 days. It is slowly attacked by cold hydrochloric acid, but is practically immune to cold, strong sulphuric acid, and nearly immune to the same acid in the diluted form. It is of course strictly immune to nitric acid of all strengths.

Balance weights made of this material retain their luster under the most trying conditions. They are immune not only to the ordinary fumes of the atmosphere, such as hydrochloric acid, ammonium chloride, nitric acid, hydrogen sulphide, etc., but even to moist chlorine gas. They present a beautiful appearance, owing to their superb luster, and are so hard that their loss from ordinary wear will be perhaps unweighable for several years. There seems to be no good reason why they would not answer equally as well as the more expensive platino-iridium alloys for standard weights and measures.

In the year 1911, I made experiments on alloys of iron and chromium with a view to ascertaining definitely their properties. I quote from my notes as follows:

*Taken from paper presented before the Engineers Society of Western Pennsylvania.

November 15, 1911. While I have known for some time that chromium, when added to iron or steel, influences or modifies their properties in a marked degree, I am now engaged in gaining a definite knowledge of.

a. The effect of chromium on the resistance of steel and iron to chemical and atmospheric influences.
b. The effect of chromium on the hardness of iron and steel.
c. The effect of chromium on the elasticity of iron and steel.
d. The effect of chromium on the cutting qualities of iron and steel.

The preliminary experiments which I have already made along this line indicate that the effect of chromium on iron and steel is much the same as on cobalt and nickel.

I have prepared the following alloys:

a. Alloy 20-C. 79.4% iron, 20% chromium, 6% carbon.
b. Alloy 15-C. 84.4% iron, 15% chromium, 6% carbon.
e. Alloy 5-C. 95.0% iron, 5% chromium.
f. Alloy 10-C. 90.0% iron, 10% chromium.
g. Alloy 15-C. 85.0% iron, 15% chromium.
h. Alloy 20-C. 80.0% iron, 20% chromium.

A number of additional experiments were made during the following winter, and the following was recorded later:

April 2, 1912. A sample of chrome iron was made by melting granulated iron, 100 grams; chromium, 17 g.; ferro-titanium, 2 g. The metal fused perfectly and was very fluid. Just before pouring, about 1 g. of manganese was added. The two bars weighed 118 g. The $\frac{5}{16}$-in square bar was forged into a thin edge, which was quite hard and elastic.

April 3, 1912. Fused 100 g. iron, 17 g. chromium, 2 g. ferro-titanium, 3 g. calcium carbide, in a covered crucible same as above. The bars weighed 118 g. The $\frac{5}{16}$-in. bar was hammered into a cold chisel, which would cut iron and soft steel. It was very difficult to file. It should contain about 1 per cent carbon. It did not seem to differ much in hardness from the sample F-2. The crucible was deeply eroded inside, which was no doubt due to the lime from the calcium carbide.

Experiment H-2. Fused iron, 100 g.; chromium, 17 g.; carbon, 2 g.; ferro-titanium, 2 g.; in a covered clay crucible.

The bars were not weighed, but the metal poured clean. The $\frac{5}{16}$-in. bar was forged into a cold chisel. It seemed somewhat harder than the preceding. It forged well, but showed a very small crack at the chisel end, which was ground out before the forging was completed. The chisel showed excellent cutting qualities. It would nick ordinary stellite with but little effect on the edge.

The chisel end was heated to about 800° C., and quenched in water. This seemed to harden it to some extent and if pressed hard it would just scratch glass. It takes a fine polish but shows rather dark color. It is not acted upon by cold nitric acid, either strong or diluted, and the acid shows only slight residue when evaporated to dryness on the surface of the metal.

April 4, 1912. Eighty g. iron, 15 g. chromium, 4.5 g. molybdenum, 2 g. ferro-titanium were melted in a covered crucible. The $\frac{5}{16}$-in. bar was forged to a cold chisel edge. It would cut nails, etc., very well indeed. It seemed also to harden considerably when heated to an orange color and dipped into water. It was afterwards made into a wood chisel which took a keen edge and showed fine cutting qualities.

April 8, 1912. Two $\frac{3}{4}$ in. square by 11 in. bars were cast, one from mixture F-2, and one from mixture H-2.

Each bar was manufactured into boring bits by the Rockford Bit Works.

Two bits were obtained from each bar and one from H-2 was broken and one from F-2 was "lost" going through.

These bits were $\frac{3}{4}$ in. in diameter and about 10 in. long. Just before finishing they were annealed in lead which rendered them sufficiently soft to be filed. They were afterward reheated and allowed to cool in the air, when they became so hard that a file had but little effect upon them. They would bore wood fully as well if not better than an ordinary bit. They hold their luster in the air under all conditions.

In order to make sure that such alloys were unknown at this time, letters were written to practically all the large steel producers of the United States, asking for a non-rusting or non-tarnishing iron or steel alloy, but the replies received were all of a negative character, and showed that no such alloy existed, but suggested the possible use of alloys of nickel and iron, but in no case was chrome-iron or chrome-steel even mentioned.

The experiments recorded above distinctly show that the non-corrosive qualities of chrome-iron and chrome-steel alloys were not only discovered by the writer at the time specified, but that their physical properties were also fully demonstrated.

It is perhaps proper to state in this connection, however, that the discovery rests not on the possibility of adding to the steel other elements which may render it more or less immune to corrosion, more or less easily workable, but upon the fact that immune chrome-steels must contain more than 8 per cent chromium. For certain purposes they may contain much more than that amount, even up to 60 per cent; such steels are distinctly workable and useful, whether subjected to heat-treatment or not. Furthermore, that the proportion of carbon may be raised as high as 2 per cent without materially interfering with the untarnishable qualities of the alloy, though such alloys are, generally speaking, more easily worked if the carbon is below 1 per cent.

Numerous metals may be added to stainless or rustless steel, and some of these may contribute slight benefit, while others may be slightly detrimental. Among these are nickel, cobalt, vanadium, silicon, boron, tungsten, molybdenum, titanium, and tantalum. It is evident that an indefinite number of alloys could be thus formed, some with and some without the above elements, but none would be stainless unless it contained the proper amount of chrominum, which is the essential element to be added to nickel, cobalt, or iron to produce a stainless alloy.

Constitution and Manufacture of Stainless or Rustless Steel.

Stainless or rustless steel consists essentially of an alloy of iron and chromium, containing usually from 0.1 to 1 per cent of carbon, though the latter element may be present up to nearly 2 per cent without interfering seriously with the working qualities of the steel.

Owing to the high percentage of chromium and its tendency to oxidize at the melting point, even in the presence of carbon, it has been found advisable to melt the steel either in crucibles or in the electric furnace. After melting, the metal may be poured into ingot molds in the usual manner, and the ingots thus obtained may be forged or rolled into bars or sheets. If the ingots are of comparatively small size, they will be found to be very hard after casting, especially if they have been stripped hot and allowed to cool rather rapidly in the air. Indeed, small bars thus produced are likely to be almost file hard.

If a small piece of the steel thus produced be placed in a beaker with a piece of ordinary steel and covered with nitric acid, the ordinary carbon steel will be dissolved with great violence while the chrome-steel will remain utterly unchanged, thus proving that its immunity is primarily due to its composition. This is true whether the steel contains carbon in large or only minute quantities.

Cold chisels cast in iron or graphite ingot molds are sufficiently hard, without tempering, to cut ordinary iron or steel.

By heating cast bars to a bright orange temperature, they can be forged readily into various forms. After the forging is completed, the metal may be allowed to cool in the air, and will be found to possess remarkably fine grain and good cutting qualities.

Quenching in water enhances the hardness to a considerable degree, practicularly if the steel contains more than 0.4 per cent carbon. It is best, however, to use oil for quenching, in order to avoid local contraction stress in the finished article, which might cause it to break under slight shock or jar.

Notwithstanding the comparatively high temperature of working this steel, the bars show almost no scale during the forging operation and when finished are covered with a blue-black "skin" consisting of a thin film of oxide. Owing to the absence of deep oxidation and resistance to deformation at comparatively high temperatures, the alloy is admirably suited for casting engine valves and distilling apparatus, and for many other purposes of like nature. When ground and polished, the alloy resists tarnish to a remarkable degree. It is superior in this respect to brass, copper, and nickel plate.

Cutting Cast Iron With the Gas Torch

IN A PAPER read before the American Welding Society, April 22, 1920, Stuart Plumley and F. J. Napolitan, of the Davis-Bournonville Co., outlined some of their experiments in relation to the cutting of cast iron with a gas torch.

They said in part: "While we are rather skeptical of the commercial value of a cast-iron cutting torch, and are convinced that, financially, we shall never be repaid for the expense of our experiments, yet there are undoubtedly occasions when the cutting of cast iron would be of great value. In ordinary scrap-yard work, it is so easy to break cast iron that it would hardly be economic to use the cutting torch as for steel.

"You are all aware, of course, of that application of oxygen cutting used largely in blast furnace practice, the opening of a 'frozen' top hole. You could not quite reconcile this more or less common application of the process with the pet theory that cast iron could not be cut. One of the usual methods for releasing a frozen top hole in a blast furnace is substantially as follows: A piece of one-quarter inch iron pipe with a brass handle at least ten feet long is attached to a manifold of several oxygen cylinders. Oxygen is delivered through this pipe at a pressure of approximately 100 lb. per sq.in. A hole is started with a star drill or diamond point, until it is about three inches deep. The metal adjacent the hole is heated with a fuel oil burner or by other means. The end of the iron pipe is ignited and the composite stream of molten iron slag and oxygen caused to impinge against the frozen cast iron.

"A spectator to this performance of infernal fury, is readily convinced that the heat is not all due to the combustion of the wrought iron pipe, but that the cast iron is burning with a violence equal to that of steel. This reaction inspired some inventors to incorporate a device in an oxy-acetylene torch for cutting cast iron, which would feed a steel wire between the cutting jet and the cast-iron piece being cut. Ignition of the wire carried a stream of molten slag on to the cast iron and it was hoped thus to propagate the cut. In a second process, a plate of steel of a definite and predetermined thickness, was placed on top of the cast iron. It was hoped that the slag incidental to the oxidation of the steel would exercise some influence over the cast iron and enable it to be cut.

"Unfortunately for those responsible for the exploitation of these devices, the inventors were more concerned with converting cast iron into iron oxide by means of the oxy-acetylene torch than they were in constructing a practical process and a practical tool. It was next proposed to simplify the reaction by supplying an apparatus with a mixture of pulverized slag and iron powder, and in fact a number of patents were issued covering various applications of such a device. Crude and elementary as such devices were, they actually produced combustion of the cast iron and went a long way in stimulating us in our endeavors to find a successful method.

"Experimental work was carried on with a torch having a good many different tubes leading to the head so that almost any combination of gases at varied pressures might be obtained. Mr. Napolitan evolved from these experiments interesting theories pertaining to the reactions which take place in cutting, together with their relation to success in cutting cast iron. He has noted these theories in a separate paper. We are presenting these theories to the members of the society for what they are worth. We can actually cut cast iron and we do it by *preheating the oxygen.*"

In the paper prepared by Mr. Napolitan, he said: "From the ease with which wrought iron is cut we may conclude that an aggregate of ferrite combines with oxygen with greatest avidity, and permits the propagation of a cut with least interruption. As the carbon content is increased, there is a material change in the nature of the metal. In place of the preponderance of ferrite grains, we recognize the formation of cementite, and its union with some of the ferrite to form pearlite—the original mass of pro-eutectoid ferrite rapidly diminishing in prominence. As we should anticipate from the nature of pearlite, no material change is noticed in the performance of these alloys under the cutting torch. Of course, an ultra-precise consumption test would probably indicate a lowering of the efficiency coefficient, but from all appearances no unusual difficulty is experienced in cutting carbon steels up to about 80 to 90 point carbon. But here, a definite transition is indicated by a distinct laboring of the cutting torch. While the torch will begin a cut with practically the same effort, and proceeds to completion without interruption of unusual delay, yet the kerf is wide and ragged and undeniably distinguishable from that of a mild steel cut. It is recognized practice, now, to preheat the piece to be cut to a black or dull red heat, when the impediment, whatever it was, seems to have been entirely eliminated.

"But let metallography explain the sudden change of properties of the steel. As the carbon content of the hyper-eutectic steel was increased, the proximate mass of pearlite increased, and the pro-eutectoid ferrite correspondingly diminished in volume, until eventually a point was reached where all of the cementite and ferrite existed in the stratified or laminated relationship of pearlite. This state is recognized as existing where the carbon content is between 80 and 90 points—the approximate analysis of pearlite is yet undefined. As the carbon content is further increased, there appears a constituent that we know as pro-eutectoid cementite—in fancy, the cementite which has been ejected from the pearlite growth. It is circumstantial that the presence of this pro-eutectoid cementite is directly responsible for the increasing difficulty of our cutting. But why did preheating of the steel before cutting make such a remarkable difference in the results? To be sure, the rise in temperature might affect the stability of any martensite, troostite, or even sorbite that might have existed, but the temperature was too far removed from the Ac_{321} point to affect the characteristics of the pearlite. And surely the pro-eutectoid cementite was unchanged—and it was this same constituent that we blamed for the difficulty.

"Again, as the carbon content is substantially increased, an equivalent interference with cutting is apparent, until, when the carbon content approaches 2.5 per cent, cutting becomes so labored as practically to cease, and no amount of preheating short of incipient fusion will permit it to propagate. As you are aware, the metal is now termed "cast iron," and a micro-

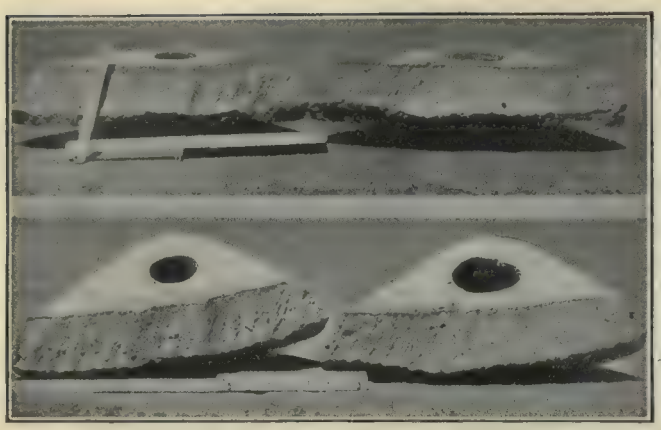


FIG. 1. FOUR CORNERS OF LARGE CAST-IRON STONE CRUSHER HEAD BEVELED WITH CUTTING TORCH FOR WELDING

analysis indicates that in addition to the presence of a certain amount of pearlite and pro-eutectoid cementite, as well as certain foreign and, to our discussion, unobtrusive substances, we recognize the presence of the final and most stable state of carbon—graphite. The pearlite constituent exercises a favorable influence upon the operation of cutting—and the pro-eutectoid cementite, while it impedes cutting, is readily compensated by a slight preheating—but the graphite presents an entirely new problem.

"We might digress from the subject enough to present some remarks that would prove the fallacy of at least one of the stereotyped explanations of why cast iron cannot be cut—that the melting point of the slag is appreciably higher than the melting point of cast iron.

A micro-analysis of the structure of an average cast iron—and by average we refer to a gray cast iron of about three to four per cent carbon—would indicate a structure identical with that of a hypothetical steel of the same carbon content, except that some of the carbon seems to have been precipitated as graphite. But should that identical pour of cast iron have been cast against a cold iron mold, or otherwise chilled, the carbon would not have been precipitated as graphite and we should have had what we shall call a "chilled cast iron," or a "white cast iron,"—and it would actually have been a hyper-eutectic steel. Such alloys are not uncommon in commerce, and the fact that operators have been able to cut them with no extraordinary effort has been responsible for innumerable false claims that cast iron has been cut. Unfortunately, the nomenclature of steels and irons is not clearly defined, and undoubtedly a chilled cast iron is but an extension of the hyper-eutectic series. The melting point of an iron-carbon alloy is a constant of its composition, whether, in the solid state, the metal exists as a typical cast iron or as a steel. Long before the point of fusion, the carbon and the iron exist in one relationship, that of austenite. The conditions affecting the pouring of a melt of cast iron would determine the final state of its constituents—and we might as readily produce a gray cast iron or a chilled white cast iron—the carbon as graphite or the carbon as in cementite. In either event, the melting points of the resulting products would be identical. We agree that chilled cast iron can be cut with comparative ease. It is evident, then, that the melting point of slag is not responsible for the difficulty encountered in cutting cast iron.

"We had concluded that while the existence of pro-eutectoid cementite appreciably retarded cutting, the presence of but a comparatively small amount of graphite completely prevented cutting. The phenomenon, if it were true, is unique, for it would pre-suppose the incombustibility of carbon. Science contradicts us immediately. In fact, our own welding practice belies us. We might point to the reaction accompanying the removal of carbon from automotive cylinders by the oxygen method—or, leaving our immediate field, we might mention the explosive combustion of carbon in ordinary gun-powder. We are forced to conclude then that, far from retarding the combustion of the steel matrix, the graphite of cast iron should actually assist it.

"We investigated further to determine how much graphite influenced cutting. We obtained specimens of so-called malleable castings of the characteristic 'black heart' structure. Such a structure is made in this country by the annealing of white cast iron in which all of the carbon exists in cementite or pearlite, the latter in some cases entirely removed. The treatment decomposes the cementite to precipitate the carbon in minute particles, differing from the graphite of gray cast iron in their extreme subdivision and uniform distribution throughout a ferrite matrix. In making a black heart casting, an oxidizing packing is used in this country so that while the core is that of a black heart casting, the mass near to the surface is ferrite. We removed this shell of ferrite so that our materials indicated, under the microscope, a uniform aggregate of ferrite and temper carbon. By preheating this piece to a dull red heat, it was cut with the characteristics of a high-carbon steel. Then we were satisfied that carbon as such did not prevent cutting, but that the physical state of that carbon was responsible. As plates of graphite, cutting was prevented; but as finely divided particles, cutting was scarcely impeded.

"Reconsidering our previous observations in the light of this development, we began to substantiate our first logical hypothesis. We found, to summarize, that ferrite permitted most readily to be cut. Pearlite with pro-eutectoid ferrite did not materially affect the conditions. A completely eutectic composition first suggested a transitory stage. The existence of pro-eutectoid cementite retarding cutting; but preheating of the piece to a red heat readjusted the conditions so that cutting was again as efficient as in the case of ferrite. As the

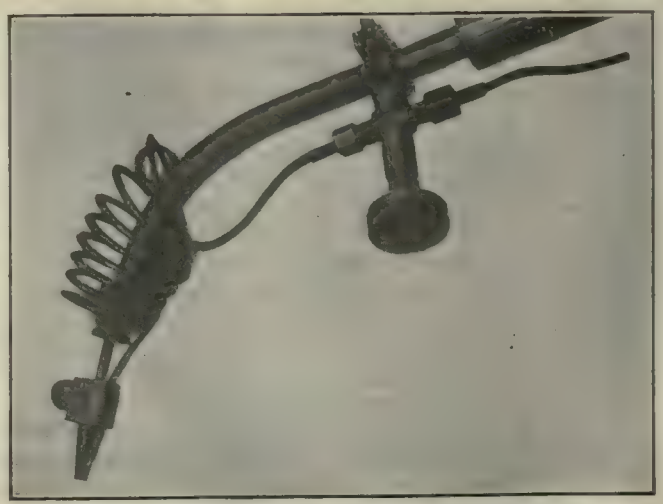


FIG. 2. CUTTING TORCH MADE TO PREHEAT THE OXYGEN CUTTING JET

comparatively low temperature produced by preheating was insufficient to effect any change in the physical state of the constituents of the alloy, we were forced to conclude that the addition of heat units affected a definite constant, which we assumed was the heat of combustion of the iron, as the two forces were of like charac eristics. Then a constant result from a variable made axiomatic the existence of a second variable. Our second variable, then, we concluded, was the cooling effect of the stream of cutting oxygen, and a further thought suggested a third variable in the time of chemical reaction between the iron and oxygen. The preheating flames ignited the steel—the cutting oxygen produced combustion—and the propagation of the cut was a natural consequence. But as the carbon content was increased, the speed of the reaction was materially lowered; however, the velocity of cutting oxygen to insure a continuity of oxygen and slag to the bottom of the cut, was a constant. Then, eventually, a point was reached where the rate of combustion between the iron and oxygen was so slow that the heat units liberated from the reaction were dissipated to such an extent as no longer to ignite adjacent masses of metal—and cutting ceased. By preheating the piece before cutting, we add to the forces on the weakening side of the equilibrium, and cutting once more obtained. The heat units so obtained compensated for the relatively less heat units liberated from the chemical combination of the iron and oxygen in a definite unit of time.

"While the pearlite and pro-eutectoid cementite are readily compensated, the graphite carbon effectively prevents cutting by the ordinary means. No addition of heat units short of incipient fusion, by preheating the object, restores the equilibrium. We cannot strengthen further one side of our equilibrium, but we have not attempted to affect the other side. We have made no attempt to reduce the cooling effect of the cutting oxygen. We therefore experimented in this direction, and found that we could so effectively preheat the cutting oxygen that we could restore the equilibrium without preheating the object."

In regard to the foregoing it will be of interest to the reader to know that the following article was published in the July, 1919, issue of *Autogenous Welding*:

Substantial progress has been made which shows that cast iron cutting with the torch is a practical commercial proposition. Proof is shown in the two views of the four corners of a large stone crusher head that were prepared for welding by beveling the edges with the torch as shown in Fig. 1. The job was accepted in our welding shop, with a promise of completion in two days, but it was found that a much longer time would be required alone to bevel the edges by chipping. The staff of the Engineering and Research Department of the Davis-Bournonville Co., which had been experimenting in cast iron, was appealed to, with the result that the four pieces were made ready for welding in less than one hour!

"Each corner piece represents a cut 4½ in. thick and 17 in. long, with an area of 76 sq.in. The cuts were made in 6½ minutes each, using 24 cu.ft. of oxygen and about 4 cu.ft. of acetylene. The cut surface produced was smooth and the edges were sharply defined, as is shown in the views. The kerf was about ⅛-in. wide at the top and bottom—about the same as would be produced by cutting steel of the same thickness. The process was not one of melting, as the sharp edges prove—in fact the finish of the cut surfaces compares favorably with that of steel. After the cuts were started they were carried through to completion without a stop, and the pieces dropped apart of their own weight."

Since it is known that the cutting of cast iron is principally accomplished by preheating the oxygen, attention is called to the fact that there have been cutting torches on the foreign market for several years so made as to preheat the oxygen cutting jet. One of these is shown in Fig. 2, the principle on which it is made being self-evident.

An Aid to Determine Pulley Diameter and Speeds

By George W. Childs

This letter is written in reference to the article entitled, "An Aid to Determine Pulley Diameters and Speeds," by Julius Klein in the May 20 issue of the *American Machinist*, page 1076, Vol. 52.

The writer has had considerable experience in compiling tables and is on the lookout for tables and data which will lessen the labor of designers and also be useful to shop men. I have made a careful study of the table edited by Mr. Klein and am of the opinion that it will not be of any particular benefit to shop men, and certainly not to designers. The formulas given for determining pulley sizes and speeds is published in nearly every manufacturer's catalogue of transmission machinery and in engineering handbooks; and, being the only formulas to my knowledge which can be used for the purpose mentioned, I have no hesitancy in stating that the average mechanic is perfectly familiar with its use.

Referring to the first example given in the description, I find the following: That it takes about one-half the time to get the required answer, i.e., 20-in. diameter pulley, by figuring with a pencil and paper that it does by using the table given. Computing the belt speed in feet per minute is also a very simple matter with which the average mechanic is perfectly familiar. For example, a 20-in. diameter pulley making 90 r.p.m., to find the belt speed in ft. per min. By referring to a table of circumferences we find that the circumference corresponding to a 20-in. diameter is 62.832 in., which divided by 12 is 5.236 ft. Multiplying 5.236 ft. by 90 r.p.m. we have 471.24 as the belt speed in ft. per min. Then again, we will assume that the average person interested in the subject has in his possession a table giving the decimal parts of a foot equivalent to 20 in., and if he has not this can be easily computed. Solving $\frac{20}{12}$ ft. $\times$ 3.1416 $\times$ 90 r.p.m. we get 471.24 ft. per min. for the belt speed as before.

Referring to the second example given in the descriptive matter, we are compelled to do some computing in using the table. I found that the result 1,523.16 ft. per min. on the last line in the description is an error and should read 1,623.16 ft. per min. Referring to the tenth column from the right and headed 549.8 and 21 in the table, I found in trying another combination that the fifth figure from the bottom, 87.07, is an error and should evidently be 81.07.

I should say that the table as published would not be a labor saver and the results would be hard to read. In case anyone should reproduce the table for his own use, he should by all means draw heavy lines across it, say at every fourth or fifth line of figures.



Special Methods for Making Radiators

By FRED H. COLVIN
Editor, *American Machinist*

Mechanical aids to the assembly of manufactured parts are often more difficult to obtain than machinery methods. This shows how radiators are assembled, soldered and tested rapidly and economically.

THE making of radiators for the Autocar Co.'s motors contains some interesting methods, particularly when it is remembered that the output is small as compared with that of large radiator manufacturers. The radiators are of the fin and tube type as can be seen in the illustrations. The fins are cut in the press shown in Fig. 1, this punching the 30 holes. Twenty-seven of these holes are punched through and the remaining three have points raised to act as separators between the fins. The punching, the raising of the separating points, and the cutting off of the strips are all accomplished at the one stroke of the press.

The way in which the strips are put in place on the tubes is shown in Fig. 2. Here the tubes are mounted in a bottom plate and a small cap or guide placed in the upper end of each tube. This is all done at once by means of a special plate. The platform *A* on which the bottom plate rests is adjusted to its proper position and a fin placed over the tube points or guides. The press is released, and the ram *B* forces the fin down over the tubes to the bottom position. At the same time, the platform *A* is automatically lowered by means of the spiral-grooved shaft *C*, so that the second stroke of the ram will leave the second fin in its proper position. This is repeated at each stroke until all the fins are put into place and the half-core is ready for soldering. It will be noted that the ram has a long stroke, imparted by the crank *DD*.

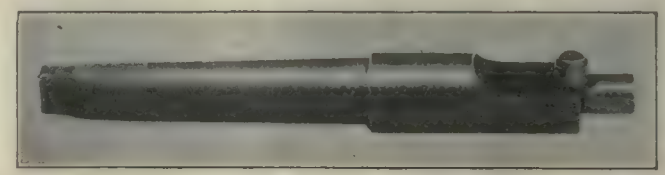


FIG. 3. TOOL FOR SPINNING TUBES

Before soldering, however, the upper ends of the

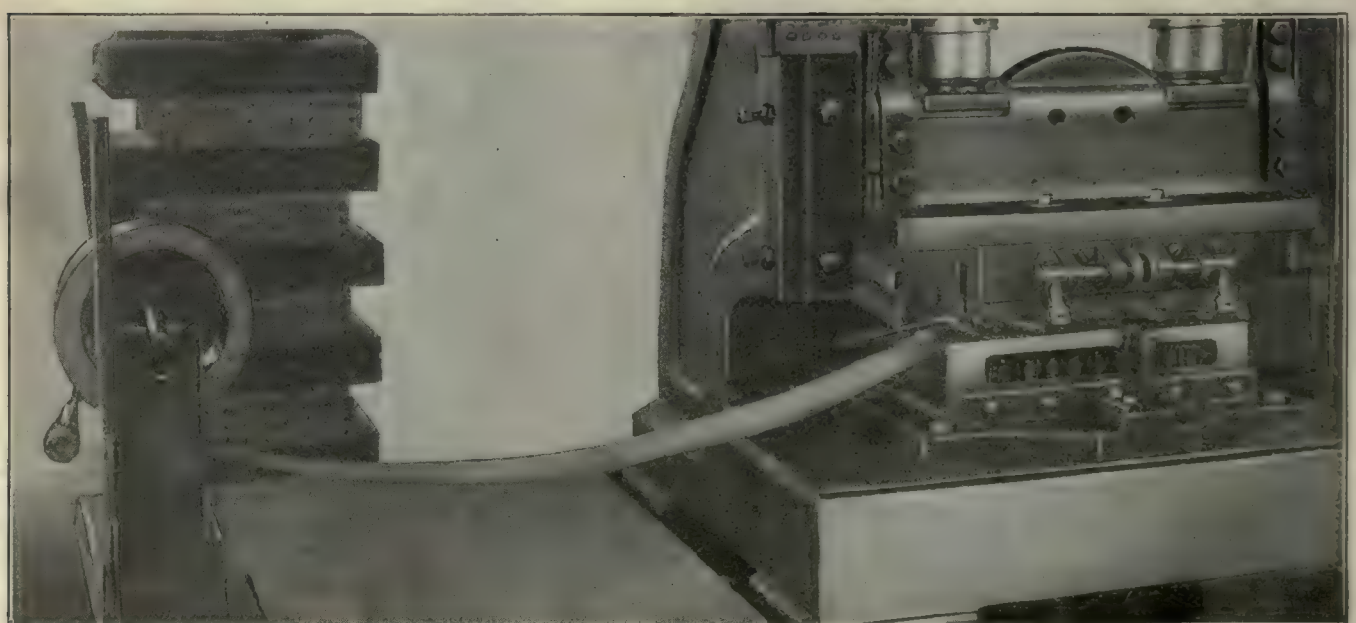


FIG. 1. PUNCHING THE FINS

AUTOMOTIVE CONSTRUCTION

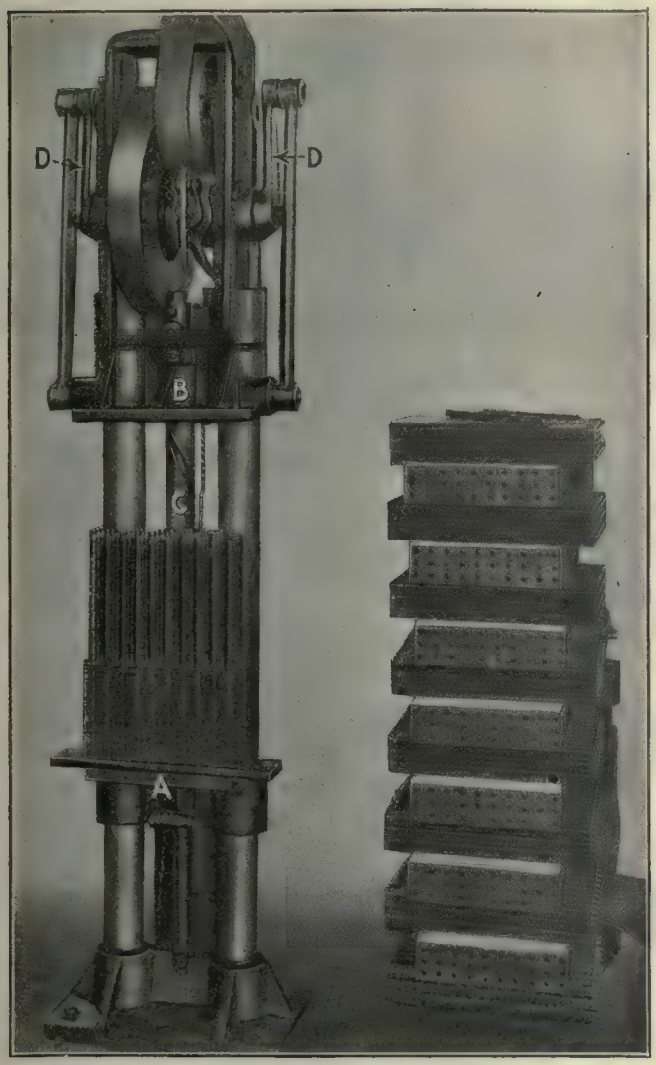


FIG. 2. ASSEMBLING FINS ON TUBES

tubes are spun into position by the tool shown in Fig. 3. This has a pilot and also a roller which beads the end of the tube to the desired amount.

The tube cores are then brought together to be soldered into position to the main tank at the top and the bottom chamber. The radiator is mounted on the wooden stand shown in Fig. 4, so as to be of a convenient height, and the shelf shown is provided for holding the soldering acids which are used for this purpose. A special gas soldering iron has been developed in a very simple manner, by which practically all of this soldering can be done without the delay of waiting for irons to be heated.

Taking Away the Soldering Fumes

The stand shown in Fig. 4 is in reality considerably more important than it looks, as it forms a connection with an exhaust system by which the fumes are drawn away from the radiator and ejected from the building by a powerful fan. This is a sort of down-draft exhaust system which has greatly increased the comfort of the men and in that way increased production and good feeling.

When the radiator has been completely soldered and attachments made, it is tested with air in the water



FIG. 4. STAND FOR SOLDERING

tank shown in Fig. 5. The main feature of this tank is the ease with which the operator can handle the radiator being tested. The radiator with all its outlets closed, except one, is laid on the rack *A* and the air hose attached to the desired opening. The operator standing at the right of the tank pushes the platform forward by the handle *B*. The platform is so mounted on the levers shown that it submerges the radiator with practically no effort on his part. Reversing this operation raises the radiator out of the water. This makes a very convenient method of radiator testing and one which can be copied to advantage for similar work.

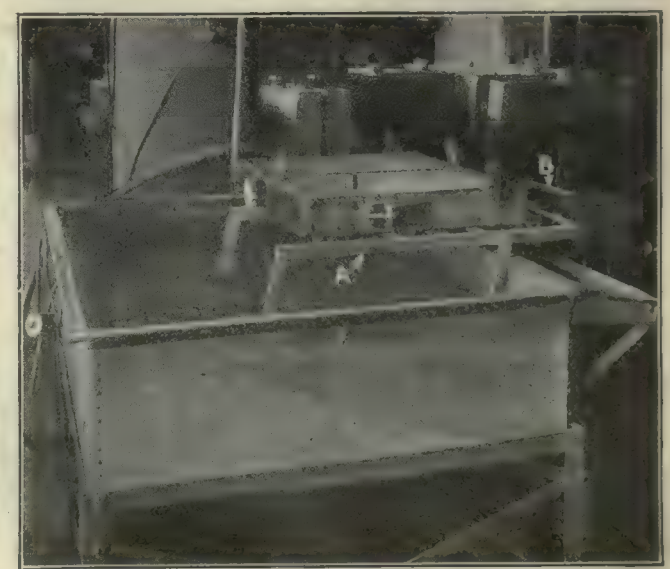


FIG. 5. TESTING FOR LEAKS



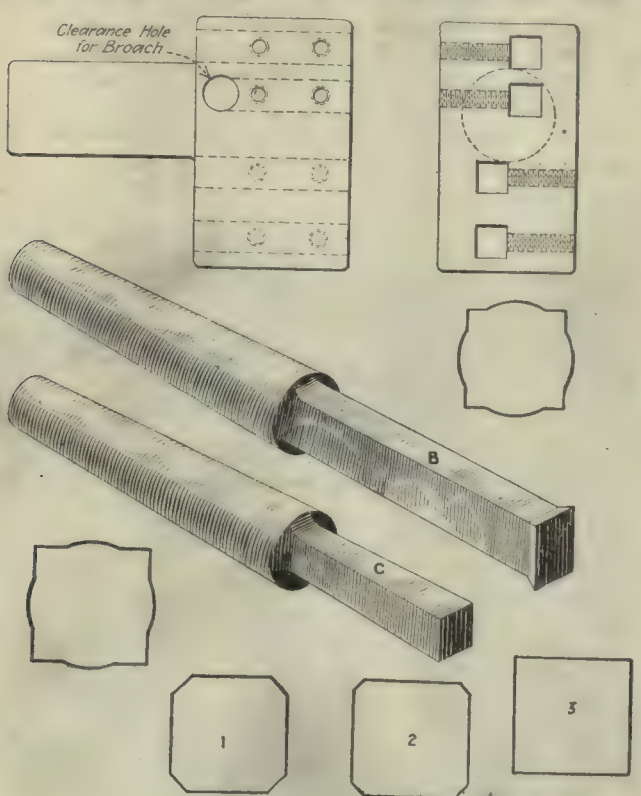
Broaching Square Holes

By John T. Clark

Recently on starting to work in a new place I was required to make some toolholders for the turret lathe, similar to the one shown in the sketch at *A*. As I was a stranger in the shop, not knowing what equipment they had, I asked the foreman what tools were available for the job, and was told that "sometimes they filed them out square; and that 'old-country' filing was pretty good"—(he was an Englishman).

Though I am from the "old country" myself, I did not relish the idea of filing the corners out of about two dozen round holes to make them square, particularly in a shop where files were neither plentiful nor in great variety, so I decided that I must find some other way to do the job.

About one-half of the holes were to be made $\frac{17}{32}$ in. square and the others $\frac{5}{8}$ in. square; it being permissible to use a $\frac{19}{32}$-in drill for the larger size and an $\frac{11}{32}$-in. drill for the smaller. This helped out a good deal as it was only necessary to take out the corners.



THE WORK AND THE TOOLS

Hand broaching was out of the question as some of the holes were "blind" and the broaches could not be driven through or back, so I decided to try broaching them in the milling machine; making broaches with taper shanks to fit the collet and using the cross-feed screw to force them in. The work was held in the milling-machine vise.

The depth of the larger holes ran from $1\frac{3}{4}$ in. up to $2\frac{5}{8}$ in. and the small ones from $\frac{7}{8}$ in. to $1\frac{1}{4}$ in. After a few experiments with different sized broaches, one like the sketch *B* was made and worked fine on the large holes. It was made to cut full size one way and $\frac{3}{4}$ in. the other way; locating it in the center of the $\frac{19}{32}$-in. holes it could be forced through without much trouble and then the table moved back and forth to make up the difference between the $\frac{3}{4}$-in. thickness and the size required by using the dials on the machine to gage the distance.

Of course, on account of the length of the broach there was considerable "spring" to the tool, but this was eliminated by giving a quarter turn to the machine spindle, thus reversing the position of the broach and forcing it through again. By repeating these tactics the hole was made quite square and smooth with sharp corners.

In the smaller holes the same method was used except that three broaches were used, two for roughing and one for finishing, and they were made as shown at *C*. It required considerable elbow grease and fetched some sweat out of me but the satisfaction of doing a good job was worth it.

Turning Hard Metal with Carborundum

By Gustave Remacle

Recently when refacing some valves, I encountered great difficulty owing to the fact that several of them were very tough and hard, and a grinding machine was not available.

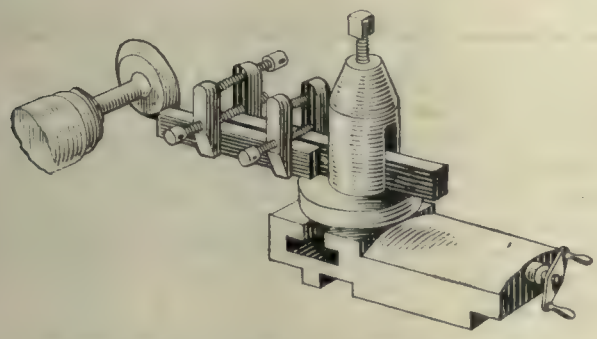
I had used steel tools which were glass hard, ground them to various shapes, and still found that I could not produce the smooth true surface which was essential.

An experienced repair man helped me out of the difficulty by suggesting the use of a piece of carborundum as a cutting tool.

I procured a piece of the carborundum that is commonly used for dressing grinding wheels and clamped it to the end of a toolholder, using two parallel clamps

and placing a piece of blotting pad between the carborundum and the toolholder in order to prevent a fracture of the stone.

I used a sharp corner of the stone when turning and during the process I found it necessary to present



TURNING HARD MATERIAL WITH CARBORUNDUM

fresh corners of the stone to the work because the stone would not hold a keen cutting edge for long.

When I saw the stone curl up a fine chip I rubbed my eyes and looked at it for several moments before I could believe it.

Stopping An Unnecessary Noise

By Martin H. Ball

While searching for unnecessary noises in and about the machine shop, and for ways to stop them, one prolific source is found that can very easily be eliminated, although it is one that is frequently overlooked. I refer to the belt-shifter guide fingers, or forks, that are used to shift the driving belt on tight and loose pulleys.

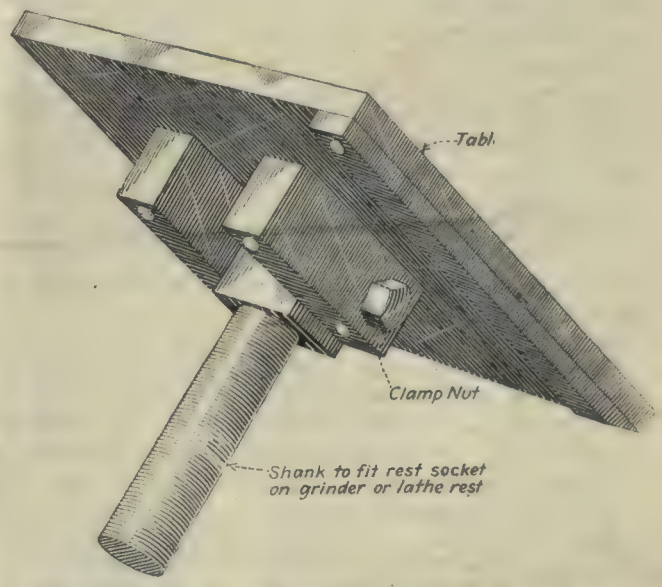
In the illustration *A* shows the noisy and wrong way and *B* the right position to secure quiet running on the same drive, while *C* shows the right way when the lower side of the belt is leading. Referring again to *A* the action is as follows: When neither finger of the pair is in actual contact with the side of the belt the fingers will tip to the left as far as their fastenings will allow, but as soon as one of the fingers is touched by the belt it will be carried to the right. As the fingers are usually placed apart slightly more than the width of the belt and because of the fact that most belts swerve sideways more or less, guiding forks so placed are almost constantly in motion and make noise in proportion to the lost motion in the sliding shaft to which they are attached, added to that in the device which connects this shaft to the shipping lever.

The cure is very simple, just place the forks at a slight inclination in the direction that gravity will hold them, and in the position that the frictional contact forces them as indicated at *B* and *C*. The angle shown in the sketches is somewhat exaggerated to make the expianation more clear. In most cases an angle of 10 deg. will give satisfactory results.

A Tilting Table for the Grinding Machine or Speed Lathe

By H. H. Parker

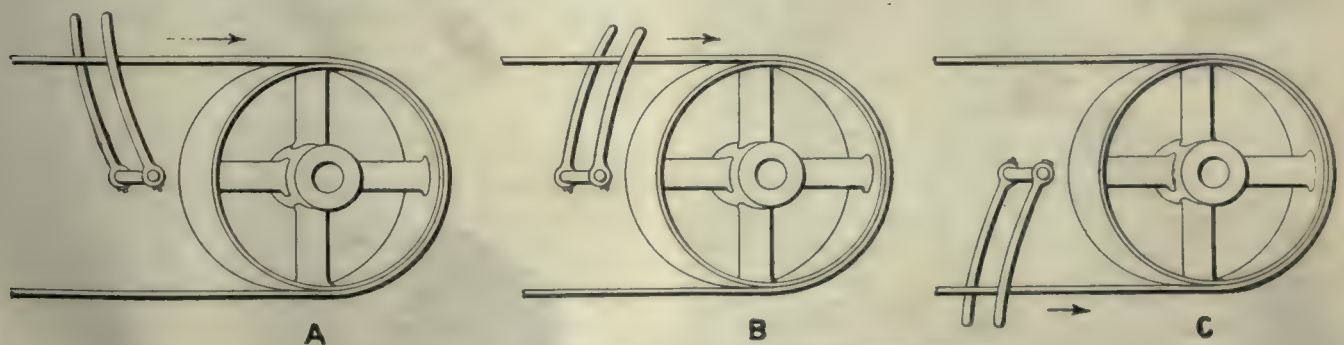
The sketch shows a small built up tilting table to be attached to a grinding stand or to a speed lathe. It may be tilted to any angle for grinding tools and other pieces of work, or if used in connection with a sandpaper disk wheel in a speed lathe chuck can be set at an angle to give draft for sanding the edges of wood patterns.



TILTING TABLE FOR SPEED LATHE OR GRINDING WHEEL STAND

As shown, the table is built up of a steel or iron plate with two pivot strips screwed to it, though if it was practicable to make a pattern and cast the table, the lugs would be cast on and a neater piece of work would result.

The lower edge of the table nearest the wheel is bevelled for clearance when tilted. A length of square cold-rolled steel will answer for the upright; the lower portion is turned down to fit the rest socket while the upper end is rounded and drilled for the clamp bolt. The square end should make a snug fit between the two table lugs.



RIGHT AND WRONG WAY TO SET BELT SHIPPER FORKS

EDITORIALS

Attention, Engineering Societies

LET us go over what we know concerning the Federated American Engineering Societies.

Its objects are "to further the public welfare—and to consider and act upon matters of common concern to the engineering and allied technical professions."

The call for an organizing conference was the outcome of a very evident need for all engineers to be represented by a single organization. The founder engineering societies, responsible, in the final analysis, for the new organization, were caused to feel such a need by a natural sequence of events extending over a period of several years.

The organization was formed at Washington, D. C., June 3 and 4, by delegates representing sixty engineering societies of the United States. There were adopted a constitution and by-laws, which are now being submitted to the engineering societies of the United States. The new organization, so far as becoming a permanent body is concerned, is dependent upon the action of these individual societies.

Several societies have taken definite action—others have acted, not quite so definitely, but very encouragingly. We publish elsewhere in this issue an article called "Progress of the Federated American Engineering Societies," which reports the action taken by a number of societies and gives other information concerning the organization.

The spirit of this editorial is to urge upon engineering societies immediate consideration and action. The metal has just been drawn from the furnace. Do the forging now. Why reheat? L. C. M.

Jumping Four Miles for a Record

LIEUTENANT WILSON of the 96th Aero Squadron has just established a world's record by making a parachute jump of nearly 20,000 feet. The recording barograph on the machine from which he made his jump showed 19,861 feet when corrected for the various errors, but a hundred feet more or less is of little moment when one is taking such a leap.

Parachute jumping has been a common "stunt" for many years, but it remained for the war to make it a practical necessity. It is barely two years since the army started experimenting with parachutes and the first tests were not any too promising. Many a sand and canvas dummy met a horrible fate as a result of the failure of its parachute to open. And now we have a successful school for parachute jumpers and to cap the climax a record jump of nearly four miles.

Can there be any doubt of the commercial future of aviation? Probably the two most serious handicaps of the new science have been its danger and its cost and now we have a proved "life-preserver" which reduces the danger to an almost negligible quantity.

At the present time all army fliers wear parachute packs whenever they go off the ground. The new pack, which is only four by ten by nineteen inches, is far less cumbersome than the early ones. In addition to this its change of location removes the serious objection on the part of the pilots that it hampered the freedom of their movements. Instead of being strapped to the pilot's back it has been transferred to that portion of his anatomy which little Johnny used to protect with a shingle on certain solemn and long-remembered occasions. Incidentally the pack in this position makes an elegant seat cushion.

The practical value of a four-mile parachute jump may not be apparent, but it is quite as real as that of the high-altitude flights of Schroeder and Rohlfs. They found high velocity wind currents of which advantage will undoubtedly be taken by the air cruisers of the future, and Lieutenant Wilson has proved the ability of the parachute to open in the thin upper air and to withstand the strain of a seventeen-minute drop through all sorts of atmospheric disturbances.

The spirit of the Wright brothers still lives in Americans, and with even half-hearted co-operation on the part of Government agencies, will bring us back to a position of supremacy in the air. K. H. C.

The Evolution of the Engine Lathe

CONSIDERABLE interest has been evinced of late as to the origin of the term "engine lathe," and various opinions and conjectures have been published in our columns.

Elsewhere in this paper appear extracts from an article by E. J. Franzen, superintendent of the Sprague Electric Works at Bloomfield, N. J., reprinted from the Sprague shop paper "The Link."

Mr. Franzen has evidently made a considerable study into the history of this indispensable tool and speaks as one having authority upon the subject. He traces the evolution of the lathe from the crude device in use hundreds of years ago, by the East Indians—and still used by them—through the period of its development, contemporaneously with the steam engine, down to the present somewhat complicated piece of precision mechanism. E. S.

Have You Ordered Your Coal?

THE question of coal may not seem as pressing as it did during the past winter. And yet we are assured that the only way to avoid the re-occurrence of the difficulty is to place our orders during the months which are usually slack and in which transportation is less difficult.

While most of us undoubtedly feel that there is more or less "bunk" in the coal operators' arguments, it behooves us to at least make an attempt to comply with their suggestions. Should this be of no avail we must look elsewhere for a remedy. But in the meantime let us see what can be done to place orders early, to buy collectively if that be possible or advantageous, to store all we can and so keep the mines busy during the summer and fall.

Under present conditions it is more a question of getting coal and of having it when we want it, than it is a question of lower prices. We pay what is demanded and have no redress in that direction. Let us get the coal orders in now. F. H. C.

The Mechanic and the Printed Page

By Marshal M. Alden

Any system that will reduce waste of material, time and effort, improve efficiency, increase production and cut down overhead, will be given an impartial trial by the fair-minded executives of any industrial or commercial establishment. And a system that will do not only all these things, but bring a greater financial return to the workers, because of their increased proficiency, will be warmly welcomed by the employees.

How and where can such a system be obtained, is a question frequently asked by executives in these days of industrial and commercial unsettlement. The answer is provided by the American Library Association, an organization of forty-four years' standing, and by the Special Libraries Association, also a national organization of high repute. According to these two cooperating Associations, the installation of special technical and business libraries in industrial and commercial establishments, while not guaranteed to produce the foregoing results, will have a direct bearing on the improved operation of the concern, its production and progress.

Under its enlarged peace-time program the A.L.A. proposes to give professional advice upon request, as to the character, scope and contents of any proposed special library. The worth of the plan could be outlined and the results forecast by experts for the benefit of the executive who considers adopting the system in his establishment. Costs would also be figured and presented with an estimate of the financial advantages which will accrue to offset the original outlay and tend to increase the gross profits.

Waste a Big Business Loss

Waste of material, time and effort is one of the great causes of industrial and business losses, often making an appreciable figure on the wrong side of the ledger. Naturally it is a factor that all executives wish to eliminate and to this end the special library is of practical and proved assistance. If the library is as comprehensive as it should be to be effective, the technical books therein will often furnish those methods of procedure in manufacture that otherwise could have been obtained only by experiments with their attendant waste of material, time and effort. While the same books are often available at the public library, the time taken to go there and obtain the information is a factor which is almost eliminated if the volumes are easily and quickly accessible in the special library within the plant.

It is quite obvious that book study of processes and machine technicalities will tend to enhance the efficiency of the worker and if the library offers the opportunity for serious reading and encourages the habit, the production results will indicate the benefits. The reading habit, once formed, is seldom dropped, it has been found, and when it is general among the forces of a factory, mill or shop, there has been a marked improvement in the amount and quality of the output. The only way to forward this habit is by having the special library at hand and showing its advantages to the employees.

"The library book taught me more about hardening, pouring and tempering steel than I learned in twenty-five years at the forge," declared an iron worker in a New Jersey factory recently. This is but one of hundreds of testimonials voluntarily given to the worth of the special library system.

Need of Books Acute

"The need of books for men in industry is more acute now than ever," declares Frank K. Walter, librarian of the special library at the General Motors Corporation. "Whether it be in agriculture, in the factory, the shop or executive office, a knowledge of the best methods of producing more goods of better quality is imperative. Only in this way can the rising level of prices be met and the high cost of living be mitigated. More than ever before, the experience of all is needed by each. Waste, whether of time, energy or material, is little short of criminal under present conditions. Vocational help through the library is not only permissible, but as necessary as many of the war activities in which the library played so prominent a part.

"Industrial corporations are realizing the need of such service and are liberally backing their own special libraries. The man who reads the technical book or the trade paper instead of resting content with what he learns from actual shop practice, is developing the initiative and individuality which have been the chief assets of American industry."

Since increased efficiency means greater and improved production at lower cost to the consumer and larger returns for the producers, both executives and employees, it follows that the means of promoting this efficiency is a valuable asset to the entire establishment and to the public. Because the special library is recognized as the means to this asset, the list of prominent concerns which are installing them is growing constantly.

The "Books for Everybody" Movement

Promotion of this system is part of the enlarged program of the American Library Association, a nation-wide movement to bring books to everybody who has limited or no access to them. The project, under the appeal, "Books for Everybody," is designed to promote the habit of reading and universal self-education through books and libraries and points to a time when the best of reading material will be within easy reach of every man, woman and child in the United States. It is a direct outgrowth of the war time service of the A. L. A. through which more than 7,000,000 books were circulated among the U. S. forces and which revealed the needs of the nation for extended library service to reach 60,000,000 persons who are inadequately served or have no means of obtaining the knowledge that is contained on the printed page.

The association's enlarged program has received the hearty endorsement of many prominent men and women in all walks of life who recognize the vast value of reading as a means of individual, industrial and business progress. To carry out the program a fund of $2,000,000 is being obtained through the individual efforts of librarians, library trustees and friends of libraries without recourse to the usual intensive campaign. It is hoped that this appeal for so worthy a cause will not go unheeded by our great American manufacturers.

WHAT to READ —for the man in a hurry



Suggested by the Managing Editor

ONCE more we are leading off with a new tool description—this time a short account of the construction and working principles of a line of duplex drilling machines built by the Moline Machinery Co. Both light and heavy machines are included in the series and between them they will account for a wide range of work capacity. An unusual special machine for sinking dies automatically appears on page 158. A product of the Keller Mechanical Engraving Co., this machine will rapidly reproduce a master die which may be of a permanent character when many pieces are to be made, or may be a wax or plaster model for experimental or special work.

What to read was not a difficult matter to decide two hundred years ago when books were few and magazines unheard of. It is far different now when so much reading matter is offered to pass the time pleasantly or profitably as the reader chooses. We are doing our utmost to make the "American Machinist" not only profitable but indispensable as a clearing house of ideas and news of the machinery world. This page is the editors' advertisement of their section of the paper. It gives the high spots.

Another special machine is described on page 162. This one is designed to bore and ream automobile engine crankcases and was built to the specifications of the Bethlehem Motors Corp. by the Baush Machine Tool Co. It employs special boring bars and reamers made by the Kelly Reamer Co. and has proved satisfactory.

Frank A. Stanley, an old editor of the *American Machinist*, has an account on page 164 of the press work entering into the manufacture of a rather intricate sheet-metal chute for a coin machine. A couple of pages farther on Lucas has one of his sketch pages showing some of the things that can be made from an old drawing pencil by the ingenious draftsman with nothing better to do.

Part IX of Macready's "Elements of Gage-Making" starts on page 167 and goes into the details of the construction and utilization of fixtures for producing gages with curved outlines. It contains practical pointers from a practical man.

And now turn back for a moment to page 152 and read "Socialism-Communism." If we hadn't told you that it was printed in the June, 1878 issue of the *American Machinist* would you have guessed it? With the exception of one or two allusions to such awful things of a bygone age as r-r-r-rum and lager it reads like an outpouring of an excited modern editor against the red agitators. The machines of the present are infinitely better than those of the seventies but where human nature is concerned there seems to be nothing new under the sun. It is some consolation, after we have read some unusually pessimistic account of the dangers of Bolshevik propaganda and teachings, to remember that forty years ago our fathers were going through very much the same experience and have lived to tell the tale.

Our old friend Entropy has some hints on how to get the men to read the plant newspaper—page 150. This is good stuff. We have been in the game for some few years but we have found some excellent advice in Entropy's remarks. "The plant paper affords the very best possible chance for the management to communicate with its employees in an unofficial manner. The only danger is that some one high up in the organization may want to preach, and that is nearly the worst thing that language is used for, at least in the shop." This is equally true outside the shop, isn't it?

We remarked last week that H. H. Farquhar had gone the ten commandments six better but we seem to have understated the case. Here he is with three more, on page 151, where he finishes up his remarks on the regulation of materials.

On page 153 we reprint a paper by Chester B. Lord, which was presented at the spring meeting of the A. S. M. E. and which attracted a good deal of favorable comment. He says "threads can be produced that are interchangeable practically regardless of tolerance, that will not loosen, and are cheaper to manufacture."

Two other society papers of unusual appeal are presented on pages 171 and 173. The first is by Elwood Haynes, of the Haynes Stellite Co., and discusses the composition of stellite and stainless steel. The other was read before the American Welding Society by two of the Davis-Bournonville engineers and takes up the cutting of cast iron with a gas torch.

The latest information on the progress of the Federated American Engineering Societies appears on page 185. If you are an engineer, or expect to be one, you can't afford to miss anything that bears on this long-needed effort to unite the engineers of this country.

What Other Editors Think

Denying Fundamentals of Democracy

By Dr. Nicholas Murray Butler

In the *Valve World*

RECENTLY the startling doctrine has been taught and practiced that the strike may be used to enforce the views and wishes of a small minority of the population in matters relating not only to public transportation and to other public utilities, but to political and public acts of every sort. This is to call back the *Liberum Veto* of ancient Poland with a vengeance.

According to this doctrine a group of individuals who do not approve of the tariff levied on wool may unite to make impossible the operation of a steamer which carries a cargo of wool from Argentina to the United States, or to prevent the unloading of such cargo when the steamer reaches the docks of New York. The Government of the United States may deem it necessary to send troops and to ship munitions to Siberia, but under this doctrine stevedores and longshoremen at the ports of San Francisco and of Seattle would be entirely justified in refusing to load or to permit to be loaded the vessels which were to carry such troops and munitions in case they, as individuals should happen to disapprove of the Government's policy in this regard.

Still others might say that they would refuse to assist in operating the railways of the United States, and would unite to prevent their being operated by others, unless a certain designated public policy in regard to railway ownership and operation were quickly adopted.

It must be apparent from these illustrations that without complete loyalty to the democratic principle, without respect for law, without sincere devotion to American ideals of government, and without good-will on the part of all elements and groups of society, the economic and political life of the nation can no longer go forward, and that we are in imminent danger of national shipwreck and of incalculable disaster.

The State Is Fundamental

Were it not for the well-known irresponsibility of many of those who attempt to guide the public by teaching and by writing, it would be startling to learn that at so critical a time as this in the history of American civilization, the doctrine is actually being formally and systematically taught that man's political organization, the state, is not any more fundamental than several other forms of human association, and that, therefore, the state has no necessarily superior claim upon the loyalty and devotion of the citizen.

There are those who assert that the political state is only one among many forms of human association, and that it is not necessarily any more in harmony with what some writers are pleased to call "the end of society" than a church, or a trade union, or a Masonic lodge, or a college fraternity.

What this means when brought down from the language of academic detachment from facts to the plane of hard common-sense is that the American nation is not really a unit but a multiple object composed of men in political relationships, in church memberships, in trade union memberships, in college fraternity memberships, and in half a hundred other co-ordinate memberships, each of which has its own claims upon our loyalty.

It is held that the political relationship is but one of many, and that the individual must decide which of his relationships and which of his loyalties is at any given time to take precedence of the others.

Making Loyalty Elastic

For example, a man might decide that his loyalty to his college fraternity overrode his loyalty to the state, in so far as the latter required him to abstain from assault and battery. Or he might decide that his loyalty to his church or to his trade union required him to defy some act of Congress or some decision of the Supreme Court of the United States.

This course of reasoning and of procedure would make of life one continual lynching. Individuals or groups of individuals, would in this way be brought into constant contempt and defiance of law, with the certain result that civilization must disappear in the smoke of armed conflict between different groups of selfish and self-seeking men.

This doctrine, which it is asserted is now being taught in American universities and even in American law schools, is given several high sounding names, but it is correctly and bluntly described as the gospel of anarchy and disorder, as well as of the complete destruction of everything that mankind has accomplished during the past three thousand years.

It is because of more or less conscious adherence to this sort of teaching that the I.W.W. and other like-minded organizations propose to force political action by economic pressure or by economic war. Those who are in this state of mind not only decry but despise democracy, and those who are frank among them do not hesitate to say so.

The spokesmen for this doctrine are often persons who have never done a day's work in their lives but who, out of sheer zeal for destruction and mad passion for notoriety, associate themselves with various organizations of wage-workers and others and endeavor to bend these organizations to their own ends.

At present this doctrine is supported by an organized and apparently well-financed propaganda. We have hardly comprehended how completely the American people are at the mercy of skillful propaganda of this sort. The experience of the war taught us that propaganda can do almost anything with public opinion, at least for a time; and at this moment propaganda of all kinds is well under way all about us except as regards the one essential subject of the state's own preservation.

The state is so busy doing things for particular interests and groups that it is neglecting the protection of its own life. It would be an odd by-product of social and industrial change if state suicide were to be one of its results.

The Evolution of the Engine Lathe

(Reprinted from *The Link*)

By J. E. Franzen
Superintendent, Sprague Electric Works

The question has been asked many times, why is the machine called an engine lathe? It was so named because it came into general use, as a power-driven machine, when driven by means of a steam engine, and its development has been parallel with and linked to the development of that very useful piece of apparatus.

There is no written history of the lathe. The first machine embodying the principle, if only in a crude way, was in use in India hundreds of years ago, and lathes with the same simple construction are in use there today.

It consists of two posts driven into the ground. Through the upper end of these posts are put pins, in such a way that they point to one another like the centers on a lathe, and between these two centers or points is placed a rod hollowed out at ends to fit the centers. On this rod are placed the articles to be turned. Power is furnished by winding a cord around the rod and pulling on this cord, first one way and then the other, giving a movement to the rod, say, first right-hand and then left-hand.

The second step in the evolution was the pole lathe operated by a cord reaching from a foot treadle, around the work, and up to a pole or wooden spring fastened to the ceiling. The work rotated alternately backward and forward, and the tool was applied to the work when it rotated towards the operator.

The third step was the hand power lathe, where the power was applied to the spindle by a belt from a separate wheel stand, the wheel being turned in one direction by hand power.

All these lathes were not of much use for metal cutting as the slide rest, lead screw, and the straight bed were not invented.

It was noticed by several inventors, all the way from 1550 to 1880, that some kind of a steady feed must be provided for the cutting tool, and also some way of adjusting it was needed. Several crude lathes were invented having the primitive form of screw for feeding the tool, but there was no way of making a screw except in a very primitive way. Several attempts were made to get an adjustable rest for the tool, but very little progress was made on the making of a lead screw or a slide rest until about 1800, when Henry Maudsley, an Englishman, built a lathe that in many respects was modern in its make-up.

Maudsley's lathe, built 120 years ago, had a cast-iron bed, back rest, lead screw with 30 threads per inch, a full set of change gears, and a carriage with a simple slide rest. The lead screw was also used as feed screw for regular turning.

Mr. Maudsley's invention consisted of arranging the carriage on the lathe so its movements were controlled by the lead screw, perfecting the slide rest, and introducing the system of change gears to regulate the movement of the lead screw in reference to the spindle.

The back geared headstock was invented by Richard Roberts, born in Wales, who also invented the first successful planer.

* * *

One of the greatest, if not the greatest, inventions in our industrial life is the slide rest, invented as stated before by Henry Maudsley. Its function is to move a cutting tool in a straight line as on a lathe, parallel with the bed or at any predetermined angle to it.

This invention made it possible to make the progress that has been accomplished in all lines of mechanical pursuits; without it there would be no sewing machines, typewriters, automobiles, flying machines, battleships, or 16-in. guns, and practically all our other machine tools would be valueless.

The slide rest is called carriage when used on a lathe; cross rail on a boring mill or planer; table on a milling machine, grinder, slotter or shaper.

* * *

In about 1840 lathes were being manufactured in this country by John H. Gage in Nashua, N. H., Samuel Flagg in Worcester, Mass., and J. & S. W. Putnam in Fitchburg, Mass., and in about 1850 by Sellers in Philadelphia, Pa.

Car Detention and Car Shortage

(From *Railway Age*)

THE widespread and harmful effect of the unnecessary detention of freight cars has recently been shown by an analysis of the official reports of the Pacific Car Demurrage Bureau for the months of February and March, 1920. The figures, which are given below, refer to railroad operation in California only, but if a similar condition exists throughout the country, one of the salient reasons for the present car shortage is apparent.

During the month of February, 1920, there were 131,448 cars reported to the Bureau, an increase of 30,178 cars over the same month last year. During the month of March, 1920, there were reported 143,376 cars, an increase of 32,365 cars over the same month last year. These figures disclose the increase in the volume of business during these months.

The next and most important item in the reports is "cars-held-beyond-free-time." Considering that 48 hours, or 2 days' free time, after the first 7 a.m. after the cars are placed for industries by carriers, are allowed for unloading and loading, the following figures are vital:

During the month of February, 1920, 7,303 cars were held beyond the free time, an increase of 46 per cent over the same month the previous year, and during March, 8,866 cars were held beyond the free time, an increase of 75 per cent over the same month the previous year. The demurrage charges assessed by the Bureau for the detention of cars in February amounted to $38,637 and in March to $58,615, or a total of $97,252 for two months, equal to an annual charge of $583,512. These figures also represent a delay to equipment equal to 80,964 car days for the two months referred to.

Chairman Clark of the Interstate Commerce Commission, in a recent address to the National Industrial Traffic League and the American Railroad Association, stated that the public would have the use of 102,000 additional cars through the saving of one hour per car each day. If a saving of one hour per day for each car would increase the supply by the addition of 102,000 cars, what would be the volume of business California shippers, alone, could move if they could save the 80,964 car days now lost by reason of detention to equipment, as disclosed by the Pacific Car Demurrage Bureau's reports? It is evident that the remedy for the present car shortage is in the hands of the shipping public.

Progress of the Federated American Engineering Societies

ONE of the outstanding features of the Organizing Conference in Washington, June 3 and 4, 1920, was the enthusiastic interest and co-operation exhibited by the delegates of the local, state and regional engineering organizations. It is not surprising therefore that these organizations should be among the first to apply for membership in the Federated American Engineering Societies. In this connection it is interesting to note that the Technical Club of Dallas, at its meeting of June 22, made application for membership and at the same time filed its claim as being the first local organization to apply.

At the annual meeting of the American Institute of Chemical Engineers held in Montreal June 28 and 29, 1920, the question of the Institute's becoming a member of the Federated American Engineering Societies was favorably discussed and referred to the Council for consideration at its meeting on July 25, at which time definite action will be taken. In the discussion, the opinion was expressed that the Institute should be a member of this organization and if its finances would not permit this, that members should be assessed the necessary amount.

The Federated American Engineering Societies was organized in Washington, D. C., June 3 and 4, 1920, by delegates representing sixty engineering societies of the United States. The object of the new organization is "to further the public welfare wherever technical knowledge and engineering experience are involved and to consider and act upon matters of common concern to the engineering and allied technical professions."

The Organizing Conference entrusted the Joint Conference Committee with making provisions for putting the conclusions of the conference into effect and Engineering Council was requested to carry on this work until the new organization has been established.

To make the organization effective to the great degree planned, the various societies must ratify the constitution and by-laws which were accepted by their delegates, and apply for admission.

The accompanying article was issued by the Joint Conference Committee July 9 as a bulletin. It is a brief of the development relative to the new organization, tells which societies have taken action bearing upon it, and will serve as a reminder to those societies which have not made their decisions.

The report of the delegates to the Washington Organizing Conference was read at the meeting of the Board of Direction of the American Institute of Electrical Engineers at the Annual Convention at White Sulphur Springs, W. Va., June 30, and the following resolution adopted:

Resolved, that it is the sense of this board that the A. I. E. E. should join the Federated American Engineering Societies, but that as there is a small attendance at this meeting and a new board will be constituted commencing with the administrative year on Aug. 1, action be deferred until the August meeting of the board and that a letter be sent the members of the incoming board, with a request that they give careful consideration to the matter and be prepared to act at the next meeting.

The report of the delegates to the Washington Organizing Conference was read at the meeting of the Board of Direction of the American Institute of Mining and Metallurgical Engineers on June 25, was favorably discussed and referred to the Finance Committee to devise and report on means of meeting the financial requirements.

The report of the delegates to the Washington Conference representing the American Society of Civil Engineers will be presented at the Annual Convention of the Society, at Portland, Oregon, August 10 to 12, 1920.

In the aftermath of the Washington Conference there has been considerable discussion of the new organization and a number of incorrect statements have been made; one of these is that "During the war, technical men observed the fact that many engineering problems required the joint action of the technical societies. This requirement was met by the formation of Engineering Council. Now the Organizing Conference proposes a new organization." This is not correct, as it has been repeatedly pointed out that the work of the Federated American Engineering Societies will be administered by the American Engineering Council which will succeed the present Engineering Council. This procedure received the approval of Engineering Council at its meeting on Oct. 16, 1919, when it indorsed the "General plan for national engineering council which previously had been outlined by the Joint Conference Committee of the Founder Societies."

It has also been suggested in the technical press that "no specific business is as yet outlined for action by the Council" and that "the federated society is so completely nebulous that one cannot commend or condemn it, and it will be some time before the new organization will begin to function." As a matter of fact the Organizing Conference at the closing session on June 3 adopted the following resolution:

Resolved, That it is the sense of this Organizing Conference that the Joint Conference Committee should be entrusted with making provisions for putting the conclusions of this conference into effect and that Engineering Council be requested to carry on its work until the new organization has been established, and by all proper means to further the program of the new organization. The conference further recommends to the contributing societies that they continue supplying the funds required by Engineering Council until its work is taken over by the new organization.

Engineering Council at its meeting of June 17, 1920, unanimously adopted the following resolutions:

Voted, That Engineering Council heartily endorse the plan of organization of the Federated American Engineering Societies and the American Engineering Council, adopted by the Organizing Conference of technical societies in Washington, June 3 and 4, 1920, and authorize its Executive Committee to proffer and perform on the part of the council such assistance as may be practicable in completing the

work of the Organizing Conference and of the Joint Conference Committee of the Founder Societies in establishing the American Engineering Council.

Voted, That Engineering Council authorize its Executive Committee to deal with any question of co-operation with the Joint Conference Committee of the Founder Societies, relating to the permanent organization of the Federated American Engineering Societies, which may come up during the summer.

Voted, That the secretary be instructed to invite future meetings of Engineering Council delegates of the societies participating in the Organizing Conference in Washington June 3 and 4, and editors of technical journals who may be interested.

The action of Engineering Council in accepting the invitation of the Organizing Conference means that the activities of Engineering Council, which are those to be undertaken by the Federated American Engineering Societies, will be continued without interruption until the American Engineering Council is prepared to take up the work.

The statement that the new organization "is completely nebulous" is refuted by the fact that the Organizing Conference in Washington adopted a complete constitution and by-laws to govern the organization which came into active existence when the American Society of Mechanical Engineers applied for membership immediately following their adoption, and at which time assurances were given that the Detroit Engineering Society and the American Institute of Electrical Engineers had taken, or would take, similar action.

To this nucleus must be added the Technical Club of Dallas, so that the Federated American Engineering Societies has come into active existence and the first meeting of its governing body will be held probably in November of this year.

There seems also to be doubt as to the purpose of the new organization as set forth in the Constitution:

The object of this organization shall be to further the public welfare wherever technical knowledge and engineering experience are involved and to consider and act upon matters of common concern to the engineering and allied technical professions.

The organization is to deal with what are commonly known as welfare or non-technical matters. It is not a social organization; it is not an organization of individual members. As its title indicates, it is a federation of societies with whose autonomy and activities it in no way interferes. It does not create a new technical society but it will succeed the present Engineering Council and will be more comprehensive as to scope and membership.

The Federated American Engineering Societies will not in any sense be a competitor of any existing organization. Its success will depend upon the whole hearted support given by the individual engineers and allied technologists of this country through the respective engineering and allied technical societies with which they are identified. The unanimity of opinion in which there was no dissenting vote, with which the following fundamental resolutions of the Washington Organizing Conference were adopted indicated that the psychological moment had arrived for an organization of this character and this fact assures its success:

Resolved, That it is the sense of this Organizing Conference that an organization be created to further the public welfare wherever technical knowledge and engineering experience are involved and to consider and act upon matters of common interest to the engineering and allied technical professions.

Resolved, That it is the sense of this conference that the proposed organization should be an organization of societies or affiliations and not of individuals.

Proposed Code of Ethics for the American Society of Mechanical Engineers

A proposed code of ethics was submitted at the spring meeting of the American Society of Mechanical Engineers by the committee, which was appointed in October 1919. It was suggested by the committee that the code adopted in 1912 is too lengthy; that a new code should be common to engineers of every branch of the profession and to architects; and that Engineering Council, or a similar joint professional body, be requested to appoint a committee from all the technical societies to prepare the new code.

The tentative code published herewith was offered for use as a code if the joint committee is not appointed and as a basis for its deliberation if the suggestion of forming such a committee is put into effect.

PROPOSED CODE OF ETHICS

1. The mechanical engineer should be guided in all his relations by the highest principles of honor, of fidelity to his client, and of loyalty to his country.

2. His first duty is to serve the public with his specialized skill. In promoting the welfare of society as a whole he advances his own best interests, as well as those of the whole engineering profession.

3. He should consider the protection of his client's or employer's interests in professional matters his essential obligation, provided these interests do not conflict with the public welfare.

4. He shall refrain from associating himself or continuing to be associated with any enterprise of questionable or illegitimate character.

5. He can honorably accept compensation, financial or otherwise, from only one interested party unless all parties have agreed to his recompense from other interested parties.

6. He must inform his clients of any business connections, interests or circumstances, such as might influence his judgment or the quality of his services to his clients.

7. He must not receive, directly or indirectly, any royalty, gratuity or commission on any patented article or process used in the work upon which he is retained without the consent of his clients or employers.

8. He should satisfy himself before taking over the work of another consulting engineer that good and sufficient reasons exist for making the change.

9. He must base all reports and expert testimony on facts or upon theories founded only on sound engineering principles and experience.

10. He must not regard as his own any information which is not common knowledge or public property, but which he obtained confidentially from a client or while engaged as an employee. He is, however, justified in using such data or information in his own private practice as forming part of his professional experience.

11. He should do everything in his power to prevent sensational, exaggerated or unwarranted statements about engineering work being made through the public press. First descriptions of new inventions, processes, etc., for publication should be furnished only to the engineering societies or to the technical press.

12. He should not advertise in an undignified, sensational or misleading manner, or offer commissions for professional work, or otherwise improperly solicit it.

13. He should not compete knowingly with a fellow-engineer for employment on the basis of professional charges or attempt to supplant a fellow-engineer after definite steps have been taken toward the other's employment.

14. He should assist all his fellow-engineers by exchange of general information and valuable experience or by instruction through the engineering societies, the schools of applied science, and the technical press.

SHOP EQUIPMENT NEWS

-Edited By-
E. L. DUNN and S. A. HAND

SHOP EQUIPMENT • NEWS •
A weekly review of modern designs and • equipment •

Descriptions of shop equipment in this section constitute editorial service for which there is no charge. To be eligible for presentation, the article must not have been on the market more than six months and must not have been advertised in this or any previous issue. Owing to the news character of these descriptions it will be impossible to submit them to the manufacturer for approval.

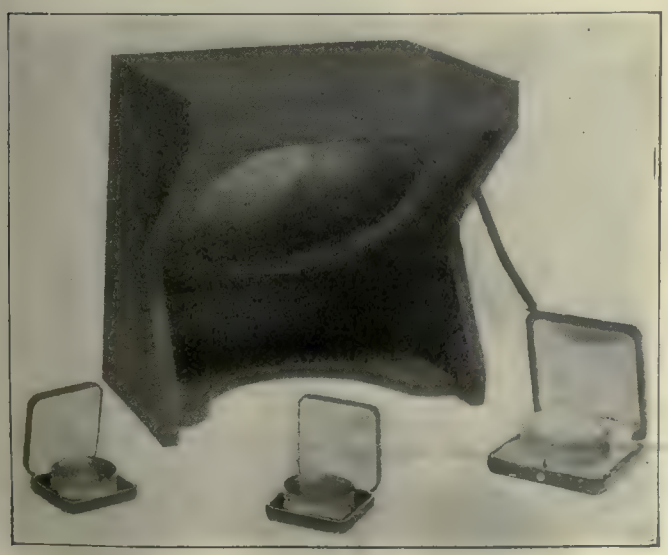
• CONDENSED • CLIPPING INDEX
A continuous record of modern designs • and equipment •

Van Keuren Optical Equipment for Comparison of Standards

The Van Keuren Co., 1706 Commonwealth Ave., Boston, Mass., is placing on the market an optical equipment for inspecting flat surfaces and comparing the length of one standard with another by the interference of light waves. The equipment, illustrated herewith, comprises two working optical flats, one master flat and one source of monochromatic light. Comparisons can be made in units of one-half wave length of light, which for daylight is approximately 0.00001 in. As it is easy to estimate with the eye one-tenth of the width of an interference band, the difference of 0.000001 in. may be seen. The equipment is accompanied by full directions for its use.

Any one of the three optical flats may be used for flatness tests, though only two are required for comparison of length. However, all the flats have one accurate surface and can be used to test each other by the method ordinarily used in originating surface plates. It is claimed that the accuracy of the working flats is within 0.000005 in. and that of the master flat is within 0.0000025 in.

The monochromatic light apparatus consists of an oak box containing a tungsten-filament lamp and a selenium diffusing glass which transmits only a light of definite wave length giving 8 interference bands in 0.0001 in. or 0.0000125 in. per band. The light is simple, requires no transformers or resistances and can be operated by either a.c. or d.c. current from a lamp socket. The whole equipment is intended for shop use.



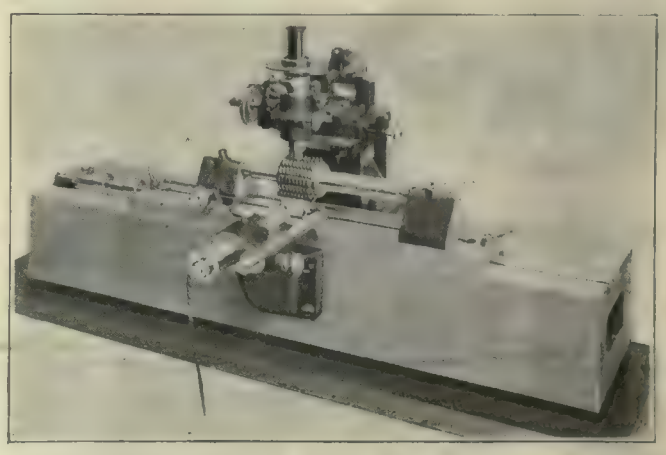
VAN KEUREN OPTICAL EQUIPMENT FOR COMPARISONS OF STANDARDS

Herbert Microscopic Measuring Machine

The measuring machine illustrated herewith has lately been placed on the market by Alfred Herbert, Ltd., Coventry, England with branch offices at 54 Dey St., New York City.

The machine has a rigid box bed, carrying a table capable of 12-in. longitudinal movement by accurate amounts by insertion and removal of hardened steel measuring rods between flat contact pieces. The table carries a pair of centers, one of which can be adjusted crosswise to enable accurate alignment of work. A microscope fitted with two crosshairs, one rotating with the outside tube and the other rotating with the eyepiece, is mounted on a compound slide controlled by micrometer screws. The outer tube of the microscope has a dial reading to half degrees and the eyepiece has a vernier reading to one minute of arc. Thus the angle shown by the crosshairs can be accurately determined.

A light projector is fixed to the machine and will project parallel rays of light through a lens upon a mirror and past the work. When measuring threads this attachment eliminates the shadows and light projected from the flanks of the thread which tend to render the object indistinct. Accumulators of 8-volt capacity are required for the projector but are not included in the regular equipment.



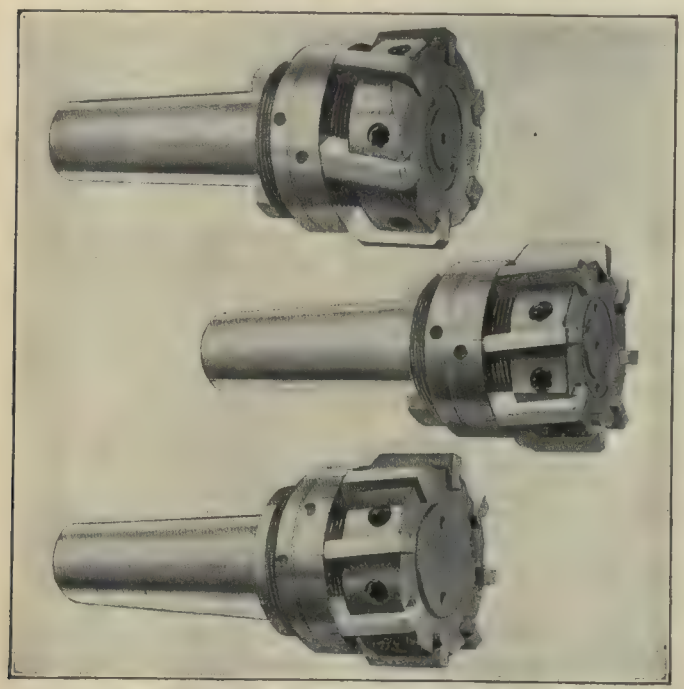
HERBERT MICROSCOPIC MEASURING MACHINE

Wetmore Cylinder-Reaming Sets

A set of special tools for reaming cylinders is being placed on the market by the Wetmore Reamer Co., Milwaukee, Wis. The tools, as shown in the illustration herewith, are designed to produce round, straight and thoroughly smooth holes and the maker recommends the use of the complete set to insure getting this result. The reamers are made in sets of three consisting of a roughing reamer, semi-finishing reamer, and finishing reamer. They are furnished with arbors to fit all makes of machines.

The roughing reamer, which is the top reamer shown in the illustration, is designed to stand the work of the initial reaming operation. The blades are set at a right-hand cutting angle and are held in place by a head lock-nut and jam-nut of heat treated alloy-steel.

The semi-finishing reamer, in the center of the illustration, has blades with a left-hand cutting angle. The



WETMORE CYLINDER-REAMING SETS

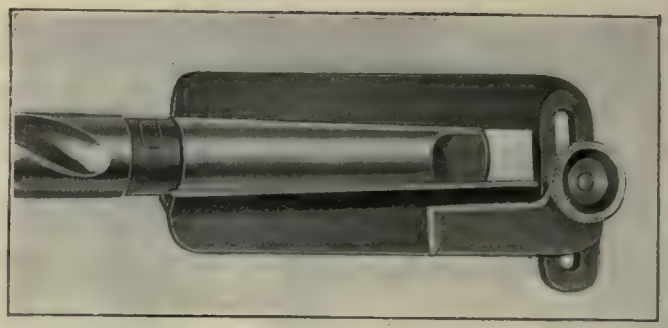
blades can be adjusted by a graduated micrometer lock-nut at the rear, which allows for adjustment of 0.001 in.

The bottom reamer shown in the illustration is the finishing reamer which is of the floating or float-in-head design, with blades set at a left-hand cutting angle, and unequally spaced. The floating device is an improved Oldham float having rollers, thus minimizing friction, and is thoroughly protected from dust and grit. All cutting blades are made of high-speed steel and adjustments may be made to 0.001 in. by means of a graduated nut.

Knauel Adjustable Taper Gage

The adjustable taper gage illustrated herewith has been placed on the market by the Knauel Tool Works, 1544 Twenty-four and One-half St., Rock Island, Ill. This device can be quickly adjusted and locked in position on any taper for duplicating work.

In use, the piece to be duplicated is laid in the lower V and the top piece brought down until light is excluded. The gage is then locked in position. The gage is made

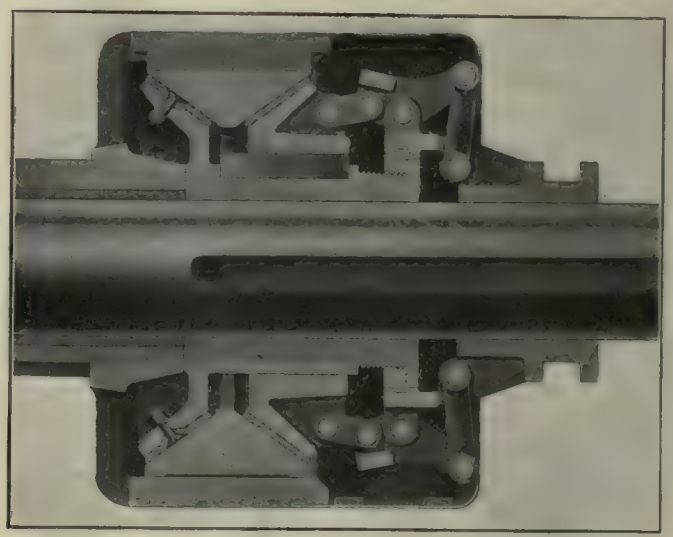


KNAUEL ADJUSTABLE TAPER GAGE

in only one size and will cover the ordinary range of tapers up to No. 11 Brown and Sharpe or No. 4 Morse.

Link-Belt "Twyncone" Friction Clutch

The "Twyncone" friction clutch, shown in the illustration, is a recent production of the Link-Belt Co., Chicago, Ill. This clutch embodies the following fea-



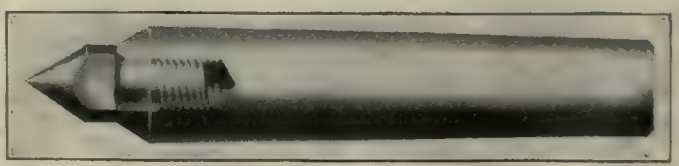
"TWYNCONE" FRICTION CLUTCH

tures: One-point adjustment; perfect balance; and complete inclosure of all moving parts.

Very high speed may be attained without causing "throw-in" or "throw out," and the clutch can be engaged or disengaged when running at any speed. The friction cones are lined with thermoid.

Ettco Insert Center

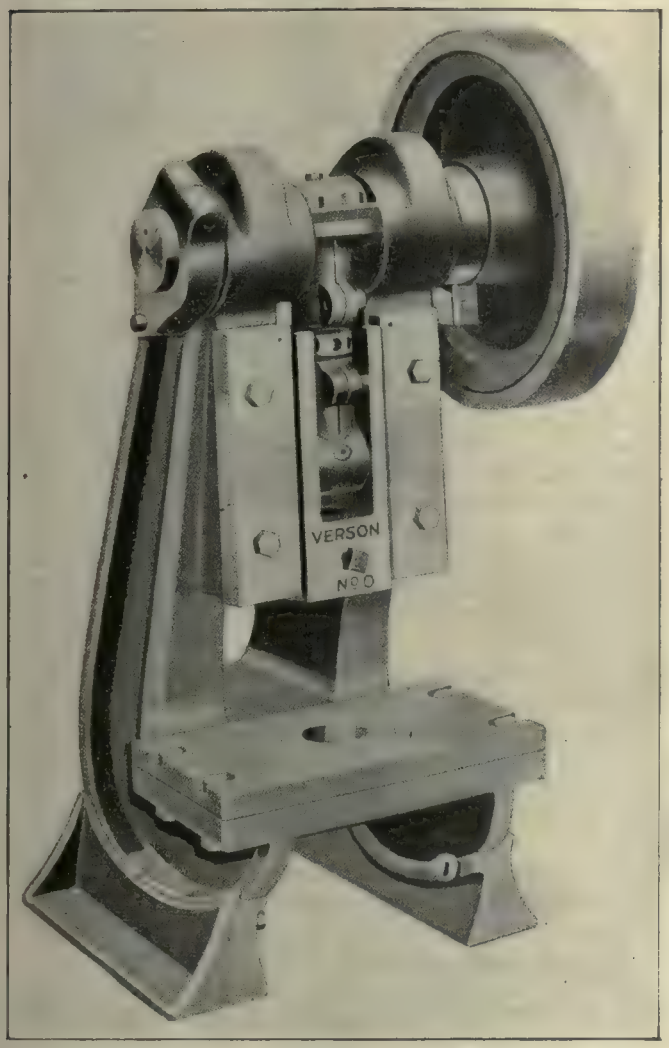
The Eastern Tube and Tool Co., 594 Johnson Ave., Brooklyn, N. Y., has introduced a line of machine centers of the type shown. The threaded points are made of high-speed steel ground to size and are interchangeable. The shanks are made of carbon steel, hardened and ground, and are furnished in all standard sizes and tapers.



ETTCO INSERT CENTER

The Verson No. 0 Inclinable Power Bench-Press

The illustration shows the No. 0 size inclinable type power bench-press, built by the La Salle Machine Works, 3013 South La Salle St., Chicago, Ill. The maker claims that this machine is adapted for the use of such manufacturers as jewelers, electrical brass workers and adding machine and novelty work, on small parts where speed and accuracy are required.



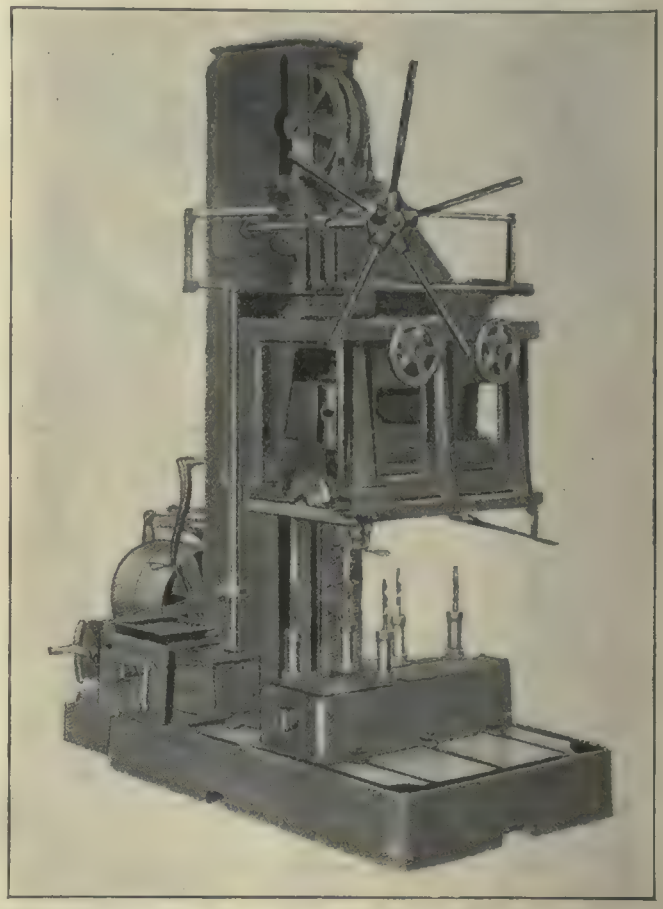
VERSON NO. 0 INCLINABLE POWER BENCH-PRESS

Specifications: Stroke, 1 in. Adjustment of slide, 1 in. Bed to slide, with stroke down and adjustment up, 5 in. Area top of bolster, 6 x 8 in. Thickness of bolster, ¾ in. Width of opening through back, 4 in. Height, bench to center of shaft, 21 in. Flywheel, 12 in. diameter, by 2½ in. face; speed, 225 r.p.m. Hole in bed, 3 x 3½ in.

It is provided with a hardened tool steel clutch with the addition of an automatic safety device which disengages at each revolution of the press, even without the release of the treadle. This automatic safety device can be disengaged when the machine is to be used for repeating strokes. The machine is of the open-back type and can be furnished with a table and legs if desired.

Natco No. 85 Inverted Drilling Machine

The drilling machine shown is a product of the National Automatic Tool Co., Richmond, Ind. It is used to advantage for deep hole drilling in cast iron as there is no accumulation of chips in the holes to interfere with the drill so that it is not necessary to back out the drills at frequent intervals to remove the chips. The machine as shown is arranged to drill five ⅝-in. holes at one time to a depth of 4¾ in. The work is held in a special fixture supported from the table which feeds downward. When placed in position the work is securely locked by means of two handwheels. The drill spindles are adjustable for position and the bearings are amply protected against dust and chips.



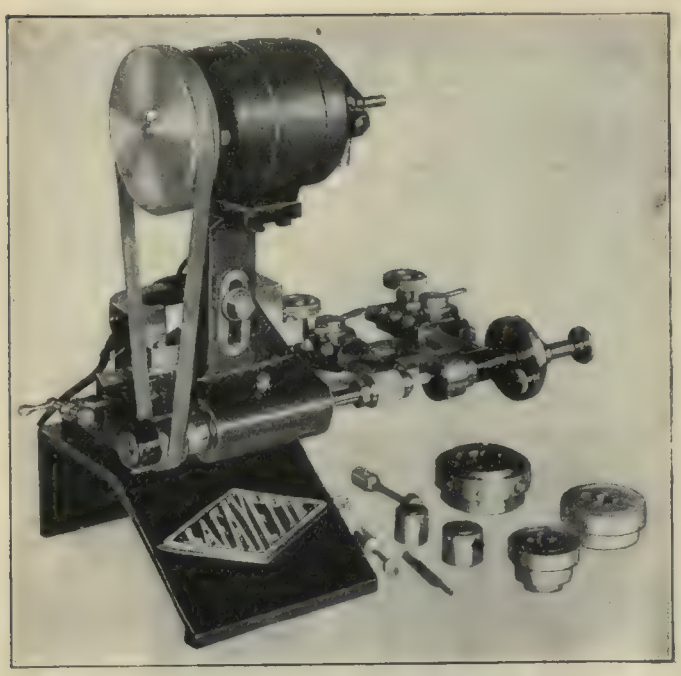
NATCO NO. 85 INVERTED DRILLING MACHINE

Baird "Yoke" Riveter

We regret to state that an error occurred in our description of the Baird Pneumatic Tool Co.'s yoke riveter in our issue of July 8, page 89. Through a typographical error the word "yoke" appeared as "type" and we hasten to make the correction.

Lafayette Button Die Grinding-Attachment

The Portable Universal Grinding Machine manufactured by the Lafayette Tool and Equipment Co., 21 South 12 St., Philadelphia, Pa., and described in volume 51, No. 20 of the *American Machinist* is now equipped with a button die grinding-attachment as shown. The attachment comprises an index plate, a set of nine die holders, a graduated adjustable feeding device for the rack work holder, chucks and abrasive pencils. The die holders will accommodate A. S. M. E. Standard and fractional dies, and the index plate is drilled for both three- and four-grooved dies. The work, while held



LAFAYETTE GRINDING MACHINE WITH BUTTON DIE ATTACHMENT

rigidly in the die holder, is controlled by the index plate which can be set to suit the various widths of flutes in the dies to be ground.

A Cost System for the Small Shop

By H. L. WHEELER

The problem of cost keeping is very often a vexing one to the small shop proprietor. The elaborate and intricate cost systems of the big shops are far too expensive to operate, and efficiency experts and systematizers are out of the question.

The system here described was designed by the writer and has been in successful use for more than two years in a shop building special automatic machinery and doing a great variety of repair work. This shop employs, on an average, twenty-five men. Two different types of machines are built and they are generally ordered in lots of four. One machine has about 450 parts and the other has about 600 parts. A good set of drawings is available for each machine, each part being show on a separate sheet 9 x 12 in. in size.

When an order for four machines is received the superintendent issues a shop order on the form shown in Fig. 1. This form is simple and merely serves as an

DUPLICATE
MACHINE SHOP ORDER

No. 370 ..... July 7 1910

Manufacture four (4) K-type folding machines complete.

Order completed ..... By ..... Supt.

FIG. 1. SHOP ORDER WHICH IS MADE OUT IN TRIPLICATE

JOB NO.		CHARGE
1382	MACHINE SHOP	370

MFGR. 28 - Toggle bolts - turn, thread & fit nuts - finished

ORD K-210 DATE 1 2 1919

NAME A. Martin NO 403 TOTAL TIME 25 hrs

FIG. 2. JOB CARD MADE OUT BY FOREMAN

order to the foreman to go ahead with the work. The order is made out in triplicate and one copy is retained by the superintendent, one goes to the office cost division, and the third goes to the shop foreman.

To start an order through the shop the following steps are taken: The foreman writes the job cards, one of which is shown in Fig. 2, giving a brief description or name of the part to be made, together with the drawing number and date. These cards are numbered consecutively and are filed in a small box which is kept on the foreman's desk. One compartment of this box serves for filing work ahead as just explained, a second contains a tab index for the men with their names and numbers, and a third holds cards for odd jobs and outside repair work.

The time card shown in Fig. 3 is given to the workman with each new job and handed back again to the foreman when the job is finished. The men make out their own time cards each day, these being checked against the regular attendance clock cards. The card will serve for one week if necessary, and each week all cards are collected and cards for the following week are given out to the men with the date of Saturday of the new week appearing thereon. The time card also bears the shop order and job number, making it easy to assemble very quickly all of the time spent on any job or shop order. When jobs or shop orders are completed the cards for each are filed in separate boxes for future reference, and they are most valuable in making estimates on new work or similar repair jobs, as the case may be.

While this system may not be scientific or accurate to decimals of an hour, it has given excellent results. It is operated at small expense, as the foreman can handle the whole system without the aid of a clerk.

S. O. 370 Job No. 1382 Week Ending AUG 1 41919

NAME A. Martin No. 403 Man's Rate 55¢ Shop Rate

	Lathe	Drill	Shaper	Planer	Bench	Floor	Repair	REMARKS
S								
M								
T	7							
W	9							
T	9							
F								
S								

TOTAL LABOR 25 hrs SHOP EX. MAT. TOTAL COST

Pac. Form 396 654 5-19

FIG. 3. TIME CARD USED BY WORKMAN

A Horsepower and Torque Chart

By John S. Watts

The chart shown herewith will prove useful in determining the sizes of gears or pulleys required to transmit a given horsepower at a speed given in revolutions per minute.

To determine the pitch and face of the teeth of a gear that will transmit the required horsepower, it is necessary to convert the horsepower into its equivalent in pounds of pressure at the pitch line of the gear. This pressure at the pitch line is dependent upon the diameter of the pitch circle, and as both are unknown quantities it is necessary to assume one or the other to solve the equation.

To use the chart, draw a horizontal line to the left from the intersection of the vertical line marked for the revolution with the diagonal line for the diameter chosen. From the point where this horizontal line cuts the vertical line marked 3,300, draw a diagonal line to the zero point at the left, and at the point where this diagonal line intersects the horizontal line for the required horsepower, we read the pressure that will be exerted by that horsepower, at the diameter and revolutions given.

For example, to determine the pressure on the teeth of a gear to transmit 40 hp. at 50 r.p.m. As already shown, it is necessary to assume a diameter for the gear which we will take as 60 in. From the intersection of the 60-in. diagonal line, and the 50-r.p.m. vertical line, we draw a horizontal line (shown dotted on the chart) to the 3,300 vertical line.

From this last point, we draw a diagonal line towards the zero point at the left, and where this diagonal crosses the 40-hp. line, we read the pressure to be 1,680 pounds.

As the gear formula alters the stress allowed on the teeth of the gear with different velocities, it is necessary to know the peripheral velocity at the pitch line and therefore this velocity has been given at the right-hand side of the chart. In the example used above, the 60-in. gear at 50 r.p.m. has a peripheral velocity of 785 ft. per minute.

The formula upon which this chart is based is

$$\text{Hp.} = \frac{\text{pressure on teeth} \times \text{peripheral velocity}}{33{,}000}$$

$$\text{and } \therefore \text{ hp.} = \frac{\text{pressure} \times \pi \times \frac{\text{diameter}}{12} \times \text{r.p.m.}}{33{,}000}$$

As the horsepower in the above formula varies directly with each of the quantities on the other side of the equation, it follows that the chart can be used for revolutions, diameters or pressures beyond its range, by simply dividing that quantity, which is too high, by ten (or any other suitable amount), and multiplying the answer given by the chart by ten or whatever figure was used.

For example, a 6-in. pulley at 500 r.p.m. will have the same peripheral velocity and will transmit the same horsepower with the same pressure as a 60-in. pulley will at 50 r.p.m.

The chart is used in precisely the same way for belt pulleys and rope pulleys, the pressure given then becomes the effective pull on the belt or rope.

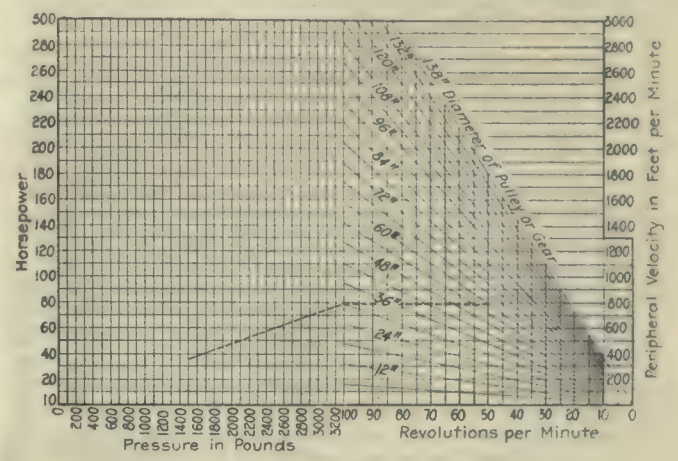
The following description of the method used in laying out this chart will serve as proof of its accuracy:

First we lay off the vertical line, marked 3,300, and divide it with horizontal lines to represent to scale the peripheral velocity up to 3,000 ft. per minute, each division representing 100 ft. to scale.

On this vertical line mark points to represent the peripheral velocity of each diameter of gear up to 138 in. at 6-in. intervals, calculated for a speed of 100 r.p.m. to the same scale and join each point by diagonal lines to the zero point at the right.

Now divide the base line of the triangle to represent up to 100 r.p.m. and erect perpendiculars at the points representing increments of 5 r.p.m.

It follows from the law of similar triangles that as the heights on the 3,300 line are the peripheral velocities for the respective diameters at 100 r.p.m., the height of any intersection of any diameter diagonal with any revolution vertical line, is the peripheral velocity of that diameter at that number of revolutions per minute, to the same scale.



HORSEPOWER AND TORQUE CHART

$$\text{As the horsepower} = \frac{\text{peripheral velocity} \times \text{pressure}}{33{,}000}$$

it follows that the horsepower at a pressure of 3,300 lb. will be $= \frac{\text{peripheral velocity} \times 3{,}300}{33{,}000} = \frac{\text{peripheral velocity}}{10}$.

Therefore, the horsepowers are marked at the left-hand side of the chart at one-tenth of the corresponding peripheral velocities.

The base line at the left is now divided up to represent 3,300 lb., and verticals raised at each 100 lb. division.

It can be seen that if a diagonal line be drawn from any point in the 3,300 line to the zero point at the left, the height of any vertical line to this diagonal line will be equal to the horsepower at the pressure represented by the vertical line, at the peripheral velocity represented by the height of the point taken on the 3,300 line. This because the height to the aforesaid part on the 3,300 line is equal to the horsepower at a pressure of 3,300 lb. at the peripheral velocity corresponding to the height at that point; and the heights of the vertical lines to the diagonal line, are necessarily proportional to the pressures marked at the respective vertical lines.

Business Conditions In England

FROM OUR LONDON CORRESPONDENT

London, June 18, 1920.

WHILE orders already received will carry on most members of the machine-tool industry for a period that can be measured in months, it seems to be undeniable that inquiries and orders of late have been much less numerous. The decline was noticed four or five weeks ago and has steadily become more marked. That it is fairly general is evident from the fact that the writer has elicited the same report by personal inquiries in four machine-tool localities in the West Riding of Yorkshire and reports from Birmingham, which mention in some cases almost hand-to-mouth working (the latter being exceptional). The holiday period setting in, fears of war-wealth or capital levies, and of dearer money, with restrictions of credit by the banks, have been causes. Then, too, doubt as to the effect of new taxation has certainly implied hesitation in enterprise.

R. McKENNA'S TAXATION FIGURES

It will be recalled that the excess profits duty was, according to all anticipation, to be removed entirely this year. Indeed, as herald of the storm rising against the financial policy and methods of our government of business men—and others—R. McKenna (the minister who as the then Chancellor of the Exchequer was responsible for the introduction of this duty during the war and who is now out of politics but engaged in banking) definitely stated only a day or so ago that "in framing it he had no conception of its continuing beyond the period of the war." He frankly pledged himself, he believed in the full confidence of his then colleagues, "that the tax should not be continued in peace." In his view the nation cannot afford to pay more than £1,000,000,000 a year in taxation. Yet, on the present basis of taxation, the revenue is estimated at £1,116,000,000, but some of the taxes are not productive for the whole year, and in a full year the revenue estimated is £1,238,000,000.

The McKenna figures need support. If they are correct it is clear that Great Britain is attempting taxation on too heavy a scale. But there is another view more prevalent as to decline; namely, that prices have reached a point at which the buyer must consider twice. Not that at present prices of machine tools tend toward reduction. On the contrary, increases have been imposed of late, on account of both the rising wages and the higher costs of castings and materials generally. Japan and India may be mentioned as good customers of late.

THE MOTOR INDUSTRY

The motor industry now shows little in the way of expansion of productive facilities. The cycle trade, too, has not come up to expectations, probably on account of high prices. The directors of one company, certainly among the oldest-established, the Coventry Premier, have frankly approached their shareholders with a view to obtaining the sum of £40,000 in second debentures bearing interest at 10 per cent, the debentures being of £10 each, and repayable at a premium of £1 at the rate of £1,000 per annum at least. Apparently, the shareholders have no choice in the matter. A bank overdraft has been refused. Accounts made up to the middle of last year suggest a loss of £41,700 and lower sales may be noted. The molders' strike is once more brought in; for, though castings do not enter so largely into cycle construction as in some other branches of engineering, the company had apparently intended to make up for bicycle losses by building roundabouts.

The fact that the bank had refused further credit in this instance is quite in keeping with present-time practice. Help is refused for any enterprise with character that approximates to the speculative. To add to the troubles of some firms, it is stated that the demand for payment of excess profits duty will be rather more insistent than in the past year or two, accomodation having been to some extent granted as to period of payment, etc., by the tax authorities. Since it was imposed toward the end of 1915, this duty appears to have brought into the exchequer the sum of about £926,347,000.

SHORTAGE OF CASTINGS STILL ON

Shortage of castings as the result to some extent of the molders' strike still shows itself in practically every branch of engineering. It is mentioned at the annual meetings of most engineering concerns: that of Greenwood & Batley, Ltd., Leeds, may be mentioned. Calling recently on about fourteen firms, the writer found only one of them satisfied with present supplies. It is recognized that Great Britain is short of foundry facilities, and up and down the country a number of foundries are being built. Not all of them, however, have been able to find the necessary skilled labor and in some districts the use of machines makes very slow progress.

The shortcomings of Great Britain in foundry work generally are in fact being steadily discovered by the persons concerned. Thus, the Institution of British Foundrymen has decided to take advantage of the government research fund, and will form a research association for the ordinary cast-iron and malleable-iron trades. A census has been taken which suggests that the United Kingdom has about 2,800 foundries, 285 being in Scotland, and 50 in Ireland, with about 800 in the Birmingham district. The necessary offices and also a research laboratory will consequently, it is proposed, be fitted out in Birmingham, under the direction of T. Vickers. So far, every encouragement has been given by the foundry industry, including various workmen's unions, and a meeting of the trade will be held shortly to start the association. Under the government scheme a fund of £1,000,000 is at the disposal of the Department of Scientific and Industrial Research for just such purposes. A similar research association for the motor-cycle and cycle-car industry has just been approved by the department named.

A PROMINENT AMALGAMATION

In the motor industry the amalgamation of the Darracq and Sunbeam companies created a mild sensation. Shares are to be exchanged on an equal basis. The capital of the Darracq Co. is 2½ million pounds, the dividend for some years being about 20 per cent on ordinary shares, with 10 per cent. on the £1,600,000 preferred shares. Of late, debentures had been repaid, and about half a million pounds worth of goodwill has been removed. In addition, the reserve fund is understood to be large. This company purchased the Clement-Talbot Co., and the business of J. Woodhead & Sons, Leeds, who supply springs, etc.; in addition, the company holds the capital of Heenan & Froude, constructional engineers of Manchester and Worcester. The Sunbeam capital is £530,000, £30,000 of that being preference shares, plus debentures at £150,000. The dividends paid range up to 33⅓ per cent. with bonuses, and last year a bonus of 100 per cent. on ordinary shares was distributed from the reserve. The initials of the three motor concerns will appear in the name proposed for the new amalgamation, namely, S.T.D. Motors, Ltd. As far as is at present known the existing works will be maintained.

The Singer Co., too, is to increase its capital to £500,000, and shortly a meeting will be held in order to arrange for the capitalization of about £100,000 from the reserve fund (£90,000) and profit and loss account. It has been stated that want of space is limiting the output possible from the machinery now installed. The present capital is, in fact, the result of a somewhat similar operation three years ago when reserves to the extent of about £50,000 were capitalized. Previous to this, however, the company had twice been reconstructed and the capital considerably reduced.

A number of firms have had their plants, etc., revalued and take credit for it, thus showing of course considerable increase as compared with values estimated even a year or so ago. All the same, many people regard present values

as inflated, and the wisdom of the policy is doubted. Greenwood & Batley, Ltd., at its thirty-second annual general meeting, heard that about £175,000, the capitalization of reserves, had been issued in the shape of bonus shares, and the chairman stated that justification will be found in the increased figure shown in the balance sheet for the value of works and plant. He was careful to point out that "the distribution of these shares in no way increases the earning power of the company." Straker-Squire, Ltd., the well-known motor people, for the year ending with March last made net profits of £46,564, paying a dividend of 10 per cent. That company has also re-valued its plant, etc., the increased value amounting to about £166,000. Of this, nearly £63,000 has been taken to write off goodwill, patent rights, experimental work, etc., the balance has been placed to the capital reserve fund.

The directors in fact believe that the property has risen further in value. They, too, state that but for the molders' strike the profits would have been considerably larger. Further capital is to be raised.

When money values are considered to the exclusion of quantities the returns on British overseas trading during the month of May last are certainly encouraging, suggesting a steady movement toward pre-war conditions. The value of the imports was £166,333,816 or rather more than £30,000,000 higher than the same month of last year. On the other side, exports at £119,319,422 were nearly £55,000,000 up on the same comparison, and made a new record. Improvement is shown in pretty nearly every direction.

A British Empire Exhibition

A British Empire Exhibition will be held in London in 1923, or earlier if possible. At a meeting which was held at the Mansion House, London, E. C., a representative of the Machine Tool Trades Association expressed regret that the government had given approval to a long-period exhibition. "Exhibitions were among the best advertising media, but six months' exhibitions which formed a fair ground were not the best method of promoting British trade." The Cologne trade fair, projected for the coming autumn, has been postponed because, owing to labor troubles, the buildings could not be finished in time. May of next year is the period suggested.

The firm of Harry F. Atkins, Ltd., Old Fletton, Peterborough, will already be known to many American readers through its slotting machines, marketed by Alfred Herbert, Ltd.; a new size of this machine is on the way. The other regular products of the firm include a lathe of 5½ in. height of centers with a head of rather more power than usual, interlocked apron motions, dead stops for length, taper-turning device, etc.

Another machine now regularly made is a twist-drill grinding machine of swinging-arm type, carrying a ring wheel 8½ in. in diameter and suitable for drills of from ¼ to 2¼ in. in diameter. Three lip drills can readily be ground, a small screw limiting the motion of the V arm. Clearance, too, can be adjusted if required. Both the main wheel and the point-thinning wheel at the other end of the spindle are guarded and splashing is prevented. A ground cast-steel spindle is employed and like the countershaft, which forms part of the machine, it is mounted on protected ball bearings. The firm has recently trebled the floor space of its workshops; also it has acquired twelve more acres of land, so that room is not wanting for further developments, which may include a foundry.

Operating in Great Britain at present are at least two systems of surface contact electric traction; namely, at Lincoln and Wolverhampton. The American will be interested in the latter where the Lorain system has been employed since 1900. On account of the heavy operating costs, age, and the need for double tracking, the system is to be displaced by the overhead trolley. Simultaneously to effect double tracking with the surface contact system and maintain running is somewhat difficult. Also the Lorain system necessitates the use of special details of equipment, as against the modern tendency toward standardization. In the interest of inter-communication and economical construction, maintenance and operation, it is concluded that the Wolverhampton tramways must be on the overhead system.

A news item of some interest here lies in the report that two of the largest Austrian screw-making concerns, Brevillier and Urban, have been bought by Guest, Keen & Nettlefolds in conjunction with the Jagy firm, Paris. The statement adds that the Brevillier Co. will enter the international screw syndicate and have a monopoly in east Europe.

Another London firm, W. Cole & Sons, automobile engineers and motor-coach builders, closed down recently, although having something like £400,000 worth of orders in hand. One of the directors has stated definitely that this is because "men did not produce enough work." Despite shortage of workers in the trade, piece-work has been refused. Complaints were made of time lost "by the constant succession of deputations from one or other sections of our employees making new demands." The trade union concerned has denied the complaint that dilution has not been permitted, and stated that the position of the firm is due to orders having been taken immediately after the war ended, thus involving now a revision of prices to make allowance for raw materials, etc. This Hammersmith firm had been established for more than 100 years; it employed about 500 work-people of all kinds, with an average weekly wage bill of about £3,000.

Hourly Output of Workmen Put at 60 Per Cent of Normal

One of the latest voices to be raised in connection with reduced outputs is that of Sir Arthur Duckham, who in his presidential address before the Society of British Gas Industries, at Sheffield on June 15 estimated that the hourly output of the average workman was in 1919 about 70 per cent of the figure for 1914, and at the present day he put the output at about 60 per cent. As a remedy for present-day evils he joined those who press for an industrial parliament. Apparently, this parliament is to be a council of representatives of employers' federations and workers' unions, so that limitations which are apparent in the Whitley councils would be once more seen. In fact, he admits that for true representation "all workers and all employers must be brought within the fold of unions of workers or federations of employers." These councils seem chiefly to be concerned with the arrangement of wages, a matter of no great difficulty when almost any price can be obtained for the article produced. No guiding principle appears, and in fact each trade or industry thinks only of itself. The same is true of a number of associations of semi-technical character which have been started-up for the smaller, and in some cases larger, industries. Sooner or later they become mere price maintenance associations.

Meanwhile, despite means as to reducing output and crushing taxation, it seems still to be possible to carry on all the usual horse racing (though perhaps not everybody attending) as a regular thing, a producer. America is encouraging us in the same direction by sending to us her best performers in golf and tennis. Well, all work and no play, etc.

Unusual Drilling in Chrome Nickel Steel

At the exhibit of the Railway Manufacturers Association, held at Atlantic City, June 9 to 16, demonstrations in drilling alloy steels, were productive of noteworthy results.

On an American 6-ft. radial, open hearth chrome nickel steel (0.50 carbon, 0.90 chromium, 1.00 nickel, 0.75 manganese) was drilled at the rate of 20 in. actual penetration per minute, with 1 in., 1¼ in. and 1¼ in. Hercules high-speed drills, made by the Whitman & Barnes Manufacturing Co., Akron, Ohio. The drills were run at 500 r.p.m. with a feed of 0.04 in. per revolution.

Holes 3 in. deep were drilled in 9 sec., attaining a penetration of 1 in. every three seconds, a remarkable performance in drilling steel of this character.



Commerce Chamber Visit to Russia Held Up By Passport Ban

No final action has yet been taken toward the selection of a commission by the Chamber of Commerce of the United States to visit Russia to investigate trade possibilities. Authorization for the appointment of such a commission was made at the annual convention of the Chamber at Atlantic City last Spring.

It was stated recently that the project has not been abandoned, and that a commission probably will be sent at a later date. The subject was taken up with the State Department some time ago as to whether passports would be granted to permit the members of the commission to enter Russia. The State Department officials informed the Chamber that no passports are being issued to Russia. Under these circumstances the commission may go to countries adjacent to Russia without attempting to cross its borders.

The recent relaxation of restrictions on trading with Russia apparently has not given sufficient impetus to the movement for resumption to trade to hasten the departure of the commission for Europe. It is expected, however, that such a commission will be appointed before long, perhaps by the time this appears in print. The selection of members of the commission, it is understood will be made upon the suggestion of the Russian-American Chamber of Commerce, of which former Secretary of Commerce William C. Redfield is president.

Industrial Research Laboratories in America

A bulletin just issued by the National Research Council lists more than three hundred laboratories maintained by industrial concerns in America, in which fundamental scientific research is carried on. The bulletin gives a brief account of the personnel, special equipment and particular kind of research carried on in each of the laboratories listed.

Industrial research laboratories have increased notably in number and activity, both in America and Great Britain, since the beginning of the war, because of the lesson vividly taught by the war emergency. It was only by a swift development of scientific processes that the Allies and America were able to put themselves in a position first to withstand and then to win a victory over Germany's science — backed by armies and submarines. And it is only by a similar and further development that America and the Allies can win over Germany in the economic war-after-the-war, now being silently but vigorously waged.

Motor Truck Opening New Profit Channels

"What the railroad did following the Civil War to open up new channels of industry and profit, the motor truck is doing today," declares J. J. Hunt, general manager of the Reo Motor Car Co., of New York.

"Naturally," he stated, "the motor truck cannot hope, nor do its owners wish it, to supplant the railroads, except on short hauls. On long journeys the rail way is the cheapest way.

"Since the war the increase in sales and production of motor trucks has been unusually great. During 1919, for example, 316,364 trucks were built, an increase of 39 per cent over figures for the previous year."

Airplane Service Between Amsterdam and London

An airplane service with the English "Airco" machine has been established between Amsterdam and London. The transit time, between three and four hours, is about a sixth of the time consumed in going from Amsterdam to London by the usual railroad and steamer route.

The airplanes fly overland from Amsterdam to Calais, France, and then cross the Strait of Dover at the narrowest point, being only about 10 min. above water. The return voyage is by the same route. As it is approximately 400 miles, the airplanes travel at least 100 miles an hour.

The passenger fare between Amsterdam and London is 150 florins ($60.30). First-class fare, with meals and cabin on the steamer, by the usual route is about half that amount.

Packages are carried by the airplanes for the equivalent of $1 per kilo (2.2 pounds) up to 5 kilos. For greater weights, the rate per kilo declines till the charge for 40 kilos (88 pounds) is $29. Packages weighing more than 40 kilos and measuring more than half a yard on any side are not carried except by special agreement.

During 1919 the value of the declared exports from Switzerland to the United States, amounting to $54,757,686, nearly tripled that of the preceding year, $18,681,792. The most important increase occurred in shipments of watches, totaling $25,244,239 in the past year as compared with $8,248,370 in 1918.

Plant That Helped Equip Monitor Changes Hands

Memories of the ironclad Monitor of Civil War fame are recalled in the recent sale of the site and plant of the Hewes & Phillips Iron Works at Orange and Ogden Sts., Newark, N. J., for it was there that the turret rings and a machine for planing the turrets of the fighting craft were made. The part the local industry had taken in equipping the boat which prevented the Merrimac from wreaking havoc among the Northern ships was always a source of pride to the late John M. Phillips, one of the company's founders.

There, too, at cost, 8,000 stands of arms were altered for the state from flintlock to patent breech and percussion guns at the beginning of the war. Twelve thousand stands of arms were altered by the company for the Federal Government. The plant also manufactured the motive machinery for the "Modoc," the "Cohoes" and other light ironclads and large quantities of machinery for gun factories throughout the country. It sent more than threescore of its workers into the Union forces.

The business was founded in New York in 1845 by Mr. Phillips and J. L. Hewes, and consisted of the manufacture and sale of steam engines, boilers and various machines. In the following year it moved to Newark, having for a time occupied a building at Bridge and Spring Sts. The present site was purchased in 1858. It shipped its products to all parts of the globe.

Mr. Phillips had been a pattern-maker's apprentice at sixteen years. Later he was identified with Seth Boyden, the inventor. The heirs of his partner sold their share to Mr. Phillips in 1873, and the plant has since remained in the Phillips family.

The property was sold by the Phillips estate, represented by Alfred F. Skinner, to the New Jersey Machinery Exchange.

5,530 Cars for Canada Roads

Among the list of new equipment just ordered by the Canadian National Railways are 112 new locomotives, 4,150 freight cars, 600 refrigerator cars, 350 ballast cars and 350 stock cars. Eighteen new sleepers, 12 new diners and 50 express refrigerators have also been ordered.

Of the new locomotives, 32 are medium Pacifics, 10 are heavy Pacific, 25 are Santa Fes, 25 are switch engines and 15 Mikados. The list of freight cars consists of 1,150 general service cars and 3,000 box cars. Delivery on the new equipment will begin shortly.

WORLD'S INDUSTRIAL FORGE
News Editor

Southeast Machinery Exports to Latin America Increasing

Machinery and machinery supplies have contributed considerably to the remarkable development of the export business between the Southeast and the Latin-American countries during the past two or three years, according to Dr. Guy King, Cuban consul in Atlanta. Atlanta alone this year, Dr. King stated, would have an export business with Cuba amounting to about $1,250,000, of which amount machinery and supplies is one of the main products represented. In 1919 Atlanta's export business with Cuba amounted to a little less than $1,000,000, and the increase this year is proportionate with the increase in export business being experienced generally throughout the Southeast, the consul declared.

World's Biggest Blast Furnace Is Blown In

The Ebbvale Co., London, England, has blown in what is said to be the world's biggest blast furnace. The furnace cost £1,000,000.

The weekly output is estimated at 3,000 tons. It is asserted that the furnace can produce steel the cheapest in the world.

Starts New Business With Prayer

The unusual proceeding of starting a great business enterprise with a prayer meeting was witnessed recently. The Meadows Manufacturing Co., Bloomfield, Ill., which has just completed a quarter-million dollar plant, assembled all heads of departments and sales managers in the offices and called in a minister to conduct an old-fashioned prayer meeting as marking the official dedication of the new plant.

About the Gasoline Supply

Henry L. Doherty says: "There'll be gasoline for us, for our children and our children's children."

The United States Geographical Survey says: "Seven billion six hundred and twenty-nine million barrels of oil still in United States fields—enough for 20 years at present consumption rate. World's deposits 60,000,000,000 barrels—enough for 168 years.

The United States Bureau of Mines reports: Reserve gasoline stocks in March reached 625,393,046 gallons, an increase in 30 days of 80,330,617 gallons. Surplus of production of gasoline, 1919, 149,446,488 gallons. Total production of gasoline in 1919, 3,957,857,097 gallons.

S. F. Bowser & Co. Has Sales Convention

S. F. Bowser & Co., Inc., Fort Wayne, Ind., manufacturer of oil tanks, pumps and storage systems, held its annual sales convention from June 28 to July 2 inclusive in honor of the 1919 members of the company's Pacemakers Club. Membership in this club is a reward for securing 500 points of business based on volume and class of equipment sold.

The convention was held for the benefit of the sales force and to secure co-operation from the factory force. As a surprise to the latter group, the salesmen pinned on the bosom of each workman a "badge of honor." A gasoline-filter demonstration of the Bowser filter was also successfully conducted. The convention was said to be the largest and most successful ever held and indicates the great co-operation existing among Bowser employees.

WAYNE ENGINEERING CO.

DESIGNING AND MANUFACTURING ENGINEERS

HONESDALE, PA., July 12, 1920.

"The Price of Meters for the Small Shop"

During the past few months, the writer has given serious consideration to the possibility of our company being one of the victims of the World Trade Club. Our concern is small, having been in existence only a few years, and the successes we have attained have been the result of constant plugging in the improvement of our small tools, jigs and fixtures. These are a large and important factor in producing, and without having this equipment in daily use we could not earn a penny. We have not the time nor money to rebuild and replace them to produce a product to metric measurements, though the metric system might be the finest in the world(?). Such a shift would mean financial disaster which no one desires, and the success of this absurd project would stand fair to eliminate us. And we think the great fraternity of small shops feel the same way about it.

W. BURR BENNETT,
President.

Commander Gatewood Now Director of Construction and Repair

Commander R. D. Gatewood of the Construction Corps, U. S. Navy, has been selected by Chairman Benson as director of construction and repair of the Emergency Fleet Corporation, relieving R. L. Hague, of San Francisco. Commander Gatewood graduated from the Naval Academy in the class of 1903 and from the post graduate course of Naval Architecture and Marine Engineering at Massachusetts Institute of Technology in 1906. He has been in charge of repairs and new construction on both the Atlantic and Pacific coasts and for two and one-half years was fleet constructor of the North Atlantic Fleet.

During the war Mr. Gatewood was superintendent of motive power for the Panama Railroad in charge of the large shops and drydocks at both ends of the Isthmus and made an enviable record in connection with extensive repair and refitting work on merchant vessels.

Shortage of Gasoline in the German Automobile Industry

[Consul Frederick Simpich, attached to American Commission, Berlin, June 2, 1920.]

In a recent general meeting of the Society of German Motor Car Manufacturers complaint was made that sales are badly blocked by the shortage of gasoline; that the importation from the United States is, in spite of very considerable orders, most unsatisfactory, seemingly on account of an enormous consumption in the United States; that it is hoped that Roumania will soon be able (as in former times) to again take up its gasoline export to Germany.

In the course of the meeting it was further stated that it was planned to work hand in hand with the Austrian automobile industry concerning all economic questions.

Deny Russia Purchased Engine Company

Olof H. Lamm, Swedish Consul General at New York, has issued a formal denial of the statement that Nydquist & Holm, Aktiebolag of Trollhaettan, the largest locomotive works in Sweden, has been sold to Russia.

"Although the majority of the shares of the company have recently changed hands, I can authoritatively inform you that there is no Russian interest behind this transaction, the new shareholders being all Swedes," he said.

Obituary

B. F. MECHLING, president of the Albro-Chemical Elevator Co., died on July 2 at his home in Philadelphia, Pa. Mr. Mechling received his education in Allentown Seminary (now Muhlenburg College). He was president of the Elevator Safety Appliance Co., Philadelphia, and a director of Mechling Bros., Camden, N. J. He has been president of the Albro-Chemical Co. for twenty-seven years.

Personals

At the meeting of the trustees of the United Engineering Society on June 24, IRVING E. MOULTROP, 39 Bolyston St., Boston, as a trustee of American Society of Mechanical Engineers, was elected a member of Engineering Foundation Board to fill the vacancy caused by the death of E. Gybbon Spilsbury.

J. E. JOHNSON, formerly secretary and treasurer of the Waterloo Gasoline Engine Co., Waterloo, Iowa, has accepted the positon of professor of practical Christianity in Boston University.

E. R. HONEYWELL, of New York, has been selected as manager of the Hares Motors Corporation of Connecticut, at the Locomobile factory in Bridgeport, Conn., succeding M. A. POLLACK, who resigned recently.

JOSEPH S. SAMPSON has been appointed traffic manager of the Wickwire-Spencer Steel Corporation's plant in Worcester, Mass.

A. H. GRAYBURN, for the past four years assistant to the vice president of the Norma Co. of America, Long Island City, N. Y., has been made assistant secretary and assistant treasurer of that concern.

EDWARD E. BRITIGAN, for a number of years connected with the American Die and Tool Co., Reading, Pa., in the capacity of engineer, has severed his connection with that company. After a short vacation he will follow machinery and automotive sales or service work.

NORMAN BELL has been made assistant sales manager for the Norma Co. of America, Long Island City, N. Y., this appointment following a connection of over three years with the concern as sales engineer. Mr. Bell's training and experience in the mechanical and automotive fields includes a former association with a leading British manufacturer of motor cars, and nearly four years in charge of the motor-accessories department of the Lunkenheimer Co., of Cincinnati.

A. J. STRONG, who has been for a number of years with the Pratt & Whitney Co. and later with Motch & Merriweather Co., Detroit, has become sales manager of the Detroit branch of the Whitcomb-Blaisdell, Reed-Prentice and Becker Milling combination. This combination was announced in a recent issue.

MESSRS. A. H. MITCHELL and E. R. ABBOTT, formerly with H. W. Cotten, Inc., have become associated with the Coe-Stapley Manufacturing Corporation, of West Haven, Conn. They will make their headquarters at 136 Liberty St., New York City, and will be in charge of the contract sales work of the company, covering quantity production of sheet-metal products, stamped, drawn or pierced work, or sheet-metal specialties completely assembled, of any metal and any finish. They will specialize particularly in work covering the manufacture of sheet-metal parts for automobiles, motorcycles, electrical devices, automobile accessories, phonograph motors and parts, clocks, etc.

Business Items

The Titan Tool Co., Erie, Pa., is the name of an organization recently formed to manufacture precision drilling and threading tools. F. A. Veith is president; J. V. Walker, treasurer; C. J. Gaugh, secretary, and J. W. McKean, vice president. These men were all formerly connected with the Modern Tool Co., Erie, Pa.

M. A. Hanna & Co., Cleveland, Ohio, has leased the property of the Buffalo Union Furnace Co., according to an announcement recently made by Frank P. Baird, president of the company. The period of lease extends for four years. C. A. Collins, second vice president of the Buffalo concern, will be retained as operating executive by the lessees. Mr. Baird said the transfer was made as a result of his desire to retire. This change will not effect the personnel or the general trade of the concern.

The new four-story addition to the Union Twist Drill Co., at Athol, Mass., will be finished shortly and will add approximately 48,000 sq.ft. of floor space to the present manufacturing space. The new addition is 63 x 190 ft. and of brick construction.

The opening of the new plant of the New Departure Manufacturing Co., at Meriden, Conn., on June 29 was celebrated by an entertainment attended by 6,000 people. This plant will be known as plant "D." It comprises several large modern buildings, power plant, administration, etc.

The Eagle Rock Tool and Die Co., West Orange, N. J., was incorporated with a capital of $100,000 to manufacture and deal in tools, etc.

Catalogs Wanted

The Standard Equipment and Tool Works, 179 St. James St., Montreal, Can., would be pleased to enter into correspondence with manufacturers of a few good lines who wish to enter the Canadian field.

Trade Catalogs

Portable Boats of Early Railroad Practice. The Baldwin Locomotive Works, Philadelphia, Pa. Record No. 97, pp. 35, 9 x 6 in. This booklet is written by J. Snowden Bell. It tells how the early method of transportation of freight and passengers between the cities of Philadelphia and Pittsburgh was successfully conducted in canal boats, which traversed the entire distance between these terminals partly on railroads and partly by canal.

Like Finding Money. Famous Manufacturing Co., East Chicago, Ind. Catalog, pp. 13, 4 x 9 in. This catalog illustrates and describes the "Famous" waste-paper baling press and the company's belt or motor-power press which is used for baling paper, cotton waste, hides, etc. It also illustrates the sheet-metal scrap busheling press which compresses into a compact mass all kinds of sheet-metal scrap, lathe cuttings, shear trimmings, metal chips, punchings, etc.

Flexible Steel Armored Hose. Sprague Electric Works of General Electric Co., 527-531 West 34th St., New York. Bulletin No. 44,552., pp. 19, 8 x 10½ in. This bulletin contains illustrations and descriptive matter of the various uses of its steel-armored hose for railroads. List prices and specifications are also given.

Machine-Tool Control. The Cutler-Hammer Manufacturing Co., Milwaukee, Wis. Booklet, pp. 48, 8½ x 11 in. The first half of the book is devoted to machine tools of all kinds—lathes, drills, boring machines, planers, milling machines, punch presses, etc., with suggestions for the selection of motor and control apparatus for the different machines. The second half of the book takes up the C-H controllers.

Lifting Magnets. The Cutler-Hammer Manufacturing Co., Milwaukee, Wis. Pamphlet, pp. 8, 8½ x 11 in. This company has issued a new pamphlet describing and illustrating its circular type of lifting magnets. It tells how many iron foundries, steel mills, shipyards, and other plants are increasing production and reducing handling costs by the use of the circular type of lifting magnets.

Tools and Machinery Supplies. Peter A. Frasse & Co., 417 Canal St., New York. Catalog, 6 x 9¼ in., pp. 800. Peter A. Frasse & Co. has announced that it has issued its first large general catalog since starting business. This catalog is printed on coated stock with cloth board covers. There are several sections. The first contains illustrations and descriptive matter on tool and alloy steel, cold-drawn steel, screw stock and shafting. The next section is devoted to complete information on Shelby cold-drawn mechanical steel tubes. This is followed by sections on transmission chains made by Renold Ltd., Manchester, England, and machinist's tools, general supplies, etc.

Forthcoming Meetings

The International Railway Master Blacksmiths' Association will hold its next annual convention at Tutwiler Hotel, Birmingham, Ala., on Aug. 17, 18 and 19. The secretary of the association is A. L. Woodworth, Lima, Ohio.

The National Gas Engine Association, Monadnock Bldg., Chicago, Ill., will hold its thirteenth annual convention at the Congress Hotel, Chicago, on Sept. 1, 2 and 3.

The American Steel Treaters' Society and the Steel Treating Research Society will hold their second annual convention and exhibition at the Commercial Museum, Philadelphia, Pa., on Sept. 14 to 18, inclusive. J. A. Pollack, of the Pollak Steel Co., Cincinnati, Ohio, is secretary of the former society.

The American Foundrymen's Asssociation will hold its annual convention and exhibit at Columbus, Ohio, on Oct. 4 to 9. C. E. Hoyt, 1401 Harris Trust Building, Chicago, Ill., is secretary.

An exposition of U. S. manufacturers at Buenos Aires, Argentine Republic, S. A., has been arranged for the month beginning Nov. 15. Information can be obtained from the American National Exhibition, Inc., Bush Terminal Sales Building, 132 West 42nd St., New York.

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The Naval Air Station at Pensacola

BY FRED H. COLVIN
Editor, *American Machinist*

ALTHOUGH we are most apt to think of the air service as being connected with the Army, we must not overlook the fact that thousands of naval aviators were trained during the war, many of them at the Naval Air Station at Pensacola, Fla. It is also well to remember that when it came to securing practical airplanes for war service, the Navy made by far the better showing, utilizing the experience of the best builders instead of waiting in the attempt to develop an entirely new plane.

It's a far cry from the sailing vessels in use when the Pensacola Navy Yard was established, to the submarines and aircraft which now use this yard as a base. The yard is admirably located and is now well equipped for its new work.

Pensacola as a naval station dates back many years, but in common with our other naval establishments it grew tremendously under the urge of war activities. It is now so different from Civil War days that Admiral Farragut and his fellow officers would feel entirely out of place. For the latter activities of the yard at Pensacola have been almost entirely confined to submarine or undersea ships, and flying boats or oversea aircraft. Located on a comparatively shallow bay and protected to a great extent from the storms of the Gulf of Mexico by outlying islands, it affords an excellent place for naval air training. Some idea of the appearance of



FIG. 1. HAULING PLANE UP WITH TRACTOR



FIG. 2. THE SALVAGE BARGE—"MARY ANN"

the training station can be had from the headpiece. This shows the various hangars, each of which accommodate several flying boats or hydro-airplanes as the case may be, and it also shows the high observation tower from which an officer keeps his eagle eye on all the men in the air so as to be able to report instantly if anything goes wrong. Should he see a plane fall, he telephones instantly to one of the fast sea-sleds which are always ready to go at a thirty-mile clip to the aid of any fallen flyer. Immediately thereafter, the scow shown in Fig. 1, and familiarly known as the "Mary Ann," starts after the fast-speeding sled to rescue the airplane or boat from its watery resting place. In the illustration shown it has just returned with a hydro-airplane which is evidently very little damaged. Although not staged for my benefit, a small plane "crashed" or nose-dived into the bay during my visit and immediately preparations were under way for rescue of both the men and the machine. Fortunately, neither man was injured in the least, although the plane sustained considerable damage to the wings and pontoons.

Another view, Fig. 2, taken from the beach and looking out over the bay shows the way in which one of the large flying boats is handled from the water to the hangar. The boat body is floated over a small car, which is shown better in Fig. 3, and a small Cleveland tractor of the crawler type hauls it up the incline and helps get it in position in the hangar. These little tractors are found very convenient in many ways in handling aircraft of various kinds in and out of their hangars.

Fig. 1 also gives a good idea of the twin-motor flying boat of the type built at the Philadelphia Navy Yard, the new naval aircraft factory which was built in such



FIG. 3. TESTING OR "SWINGING" THE COMPASS

record time during the war and which turned out large numbers of these boats before the signing of the armistice. The men around the hull and also up between the motors give a good idea of the size of the whole craft.

Navigation of the air is in many ways more difficult than navigation on the sea, a reliable compass being one of the first essentials. Fig. 3 shows one of the flying boats being swung to various points to test the accuracy of the compass which has been installed for the guidance of the pilot. As all these compasses are of the magnetic type it is necessary to test them with reference to magnetic material in their vicinity and to correct any local attraction by means of small correcting magnets which are supplied by the makers of the instruments. For this purpose a circle was laid out on the concrete pavement in front of the large hangar and the points of compass carefully determined and marked on it. The plane is then wheeled into the center of the circle and swung until its nose and tail point North and South and the compass examined and adjusted for this position. The whole ship is then swung to other positions and tested and corrected in a similar manner at the various points. The care with which the ships are located so as to point in exactly the proper direction, can be judged by noting the use of plumb-bobs at both the nose and tail of the ship.

This view also shows something of the normal construction of the hangars in order to secure a clear opening for handling the aircraft in and out. The huge doors fold back entirely out of the way and in addition to this the I-beams, which form part of the framework for the front over the doors, are hinged at the top and swing up to one side so as to be entirely out of the way when the ships are being taken out or in. Two of these beams, swung nearly to their upper position, can be seen in Fig. 3 behind the end struts almost directly over the ship's number, 854.

Dirigible Hangars

In addition there are also large dirigible hangars, although neither of them is capable of housing ships of the R-34 type. These are extremely interesting structures and give some idea of the progress which has been made in air navigation.

One of the important features of the plant is an instrument repair room in charge of an expert instrument maker who not only keeps compasses and similar instruments in good order, but has also designed and built others for special purposes. The yard is under the command of Captain Harley H. Christy, assisted by an able corps of both reserve and regular officers, not forgetting the many airplane mechanics who keep the airplanes and motors in serviceable condition.

An Expanding Punch for Aluminum Ware

By Frank A. Stanley

The sheet metal utensil at the left in Fig. 1 is one of a line of articles manufactured by the Aluminum Products Co. in their plant at Oakland, California.

This piece of aluminum ware is about 6 in. in diameter and around its cylindrical body there are a series of twenty flats slightly over 1 in. in width. These flat surfaces are produced by means of the collapsing and

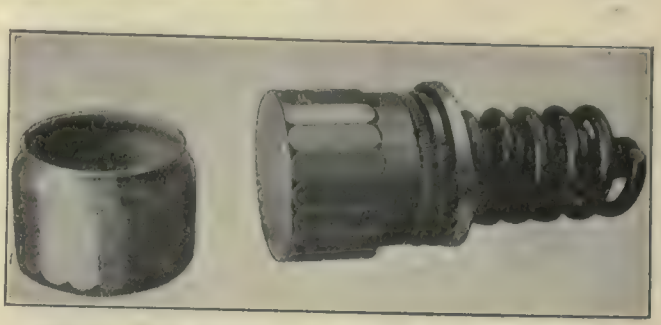


FIG. 1. THE EXPANDING PUNCH AND THE WORK

expanding punch shown at the right which, after being expanded into the walls of the sheet-metal shell, is automatically collapsed to permit its removal upon the upstroke of the press.

The aluminum shell is drawn up in a toggle press, double acting, and in three sets of dies. The final operation on the article is the spinning of the neck and the shaping of the top which is accomplished in a regular spinning lathe with suitable forms and tools.

The expanding press tool consists of a central body *A*, Fig. 2, a set of jaws or punch sections *B*, which are held together in cylinder form by two coiled springs as shown, a spring actuated pad *C* at the lower end, a rear pad *D* at the upper end and two springs *E* and *F*, all of which parts, with the exception of spring *E*, are shown in the assembled unit Fig. 1.

It will be seen that the lower end of the central punch body is tapered slightly and that this taper corresponds to an internal taper formed on the expanding jaws. The two springs coiled around the ends of the jaws or punch sections tend always to close the sections to the smaller diameter as permitted by the taper portion on the central body or shank. When the sections are down over the lower end of the central body they close and are in position to enter the work which is held in a suitable die on the press bolster. When the press ram descends the circular pad at the lower end presses back against its spring and as the punch sections cannot descend further, continued downward motion of the press forces the taper end of the body *A* against the taper in the punch sections and causes the latter to expand into the wall of the vessel, thus producing the series of flats around the shell. With the following up stroke, the stiff pressure spring *F* behind the punch sections holds them down until the central body has lifted sufficiently to allow the sections to collapse around the shank, in which position the entire device rises out of the work.

The thin pad *C* acts as a pressure pad to hold the work as the punch descends and to prevent it from lifting on the up stroke of the press.

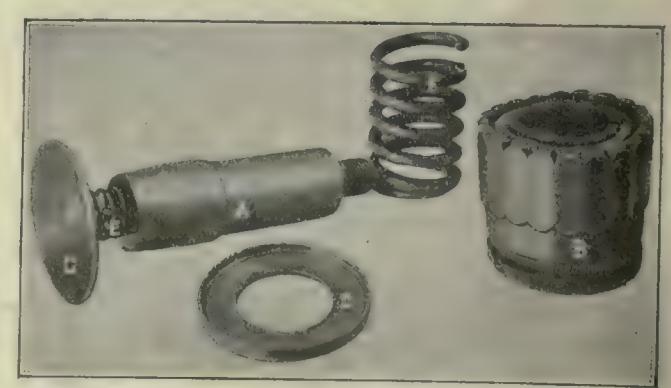


FIG. 2. COMPONENT PARTS OF THE EXTENDING PUNCH

Test of Large Roller Bearings Under Heavy Loads

By G. M. BARNES
Lieutenant-Colonel Ordnance Department, U. S. A.

The rollers in these bearings were 4.9 in. long by 1¼ in. in diameter—16 in a cage. The inside diameter of the inner casing was 7 in. From the observations and measurements taken it is concluded that this bearing could be safely used up to the total load of 800,000 pounds at which tested.

THE Ordnance Department, U. S. Army, has recently designed equipment which will employ large roller bearings. These bearings will be used under very heavy loads. Very little actual data could be found on this subject and the various roller bearing companies hesistated to state the maximum loads under which roller bearings of this size could be used.

A test of a roller bearing of the size required was therefore made at Watertown Arsenal, Watertown, Mass., using the large Emory hydraulic testing machine at that plant. The roller bearing used in the test consisted of a cage of sixteen rollers, each 4.9 in. long by 1¼ in. in diameter. The inside diameter of the outer casing was 11.25 in. and the outside diameter of the inner casing was 8.75 in. The inside diameter of the inner casing was 7 in.

The method of applying the loads to the bearings and of measuring the torque is clearly shown in Fig. 1. The bearings, axle and a lever used in the test are shown in Fig. 2. The starting loads were obtained by means of a large dial spring balance fastened at the end of a lever 120 in. long. This lever fitted over the top of the axle which is 7 in. in diameter, and which served as a bearing for the three sets of roller bearings held in the fixtures secured to the testing machine. The rollers were well cleaned and lubricated and care was taken that the pull was always at right angles to the lever.

The loads were applied in increments of 50,000 lb. and the forces at the end of the 120-in. lever were read and recorded through an angle of 72 deg. Three readings of the starting forces were taken at each angle of 12 deg., thus making a total of eighteen readings for each increment of load applied.

The average of each group of readings at each of these six points was recorded and the average of these six was taken in computing the average torque. After each increment of 50,000 lb. above 150,000 lb. load, the bearings were taken out, examined and the rollers and casings carefully measured to detect any deformation which may have occurred.

It will be noted that, although three sets of roller bearings were used in the test, only one set was tested under the loads given in the table. The other two bearings each carried one-half of the total load.

Two tests were made. During the first test the loads were run up to about 450,000 lb., at which point the rollers started to indent the inner and outer casings.

RESULTS OF ROLLER-BEARING TEST

Load Applied W	Fa	Fmin	Fmax	Ta	Tmin	Tmax	u
50,000	3.50	3.10	4.00	420	372	480	0.001050
100,000	3.50	1.83	5.16	420	216	611	0.000520
150,000	4.25	2.50	6.00	720	720	720	0.000425
200,000	7.00	4.50	9.50	840	540	1,140	0.000520
250,000	13.70	8.62	18.70	1,644	1,034	2,200	0.000820
300,000	15.72	10.11	20.22	1,884	1,212	2,424	0.000783
350,000	13.80	11.24	16.32	1,656	1,244	1,956	0.000590
400,000	19.36	15.36	15.28	2,316	1,824	2,762	0.000720
450,000	20.83	18.44	23.21	2,496	2,208	2,784	0.000690
500,000	30.70	25.65	35.67	3,684	3,172	4,272	0.000920
550,000	36.90	34.10	39.76	4,428	4,092	4,760	0.001010
600,000	44.30	38.76	49.78	5,316	4,644	5,976	0.001100
650,000	55.70	48.42	63.10	6,684	5,808	7,572	0.001290
700,000	82.27	80.32	84.21	9,872	9,638	10,104	0.001760
750,000	103.90	95.50	112.50	12,480	11,460	13,500	0.002080
800,000	144.30	128.60	160.00	17,316	15,432	19,200	0.002700

NOTATION AND FORMULAS

W — Load applied in pounds.
Fa — Average starting force in pounds.
Fmin — Minimum average starting force in pounds.
Fmax — Maximum average starting force in pounds.
Ta — Average starting torque in inch pounds.
Tmin — Minimum average starting torque in inch pounds.
Tmax — Maximum average starting torque in inch pounds.
Rc — Distance of center of rollers to center of bearing in inches.
r — Radius of rollers.
u — Coefficient of friction (calculated).

$$\frac{Ta}{Rc} = \frac{120\,Fa}{Wu} = \frac{r}{rTa}$$

$$u = \frac{rTa}{RcW}$$



FIG. 1. SET-UP FOR TESTING ROLLER BEARINGS



FIG. 2. THE BEARINGS WHICH WERE TESTED AND PART OF THE TESTING EQUIPMENT

These indentations increased perceptibly as the loads were increased. A maximum load of 800,000 lb. was applied to the bearing, at which the coefficient of friction was computed to be 0.0055. It was concluded that the inner and outer casings were too soft. Measurements showed the rollers had not been damaged.

The test was then discontinued and new casings were manufactured, having a sclerescope hardness of between 96 and 100. The test was then repeated and the results of this test are shown in the table.

Careful measurements were taken of the rollers and casings after the maximum load of 800,000 lb. had been applied. No deformation of any of these parts could be found. The table shows that at 800,000 lb. load, the coefficient of friction of the bearing was 0.0027.

From the observations and measurements taken during and after the test, it is concluded that this bearing could be safely used up to the total load of 800,000 lb., at which tested. The three bearings used for the test were unharmed and will be used in service under loads of about 300,000 pounds.

The Problem of Your Schools

By Laurence Parker
Vocational Co-ordinator, Woodward Technical High School, Toledo, Ohio

You will have, in your city, just the kind of schools that you desire. They will turn out just the grade of students that you want them to. If you are indifferent as to their management, they will turn out an indifferent product.

Now what sort of product have the schools turned out? It averages way below a marketable grade. Of the thirty-eight millions in this country who work for wages and on salaries, few have been trained for the work they are doing. Yet most of them were at school for several years. Less than 1 per cent are really trained. Most of what training they have was received in the "school of hard knocks" after they left school. Of all the thirty-eight million, the number who rise above the plane of shallow thinking, indifferent effort and inefficient service are so few that the percentage is not worth calculating.

Now if a factory should turn out such an unmarketable product, there would be an investigation made, provided there was time to do so before the receiver took charge. What is wrong? Why is the product so little adapted to present day needs? The educational system is founded upon the needs of days gone by. It is planned to give what used to be known as "cultural" rather than practical education. It has a program planned to prepare a boy for high school, college and the "learned" professions.

Of course every boy and girl should be given all the help possible that they may secure higher education. But how many boys and girls of today can avail themselves of this higher education? How does this program fit present day conditions? Industry has changed our whole manner of living and earning. The great need today is for men and women trained in the fundamentals of business. The professions are overcrowded.

Less than 50 per cent of those who reach the seventh or eighth grade go to high school. So over half go to work with only high school preparation in their heads. Then only 10 per cent of those who start high school ever finish. The others, without industrial training, go out into the world to sink or swim. Like true Americans they usually overcome the handicap and swim.

Some one has said that it is unfair to pave the road to the white-collar position and leave the way to the overall job a faintly marked trail. It is not only unfair but it is unprofitable as well. When the hard-headed men of business become active in school management, bringing with them the things that have made their own businesses successful, there will be more schools to train boys and girls for life *as it is*. They will be schools for successful life instead of comparative failure. Guy Bilsland says, "The problem is to teach life, not Latin; to teach him to work, not to worry; to produce, not to perambulate."

In the vocational schools of the modern sort, an attempt is made to give practical work somewhat as we describe. It is pioneering as yet. There are few practical text books, and few trained teachers. There is a great scarcity of school administrators who have the vision and who realize the needs of the majority of the boys and girls in your schools. These problems of education are being discussed in the educational magazines and at the educational conventions, where no doubt such discussions do great good. But if we are to have schools to fit these boys and girls for industry, these problems must be fully discussed in the magazines of industry and the help of the leaders of industry enlisted in the management of the school systems.

Holding Very Small Pieces For Turning

By S. Harmer Knight

The following idea helped me so neatly to solve an emergency problem that I believe it worth passing on for the benefit of your readers.

A number of small idler pulleys of german-silver $\frac{1}{2}$ in. in diameter by $\frac{5}{64}$ in. thick with a $\frac{3}{64}$-in. hole and a round-bottomed taper groove $\frac{3}{64}$-in. wide and deep, had to be made in the shortest possible time.

They were turned to size from german-silver rod, drilled and cut off as plain washers so that they could be mounted separately on a spindle, trued with the hole.

A special round-nosed tool was carefully shaped, under a high-power magnifying glass, for clearance and free cutting, but with the well known resistance of german-silver, I expected difficulty in holding such small pieces against the thrust of a grooving tool.

There was not time to solder each piece independently to the spindle and, after grooving, to remove it, clean off the solder, and remount and re-center the spindle; so some other method had to be devised.

The chucking spindle was turned from $\frac{1}{4}$-in. drill rod, shouldered to fit the hole in the washers, and the end threaded for a number 2-56 common hex brass nut. This of course would have very little binding power on the washers, but it occurred to me that if the face of the shoulder was nicked up so as to form teeth like the surface of a number 2-cut file, pointing forward in the direction of rotation, and the washer tapped up against this surface, the nut, small as it was, would hold it.

The results proved entirely satisfactory, as the pulleys were finished easily and quickly, with no marring of any account from the spindle, which was not even hardened for the purpose.

This makes a simple and convenient method for chucking washers of any kind which need to be reduced in size—a not infrequent necessity.

Garvin No. 3 Duplex Slot-Milling Machine

By C. J. PRIEBE
Associate Editor, *American Machinist*

Railroad shops, in addition to making ordinary repairs to locomotives, produce many new parts that have heretofore been ordered from the builders. Some parts, such as crossheads and piston rods, must be slotted for taper keys, and unless machines adapted to the job are at hand such work is very tedious.

A LARGE-SIZED slot-milling machine, especially designed for cutting cotter slots in locomotive crossheads and piston rods, is made by the Garvin Machine Co., Spring and Varick Sts., New York City. The machine mills both sides of a slot simultaneously, the work reciprocating and the cutters feeding inward intermittently. When milling slots entirely through a piece, one cutter automatically retreats before the two cutters meet, and the other one continues to advance and complete the slot.

Method of Holding the Work

The work is mounted in a fixture on the table, the accompanying illustrations showing a locomotive crosshead mounted on the mandrel *A* in the fixture *B*. The The same fixture can be used for any size of crosshead by employing a suitable mandrel. The mandrel is clamped rigidly by tightening the nuts holding down the hinged cap of the fixture *B*. An angle-block *C*, Fig. 2, on the table supports the overhanging crosshead, a wedge being fitted in the guide-ways of the head so as to prevent rotation. The wedge can be placed on either side of the block, so that either a right- or left-hand head can be slotted. The slanting position of the crosshead is necessary because of the fact that the slot must be cut at an angle to its vertical axis.

The same fixture *B* is used to hold the piston rod while slotting, one of the rods already slotted being shown in front of the machine in Fig. 1. By means of suitable bushings, any diameter of rod can be held. Because of the fact that the slot in the piston rod is required to be at a slight angle to the center line of the rod, the fixture *B* can be swung slightly by means of a special tongue fitted to the table slot.

The Table Motion

The table is mounted on a saddle bolted to the bed of the machine. Its motion is derived from the driving motor to be seen in Fig. 2, the train of gears shown providing the necessary speed reduction. No gear-shift mechanism is provided, the speed of the table being changed by varying the speed of the motor and by changing the gears in the train.

The gear train drives a worm and wormwheel running in a bath of oil, the shaft of the wheel being held in the bracket *D*. The wormwheel carries a crankpin, on which is mounted a hardened block fitted in a hardened slot on the bottom of the table and at right angles to its length. Rotation of the wormwheel causes the table to reciprocate, the length of stroke being varied by changing the position of the crankpin in relation to the center of the wheel, a scale on the side of the table showing the length of the stroke. The longest stroke obtainable is 10 in. The table is run for most work at a mild-stroke speed of 18 in. per min.

Cutters of the fish-tail type are used in the machine.

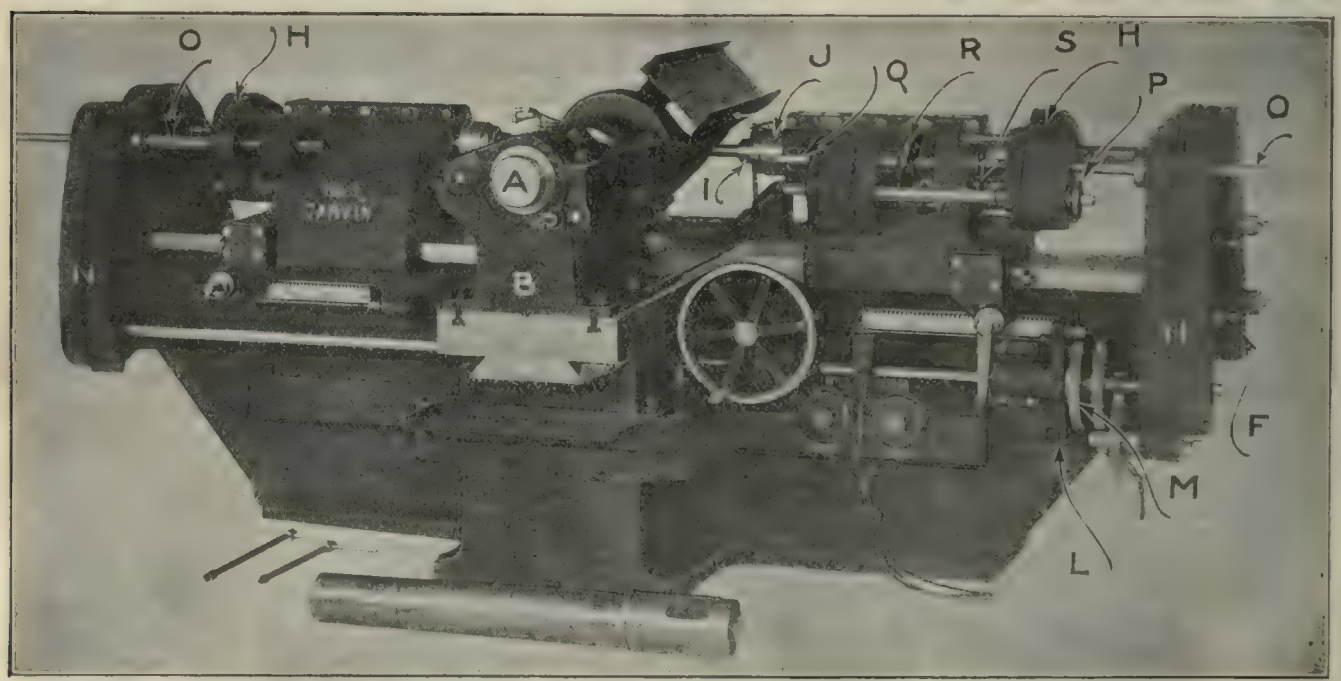


FIG. 1. FRONT VIEW OF SLOT-MILLING MACHINE

Specifications: Size of cutters used, ⅞ to 2½ in. Table: size, 21 by 87 in.; maximum travel, 10 in. Swing; over table, 30 in.; over bed, 12 in. Spindles; taper hole, No. 11 B. & S.; maximum distance between, 41 in. Spindle sleeves; diameter, 6 in.; length of bearing, 24 in. Feed; total per spindle, 6 in.; per table stroke, 0.01 to 0.025 in. Motors; speed, 650 to 1,950 r.p.m.; horsepowe . 5. Length of bed, 128 in. Floor space, 100 x 190 in.

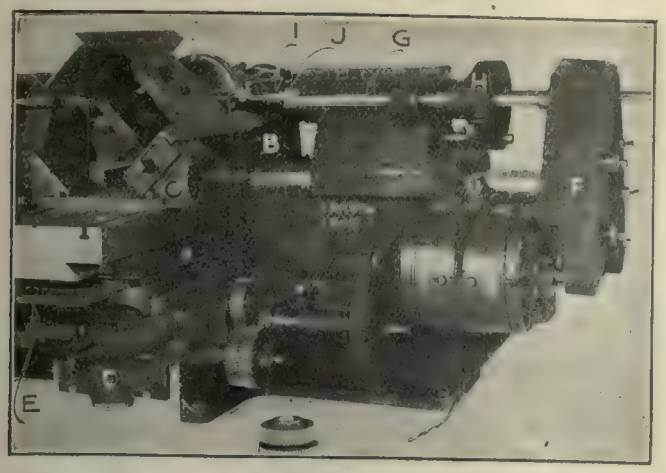


FIG. 2. REAR VIEW, SHOWING TABLE DRIVE

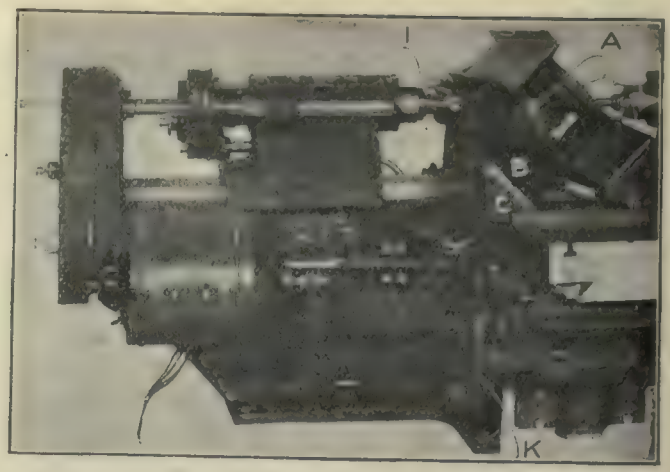


FIG. 3. REAR VIEW, SHOWING FEED DRIVE

The spindles and headstocks are duplicates as far as the drive is concerned. As can be seen from Figs. 2 and 3, each spindle is driven by a separate motor mounted at the back of the machine, the motors being of 3-to-1 variable speed and of 5 hp. each. They are started and stopped by push buttons, and the speed of each is controlled separately by rheostats on the front of the machine. In case of accident to either one of the motors the other one will stop automatically. The drive is transmitted from the motor through a train of gears, inclosed in the cover *F*, to the splined shaft *G*, from which a pair of gears in the housing *H* drives the spindle *I*. The cutting speed is ordinarily 70 ft. per min. The spindle runs in the quill *J*, which slides in the headstock, providing a feed of 6 in. for the cutter.

To accommodate work of different sizes the headstocks can be moved along the bed by means of the hand lever and racks shown in Fig. 1. When taking a cut, however, the headstocks are locked in position. Stops are provided, so that the headstocks can be returned to position after being run back out of the way.

The Feed

The feed of the cutters takes place at each end of the table stroke, being between 0.01 and 0.025 in. It is derived from two wedge-shaped blocks on the bottom of the wormwheel, the blocks pushing down one end of a pivoted arm and thus causing the double-armed lever *K*, Fig. 3, to rock. The lower arm of *K* imparts its intermittent motion through links to the arm *L* (Fig. 1), the swing of which can be adjusted so that the pawl at its upper end moves over different numbers of teeth on the wheel *M*.

The ratchet wheel *M* fastened to the long shaft transmits the feed motion to both heads. When the pawl is disengaged from the teeth of *M* the feed may be operated by the handwheel on the front of the machine, both spindle sleeves being operated simultaneously. The gears shown at the right in Fig. 1 are for the purpose of providing an automatic stop for the feed, and by means of them the feed can be tripped at any desired point. The motion of gear *M* and of the long shaft is transmitted through trains of gears in the housings *N* to the splined shafts *O*.

Since the method of feeding the spindles is the same on each head, reference will be made only to the head shown on the left in Fig. 1. The shaft *O*, threaded on its inner end, rotates in a nut on the headstock, so that, when turning, the spindle quill slides in the head.

When slotting crossheads the mandrel *A* is first put in position, the cutters are brought to the depth to which it is desired to feed them and the trip mechanism is set. After the cutters have been run back and a crosshead placed in the machine, the motors are started, the cutters advanced by the handwheel, and then the pawl is dropped down to engage the power feed. Upon completion of the cut the pawl is automatically thrown out by the trip, and the cutters are run back by the handwheel.

Feed-Reversing Mechanism

When slotting through solid work, as in a piston rod, the mechanism shown on the right head in Fig. 1 comes into action. By means of the knob *P* the gears inside the cover are put in mesh, thus causing the hollow screw *Q* to move toward the right. The threads of the shaft *O* do not engage the sleeve *Q*, but have clearance on the inside of it. When the cutters have advanced close to each other the top of yoke *R* strikes a stop, which causes the bottom of the yoke to strike a lever and disengage the latch *S* which holds the feed nut in place. The screw *O* then strikes the bottom of the hollow screw *Q*, which is still advancing. Thus *O*, the nut and the spindle quill are all pushed to the right, so that both cutters move in the same direction and the left one finishes up the slot. The feed stops as soon as the pawl is automatically disengaged. When the spindle quills are run back by means of the handwheel, the latch *S* again engages the nut and holds it in position. Proper timing of the release of the nut and of the contact of the two feed screws is obtained by adjusting the action of the mechanism before the piston rod is put in the fixture *B*.

It should be noted that all motions are positively driven. The bed and saddle are provided with troughs for collecting the cutting lubricant, which is circulated by the pump shown in Fig. 3. The machine, known as the No. 3, is capable of slotting the largest locomotive crossheads, and it is adapted to other work such as cutting keyways and slotting fork ends.

The New Adventure

By Entropy

Every generation has its proportionate share of men who must, in order to be happy, discover something. If the discovery of that something is attended with risk of neck or pocketbook, it is all the more alluring. Colum-

bus simply had to discover something; whether it was the East or the West Indies was not the point, he had to discover. Peary had the same need. America had already been discovered, Stanley and Livingstone had taken all the "new" out of Africa, so naturally he turned to the North Pole.

Geographically, we are pretty well caught up on exploration, and while we are waiting for the transportation problem to Mars to be arranged we must have something on which our pioneers and explorers can use their energies. A fertile field is right here in our midst, one that the explorer can work over for many years to come and leave unexhausted. There need be no physical danger, but there is real risk to the pocketbook and some danger to reputation.

The Field for Investigation

The field for investigation is here about us, going past us every minute in every crowd. Stand on any business corner, 42nd St. and Broadway, if it seems better, but even a country store will give one a lifetime's work. Look at the people. Some of them will develop. Some will work and become wealthy. Some will become wealthy with no apparent effort. The rest just sort of trickle through the seive and we never hear of them. We all know that chance has a great deal to do with the future of a great many of these unsuccessful people. We know that if they were put in the right environment many of them would become successful. We do not know which ones. Is there a more enticing field for exploration than this? What young man is there that would not agree to split even on all that he made over ten thousand dollars a year with any one who would train him to earn it? And there are a lot of men earning it who did not hope when they were young ever to see ten thousand dollars except through the grating of a cashier's window. You may spend a few thousand dollars on one man and have nothing but a puffed up windbag as a result, or you may spend a few hundred and begin to get returns at once. It's a big risk, but does not that make it all the more worth while?

Means of Developing Men

All the large companies are doing something of this sort but they are trying to play safe. That is, they do not spend much money on a man until they feel pretty sure of him. Take a young man, put him through college or engineering school, put him in the factory to find his level, and he may find it many strata lower than he would if he were given the right encouragement. It is the difference between treatment by discouragement and treatment by encouragement. Many employers say that that is the first thing they want to know, "Has the man courage?" Courage is a matter of environment. Who would not be courageous in business if he knew he had the United States Steel, or the General Electric, or International Harvester back of him? And how many men with responsibilities on their shoulders would be courageous when spending the money of these firms if there were any uncertainty as to what their backing would be?

Suppose that only one-quarter of the men selected and taken on for training and building up come out to advantage, will it pay to do it? Suppose that we consider that the least that we will call success is the increase of annual earning capacity a dollar a day. The average young man at 21 years of age may be expected to live at least 40 years longer. His dollar a day amounts to a salary of $12,000. This is a minimum for only 25 per cent of the men, which amount we will assume will succeed. It is certainly safe to say that the four men among whom one is found who achieves this very little advance in income will not have cost $2,000 each, for the other three will not have been the subject of experiment very long. The risk is there however. If the course is not character building, if it is purely technical, then it had better have been left to the schools; but our manufacturers and other business men as well, are finding that the man direct from school is not ready to take a worthwhile part in their organizations without further training, not merely in the technical branches of industry, but in the ethics of business. Unfortunately, colleges, even those which have strong courses in economics and sociology, do not seem to make a very close connection between the boys themselves and the business and social world. They seem to study it as if the students were to remain innocent bystanders.

Details of the System

How can a venture of this kind be carried out? What is the ship on which the adventurer is to make his voyages? One shop is not enough. A man may succeed in the first thing in which he is placed; but to our explorer, the fact that he achieves a measure of success only makes him suspect that he might make more of a success elsewhere. It is like speculation in stocks or anything else. Selling out and seeing the market go higher is a doleful game. And if the candidate is a failure in the first trial, why throw him away? Why not try him in another shop under a different boss? For we have to admit that many of the successful men we meet every day would not have been worth anything under certain other employers. It is a question of fitting the man in where his surroundings are congenial and where he can take root and grow.

The voyager into these unchartered seas must have behind him firms which have the facilities for giving his proteges the opportunities which he demands for them. He should pay their salaries or living expenses, so that the shop will not feel the need of paying them anything, or at the most, paying them only what they earn. I recall one young man undergoing a process of this kind who earned in one of his best weeks the sum of 34 cents, according to the piece-work rates in the room he was in. He learned a great deal, one of the things being the value of a dollar—or rather of 34 cents.

If he is successful, if he can pick the right men to develop, and if he is wise enough to know when to stop leading them and to let them go on their own responsibility, the adventurer should make a large profit, and he will make it without taking anything away from anyone. There must be vast unexplored opportunities in this work, but they can only be found by men who have clear vision and who are not easily discouraged by setbacks. Also, there will be a temperamental lot of young men with whom to deal; they will be sensitive and high strung in many instances, and they would not be worth anything if they were not. Many times the promoter will find that the shops in which he places his proteges will turn them out in disgust; and yet, if he sticks to it, he may easily have the same shops begging for his men when they have developed into the finished product.

Is it not an inviting field for exploration?



The Evolution of the Workshop—XI

By H. H. MANCHESTER

Metal-working industries in America sprang up and developed rapidly in the period from 1810 to 1840. Important inventions were numerous, the production of such things as firearms, nails, and engines received a great amount of attention. This article gives a survey of the metal-working plants existing throughout the States during this period.

(Part X appeared in our July 8 issue.)

IN THE United States the period from 1810 to 1840 was in general one in which the factories were struggling for a footing against importations from England, and was marked by three serious financial crises. On the other hand, in the South the cotton gin had given a tremendous stimulus to cotton raising, while in the West the introduction of the steamboat was leading to the rapid settlement of the lands adjacent to the rivers. In short, throughout the whole era, development of farms was more important than that of mills or factories.

The workshops, however, at least kept pace with the demands. The engine for the Clermont had been ordered by Fulton from Watt and Bolton at Birmingham, to be made in accordance with his specifications; but the engines for Livingston's and Fulton's subsequent boats were built by them in America. In 1811 the first steamboat for the Western rivers was constructed entirely at Pittsburg, with the aid of Stowdinger, the engineer in chief of the North River boats. At that date there had been five steamboats built successfully to run on the Hudson, one for the Delaware, one for Lake Champlain, one for the St. Lawrence, and this one, the "New Orleans," for the Mississippi. In England, in this same year, there was only one steamboat running, the "Comet," which was in operation on the Clyde. Two years later there were two factories for steamboats located at Pittsburg, near which iron and steel for the engines were already produced. By 1818 thirty steamboats had been constructed on Western waters. An important advance in principles was made in the development of machine tools for the more accurate construction of interchangeable parts, especially for firearms. This idea, which seems to have been practically applied first by Eli Whitney, was also put into practice by Colonel North at Middletown, Conn., before 1814. In 1817, for example, he was using milling machines with cutters of irregular form for milling the pan and between the bolsters in the flintlock musket. This same year we hear of Asa Waters of Millbury, Mass., welding barrels under trip hammers by water power, and of a nut boring machine put into use by James Green at Harper's Ferry.

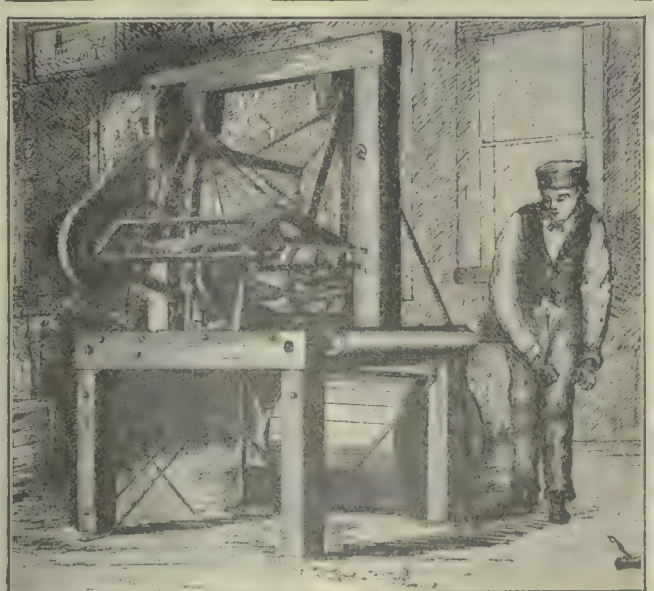


FIG. 66. BLANCHARD'S GUN-STOCK MACHINE

In 1818 Asa Waters took out a patent for turning gun barrels in a lathe, and it proved at once an improvement over the previous method of grinding them. It was while working this lathe that Thomas Blanchard conceived his idea for a machine, shown in Fig. 66, to

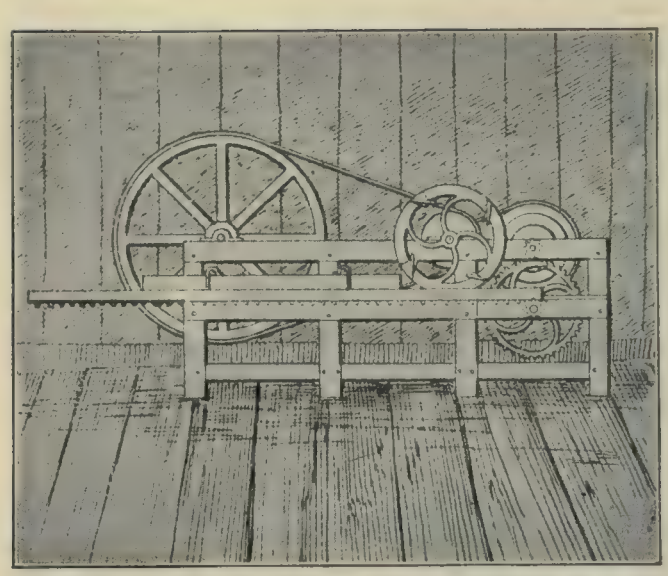


FIG. 67. A ROTARY-DISK PLANING MACHINE OF 1826

form the stocks of guns, which was patented in 1819, and soon afterward developed into his famous lathe for turning irregular forms. Blanchard was kept employed at the Harper's Ferry and Springfield gun factories, and received nine cents a musket for the use of his machine. He was also the inventor of thirteen other machines.

In 1819 J. H. Hall at Harper's Ferry made one hundred rifles which, according to a report of 1827, were entirely interchangeable. In 1830 cutters of irregular form were being employed for milling pistol locks. In 1834 Thomas Warner had a plain milling machine at work making lock plates, and others were employed at Middletown as well as at the Springfield armory where Warner was. In 1840 Warner built five such milling machines and was attaining interchangeable parts by combining milling and jig-filing.

The chronology of the period gives a fairly good conception of the progress being made in the workshops. In 1811 we hear of a machine for cuting off the ends of bolts invented by John Rewey, and a file cutter by Ernst Gehbe. In 1812 Morris B. Belknap also patented a machine for cutting files and sickles, and William T. James took out a patent for one which was in use at Union Village, while an improvement in wire drawing was made by William Wadsworth. In 1813 Jacob Perkins of Newburyport, Mass., who was already the originator of a number of inventions in our field, received a patent for making the shanks of screws, while Abel Stowell of Worcester patented two machines for making and finishing the heads of screws. It may also be of interest to note that Thomas Blanchard, who later invented the lathe for irregular forms, took out a patent for a horizontal sewing machine. In 1814 Moses L. Morse constructed a machine for manufacturing pins at one operation, but it is stated to have been too delicate to be a permanent success.

Activities After the War

After the close of the War of 1812, Secretary of the Treasury Dallas, as a basis for a new tariff, in 1816 classified the industries of the country in accordance with their ability to supply the home market. In the first class, as capable of filling the country's needs, he included the manufactures of iron castings, fire and side arms, cannon, muskets, pistols, and all sorts of carriages.

The second class, in which were placed those manufactures that were not then capable of filling the demand but might become so, included metal buttons, plated wares, iron manufactures of the larger kinds, shovels, spades, axes, hoes, scythes, etc., and nails, large and small. The third class, which was still mostly imported, embraced cutlery, needles, and iron mongery, except the larger articles.

In 1816 Jesse Reed of Hanover, Mass., the son of Ezekiel Reed, took out a patent for making tacks by machinery at one operation. Six of these machines were soon in use at Pembroke, one of them with one man running it producing 60,000 tacks a day. The next year Thomas Blanchard took out a patent for a machine to make tacks that had been first invented by him in 1806 at the age of eighteen. It was said to produce 500 tacks a minute, and was sold by Blanchard for $5,000. In the following year we hear of a patent for cutting metal combs, produced by Daniel Pettibone of Philadelphia, one for rolling metal tubes by Cyrus Eastman of Hillsborough, and lathes for turning gun barrels by both Sylvester Nash of the Harper's Ferry arsenal, and Asa Waters of Millbury, Mass.

Beyond comparison the most definite and dependable picture of manufacturing a hundred years ago is obtainable from the detailed accounts of the manufacturing establishments in the country reported for the census of 1820. The marshals in 1810, in their reports of manufactures, had included those made at home as well as in factories, but in 1820 the investigation was confined to mills and factories. On the face of the returns there seems to have been a falling off in production, but this is undoubtedly due to the omission of home manufactures, which is in itself an indication that the increasing importance of the factories was being recognized.

In the great majority of cases, however, the factories claimed that business had dropped off greatly since the close of the war or at least since 1818.

Distribution of Industry Throughout the States

How small the development of the factory system still was may be judged by the fact that in all Maine there was reported only one plant which made its products from iron or other metals. New Hampshire reported only three metal-working factories, two nail mills and one scythe factory. In Massachusetts, ma-

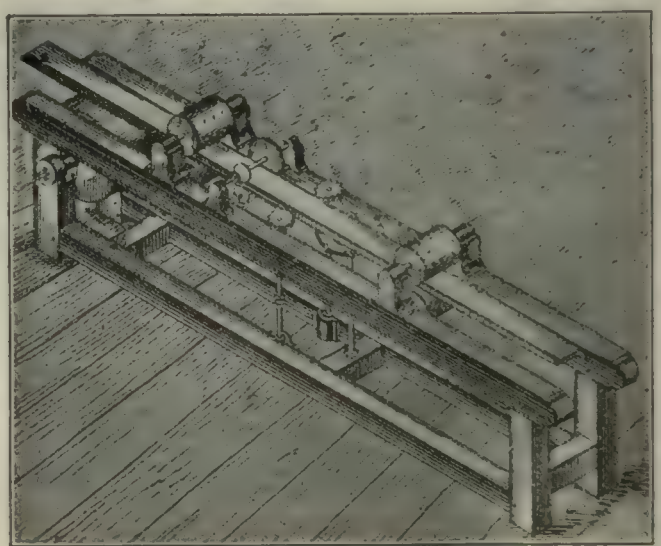


FIG. 68. A PLANING AND NOTCHING MACHINE OF 1834

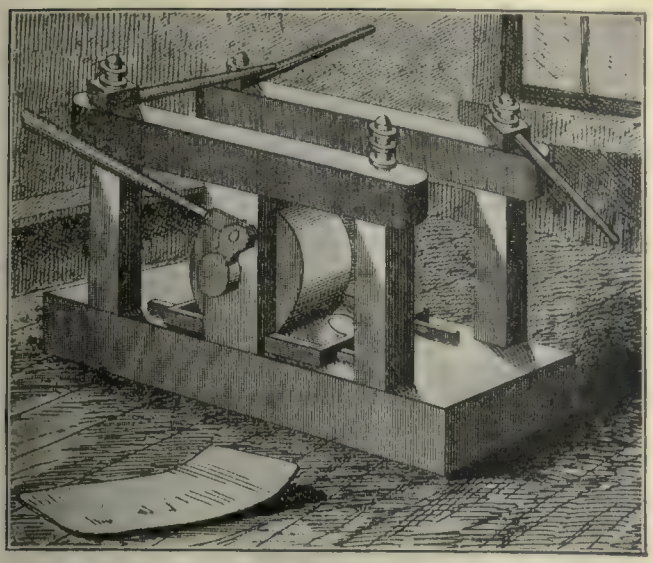


FIG. 69. A MACHINE FOR MAKING HORSESHOES

chine shops handling iron or other metals were listed in six counties, the nail mills, which also made rods, hoops, and brads, being the most important. The scale of wages was very low, as may be judged by the fact that in Plymouth County 72 employees in the nail mills received only $22,800 a year.

All Rhode Island reported only one metal-working machine shop, a nail mill that used machines for slitting, cutting, and heading. Connecticut reported at least twenty-eight machine shops working metals. These included eight producing bar iron, which were perhaps primarily foundries but made also plow shares, molds, and anchors. There were six manufacturing brass clocks, three forging anchors, three making firearms, three nail mills, two producing augers and screws, and one each making steam engines, stoves, and swords. A musket plant at New Haven gave its product as being worth $26,000 a year, and its consumption of iron as 30 tons. It had 53 employees, paid out $15,000 yearly in wages, and made use of machinery run by water and invented by its owner.

Vermont sent in accounts of only three factories in our field, all in Rutland County. The amazing contrast between a century ago and the present is emphasized by the scarcity of metal-working machine shops in New York City, only twelve being reported. There were no metal machine shops in Kings County, and only one in Queens. In all the rest of the State of New York there were only 65 enumerations. In New Jersey seven counties reported one or more mills for making bar iron, but besides these there were only one nail mill, a copper foundry and a stove factory in our field. Outside of Philadelphia, in the so-called Eastern District of Pennsylvania, seven counties listed plants making bar iron with about 35 forges, and there seem to have been seven plants making pig and castings and two rolling mills. In the Western District of the State factories of iron products seem to have been more prosperous than in the Eastern District. This was probably because the mountains protected them from importations from England, and the steamboat was increasing the possibilities of the Ohio and Mississippi valleys. In Allegheny County the plants making bar, boiler, and nail iron consumed 1,500 tons of pig worth, with other materials, $60,000, had a capital of $80,000, and were the biggest producers of the western district of the State.

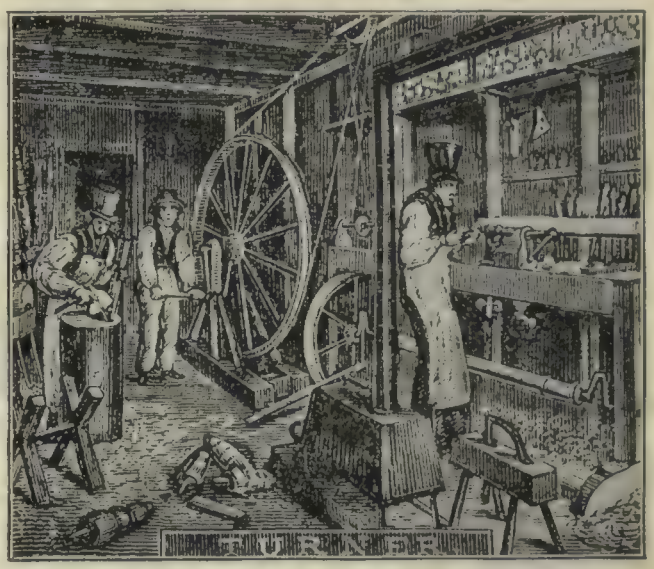


FIG. 71. A TYPICAL TURNING SHOP OF 1840

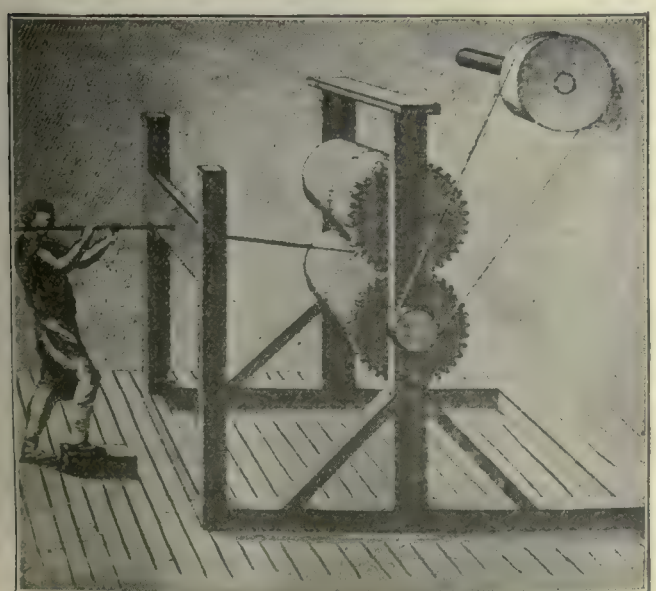


FIG. 70. A WIRE-NAIL MACHINE OF 1834

The only metal factories reported by Delaware used rolled and slit iron, bar iron, and pig. Baltimore had two mills making bar iron, sheet iron and nails, one of which produced boiler plate. Outside of Baltimore, there was a cannon factory in Cecil County which had a boring machine, and two factories there which had slitting and nail mills.

The marshals in the South, in the absence of factories, reported shops where the work was still done entirely by hand. Virginia had a number of foundries of pig iron and bar iron mills, but the only machine tools reported were in nail factories in Richmond and in Monongalia County.

In North Carolina there were three nail mills in Burke County and a shovel factory in Rutherford County. In South Carolina there was a musket factory at Greenville that had a production worth $30,000. Georgia reported one boring machine, and Alabama a shop with mill cranks, but these seem to have been the only machine tools in the two states.



FIG. 72. A CUTLERY SHOP OF 1840



FIG. 73. A PRIVATE GUNSMITH SHOP OF 1840

In the new states west of the mountains, and especially in the Ohio valley, machinery seems to have been more general. In Cincinnati steam and fire engines were made to the value of $130,000 a year. Cincinnati also had three lathes run by horsepower and two nail machines driven by oxen. In the rest of Ohio the most common metal-working machinery was the nail mill, of which there were nine.

The only genuine machine shop in Kentucky seems to have been at Louisville. Tennessee reported about twenty mills making bar iron and five foundries of cast iron. There were listed also one rolling mill, two nail factories, and four boring machines for guns. There were no metal-working machine tools reported in Indiana, Illinois, Missouri, or Louisiana.

The annals of the period between 1820 and 1840 show that American inventive genius was paying more attention to other subjects than to metal working, but they contain various items of interest. In 1822 N. Wright of Onondaga patented several coopering machines. In 1827 John McClintic constructed what was called the first practical mortising and tenoning machine, and the next year William Woodworth took out a patent for his machinery for planing, tonguing, and grooving. While these machines were for wood working, they had considerable influence in the machine shop. Figs. 67 and 68 show two wood-working machines which represent the best practice of the times.

In 1830 the first locomotive built in the United States, the "Phoenix," was constructed at the West Point Foundry, and the development of the railroad which followed lent tremendous importance to metal working machinery a decade or two later.

A machine for shaping horseshoes was patented in 1828 and is shown in Fig. 69. In 1831 cast steel was not as yet considered a success in America, and cutlery made here was exhibited at the Franklin Institute for the first time. The next year coke was first successfully used in the manufacture of iron in the United States. J. J. Howe's valuable pin-making machine was patented the same year. Fig. 70 shows a wire-nail machine of 1834.

What was probably the first factory in America for making machinists' tools exclusively, was established in 1837 by John H. Gage at Nashua, New Hampshire. Figs. 71, 72, and 73 give a good idea of how most work was turned out at this time, the small shop still being greatly in the ascendancy.

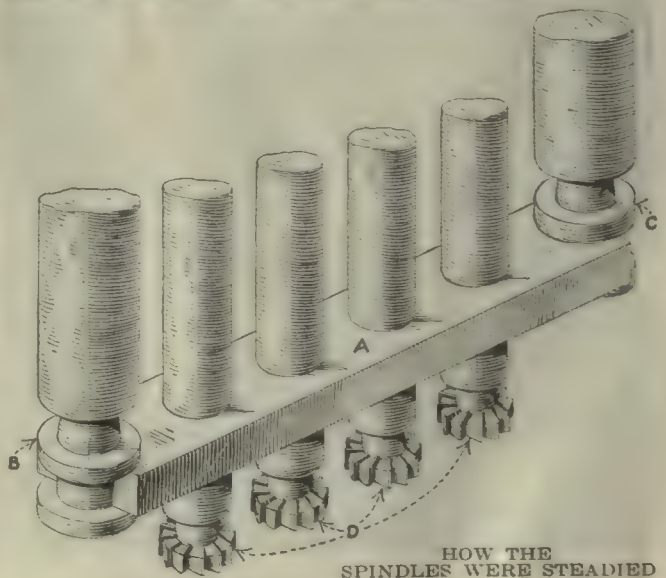
Steadying Drill Spindles

By Frank C. Hudson

A rather novel method of supporting four drilling-machine spindles so as to use them for milling is illustrated herewith. This is a multiple-spindle drill with spindles all in a row and close together. They were spaced to make them right for the work in hand, milling the compression space in cylinder heads, by means of the flat steel bar *A*. This was bored with four holes correctly spaced and of such size as to afford a good running fit for the spindles.

The ends of the plate *A* were bored to a half circle to fit the special heads *B* and *C*. These heads have taper shanks which fit the spindles and the collars support the ends of the plate at both top and bottom.

As all spindles feed up and down together, the plate *A* always supports the four milling spindles at the same point above the cutters *D* and substantially prevents springing which would otherwise occur.



HOW THE SPINDLES WERE STEADIED

Testing the Accuracy of Micrometers in Common Use

By C. A. HUBBELL
President of the T. R. Almond Mfg. Co., Ashburnham, Mass.

The data gathered by the author of this article and his assistants call attention to the fact that many employers and workmen consider a micrometer to be "always right," regardless of its use or abuse. Too much is generally taken for granted in regard to precision tools.

ALL of the data herewith presented have been compiled from the inspection of a great many micrometers of all makes in many different factories in different cities. Each instrument was checked for correct reading each tenth of an inch making eleven points from zero to one inch inclusive. The well-known Johansson master gage blocks were used as standards and the compiling of the data in the form of curves and plots was continued until there ceased to be any change in general shape, indicating that sufficient information had been collected to determine definitely the general, or average conditions throughout the country.

It is interesting to note that this checking caused to be discarded as unusable approximately 3 per cent of all the micrometers inspected.

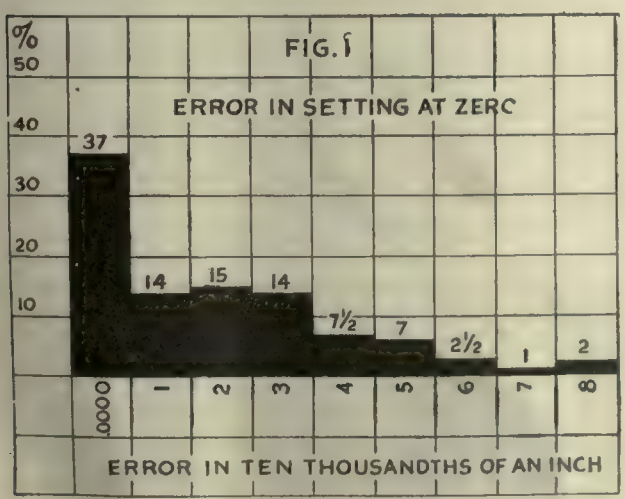
A most interesting and rather unexpected condition appeared in the large number of micrometers inaccurately set at zero. This error was almost universally minus and probably due to wear of the anvil and the end of the screw and is an indication of the care which the average mechanic gives to his tools, only thirty-seven per cent reading correctly at zero. A further interesting light was thrown on this subject when of the micrometers tested those owned by the employer were compared with those belonging to the employee. Fifty-two per cent of the employees' instruments were correct at zero; forty-eight were incorrect, while only 20 per cent of the employers were correct; 80 per cent were incorrectly set at zero. This seems to demonstrate pretty conclusively that it is quite universally nobody's business to look after the "firm's" tools, and emphasizes the importance and necessity of a periodical inspection of all gages.

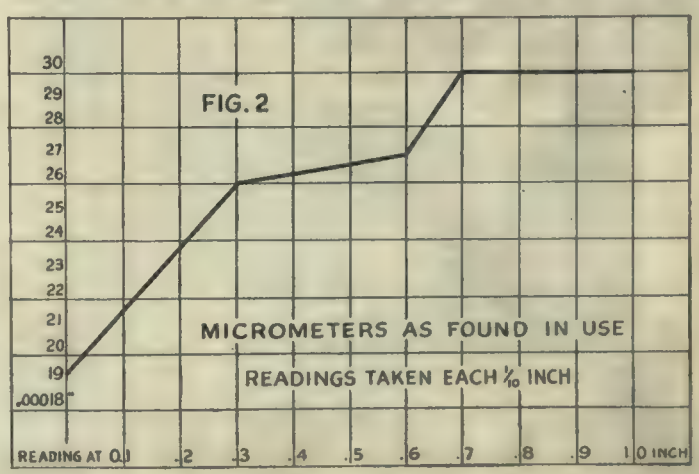
The average error in zero setting is about one-quarter of one-thousandth. It is not, however, the average error which causes troubles, but rather the error beyond some certain amount. The plot, Fig. 1, shows details of the errors at zero. Thirty-seven per cent of all micrometers are correct at zero. Fourteen per cent have an error of .0001 at that point; 15 per cent have an error of .0002, etc. Twelve and one-half per cent have an error at zero of one-half thousandth, or more.

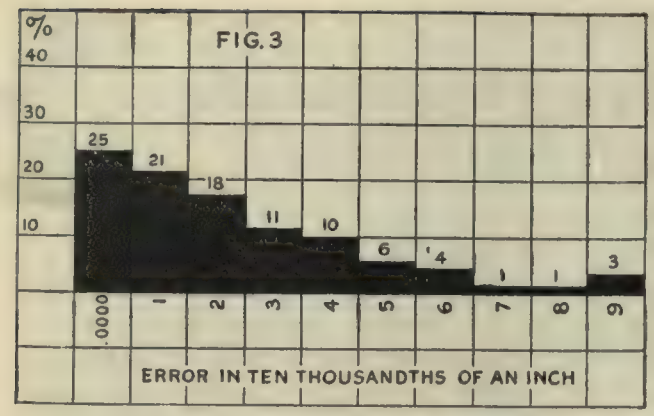
The errors at the ten other points checked (i.e. $\frac{1}{10}$-$\frac{2}{10}$-$\frac{3}{10}$ in., etc.) are shown as an average, in the curve, Fig. 2, and are due, in excess of the error in setting at zero, to inaccuracy of the micrometer screw. The curve was plotted by averaging the reading of all micrometers at zero (which is practically 0.0002 in.), all at 0.100 in. (which is practically 0.00022 in.), all at 0.200 in. (which is 0.00024 in.), etc. From 0.700 in. on, the average error is three-tenths of a thousandth.

The plot, Fig. 3, is made from the same data as the curve, Fig. 2, but shows the frequency of deviation, or different amounts of error. This plot shows all the readings of all the micrometers. For instance, suppose there were one hundred micrometers checked at the eleven points 0, .1, .2, etc. to 1 in., inclusive, then there would be eleven hundred readings in all. As shown in Fig. 3, 25 per cent of all these readings showed no error at all, or were correct; 21 per cent showed an error of one-tenth of one-thousandth (0.0001 in.); 18 per cent showed an error of two-tenths (0.0002 in.), etc., etc. Fifteen per cent showed an error of one-half thousandth, or more.

The plots and curves so far shown are all from data exactly as found in commercial use. The condition of the micrometers is due to the joint effect of the original condition of the instrument and the care or lack of care







of the owner and user. An effort was made to compare the different makes of micrometers and to do this fairly the very prevalent error of the zero setting of course, had to be eliminated. This correction also made it posible to compare new micrometers with those in use for some time.

In making this latter comparison no average difference is apparent, the instruments in use giving the same curve as new ones when those which show abuse are eliminated. There seems to be no question but that an instrument with reasonable care shows no wear in the screw and with proper attention to adjusting for wear of the measuring surfaces (anvil and end of screw), maintains its original accuracy.

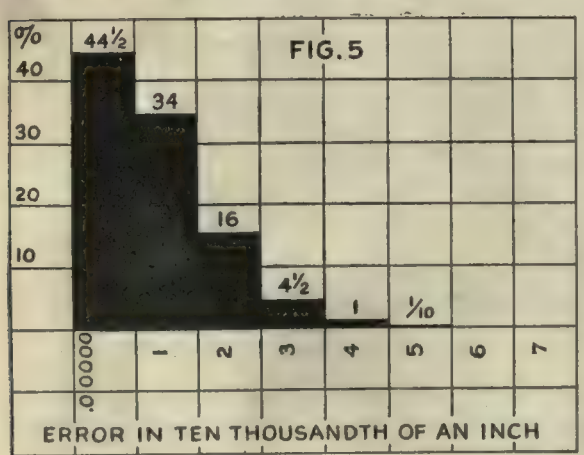
Fig. 4 shows the curves of the average measurements at each tenth of an inch, of micrometers made by four different manufacturers. All readings are corrected to eliminate any error at zero. It is evident there is no striking difference. The one showing greatest average error is one and a quarter tenths. They all indicate an accumulative error increasing from nothing at zero and rising to a maximum at or near one inch.

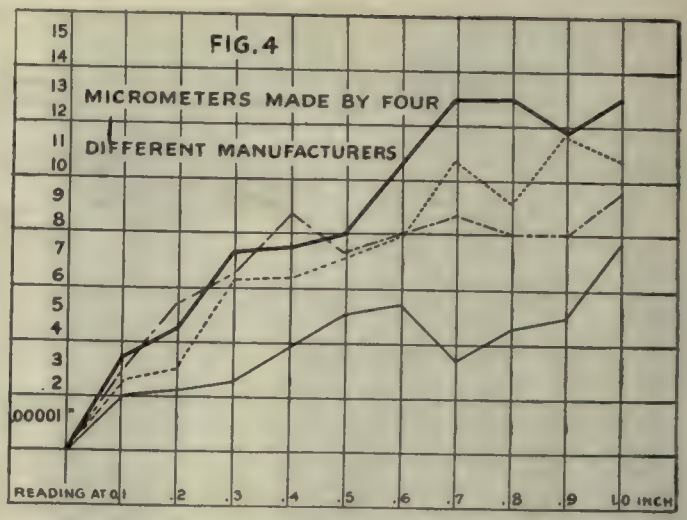
Average Measurements

The plot, Fig. 5, is from the same data as above and shows the frequency of deviation the same as Fig. 3, but after correction to eliminate error at zero, and hence shows the accuracy of the pitch of the screw the same as the curves in Fig. 4. Forty-four and one-half per cent of all the readings are without error. Thirty-four per cent have an error of one ten-thousandth of an inch, etc.

In Fig. 6 the average reading of all the micrometers in three different factories in the same city are plotted.

The two lower curves are machine shops. The higher one was a factory using two hundred





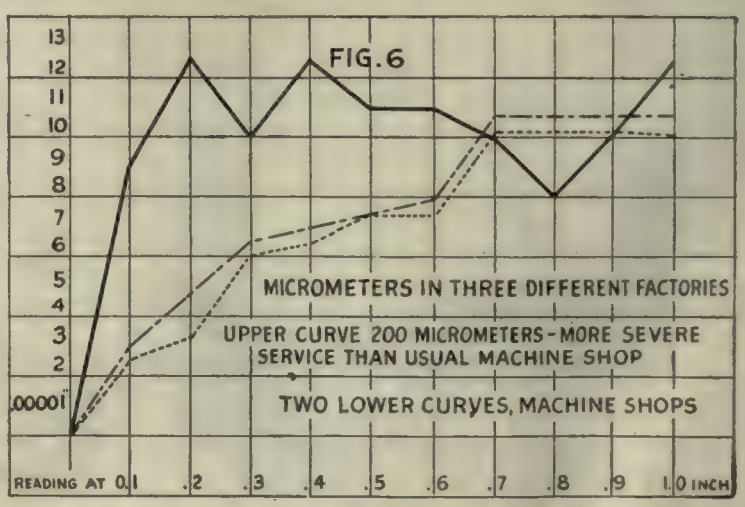
micrometers and under conditions somewhat more severe than the usual machine-shop service.

The curves of averages all show, as noted before, a tendency to accumulative error, but it is seldom seen however in individual micrometers.

Standardization Work in Europe

Mr. P. G. Agnew, secretary, American Engineering Standards Committee (A. E. S. C.) has rendered a report upon his recent visit to Europe, where he attended a meeting in Brussels of the International Electrotechnical Commission. He states in his report that during the trip he was able to call personally upon the secretaries of the national standardization bodies of England, Holland, Belgium and France and that the desire was expressed by each society for co-operation with America in all cases where it should be found feasible to obtain international agreement. The report tells of the organization and the work of the different engineering societies, the salient points being covered in the following paragraphs:

The British Engineering Standards Association was organized in 1901 as the Standards Committee by five leading technical societies, and was incorporated in 1918. The executive authority is vested in the main committee of 24 members, 19 of whom are appointed by the five engineering societies mentioned, and the remaining five by the appointed members. Sectional committees have charge of the technical work in different



subjects, with sub-committees under them. Under the sub-committees are panel committees, there being some 275 committees with a membership of 1,370. The chairmen of sectional committees are named by the main committee, but the members are designated by organizations directly concerned in the work undertaken. The members may designate men such as consulting engineers to complete the committee. The income of the association is derived from many sources, the government, municipalities, railways, industrial associations and private firms all contributing. The work performed covers a very broad field. The publications of standards or specifications are revised when necessary, and they are also translated into foreign languages.

In France the "Commission Permanente de Standardization" is an official organization and is supported entirely by the government funds, which is true of no other standardization society. It was established in 1918. The commission itself has twenty-four members, nine representing various government departments, one the Academy of Sciences, and the remainder national engineering and industrial bodies. The members are appointed by the Minister of Commerce, after being nominated by the organization which they represent. The actual technical work is in charge of fourteen sub-committees, each working upon a different subject. The French National Committee of the International Electrotechnical Commission functions as the electrical committee. Tentative specifications, as drawn up by the sub-committees with the co-operation of the government departments, are submitted to the various interested bodies and to the technical press for criticism before the specifications are definitely decided upon and approved by the commission. Already a large list of specifications and standards have been officially adopted.

In Belgium the "Association Belge de Standardisation" was organized in 1919, chiefly by the "Comité Central Industriel de Belgium," which is a strong organization representing eighty associations and playing an important part in the reconstruction of Belgian industry. The main committee of the association comprises thirty-seven members, four representing the "Comité Central," thirteen representing the national engineering societies and twenty representing various industrial associations. The main committee appoints working committees, usually ten to fifteen men on each and composed of representatives of the organizations interested in the particular subjects being investigated. Owing to the industrial position of Belgium and its commercial relations to other countries, the association is making extensive use of the standardization work of other nations and is modifying it to suit the needs of Belgium. A series of standard bolts and rivets has been worked out, among other things, and work on mechanical power transmission, steel sections and reinforced concrete is now being carried on. The income of the association is derived from the organizations represented and from subscriptions received from firms and individuals.

In the Netherlands unification work is cared for by the "Main Committee for Standardization in the Netherlands," which was organized in 1916. It consists of fifteen members, two being furnished by both the Society for the Encouragement of Industry and the Royal Institute of Engineers, and the others being designated by the committee itself. As in the case of Belgium the standardization work is much affected by that of the surrounding countries. The standing committees, there being seven at present, are chosen by the main committee, and sub-committees handle the more detailed part of the work. The central office does a larger part of the technical work of standardization than is the case with the other national standardizing bodies, even making tentative proposals for the consideration of the committees. As in the United States, the main committee is not responsible for technical details but is responsible for procedure. Standards tentatively approved by the standing committees are given a great deal of publicity before being officially approved. The government supplies $6,000 of the income of the organization, which is $16,000.

In Italy the national engineering society is at present forming an engineering standards organization.

There is a movement at present in some of the countries to promote co-operation between the associations and the government departments. The idea is generally accepted that many advantages might accrue from co-operation between the committees of different countries. The idea of an international organization patterned after the national ones has received some attention, but nothing will probably be done in this line for some time.

Saving Pattern Work by Using Stock Cores

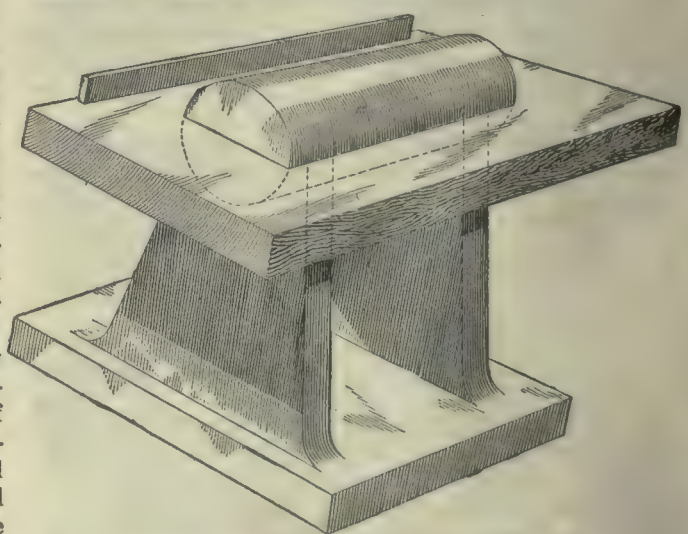
By William C. Nelson

On page 355, vol. 52, of *American Machinist* M. E. Duggan advocates the saving of pattern work by using stock cores.

Referring to his illustrations, core "*D*" is shaped over the journal bearing. To dig out or scrape a core like this would require much time and patience and would lead to some very strong language from the molder to whom the job might be given.

A far easier way to produce this core without the aid of a corebox would be thus: Have the flaskmaker saw out a board in the shape as shown in the illustration herewith. Place this board over a pattern, and, with the aid of a straightedge, ram up a core. Send board and core to the oven to bake and proceed further as Mr. Duggan suggested.

In good foundry practice, it does not always pay to attempt to save patternmaking.



MAKING A CORE WITHOUT A CORE BOX

A Jump Test for Motor Trucks

THE purpose of these tests, held on Nov. 25, 1919, was to subject various models of trucks to shocks far in excess of anything likely to be encountered in actual service, in order to study the effect of different spring and tire equipment on impact, and the effect of unsprung weight upon road impact, as well as the effect of varying speed on those impacts. In other words, to study the "grief" on both road bed and truck chassis and how it is modified by varying factors for unsprung weight, tire equipment, and speed.

A test along the same line had already been attempted by the Bureau of Public Roads in conjunction with the Bureau of Standards, where road impact was studied by having trucks drop over a low platform onto another platform. This test was not satisfactory, for it took into consideration only one factor, viz., road impact, and left out any study of the stresses set up in the truck, as well as the effect of rebound, etc. Also, the distance dropped was very moderate.

The International Motor Company's Test

To overcome these shortcomings and to study these neglected factors, as well as to investigate a large number of empirical and theoretical assumptions on these and kindred subjects, a series of "jumping tests" was conducted on Nov. 25, 1919, at 79th St. and North River, New York, using for the first time a new system of motion pictures to record accurately the results obtained.

Trucks were run at speeds of from 15 to 18 miles per hour along a straight-away and over a sharp incline. They naturally sprang into the air and struck the ground as from a vertical drop of several feet. A stretch of level ground was used as an approach, and the trucks gathered headway over this for the jumps under their own power. The speed of each truck was determined by taking the time required for the last 100 ft. of its run. The take-off platform, built of heavy lumber, was 6 ft. long and raised 1½ ft. at the far end. It can be seen in Fig. 1.

Five different Mack trucks were used in this test, consisting of one 2-tonner, having pneumatic front tires and solid rears, a 2½-tonner of the same type having pneumatics all around, a 3-ton truck, a 5-ton truck, and a 5½-tonner, all on solid tires. These trucks were numbered respectively E-8, E-17, E-15, E-18 and E-22, all of which are shown in Fig. 2.

*From a paper read by A. F. Masury, chief engineer of the International Motor Co., on April 8, before the Metropolitan Section of the Society of Automotive Engineers.

The trucks themselves were painted in the following manner for the purpose of aiding observation. The tire rims, one spoke on each wheel, and the hub caps were painted white. The white rim enabled tire deflections to be measured and the white spoke showed the revolutions of the wheels. A strip of sheet metal marked off in 3-in. bands of black and white extended down past the hub caps from the lips of the fenders and served to show the rise and fall of the hub.

Recording the Data

The horizontal distance which each truck jumped was measured by a curbing along the back of the runway marked off in feet, see Fig. 1. A large blackboard, marked off in 1-ft. squares behind the curbing, showed the height of the jumps. Since the moving pictures show the trucks against these scales, the positions of different portions of the trucks at any instant can be accurately determined.

An Eastman Kodak timer showing seconds was placed where it would be photographed on the film. A hand sewing machine with a white card on the plunger was set on a table back of the incline. For each revolution of the crank the plunger rose and fell three times, and a man with a stop watch turned the crank three times per second, thus measuring eighteenth parts of a second. A phonograph motor and turntable, not shown in the figures, was placed on the stone buttress at the near side of the incline. On the turntable was mounted a cylinder marked off in four equal sections. The first being solid black, the second white on top and black on the bottom, the third solid white, and the other black at the top and white at the bottom. The governor was to give a speed of 60 r.p.m., so that the pattern on the cylinder showed quarter-seconds.



FIG. 1. GENERAL VIEW OF THE APPARATUS USED

The Pictures

The pictures taken were both of the ordinary type with sixteen exposures per second, and those known as novograph pictures in which 160 exposures are made per second. Fig. 3 shows the camera equipment. When the film obtained with the novograph camera is projected at the standard rate it shows a moving picture in which the speed of motion is only one-tenth that of the subject, thus giving almost ideal conditions for the accurate and careful study of the subject in motion. Fig. 4 shows one of the big trucks leaving the incline and Fig. 5 shows one of the smaller trucks striking



FIG. 2. TRUCKS USED IN THE TEST

the ground, an idea of the severity of the test on a loaded truck being given.

The films were studied both running and still, accurate measurements and calculations made and conclusions definitely arrived at. By the use of an incandescent projector the films could be stopped at any desired point for special analysis. In this way the time in the air of each axle, the time and amount of deflection of each spring and tire, as well as distance moved vertically and horizontally of each of the parts, were accurately recorded, both on the original jump and on the rebound.

Data and Results

Tables giving the data and results of the tests were prepared. The weight, both sprung and unsprung, of the front and the rear, the tire equipment, the speed of the machine, and the distance of the jump were determined for each truck, besides the spring and tire deflection as measured from the pictures. The forces of the blows struck by the falling trucks were calculated from the formula which follows.

The energy exerted by a falling body is equal to the energy required to raise it to the height from which it fell. If the vertical velocity and weight are known the energy equals the weight times the vertical velocity squared, divided by twice the acceleration due to gravity, or:

$$E = \frac{WV^2}{2G},$$

where W = Weight in lbs.

and V = Vertical velocity in feet per second.

In the case of a motor truck driven over an upward inclined plane the vertical velocity can be obtained from the speed of the truck and the angle of the incline, or:

$$V = \frac{S \times 88T}{60} = \frac{22ST}{15}$$

where S = Speed in miles per hour

and T = Tangent of angle of incline.

The average force of a blow equals the energy

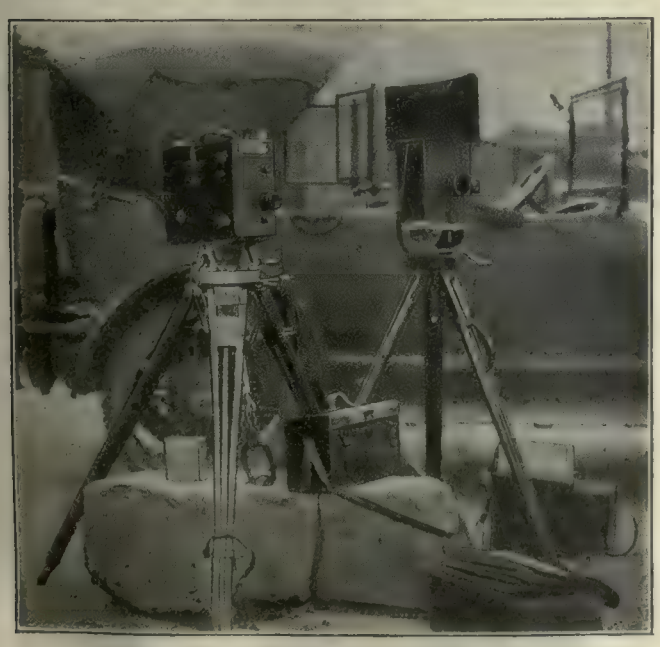


FIG. 3. THE CAMERA EQUIPMENT



FIG. 4. A TRUCK LEAVING THE PLATFORM



FIG. 5. A TRUCK STRIKING THE GROUND

of the moving body in ft. lbs., divided by the distance in feet required to stop it, plus the weight of the body, or:

$$F = \frac{E}{D} + W, \quad \text{where } D = \text{Distance to stop in feet.}$$

Combining these three formulas we have:

$$F = \frac{W\left(\frac{22\,ST}{15}\right)^2}{64.32\,D} + W$$

This formula can be applied to the unsprung weight of a motor truck by taking the deflection in the tires and ground, and to the sprung weight by taking the spring and tire deflection. These forces should not be added together, for they do not occur at the same instant.

Conclusions

The conclusions drawn from this test are that the impact of a truck striking the ground after bounding over an obstruction is approximately proportional to the weight and to the square of the speed, and inversely proportional to the resiliency of the springs and tires and to the ratio between sprung and unsprung weight. By this is meant that, while at given speed twice the weight will strike the ground with twice the force from a given height, if the same weight strikes the ground at twice the speed, it will strike the ground four times as hard; but that springs or tires twice as resilient will halve it, although with great unsprung weight the effect of the resilient springs will be lost.

In the test the pneumatics saved the road two-thirds of the grief, and the vehicle itself one-fourth. Following this thought to a logical conclusion it would seem obvious that, contrary to popular impression, the heaviest trucks might be less destructive to roads than the lighter ones. Not only would a 7½-ton truck on pneumatics do less damage to the road bed than a 5-tonner on solids operating at the same speed, but also, inasmuch as the heavier truck is a slower vehicle as a rule than the light one, another consideration enters in favor of the heavier truck. Since speed has been shown to have effect as its square, whereas weight does not, it is seen to be the principle determining factor.

Looking Backward

By H. B. Stillman

In comparing conditions of shop life to-day with those of twenty or thirty years ago, as I did in a previous article under the above title, I should have stated that my opinions were based upon my own experience and observations in factory work. I started shop work at fourteen, and now, at forty, am still at it; therefore I do not feel as if I could be justly accused of talking through my hat when I say that in my honest opinion the average wage-earner is to-day better off physically, morally, and mentally, than he was twenty or thirty years ago.

In the matter of factory lighting, for instance, how many of us with a quarter of a century or so of shop life back of us would care to swap the modern system of lighting—the bright electrically-illuminated shop of to-day for the old kerosene lamp in general use about the time of the Boer War and later? There may have been other means of furnishing artificial light at that time in towns unprovided with gas, but I was never lucky enough to have my name on the pay-roll of any shop but what depended upon these old smoky, smelly kerosene lamps.

I firmly believe that these lamps were the cause of more headaches, more eye strain, and more profanity than most other agencies. Any workman who is inclined to be "fussy" with his work, and especially the mechanic of the old school who takes pride in turning out a neat piece of work, will agree with me when I say that the modern system of factory lighting has reduced a lot of our worries and trials on that score.

Another feature I wish to mention is the various plans many manufacturing concerns have adopted to win the esteem and co-operation of employees, and to assist them in matters entirely outside of the days work. The plant where I am employed recently installed a library for the free use of all the hands, under the same rules and restrictions common to public libraries. A committee is appointed to select the books and these volumes include the latest and best in fiction as well as standard technical works for those who can appreciate instructive matter of this kind. I would like to ask if any of the "old timers" who pine for the good old days can recall many instances where good reading matter was furnished free to the help, or if they can recollect any circumstances where a set of standard text books were at their disposal without cost to them?

I wonder how many workmen appreciate the fair play policy adopted by most progressive manufacturing concerns at the present time? The policy which gives the worker who has had difficulty with his foreman a chance to tell his side of the story? In these days it is conceded that the foreman isn't always right, and usually there is an employment manager, welfare superintendent, or someone with the necessary ability and tact to investigate and smooth out matters of this kind, assuring the complainant of a square deal.

A case in point happened in a neighboring factory where a dispute arose between a workman and his foreman over some trifling affair about the work. One word led to another and the upshot of the matter was that the workman gave his notice to quit that night. The superintendent, a true advocate of the "live and let live" principle, called the workman into his office and asked him to explain. Upon hearing his claim that the foreman had been trying to rub it into him, the superintendent ordered him back to his bench with the promise that the matter would be immediately investigated.

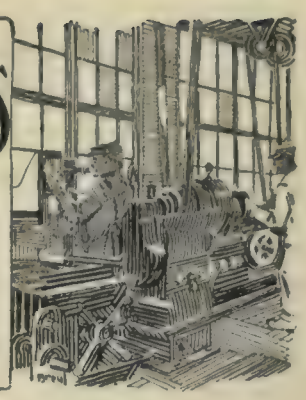
The trouble was found to have originated several months before in a matter entirely foreign to the shop, and was settled very sensibly by transferring the worker to another department, where he is still on the job.

In the old days a large share of the hiring and firing rested upon the foreman, along with other responsibilities of which the average department head of to-day knows little. The foreman was on the job to get the work out, and it was up to him to say who should or who should not help him do it. Foreman had their likes and dislikes the same as the rest of us and as a rule they were not inclined to do any "pussy footing" as far as retaining help is concerned. Men were plenty and jobs were scarce, so why worry as far as a man or two was concerned.



MODERN PRODUCTION METHODS

By
W P. Basset
of
Miller, Franklin, Basset & Co



Controlling the Work in the Shop

Rigid planning, based on the theoretically possible production of men or machines and which makes no allowance for emergencies, always has failed and always will. That is why so few manufacturers attempt to plan the work of their shops more than a day or so ahead.

(Part VII was published in our issues of July 1 and 8.)

THE common idea, founded on the teachings of the early industrial engineers, is that a schedule of production, once drawn up, must be lived up to whether "school keeps" or not. That idea offends the common sense of most managers, for they know that workmen quit, machines break down and the actual production of both varies above and below their theoretical capacity. If an inelastic schedule exists, it can not stretch or contract to meet the actual accomplishment in the shop—it will therefore break and become useless at the first emergency. And the emergency which causes the breakage may be so slight a thing as that John Jones at milling machine No. 5 has had a bad night and today is turning out but eight parts an hour when the schedule says he shall turn out ten.

Whenever anything happens in the shop to slow down or interrupt any operation, obviously all succeeding operations will be affected. But what is that to the clerks in the planning office away from the sweat and noise of the shop? The schedule they have made allows for no delays—therefore there can be none.

The "Booth System"

Such planning is worse than useless. Better than that is the extreme opposite method of handling production from hand to mouth by means of stock chasers, who with all their faults are at least in touch with the shop and in sympathy with its trials and troubles.

Neither of these two methods is necessary. The good points of both can be attained. The central planning department can be given control of production from raw materials to finished stock, and yet its plans and schedules can be flexible and adjusted to the day-by-day happenings and breakdowns in the shop.

The method I am describing does just that—does it quickly and easily by means of what, for the sake of brevity, I shall call the "booth system."

I have said that the planning department must be given sufficient authority to enable it to carry out its plans. This authority must be exercised in such a way as not to interfere with the authority of the individual foremen. One of the chief objections to the stock chasing system has been the breaking down of discipline and morale due to the intermittent interference by stock chasers with the laying out of the work in the manufacturing departments. The booth system obviates this, yet gives the planning department control of the flow of work in a department, and assures flexibility to the planning.

Of necessity, the method of handling the work through the booths varies greatly with local conditions. The success of a highly developed production department depends largely on smooth running booths precisely adapted to the peculiar conditions of the plant.

No matter how many of the practically innumerable methods of handling production booths I were to describe, I could not cover the needs of all kinds of machine shops, for the details must be different to meet the conditions in the individual shop. So I shall describe the booth system as used in the plant of the Warner Gear Co., as throughout this series I have largely used that concern's method as a model. The conditions met in that plant, I believe, are fairly typical of those in the majority of machine shops.

Issuing Work to the Shop

Before getting to the booth, however, we must go back to the central planning department to see how work is issued to the shop in accordance with the plans as shown by the schedule control graph and other forms.

From the parts list, Fig. 15, the planning clerks make out for each lot of each part a requisition, Fig. 39, in duplicate; three copies of a service card, Fig. 40, for each operation; a move order, Fig. 41, for each time the lots move from the jurisdiction of one booth to another; an in-slip, Fig. 42, in duplicate; and a traveler form, Fig. 43. These forms are made out as shown, by the production department, in advance. Since one form for each lot in the series must be made out identically except for the lot number, some duplicating process will be found to cut what otherwise might be an onerous clerical cost. We have found the gelatine machine to be very satisfactory for this purpose. As many sets of the tickets may be made out in advance as time and general conditions warrant.

They are filed by part number in the production department in a file called "service cards to be given out." A handy way to file the forms is as follows: First the service cards for the first operation attached to the copies of the requisition. Service cards then follow in sequence of operation, the in-slips being attached to the service cards for the last operation. Move orders are attached by means of a clip to the service cards for the operation preceding the move.

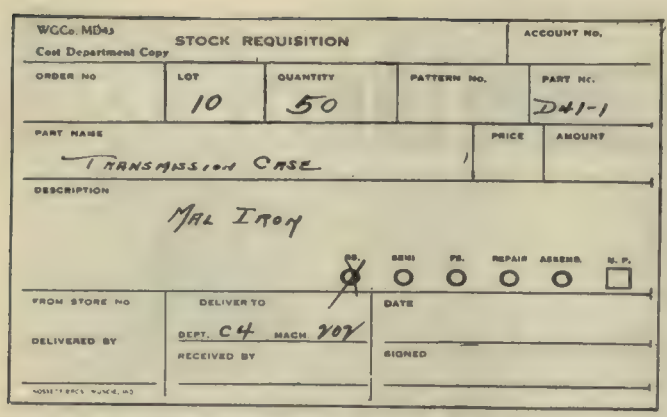

WGCo. MD43
Cost Department Copy
STOCK REQUISITION
ACCOUNT NO.
ORDER NO | LOT 10 | QUANTITY 50 | PATTERN NO. | PART NO. D41-1
PART NAME Transmission Case | PRICE | AMOUNT
DESCRIPTION Mal Iron
NO. SEMI FIN. REPAIR ASSEMB. N. F.
FROM STORE NO | DELIVER TO DEPT. C4 MACH. 207 | DATE
DELIVERED BY | RECEIVED BY | SIGNED

FIG. 39. STOCK REQUISITION (MADE OUT IN DUPLICATE, 1 PINK AND 1 GREEN)

The schedule control man, watching his schedule control charts, sees that part D-41-1 is due to start June 1, in department C-4. From the file he removes the requisition and all service cards pertaining to the progress of the proper number of lots of part D-41-1 through department C-4. These are sent to the booth man of department C-4.

The booth man is the point of contact between the central planning department and the shop. The number of men and machines which a booth man can handle depends largely upon the number of lots going through his department daily. Since each time a lot is completed on an operation it demands clerical work, it is apparent that the nature of the work in a shop will determine the size of a booth's department. About 225 time changes is the most a good booth man can handle. If for cost finding purposes the shop is departmentalized, it is often well to departmentalize the booths to correspond somewhat.

Construction of the Booths

The booths themselves are of light construction and occupy a floor area of about 6 x 9 ft. Exterior and interior views of a typical one are shown as Figs. 44 and 45. The front of the booth is sheathed to about 3 to 4 ft. from the ground where a counter is placed on the inside of the booth. Above this, wire screening is placed for a height of about 5 to 6 ft. An opening is provided in this netting through which the service cards may be handed to the men.

Mounted in the screening is a board which is pivoted at the top and bottom so that either side may be turned toward the shop. A strong clip is attached on each side. One side of the board is painted red and is known as the "truckers" side and the other black and called the "booth" side.

Hanging on the back wall of the booth is a production board, divided into sections, each section of which is divided into three compartments as shown in Fig. 46. Each section is labeled to correspond to one of the machine tools under the control of that booth. In the bottom compartment are kept the tickets for the job running on the machine; the middle pocket holds the tickets for the next job which is already at the machine, and the top pocket is for work that is in the department, but which has not as yet been moved up to the tool.

For timekeeping an electrical or mechanical device should be used. A rack is also provided to be used in connection with the time-keeping. The pockets in this rack are numbered to correspond with the man's number in the department. Aside from a few box files and the usual office supplies there is no other equipment in the booth.

When the job tickets, which are sent out from the central control, are received by the booth man, he files them by machine number, keeping them in the sequence in which they were received by him. These, of course, are placed back of any work which is already in the file. Travelers are filed by part number in a separate file of suitable size.

How the Booth Work is Handled

Now to get down to how the work of the booth is handled: Let us say that the booth man, looking at his board, sees that there are but two jobs ahead of machine No. 202, and that machine No. 202 performs the primary operation.

How does he insure that there will be work for the machine, so that no time will be wasted? He takes from the job file the service cards for machine No. 202, to which are attached two copies of the requisitions. He puts the service cards in a temporary file, arranged by machine-tool number. From the traveler file he takes the traveler which corresponds to the requisition, and sends it, together with the two copies of the requisition, to the stockroom called for on the requisition.

If the job which the booth man has ordered out for the machine is different from the one running there at present, he fills out four copies of a "set up instructions" form, Fig. 47, sends one copy to the tool crib as a notice for them to get the tools ready for the new job going into the machine; the second to the foreman as a notice that that job is to be set up; the third to the salvage department, and keeps the fourth copy himself. He gives on this order all of the necessary information as to part number, machine and operation for the new job, and also tells approximately when it should be ready to set up. This order should be given out at least an hour before the tools are required, to give the tool crib attendant time to determine whether all of the required tools are ready. If they are not, the booth man is to be notified immediately so that some other job may, if possible, be lined up for that operator.

The stock keeper places the traveler together with the required amount of material on a truck. The trucker then takes the lot and one copy of the requisition and leaves the lot at the machine called for on the requisition. He then puts the requisition on the booth man's side of the move board, and returns to his other work. The copy of the requisition which has been left in the stores is posted to whatever records may be kept by

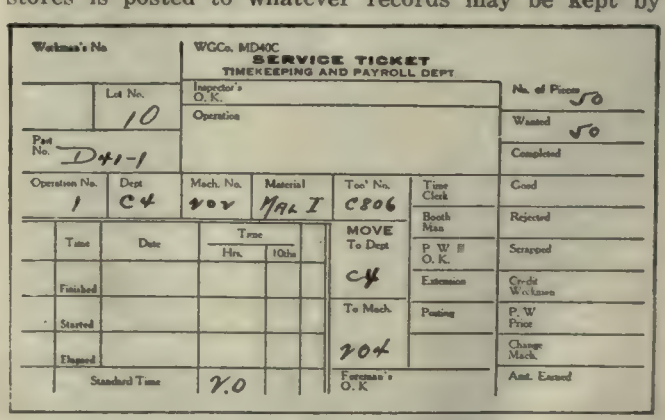

Workman's No.
WGCo. MD40C
SERVICE TICKET
TIMEKEEPING AND PAYROLL DEPT
Lot No. 10
Inspector's O.K.
Operation
No. of Pieces 50
Wanted 50
Completed
Part No. D41-1
Operation No. 1 | Dept C4 | Mach. No. 207 | Material Mal I | Tool No. C806 | Time Clerk
Good
Booth Man
Rejected
Time | Date | Time Hrs. | 10ths
MOVE To Dept C4
P. W. & O. K.
Scrapped
Finished
Extension
Credit Workman
To Mach. 204
Posting
P. W. Price
Started
Elapsed
Change Mach.
Standard Time 7.0
Foreman's O.K.
Amt. Earned

FIG. 40. SERVICE TICKET (MADE OUT IN TRIPLICATE, 1 WHITE, 1 YELLOW AND 1 MANILA)

MOVE ORDER WGCo MD41

ORDER NO	LOT	QUANTITY	PART NO
	10	48	D41-1

MOVE FROM		DELIVER TO	
DEPT C4	MACH 76	DEPT C4	MACH 21
DEPT	MACH	DEPT	MACH

REMARKS

DATE SIGNED REC'D

FIG. 41. MOVE ORDER

IN SLIP WGCo.MD42
PRODUCTION DEPARTMENT COPY

Date _____ Order No. _____
Pattern _____ Part No. D 41-1
Lot No. 10 Stock R.S ○ Semi ⊗ F.S ○ Repair ○ Assemb. ○ Scrap □

Quantity	Description	Price	Amount
46	MAL I TRANS CASES.		

Send to Dept. SEMI ST. Storekeeper _____ Inspector _____ Sect. Bin

FIG. 42. IN SLIP (MADE OUT IN DUPLICATE, 1 BLUE AND 1 PINK)

the stores keeper, and is then sent to the cost department for its records.

The copy of the requisition which has been left by the trucker on the move board notifies the booth man that the work is at the machine and that he can release from his second file the service cards for that lot. These he places in the second pocket of the production board in the compartment for the machine that is to perform the first operation. The requisition is then returned to the planning department.

Following the Lot from Operation to Operation

We have next to consider the steps necessary to follow a lot as it goes from one operation to another.

Let us assume that the operator on machine No. 202 has completed a job and that his net job is the one which we have just requisitioned from the stores. When he finishes the job he is on he comes to the booth window and turns in his service card for the previous job. On the back of this service card has been noted the number of his next job. At the same time that he turns in his service card he also turns in the traveler which he has taken from the lot he is to operate next, as shown on the back of the service card he has just turned in.

The "man's copy" and the "time-keeping copy" of the service card for the previous job are both rung out. At the same time the service cards for the next job on machine No. 202 are taken from the center pocket of the board, which you will remember holds "work ahead or at the machine." The man's copy is checked with the traveler to see that it corresponds as to part number and lot number, and, if it does, is rung in. This checking is done in order to safeguard against the workman being given a service card for the wrong lot. The time-keeping copy of the service card for the previous job is placed on the move board as a signal to take the completed work to the inspection department; or if no inspection is necessary, to the machine that is going to perform the next operation.

Filing Service Cards

The man's copy from the previous job is now placed in a file arranged by the man's number, of "men's tickets awaiting inspection report." The cost and production copy of the service card is placed in another file of service cards awaiting inspection report. This file is set up by machine numbers. The file of the man's copy of the service card awaiting inspection is set up by days, to give a check on the inspection department lest they do not inspect the work in the sequence in which it comes to them, and also to insure that the work does not lie around the inspection bench too long. This file is gone over every morning and jobs that have not cleared the inspection department are reported to the head inspector for action. When the lot has been inspected, the inspector returns the copy of the man's service card to the booth with his report as to pieces good, rejected, and scrap. He also enters upon the traveler the same date and also the number or numbers of the men that worked on the lot.

From the copy returned from the inspection department the booth man enters upon the man's copy and the cost and production copy the results of the inspection. If a job is not

PART NO. D41-1				LOT NO. 10	NO. PCS. 50	MATERIAL MAL IRON.
Op. No.	Dept. No.	Workman Day	Workman Night	Insp. No.	Rejected	Pieces Good	Operation Name
1	C4						TURN FLANGE
2	C4						FACE FLANGE
3	C4						(THIS OP IS VERY TROUBLESOME)
4	C4						DRILL OIL HOLES
5	C4						DRILL BOLT HOLES
6	C4						COUNTERSINK BOLT HOLES
7	C4						GRIND FLANGE
8	C4						FACE IDLER
9	C4						DRILL IDLER HOLE
10	C19						STOCK.

TRAVELER WGCo. MD44

FIG. 43. TRAVELER FORM



FIG. 44. EXTERIOR OF BOOTH

inspected on the day the work is performed, the man's copy goes to the payroll department and the man is paid for the number of pieces that are shown on the ticket. The man's copy is checked in the booth at the end of the day, before it is sent to the time-keeping department, to see that no time is missing when all such cards have been collected. If the inspection report is late and does not arrive until the following day, the time-keeping copies, with the inspection report entered on them, are sent in with the other service cards to the payroll department and are used as a charge back on the payroll, the payroll department sending back to the shop the corresponding man's service card which may be given to the man if desired.

There is a difference of opinion as to whether or not it is desirable to give to the men the copies of their service cards. Usually, the extra effort seems worth while, for the men like to know in advance what their pay for the week will be, and in these days it pays to coddle the men to that extent, surely.

Lots Requiring More Than One Day to Complete

If a man is unable to finish an operation on a lot by quitting time, it is obvious that some means must be provided to carry on the work the next day. We handle the situation in this way: For those jobs which are going to extend over, an additional time-keeping and man's copy of the service card is made out in the booth. When the workman finishes work on the job for the night, he turns in the first copy of his card, stating on it



FIG. 45. INTERIOR OF BOOTH

the number of pieces that he has completed. This amount, subtracted from the number of pieces in the lot, is marked on the two copies of the service cards made out for the next day. The service cards which he has turned in are handled in the same manner as explained before. The second set is then placed in the time file, ready to be given to the man when he comes in to begin work in the morning.

If for any reason it becomes desirable to carry forward some of the pieces of the lot before the whole lot is finished, a complete set of service cards for all succeeding operations is made out for the quantity that is to be sent forward. If the original lot is No. 10, these delayed or forwarded pieces are given lot No. 10A, enabling them to go through the shop as a unit.

If a situation develops where a man working on a lot is called upon to stop work on that lot in order to let through some job that has fallen behind, the man's copy and the time-keeping copy of the service cards are rung out and are attached to the white copy, and put in the center pocket of the machine showing that the

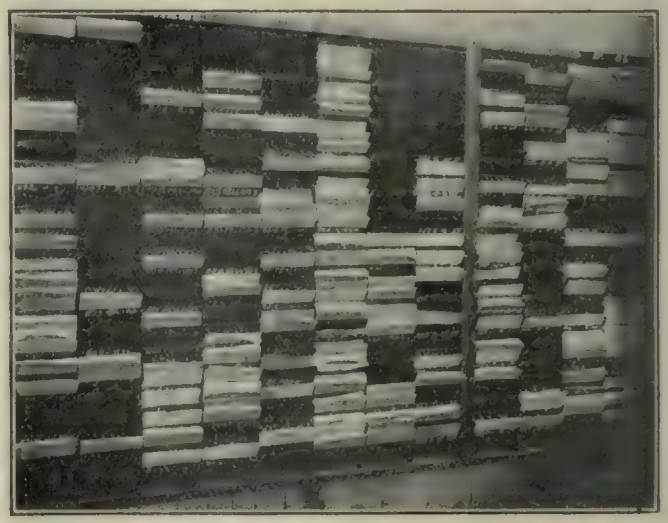


FIG. 46. THE PRODUCTION BOARD

job is at the machine and is to be worked on next. The new job is handled as described before. The partly finished lot should be finished up as soon as possible after the rush job is completed.

Notice for Final Inspection

When the last operation on a part is completed and the inspection report has been received on the manila copy of the service card, the quantity of good pieces is entered by the booth man on both copies of the in-slip and these are placed on the move board as a notice to take the parts called for into the final inspection.

The final inspector after checking over all pieces, signs the two copies of the in-slip, changing the quantity called for if any parts are rejected, and making out a rejection notice for the rest. The move man then takes the good pieces with both copies of the in-slips to the finished stockroom.

The finished stock keeper removes the in-slips from the work, checks the quantity again, and after entering the quantity on his record sends the pink copy to the cost department and the green copy to the production department.

The green copy acts as a posting medium on the operation check sheets and production record, after which they are filed by days for reference.

WCCo. MD26

Mach No | SET UP INSTRUCTIONS Tool Crib Copy | Date 6/1/19

Part No	Operation No.	Lot No.	Man's No.	Material
D41-1	1	10	491	Mal. I

Operation Name Turn Flange

Machine Name 202

Deliver all tools for the above operation to workman at machine indicated NOT LATER THAN 8 A.M. P.M.

Time of Posting Notice 7 A.M. P.M.

KLM

Booth Man

FIG. 47. SET UP INSTRUCTIONS (MADE OUT IN QUADRUPLICATE)

All of this talk of booth men, planning department and so on, might well lead the reader to believe that to plan production a large number of so-called non-productive clerical help would have to be put on the plant payroll. The contrary is true. For one thing, the stock-chasing force is nearly eliminated. The booth men do the work both of the time keepers and stock chasers. The accompanying table tells the whole story of what happened to the non-productive labor in the plant of the Warner Gear Co. when production was fully planned.

Department	Before Production Was Planned	After Production Was Planned	Increase or Decrease
Inspectors	118	74	—44
Truckers	42	23	—19
Production and planning	12	39	+27
Stock chasers	22	6	—16
Tool room	39	23	—16
Tool crib and tool grind	33	32	— 1
Shop clerks	26	13	—13
Sweepers	43	27	—16
Shipping	11	12	+ 1
Receiving	10	10	0
Millwrights	81	61	—20
Storerooms	42	40	— 2
Factory office	20	42	+22
Total	499	402	—97

Note that in spite of the greatly increased amount of goods which came in and went out of the plant, there was no increase of receiving clerks and only one additional shipper was put on. That is because their work, too, was planned so that it did not come "all in a bunch," but ran about the same, day in and day out.

The same reason was responsible for the cut in non-productive labor throughout. When work comes through irregularly, it is necessary to have enough men on hand to take care of the "peaks" which occur when a rush of work comes through. These same men are naturally more or less idle between the rush periods.

A well planned shop has no rush periods. Since the work flows evenly, each hour sees just about the same amount of materials moved by the truckers, and inspected. Hence fewer truckers and inspectors are needed. Even the work of the sweepers can be planned so that at a certain hour each day the same department will be cleaned and the sweepers will be moderately busy all day with no alternating periods of frantic rush and idleness such as is usually customary.

The reduction of 16 men, or 73 per cent, in the stock-chasing force of the plant under discussion was a direct measure of the reduction of emergencies. Most of the work now moves according to schedule and gets to its destination at the appointed time without being given any special attention.

So, too, the need for new tools is foreseen, and last minute orders for tools are avoided. A force of 23 toolmakers working full time now regularly handles more work than did the former 39 who were rushed one day and idly waiting for something to do the next.

Even though the number of men who give out and care for the tools was reduced by only one, remember that the production of the plant was increased 62½ per cent, which normally would call for a similar increase in toolroom attendants. The same holds true for such other non-productive departments as shipping, receiving, stores and so on; 61 millwrights now do fully 50 per cent more work than 81 formerly did, due to the fact that their work is foreseen and planned.

The staff of the production and planning department has been increased to 39 from 12. That was to be expected, but 13 of the increased number of clerks was transferred from the old factory office, the force of which has been cut in half.

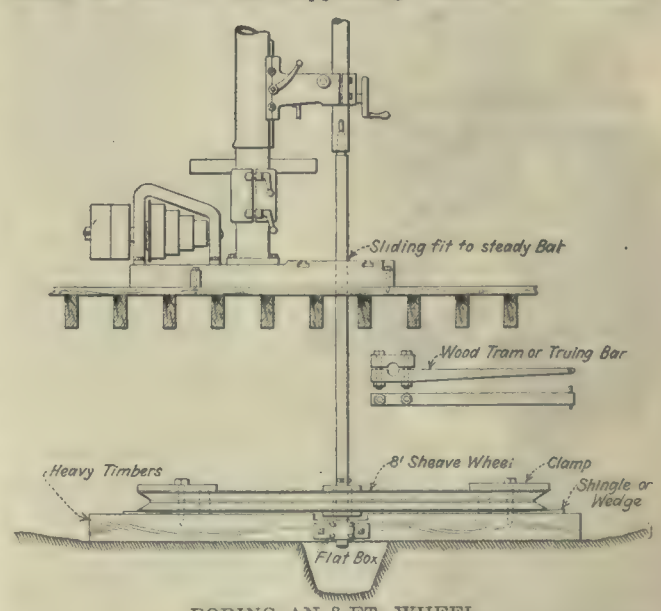
These savings in overhead are mere details, of course, but often they alone more than repay the change from unplanned to planned production. It must not be forgotten that the big advantage of planning is the increased production at lower cost which it makes possible.

Reboring an 8-ft. Wheel

By J. W. Gore

While I was master mechanic at one of the large mines in northern Tennessee, we had an 8-ft. sheave wheel on one of the conveyors go to pieces. We found an extra wheel but to our unpleasant surprise the bore was only $3\frac{1}{8}$ in., instead of the $4\frac{7}{16}$ in. required.

The 24-in. drill press used for the job was located at a point in the shop where the floor was from 4 to 5 ft. above the ground, which permitted setting up the wheel on the ground, using four heavy timbers to support it. The bed of the drill press was drilled through, the hole being made a size to allow a sliding fit for the boring bar. The free end of the bar was supported in a flat box bolted to one of the supporting timbers. Ordinary



BORING AN 8-FT. WHEEL

shafting was used for the boring bar and on account of its length it had to be inserted into the machine spindle from underneath the shop floor. Preparatory to boring, the wheel was trued up, its exact position being determined by a wooden tram clamped to the boring bar.

Facts About the F. A. E. S.

How is the Federated American Engineering Societies to advance the interests of the individual engineer? By causing the advancement of the profession through a greater recognition, by the public, of the engineer and allied technologist; and by increasing the solidarity and raising the standards of these professions.

THE Federated American Engineering Societies will be successor to and will carry on the work of Engineering Council, broadening the scope of the work and standing for a much larger field. It is expected that the Federation will represent from fifty to one-hundred engineering or allied technical societies, whereas Engineering Council takes its membership from the four founder engineering societies only.

Reasons for Choosing the Name "The Federated American Engineering Societies"

As the later organization is larger in scope, so is its name more inclusive than that of Engineering Council. Forming a suitable name was the cause of much serious thought on the part of the committee on constitution and by-laws of the organizing conference. "Federated" was chosen in preference to "Association," "Confederation," "Federation" and others. "American" was used to make the name distinctive if our own shall be successful, because other nations are contemplating the formation of similar societies. "Engineering" is a broad word and was therefore chosen as the best single word to represent the membership contemplated. "Societies" indicates that the organization is one of groups and not of individuals.

Basis of Representation When Both State and Local Organizations Exist

The constitution provides that a state council or organization, representative of the engineers and allied technologists in the state, can be represented on the American Engineering Council, which is the executive body of the organization, on the basis of all the engineers and allied technologists in the state. If, however, there exists a strong local organization or affiliation, which elects to have its own representative or representatives on the Council, then the state council or organization is entitled to representation on the basis of all the engineers and allied technologists in the state, less the engineers and technologists that are to be represented through their local organization or affiliation. This will not prevent the local organization or affiliation from participating in the work of the state council or organization in the consideration of matters affecting the state only.

Money Contributions from Member Societies

The constitution and by-laws provide for funds contributed by the member societies for the support of the Federated American Engineering Societies. Inasmuch as it would be unreasonable for a small local society to pay as large a contribution as a national society the constitution provides that the contribution shall be on the basis of the number of members in the organization at the rate of $1.50 per member for national societies and $1.00 per member for local, state and regional organizations or affiliations. The individual, therefore, does not directly pay any dues but the member-society of which he is a member contributes to the support of the Federated American Engineering Societies on a per-capita basis of its membership. It therefore follows that any one who is a member of several organizations which hold membership in the Federated American Engineering Societies will be counted in the total membership of each society as a basis of its contribution.

The Federated American Engineering Societies will function through the American Engineering Council which will meet either annually, or bi-annually, as it will determine. This American Engineering Council will consist of representatives from the member-societies on the basis of one representative for from 100 to 1,000 members and an additional representative for each additional 1,000 members or major fraction thereof. From this body of representatives will be formed an executive board of thirty, consisting of six officers and twenty-four other members selected in part from the national societies and the remainder from the local, state and regional organizations or affiliations, according to the ratio of the number of representatives from the national societies to the number of representatives from the local, state and regional organizations or affiliations in the American Council. This executive board will meet monthly or as often as may be found to be necessary to properly transact the business of the American Engineering Council. There will be an executive officer who will also be the secretary of these bodies and who will be entrusted with carrying out their instructions.

The Organization Is Democratic

If a democratic organization is taken to mean one in which its constitutents have a voice in its affairs then the Federated American Engineering Societies is truly a democratic organization. Member-societies of this organization are represented on the American Engineering Council which has full power to control and to direct the activities of the American Engineering Council and of its executive board and can determine whether it is necessary for the former to meet annually, bi-annually, or tri-annually, or how frequently the latter shall meet.

On the basis of the present membership of Engineering Council the income from the contributions provided in the Constitution of the Federated American Engineering Societies would be about $75,000. At no time in the history of its existence has the budget of Engineering Council exceeded $50,000. Provision is made, however, that

> "The executive board shall, whenever practicable, provide for the whole or a part of the expense of members or of representatives attending its own meetings and those of the council."

On the basis of past experience, it is estimated that if the expenses of all the representatives on American Engineering Council and of the members of its executive board were paid to each meeting of these bodies, there would be involved an annual expense of about $25,000. The purpose of these expenditures is to secure a full attendance of the representatives of the American Engineering Council and on the executive board, especially during the earlier years of the organization. As will be noted in the excerpt from the constitution the expenses of representatives of the council and members of the executive board will be provided from such funds as may be available. If, in the judgment of the executive board this money should be required for more urgent work the expenses of the representatives and members would not be provided for.



Machining Methods in Pierce-Arrow Shop

By FRED H. COLVIN
Editor, *American Machinist*

Without going into complete details of manufacture, this article shows a few of the interesting methods and fixtures used by a well-known builder of high-grade trucks and passenger cars. Some of these are unusual, and full of suggestions for work of various kinds.

THE rough-turning of the pistons is done in the usual manner, after which they are drilled in the cylindrical drilling fixture shown in Fig. 1. The fixture is a sort of spool, the two heads, *A* and *B*, resting and turning in the supports *C* and *D*, which are bored to the same diameter. It will be noted that these supports are relieved in the center, which not only allows chip room but also avoids the necessity of having the arc an exact fit for the ends of the spool. The drill bushing is removable and is held in place by hooking the lip on the end under the screw *E*. After drilling one side, the spool is turned half way round, which brings the opposite bushing under the drill.

The details of the drilling fixture are particularly interesting owing to the unusual design. These details are shown in Fig. 2, where the open end of the piston *A*, which has been previously bored, is slipped inside the fixture and over the centering plunger *B*. Inside of this is a plug carrying the yoke *C*, which has V's on each side. These fit around the inside of the piston pin bosses and are provided with the spring *F*, which allows for slight inequalities and variations. Then the end plate *D* is placed in position and turned slightly so that the cam *E* locks under suitable lugs provided for this purpose. The two setscrews *FF* are then tightened and force the piston and the plunger *D* against the spring shown until the end of the piston stops against the pins *GG*. The hole is then drilled through the bushings *HH*, which are positioned by means of the index pins *II*, these fitting in suitable openings in the cradle which carries the spool shown.

It will be noticed that the plunger *D* is free to move

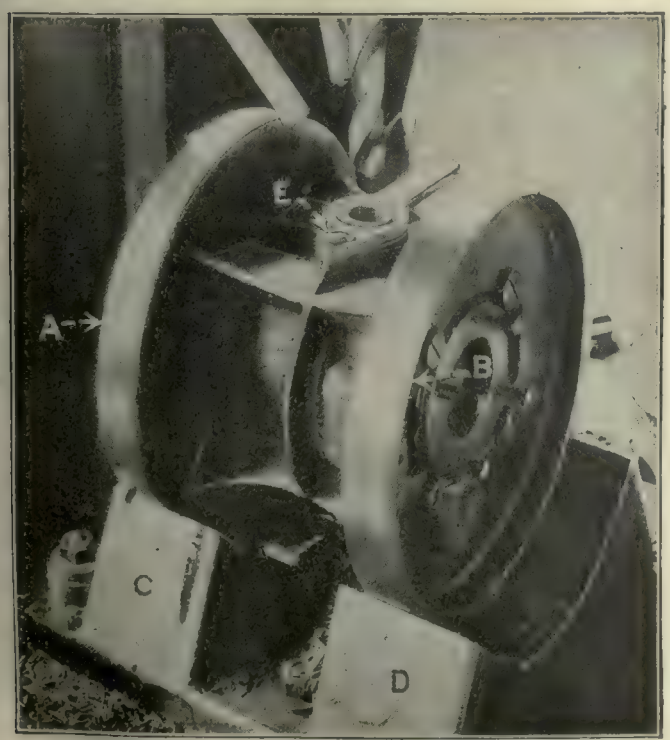


FIG. 1. PISTON-DRILLING FIXTURE

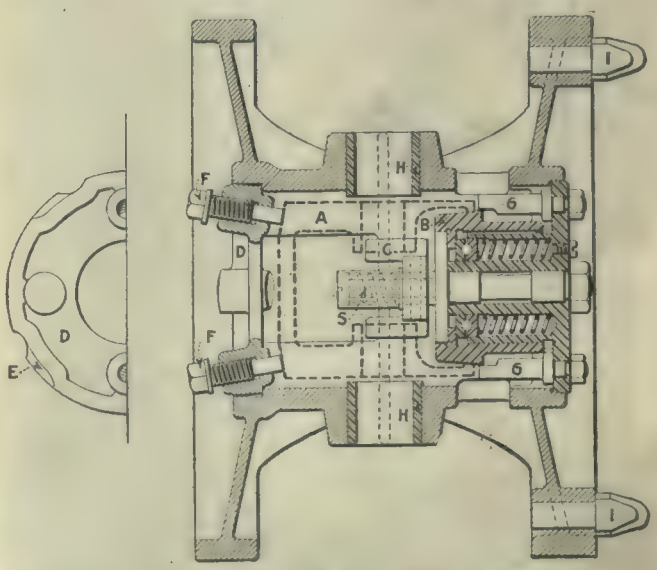


FIG. 2. DETAILS OF DRILLING FIXTURE

AUTOMOTIVE CONSTRUCTION

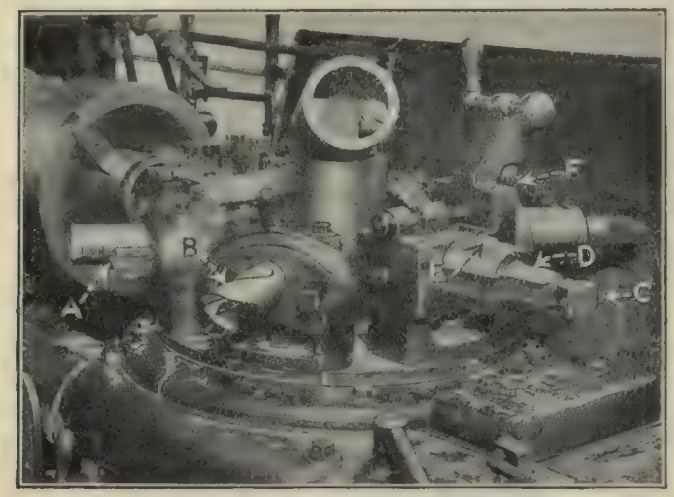


FIG. 3. BORING INSIDE OF PISTON



FIG. 4. HOW INSIDE OF PISTON IS FINISHED

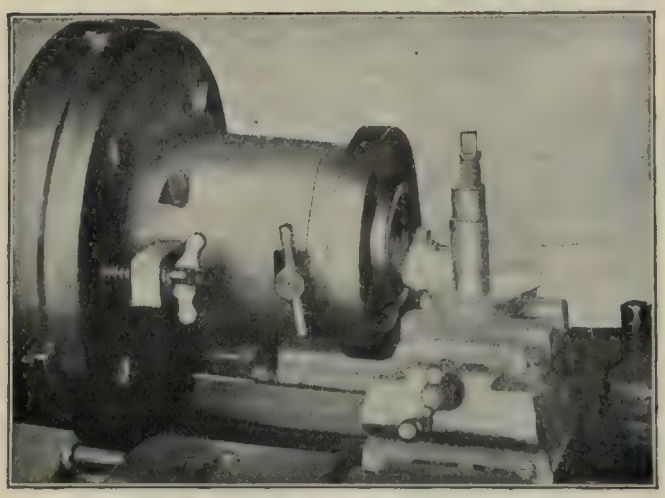


FIG. 5. FINISH-BORING THE OPEN END

around the central portion so as to allow the lugs to easily center themselves, a ball thrust being provided at *X* for this purpose, and making a very complete and easily operated fixture for securing great accuracy.

After the rough-turning, the piston goes to the Jones & Lams machine shown in Fig. 3. The chuck used has a concave face, and the open end of the skirt is bored and faced by the tools at *A*. The drill at *B* is specially ground on the point and relieves the center of the piston head so as to make way for the inside facing tool *C*.

FACING INSIDE THE HEAD

This facing tool is held in a flat holder which can pass between the piston-pin bosses when the work is stopped in the proper position, the bosses clearing the reduced portion of the holder at *D*. The holder is pivoted at *E* and controlled by the handle and screw shown through the pair of beveled gears at *F*. This gives the facing tool *C* sufficient movement to face the inside of the piston head to an arc with the radius *EC*, thus finishing the inside of the piston except for

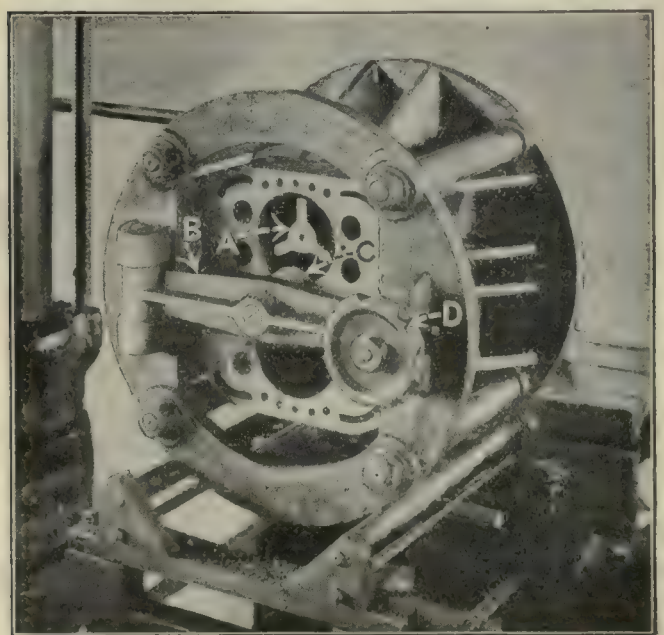


FIG. 7. FIXTURE FOR DRILLING CYLINDERS

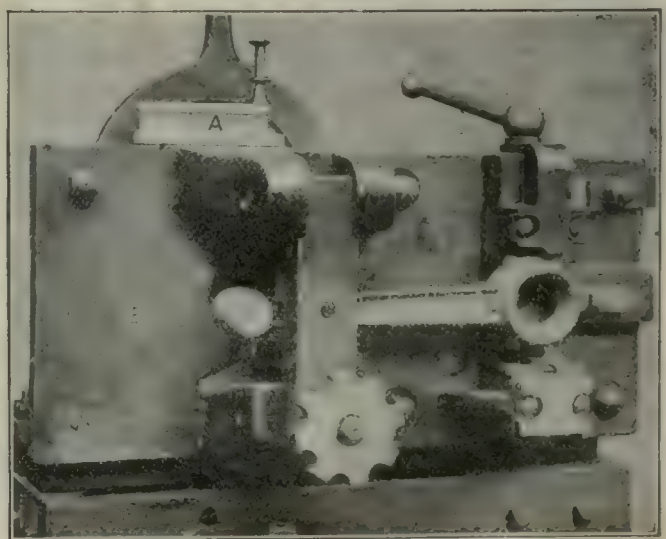


FIG. 8. TESTING CONNECTING-ROD FORGINGS

AUTOMOTIVE CONSTRUCTION

that portion of its length occupied by the piston-pin bosses. This leaves the piston finished inside as shown in Fig. 4.

Then the piston goes to the turning fixture shown in Fig. 5, where the open end of the skirt is carefully bored and the end faced square. Details of this fixture are shown in Fig. 6. The piston is simply slipped into the fixture shown and the hardened and ground locating pin *A* is slipped into place. This pin *A* is a close fit in the piston, but not in the fixture, as can be seen by the clearance around. The plate *B*, carrying the plunger *C* at its back, is then forced against the solid end of the piston by means of the cross handle *D* and the lever *E*. This moves the spindle forward until the projecting ends of the pin *A* seat against the hardened blocks *FF*, which give a definite distance from the piston-pin hole to the end of the skirt. This is then faced off to the desired length and is also squared with the piston-pin hole.

Another form of circular fixture is shown in Fig. 7, where the block of two cylinders is located by the three-lobed support *A* in one bore and a short stud fitting into the other bore. The cylinder block is held in position by the swinging arm *B*, carrying the contact pad *C*, the whole being forced into place by the hand-wheel *D*. Mounted in this fixture, the cylinder block can be turned to any position parallel with its bore for drilling or tapping the various outlets and other holes which surround the cylinder. The fixture rests on two rollers, which make it easy to turn.

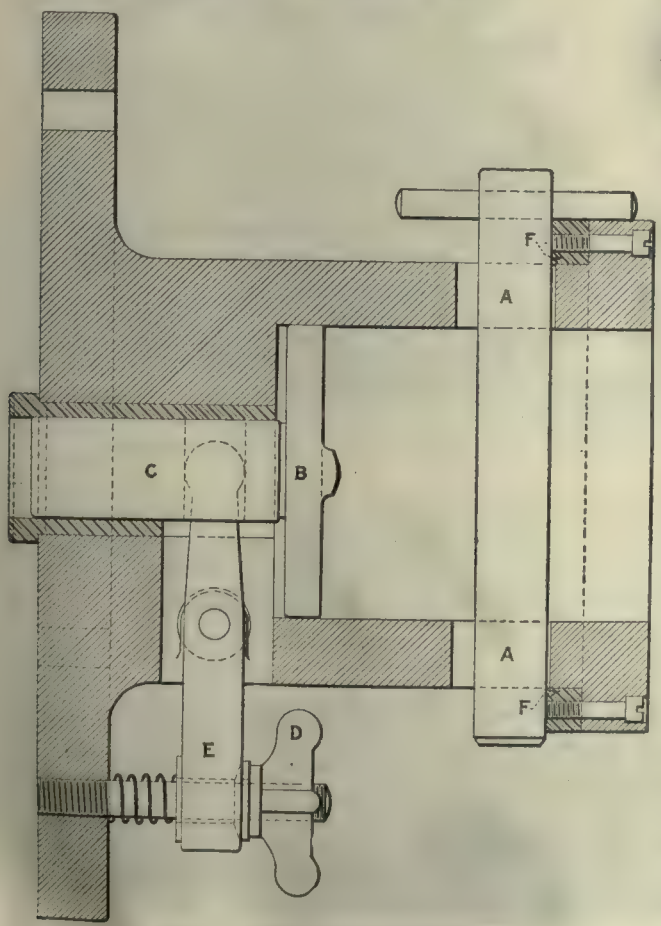


FIG. 6. DETAILS OF FIXTURE

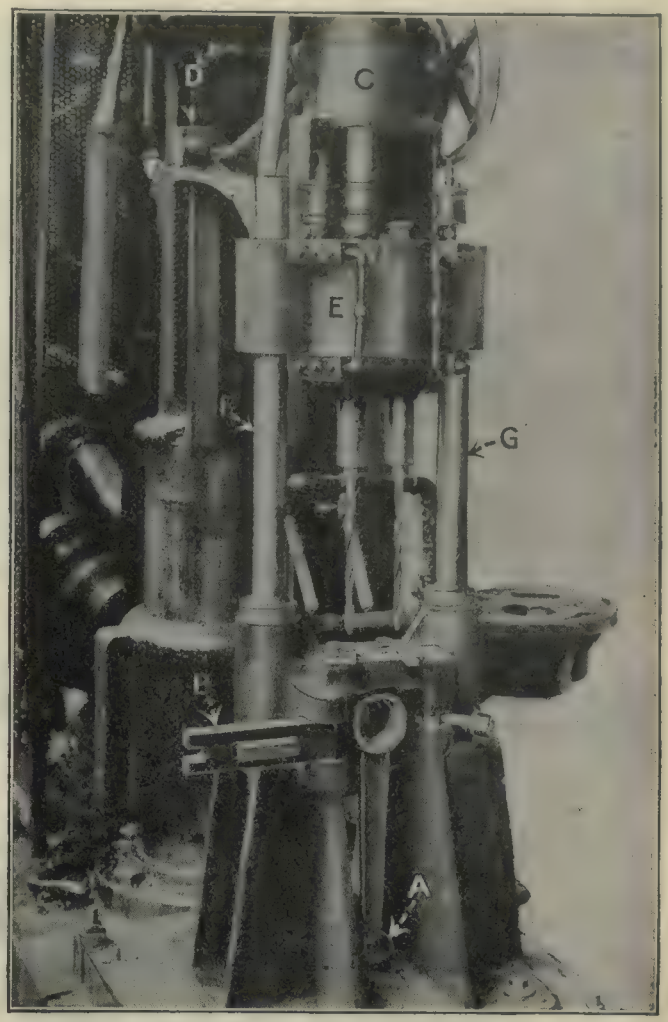


FIG. 9. DRILLING BOLT HOLES

The fixture for testing and straightening the connecting-rod forgings is shown in Fig. 8. The fixture holds the rod by a point in the channel near the small end, and also by the outside of the two bolt bosses. Held in this position the gage *A* tests the ends of the piston-pin boss by means of the two buttons shown on the gage stud. The surface *B* of the fixture is planed flat for this purpose. The whole gage is turned up on edge in order to be more clearly shown.

The next operation is the drilling of the small end, after which the two bolt holes are drilled in the fixture shown in Fig. 9. Here the rod is positioned by the piston-pin hole over the stud *A*. The swinging clamp *B*, carrying an equalizing pad in the center, clamps the upper end of the rod during the drilling operation. The drilling is done by a very substantial auxiliary head, which forms part of the fixture, and which surrounds the drilling-spindle guide at *C*, and bolts to the face on the column at *D*. The drilling head is contained in the housing *E*, which is guided by the pillars *F* and *G*, the whole converting a standard drilling machine into a special machine for this purpose.

The sawing of the cap from the rod is done in an extremely ingenious milling attachment shown in Figs. 10 to 13. This is a double-spindle machine, the first spindle carrying the slitting saw *A*, Fig. 10, and the

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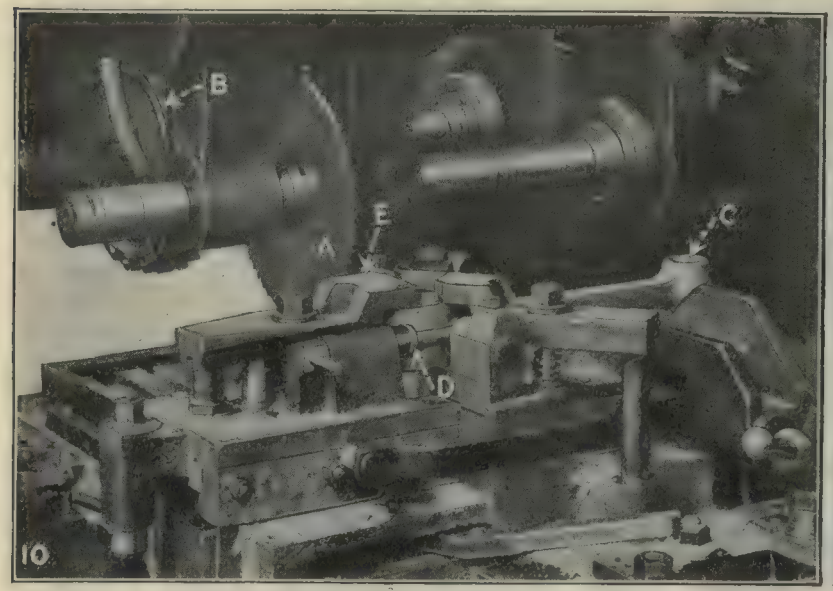


FIG. 10. SAWING AND FACING RODS AND CAPS

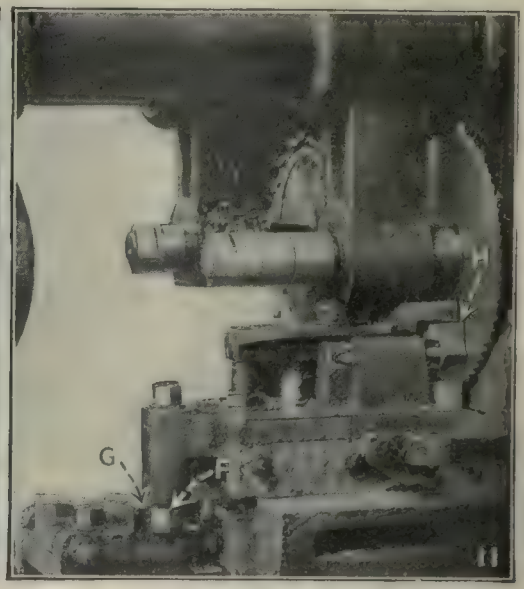


FIG. 11. END OF FIRST OPERATION

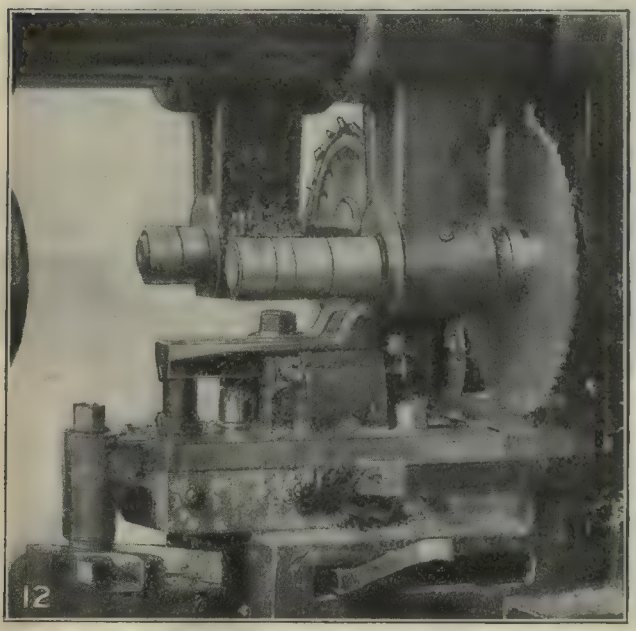


FIG. 12. MILLING THE JOINT SURFACES

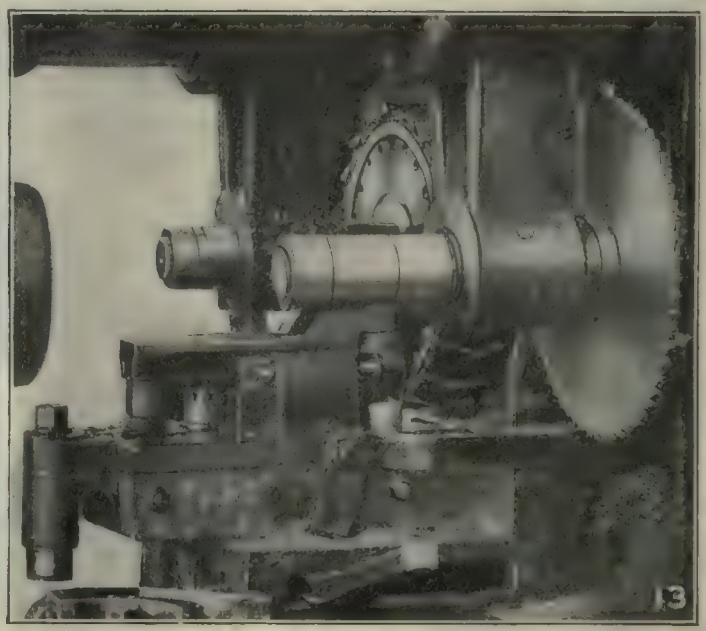


FIG. 13. FINISHING THE MILLING OPERATION

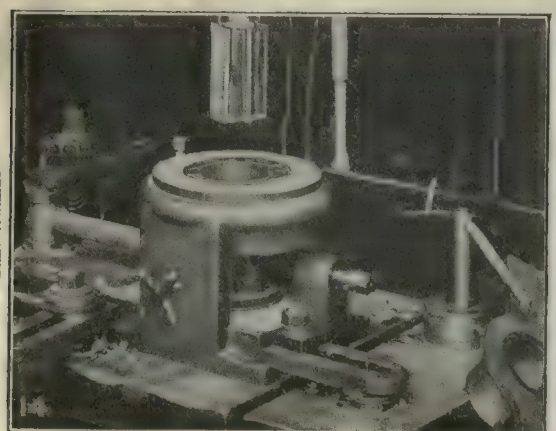


FIG. 14. REAMING THE LARGE END

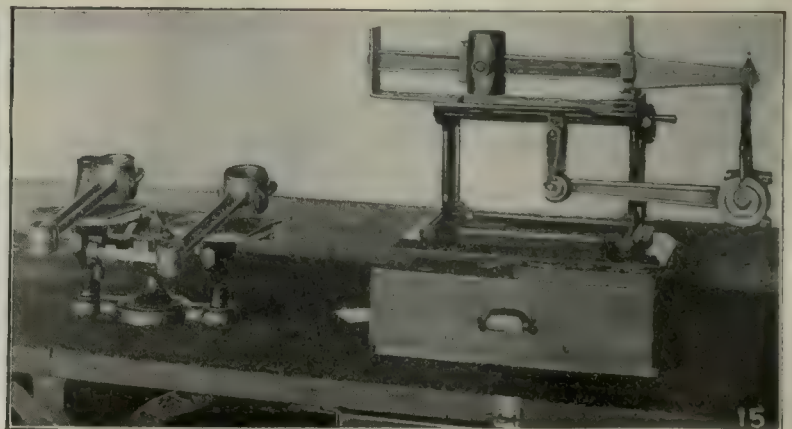


FIG. 15. WEIGHING THE RODS

AUTOMOTIVE CONSTRUCTION

second an inserted-tooth milling cutter *B*. The connecting rod is located by the piston-pin hole at *C*, the large end being positioned by studs in the bolt holes, as at *D*. It will be noted that the large end is clamped at three points, one of these being the broad clamp *E* which covers almost the entire cap.

As the table carries the rod under the slitting saw, the roller *F*, Fig. 11, approaches the sliding cam *G*. This figure shows the slitting saw having just finished the cut and the cap *H* beginning to move away from it under the action of roller *F* and cam *G*.

In Fig. 12 the portion of the fixture carrying the cap has moved out to its extreme position, the roller being practically at the end of the cam.

In Fig. 13 the inserted-tooth milling cutter is just finishing its cut, and has faced the joint surfaces on both rod and cap, so that they require no further attention. This replaces the former method of sawing off the cap and finishing these surfaces by grinding in a separate operation. This method insures the joint surfaces being at right angles to the bolt holes, which is a distinct advantage.

The rod and cap are then bolted together and the large hole bored and reamed. The fixture, together with the reamer, is shown in Fig. 14. The fixture has removable bushings to accommodate both the boring tool and the reamer.

The final weighing of the rods is shown in Fig. 15. The use of the plain balancing scale is to obtain rods of equal weight for the same motor, while the other scale weighs the large ends of the rods and enables the assembling department to use rods having the same weight at the large end.

Motor-Truck-Assembly Details

The very substantial type of pedestal used in erecting the heavy chassis of the Autocar truck is shown in Fig. 1. This is of cast iron and is used instead of wooden horses, being more substantial, reliable and durable.

It will be noted that a somewhat unusual method is used in bolting the springs to the axle. The nuts on the U-bolts have two lock washers, one between the first nut and the ear on the spring pad and the other between the two nuts. The illustration also shows the four, tight-capped substantial oil cups which are used for lubricating the bearing of the brake arm.

A Fender-Fitting Fixture

The assembling stand shown in Fig. 2 is in reality a fixture for fitting fenders of Autocar trucks. The stand, which is a bench having a cast-iron top, *A*, has suitable projections for holding the fender irons *B* and *C* as well as the crossbar *D* which represents the running board of the truck.

The fender irons shown are bolted to blocks which represent the frame, and allow the fender fitters to see exactly how the fenders are going to fit when they are put in place on the truck itself. The fenders are bolted to the irons and, with the irons in place, go to the chassis for assembly.

The left-hand fender is shown in place resting on the other end of the crossbar *D* and held by the fender irons. The gages *E* and *F* show at once whether the fittings line up as they should.

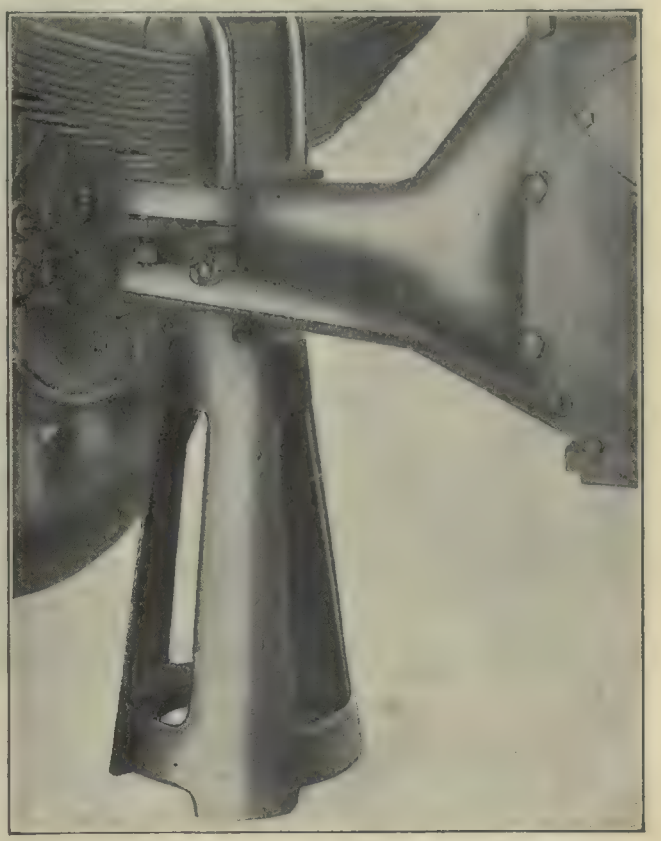


FIG. 1. A SUBSTANTIAL ASSEMBLING STAND

Fitting in this manner saves considerable time in the final assembly and insures everything being properly positioned when the truck leaves the factory.

Painting a Truck Chassis

Fig. 3 shows a very satisfactory method of painting auto-truck chassis or similar machinery, using the spray method. As will be seen this is done in a small room built especially for the purpose. The chassis is mounted on a double-castered truck, and the bright parts protected as at *A* and *B*. The caps *A* which slide over the



FIG. 2. FIXTURE FOR FITTING FENDERS

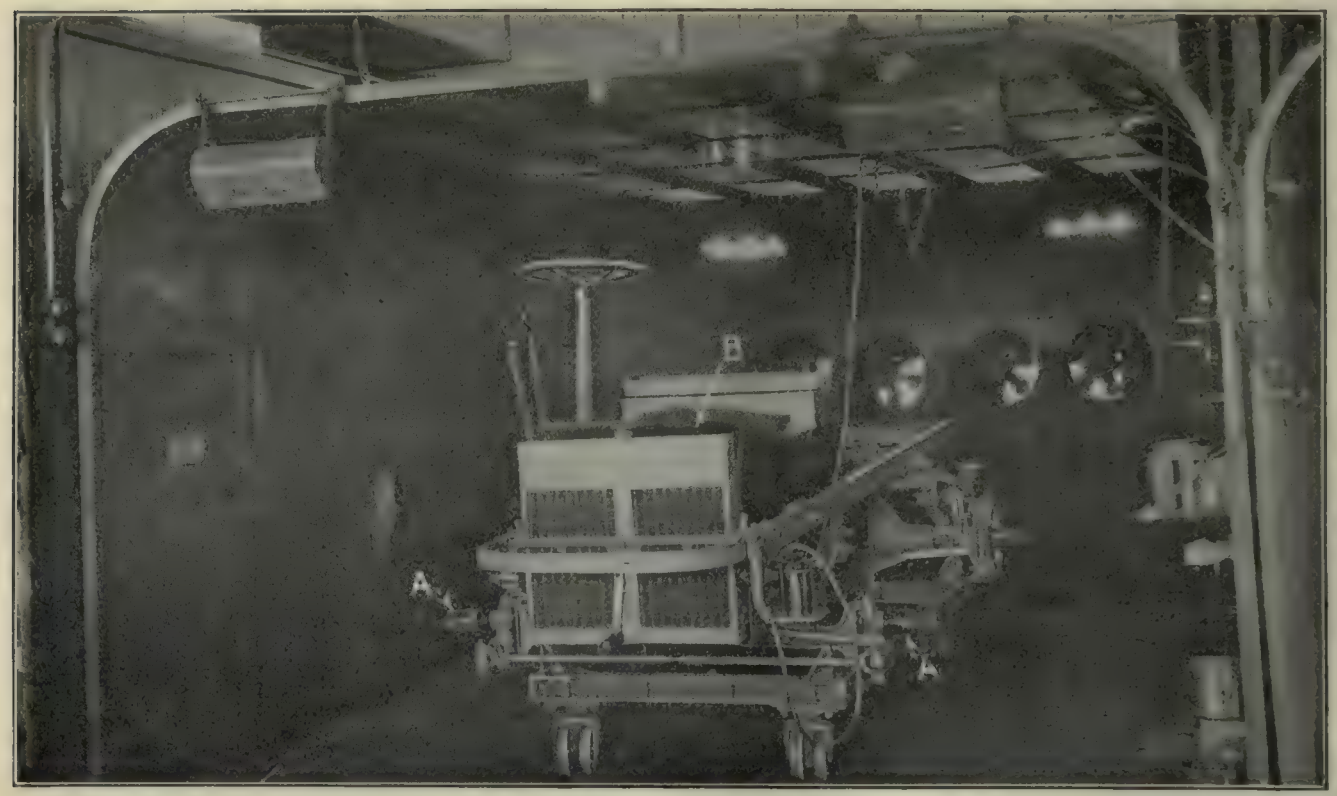


FIG. 3. PAINTING THE CHASSIS

axles can be of any light material, and the top of the motor is protected by the pieces of sheet metal or cardboard shown at *B*.

Illumination and Ventilation

Skylights of wired glass allow considerable daylight to filter through into the room and the four groups of lamps, two at each end, give all the additional illumination necessary. There are also four exhaust fans at the back, each independently driven, so that any desired degree of ventilation can be obtained. After a chassis has been spray painted, a canvas cover is let down over the front of the room, protecting the paint from dust until it sets.

An Executive "Follow Up"

By W. Burr Bennett

President, Wayne Engineering Co., Honesdale, Pa.

Most men in executive positions will admit that one of their most trying jobs is to see that their orders are executed. Even in the small shop where the contact with the various department heads is closer than the large shops, it is difficult to see that the dozens of daily instructions are carried out. It is especially true now when even the best of men are afflicted with that great American disease of "Let George do it," which is further complicated by the high fever of "Passing the buck."

Notwithstanding the fact that the modern progressive shop is well equipped with a planning, production and cost-keeping system, the various employees who are burdened with the aforesaid afflictions can manage to "overlook" about 50 per cent of the various small details assigned to them.

As a corrective measure and by way of living up to one of the late H. L. Gantt's axioms, which stated that "The authority to issue an order involved the obligation of seeing that it is properly executed," the form shown herewith was devised. It is printed on the convenient 8½ x 11-in sheet. A new sheet is used daily and carefully filed when complete. The various details are noted opposite the proper department and the head of that department is required to state the date when he will promise completion of the task assigned. If the time is three weeks away the first follow up is made by a personal interview a week later and is noted in the column 1-FU which is a symbol for first follow up. This is carried through for the second and third weeks respectively and when the task is completed the date is noted in the date finished column. Of course the times vary, some are taken care of at once, in which case only the finish date is noted; on the other hand some items take three days or even three months.

This scheme has now been in operation about six months and has been found very satisfactory. It is simple, accurate and when carefully followed gets results.

MAINTENANCE DEPT.	TOOL ROOM	FINISHING DEPT.	ASSEMBLY DEPT.	SHIPPING	STORES	PRODUCTION DEPT.	ENGINEERING DEPT.	PLANNING OFFICE	BUSINESS OFFICE	DEPT.	DATE
MR. BROCK	MR. FOX	MR. JAYCOX	MR. BAUMAN	MR. ROBINSON	MR. HEFT	MR. FOX	MR. COMMISKEY	MR. DUDLEY	MR. KRANTZ		
										ITEM	EXECUTIVE FOLLOW UP
										DATE FINISH	
										DATE 1 FU	
										DATE 2 FU	
										DATE 3 FU	
										DATE FIN.	

FOLLOW-UP FORM



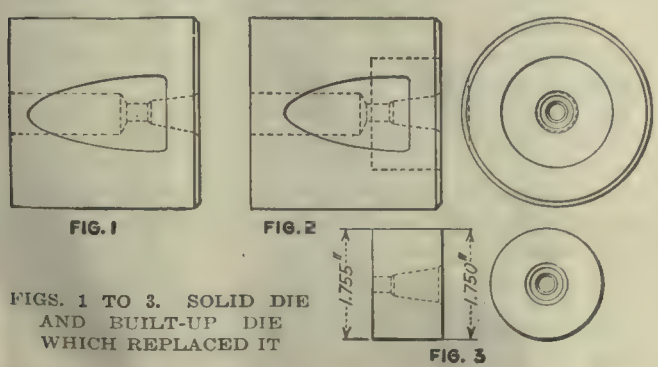
Methods of Making Cold Header Dies

By H. W. Armstrong

The writer redesigned some header dies in a way which may be of interest to others on similar work. The dies which we had been using in our shop were made as shown in Fig. 1, of solid steel. If properly made and hardened they lasted quite a while, but if they were too soft they would be used up quickly. On the other hand if too hard they would split open. In any case they are quite costly to make as there is required a large piece of tool steel of very good quality.

The writer thought that by substituting a soft steel exterior and using a tool steel center (see Fig. 2), the cost of steel could be greatly reduced. Moreover the tool steel insert weighed less and could be handled more easily when machining. Also the exterior or holder could be used indefinitely, substituting new inserts when necessary. This method had been tried before but without success because the insert had been made with the sides straight or parallel. The holder was bored out slightly smaller after which it was heated and the insert shrunk into place. This method failed because the insert would very often pull out and sometimes would get caught between the punch and die, causing serious damage.

The following method was then tried out with success and adopted. The holder was bored out on a slight taper, the greatest diameter being at the bottom and about 0.004 to 0.006 in. larger than at opening. The insert was made with a corresponding taper but about 0.005 in. larger throughout than the hole in the holder (see Fig. 3). Then the holder was heated and the insert shrunk into place. None of these have ever pulled out as the taper-shrunk fit will not permit the insert to pull out without subjecting it to a greater strain than is possible under working conditions.



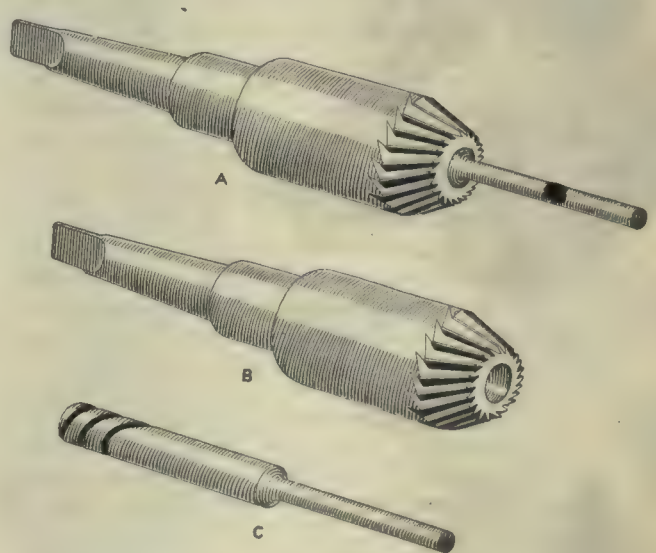
FIGS. 1 TO 3. SOLID DIE AND BUILT-UP DIE WHICH REPLACED IT

Chamfering Tool for Valve Seats

By J. V. Hunter

A maintenance engineer in a large gas engine manufacturing plant recently stated that in the past they had trouble due to the pilots on the chamfering tools, used for finishing the valve seats, wearing rapidly and causing them to chamfer the seats out of true with the valve-stem holes. This was caused by the chips and dirt that fell down on the pilots which were made integral with the tools.

This trouble was done away with entirely by using the type of tool shown in the illustration. *A* is the assembled tool and *B* and *C* the two parts of which it is composed. The body is made as at *B* with the center hole accurately finished to a standard diameter. The pilot *C* is likewise made up with its shank the correct size for a snug running fit in the tool bore; and it will be noted that it carries oil-grooves to distribute the oil and insure that it will not bind in the bore. The pilots are made in several sizes, varying a fraction of a thousandth from one another, and in each case the operator selects one which will fit tightly into the valve-stem hole which he is chamfering. The tight fit insures the pilot both against side play and turning in the hole, so that the rotation all occurs on the upper shank which is above the chips and dirt. Since using these chamfering tools the inspectors have found less cause for complaint and the maintenance for the tools has been much less.



CHAMFERING TOOL WITH REMOVABLE PILOT

What Other Editors Think

Which Way Are the "Trade Winds" Really Blowing?

By Everit B. Terhune
Manager, *Boot and Shoe Recorder*

IT is high time that a certain type of American business men cease worrying, and take comfort from some plain, easily discoverable facts.

I am getting a growing conviction that in some commercial quarters pessimism is masquerading as marvelous shrewdness, far-sightedness, conservatism.

I sense a tendency on the part of a few business men here and there to construe present *unusual* commercial conditions as the inevitable forerunner of *panic* conditions.

If one has the interest to chase this pessimism to its source, then puts that source under the magnifying glass of intelligent, uninflamed business analysis, of what does he find it to consist?

Just this: Commodities are very high; the consuming public is crying more nearly in unison every day for lower prices; labor is in an aggravated state of unrest; and commercial, social and political conditions in Europe are generally bad.

Granted—every bit of it!

But, even so, please permit some of us to retain our mental equilibrium; bear with us while we decline to become frenzied over these things, and allow us for a moment to put the facts through a laboratory test.

Which way are the "trade winds" *really* blowing?

So far as I know, or can find out, no business depression in the United States ever occurred in or immediately followed a period in which money was anywhere nearly as plentiful as it is today and has been for two years—with a record-breaking bold balance to justify and even *necessitate* it.

So far as I know, or can find out, no commercial cataclysm in this country of ours has ever come at a time of conspicuous *under*-production of *necessities*. Over-production *has* been a contributing cause of business lethargy.

And so far as I know, or can find out, no real business paralysis has ever accompanied or immediately succeeded a time when the working man—or the farmer—was anywhere nearly so much the master of his financial destiny as he admittedly is today, and is admittedly going to *continue* to be for many years.

Truly, I think the well-known volatile temper of the American business man has never been more strikingly demonstrated than in this silly inclination on the part of a few of him to mistake the probably approaching *readjustment* of commercial matters for a *stagnation*.

And here, I think, we get the real answer: We shall have a *clarifying* of industrial relations, a *straightening-out* of commodity values, and perhaps of trading prices and profits ratios—but a panic, a business depression, a period of radical commercial curtailment, *NO!*

I am quite satisfied to let the coming twenty-four months prove me a false or true prophet.

What I am principally quarreling with is the superficial character of the judgment that a few self-appointed calamity-howlers always insist on applying to a business situation whenever it is anything but 100 per cent rosy.

They like to interpret a prospective, natural easing-off of abnormally high prices as bottom-dropped-out affair.

They view an upset labor situation as forecasting an industrial tragedy—entirely forgetting, apparently, that a labor crisis never comes when production of living necessities is tremendously under normal requirements.

To them the unparalleled accumulation of gold reserves in this country at present, with its unavoidable influence toward high prices, high wages and popular extravangance, means nothing at all!

Two years ago everyone was proclaiming, truthfully, that "business in the United States is just entering an era of the greatest prosperity it has ever known."

Right! — and we ARE in it, and, if we will merely ignore or suppress the stupid croakers, we shall easily continue in that prosperity for many, many years!

The War set the international stage for this precise prosperity. By it we became, involuntarily, uncontrollably, the logical supply source for a good share of the rest of the world for the major part of *ten years.*

Do we business men of the United States now propose throwing this advantage—this responsibility—to the four winds, merely to give foolish substance to the frothiness of a few false prophets.

I talk business with a great many men influential in the shoe industry and in other lines; and, believe me, I get *facts.*

If I should epitomize the worth-while statements made to me of late by the worth-while men of business, they would come down to about *this:*

"Let's not even dream of poor business while all about us we have, and must for a long time have, the elements that always make business *secure.*"

"Any business man who thinks he can forsee commercial depression when his own country and half the rest of the world are clamoring for goods ought to be surveyed by an alienist!"

"We should at least scratch the surface of our tremendous trade advantage before we begin to wonder if we have exhausted it."

I want to say that business journalism is an excellent barometer of coming business conditions. Advertisers are as canny as they make them! An advertiser can scent a distant slump in business more keenly than any other kind of business individual I know.

Yes, prices are going to be revised downward, some time; broadcast personal extravagance is going to run its course, and prosperous sanity return; labor is going to rub its eyes clear and jump enthusiastically into the pleasant and profitable work of making production more nearly match the demand for it.

Who are going to straighten out the situation, and bring America's business to its proper basis *without* interrupting it?

The *American people themselves*—of course

The Van Norman No. 9 Hole-Grinding Machine

SPECIAL CORRESPONDENCE

THE grinding machine illustrated and described in this article has been brought out by the Van Norman Machine Tool Co., Springfield, Mass., and is intended for finishing holes by grinding and also for grinding the flat faces of circular work, the work being held in a chuck or other suitable fixture.

Figs. 1 and 2 are respectively front and rear views of the machine and show its massive construction. The base has ample strength and rigidity to keep the work and grinding spindles in alignment with each other under the most severe grinding conditions, thus insuring straight work.

The drive is self contained and is mounted on the machine base, avoiding the necessity for an over-head system such as is usually furnished with belt-driven grinding machines. The machine can be furnished with motor drive, in which case the motor is placed inside the cabinet base where it is protected from grit and dirt. Here the motor is entirely out of the way and by reason of its location the machine does not require any additional floor space. All driving shafts are mounted in self aligning ball bearings.

Production grinding requires that the stock to be removed shall be taken off in the shortest possible time. In conforming to such requirements it is necessary that both the work and the grinding wheel shall be rigidly supported and absolutely free from all vibration.

Fig. 3 shows the construction of the work-head spindle and its bearings. The spindle is submerged in oil and is protected by a packless gland system that seals oil in and dirt out. The grinding-wheel spindle, Fig. 4, is mounted on a quill which can be adjusted lengthwise in the grinding head. Ball bearings are provided both at the front and rear end. The front bearing, or that nearest the grinding wheel, is fixed in the quill, while the rear bearing is held in a sliding bushing. By this arrangement any lengthening of the spindle by expansion due to heat generated by grinding, will cause the rear bearing to be pushed back by the shoulder on the spindle and prevent any binding between the shoulders. The quill is designed to give rigidity to the spindle under the severest conditions imposed by heavy grinding. It is not intended that the wheel spindle is to be removed from its quill for the purpose of inserting another spindle of different size or length but that a quill fitted with a spindle adapted to the work shall be used.

An analysis of grinding-machine production will show that the factors of time consumption are: loading the machine, actual grinding, gaging, unloading. Rapid production, especially in grinding holes, requires that the machine shall have been designed with the above factors in mind, otherwise the time consumed in handling and gaging the work will be out of all reasonable proportion to that consumed in actual grinding.

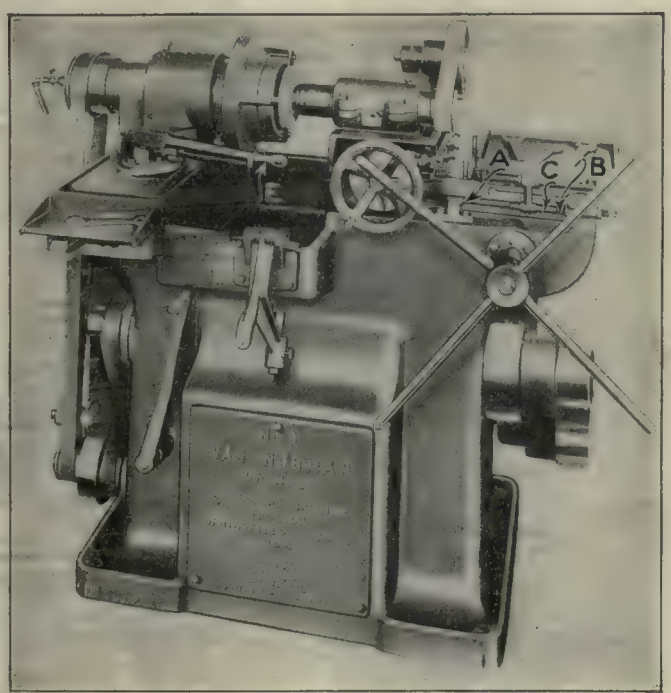


FIG. 1. VAN NORMAN NO. 9 HOLE-GRINDING MACHINE

Specifications: Swing, 20 in. Will grind holes 4½ in. deep. Speeds: work spindle, six, from 72 to 431 r.p.m.; grinding spindle, three, from 3,400 to 19,000 r.p.m. Motor: 3 hp., 1,200 r.p.m. Floor space, 39 x 63 in. Weight: net, 2,950 lb.; boxed, 3,100 lb.

Probably no factors limit the production capacity of a hole-grinding machine to so great an extent as those of loading, gaging and unloading. The reason for this is the natural slowing up on the part of the operator, owing to his fear of contact between his hands and the abrasive wheel which is unavoidably very close to both the work and the chuck or holding fixture. To stop the wheel each time the work is to be gaged or unloaded or loaded would result in an enormous loss of time.

In designing this machine the maker has taken care to protect the operator's hands from accidental injury while handling work in and out of the machine and during the times it is necessary for him to gage or otherwise test the parts being operated on. This safeguarding consists in supplying means by which the distance between the work and the grinding wheel can be quickly made greater in two directions.

Referring to Fig. 1 it will be noted that the carriage upon which the grinding spindle is mounted is provided with means for longitudinal movement through a pilot wheel and rack and pinion. This movement is limited by the positive stop *A* and the adjustable stop *B*, between which is hinged the bar stop *C*. By swinging the bar stop *C* upward and out of line with the other stops, the carriage can be moved back, withdrawing the grinding wheel axially from the work.

The work head is mounted on a transverse slide upon

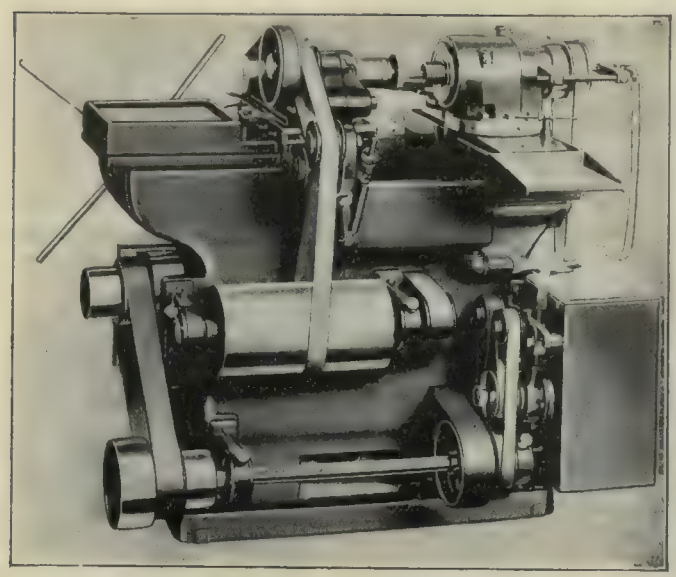


FIG. 2. REAR VIEW OF GRINDING MACHINE

which it can be moved by the lever *E* through the usual rack and pinion arrangement. It will thus be seen that with the wheel moved axially away from the work by the movement of the carriage, and the work moved transversely away from the wheel by the movement of the work head, there will be ample room for the operator to gage the work and to handle it in or out of the machine without danger of injury to his hands.

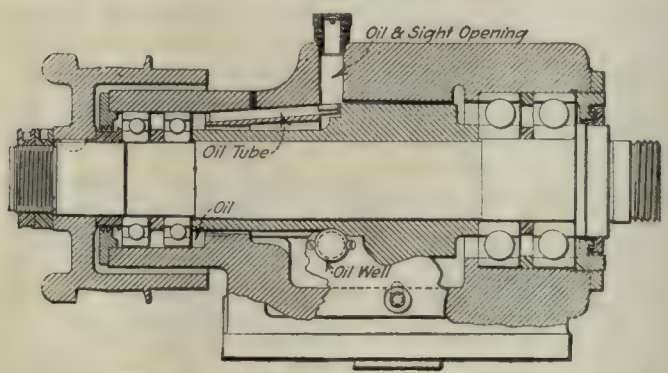


FIG. 3. THE WORK-HEAD SPINDLE

There still remains the necessity of stopping the work spindle from revolving before the work can be handled or gaged and this is taken care of by releasing a clutch and the automatic application of a brake which brings the spindle to a quick stop. The operator can make all these moves quickly while maintaining a position of ease and the time consumed will be much less than if the grinding wheel were stopped and started.

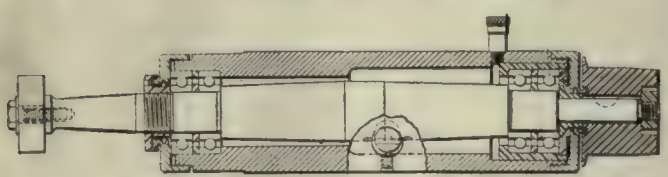


FIG. 4. THE GRINDING SPINDLE AND QUILL

The work head can be returned to and locked in its normal position without change in alignment.

By the use of a cup wheel holes can be ground and the work faced without changing the wheel or re-mounting the work. In face grinding, the work head is traversed while the wheel remains in one position. Adjustable stops are provided on the work-head slide through the use of which the head can be set in different positions so that holes having more than one diameter can be ground. The work head is mounted on a swivel base graduated both in degrees and in taper per foot so that taper holes can be ground to either system.

The machine is equipped with a wheel turning attachment and a pump for coolant.

Making Employees Interested in Their Work

By Oren D. Harris

Excellent and instructive as is Professor Kitson's article in the May issue of the *American Machinist*, on "Making Employees Interested in Their Work," it is by its very nature broad and of only general application. Several points occur to me wherein his general deductions may be specifically applied to increasing the interest of employees, particularly in mechanical lines of production. Perhaps none of these applications can be classed as original, but if there is "nothing new under the sun," it is at least interesting to note how Old Man Experience follows right along the line of Professor James's arguments—or, perhaps, this should be said vice-versa.

At any rate, it seems to me that in one thing at least the machinist trade has an incomparable advantage over most other occupations. I do believe that, as a rule, there is a greater interest in the work itself and in the opportunities presented by the whole engineering business shown by those entering it than in almost any trade or occupation, possibly barring what our grandfathers used to call "the learned professions."

Perhaps the shop paper could be used to induce a little more curiosity as to the contents of the factory library, and encouragement should be given to the workman in the matter of individual subscriptions to technical magazines. Part payment by the employer of the purchase price of study courses pursued by workmen will give encouragement, without forfeiting the sense of responsibility which might result from having the whole amount assumed by the employer. In some cases a well-managed suggestion box proves a benefit by bringing out useful suggestions and by making the men think beyond the beaten track. The amount of the reward and the actual fact of winning it are both sufficient inducements to cause a worker to keep on looking for inefficiencies which can be remedied.

Attention to the comfort of employees in the matter of simple conveniences will result not only in greater interest, but in greater producing efficiency as well.

In the matter of getting employees interested in their work by showing an interest in their welfare outside of the shop, the first step of many employers is the promotion of sports, which will be of interest to only a small number of the younger men as a rule, rather than to the more mature men. The method in which many firms are now offering to help their men accumulate savings by giving them cash dividends, stock dividends, and by maintaining convenient branch banks will likely to appeal to the most responsible of the men. The plan of helping finance the buying or building of homes should be one of the surest means of encouraging loyalty and interest, especially in these days of the scarcity of houses.

Hunting Psychologists

By Entropy

This is not an advertisement. The job is filled. One of my friends who runs a shop with quite a good-sized office attached asked me to locate a psychologist who could discover whether his organization was good or not. Of course I made him sign off all claims against me in case the man did not prove profitable. Then I answered advertisements which implied that psychological methods of selection were to be used. The first chap I struck had advertised for a cashier. Handling money has always appealed to me so I went to see him with some real interest; but he apparently was quite a psychologist for he told me immediately that I did not want the job, because his firm did not intend parting with money enough to keep me going. He explained that he knew by my looks and the fact that one button on my coat was nearly off that I was married and he did not see how any married man was going to carry the job and dress as well as I did. I did not get anywhere near his psychological tests.

The next ad that I saw did not give any details at all. They gave a box number and asked for an executive. Being an executive always appealed to me, my idea of an executive being a man who has a nice flat-top desk with nothing on it but a plate glass and a calender marked with the date the fishing season opens. Bearing in mind my experience with the first man, though, I carefully selected my other suit, the one I wear holidays to take out the ashes. My wife very kindly sewed all the loose buttons on, and I dusted it off as much as possible, being careful not to disturb the shine on the elbows and other prominent places.

This chap was posing as an imitation of a seal, being one of these self-satisfied fellows with long hair combed straight back and oiled to the last word. He started off by telling me that the examination through which he proposed to put me would demonstrate whether I was fitted for the job or not, so that I would see if I fell down, that I was unfit for the job. In other words, there would be nothing personal about it. Now I feel quite proud of one or two things I have done and I tried to tell him all about it. He waved me away with the remark that he cared nothing about my past, only of my future. Then I tried to find out what he wanted his man to do. He said he was not allowed to tell, that all he was going to do was to find the man best fitted for the job that was to be handed out, and then they would hire that man.

I suggested to him that I had spent a lifetime in certain lines and that I did not want to wander too far astray from them. "Why," said he, "if you can get a good job with plenty of money, what do you care what you do?" I then dug out of him that what he thought was good money was about $1,800 a year. I made a mental reservation, but told him to go ahead with his questions. He had nothing new, however, just the old line that tests concentration by asking foolish questions, memory by photographs, and association of ideas and all the rest of the stuff that has been public property for five years. I passed, but I felt obliged to tell him that the job, which he finally said was selling bonds on commission, was nothing that I wanted. The whole game was to get men so imbued with the idea that their minds were of just the type to sell bonds that they would go out and sell to all their personal friends and then they could be discarded in favor of a new crop. I did not recommend the imitation seal.

Then I struck a man who did not claim to be a psychologist at all but whom I suspect of such leanings. I met him by accident and was not dressed to make any particular kind of an impression. He started off by telling me just what the job was that he wished filled, just what sort of people the man selected would have to co-operate with and just who could be expected to object to co-operation. He then drew out of me all my experiences that bore on the job, some of which I will have to admit now were made up for the occasion. After we had talked for nearly an hour he and I agreed, however, that I did not want the job, and then he turned around and told me that he had known all along that I was not looking for a job at all

Which Was a Psychologist?

Of the three, which was the psychologist? Or, if they were all in that class, which is the type that can find a useful place in the world? Is it justifiable for one to entirely throw away the experience which he has gained by hard work? Is it reasonable to expect that every man who comes looking for a job is down and out and therefore ready to take any job that promises a fair living? To be sure, most of us work for a living, but most of us can earn more in a congenial job, and one for which our past work has been a preparation. Psychology, as I understand it, is the application of common sense to the workings of the human mind. The mind is perverse under affront and insult. If it is desired to rouse a man's antagonism the easiest way is to tell him that he is not competent to pick out his own kind of work. It may be that he is not competent, but it is very far from soothing to him to tell him the truth even in that case.

Everything that we do forms habits, good or bad, as the case may be. Habits are worth money in the market or they cost money. The habits of honest and clear thinking are assets, those of laziness and procrastination are liabilities. These can be estimated from the history of the man. All the tests which may be applied may find him prepared, and he may, under the stimulus of excitement and interest, pass an examination in a way that his habits make it virtually impossible for him to keep up. A man may be able to center his attention for a short time on an interesting or new problem and yet be so utterly bored with the repetition of the same problem that he may make so many errors that it is not profitable to employ him.

Will-power hardly comes within the scope of these short examinations. Men who have shown wonderful will-power at one time have apparently entirely failed to show it at others. The state of physical comfort has a great deal to do with it. The presence or absence of disturbing affairs which call for their own share and more of will-power, can only be guessed. A man may be asked to present himself for examination at a time when his wife or child is sick and he is using all the will-power that he has to keep up his courage, and he is likely to make a sorry exhibition when called on for evidence of more.

And so in a great many ways it is unwise to throw away records of past performance. It is true that each employer is concerned chiefly with the future, but if he throws away the past he has lost a great deal of value for judging the future.

WHAT to READ —for the man in a hurry



Suggested by the Managing Editor

A LITTLE sketch of our naval station at Pensacola opens the ball this week. The illustrations show some of the every-day work with big flying boats at the station. Two other automotive articles appear on pages 221 and 225. They are both by Fred Colvin and deal with two of our oldest motor vehicles, the Pierce-Arrow and the Autocar. The Pierce article takes up the high spots only of some of the operations on pistons, cylinders and connecting rods, but gives details of interesting fixtures. From the Autocar shop come assembling and painting helps which are ingenious. An automotive kink from the western editor is printed on page 227 and strikes us as being worth noting. It is a valve-seat chamfering tool with detachable pilot to get away from chip difficulties.

What to read was not a difficult matter to decide two hundred years ago when books were few and magazines unheard of. It is far different now when so much reading matter is offered to pass the time pleasantly or profitably as the reader chooses. We are doing our utmost to make the "American Machinist" not only profitable but indispensable as a clearing house of ideas and news of the machinery world. This page is the editors' advertisement of their section of the paper. It gives the high spots.

The Ordnance Department, through Colonel Barnes, sends us an account of a test on large roller bearings made in the famous Emory testing machine at the Watertown Arsenal. Performance data on 12-in. roller bearings are scarce and the results of this test are therefore doubly important.

A special machine for railroad shops is described by Cedric Priebe, our youngest editor, on page 202. It was built by the Garvin Machine Co. for milling slots in crossheads and for work of a similar nature.

A new grinding machine which is finding its share of favor is the Van Norman of which an account begins on page 229. It is a production machine for finishing holes by grinding and also for grinding the flat faces of circular work. Some of the first ones have gone to the automotive industry.

More of our old friend Entropy's homely philosophy follows the Van Norman article and once more we commend his remarks to your thoughtful attention. This week he takes an exploring trip into the realms of man training and arrives at the conclusion that it is a very rich territory from which much is to be gained.

The period in our history from 1810 to 1840 saw many far reaching developments in the machinery world. H. H. Manchester discusses them in Part XI of his Evolution of the Workshop, page 205. Among them were the first American-built steamboats and locomotive engines, nail and tack making machines, milling machines and tenoning machines and the extended use of interchangeable parts. Here is one of the results of a micrometer test which C. A. Hubbell, president of the T. R. Almond Co., describes on page 209. "A rather unexpected condition appeared in the large number of micrometers inaccurately set at zero. . . . Fifty-two per cent of the employees' instruments were correct at zero while only 20 per cent of the employers' were correct. . . . it is quite universally nobody's business to look after the firm's tools." Have you had yours tested lately? "Modern Production Methods" appears again this week with Part VIII, which covers the control of the work in the shop or, more briefly, planning. The "booth" system is described and its advantages over stock-chasing are pointed out and some of the forms employed in this work are taken up in detail. Mr. Basset winds up this part with some figures to show an actual saving in the non-productive labor at one plant.

Recognition of his services, long due the engineer, is beginning to be given—and the engineer is beginning to perceive that seeking for this recognition is a part of his duty. The engineer of discernment will see that the F. A. E. S. (Federated American Engineering Societies) will advance the interests of the individual engineer by causing the advancement of the profession, through a greater recognition, by the public, of the engineer and allied technologist and by increasing the solidarity and raising the standards of these professions. Facts about the F. A. E. S. are told on page 220. There is also an editorial on page 234.

Conditions abroad are described on pages 238 to 241 where you will find articles on England, Czecho-Slovakia and Germany. Our London correspondent also includes a few words on Scandinavia. You will want to know what the association of German Tool Manufacturers thinks of the future for German machine tools. As for Czecho-Slovakia her possibilities are almost limitless for her resources make her practically self supporting and she has plenty of skilled and thrifty workmen.

Packing For Export

COMPLAINTS from across the water are piling up against the careless packing of our export machinery.

One of the largest English machine-tool dealers has been compelled to send all of the American machines received to the shops to be thoroughly cleaned and overhauled before they are put on sale.

One lot of automatic machines was so deeply pitted with rust as to be only available as second-hand equipment.

Another large French dealer follows the same course as the English firm, in order to preserve the reputation of the machines he handles.

Not only are very many of the machines which cross the water badly rusted, but in numerous cases the boxing is so poor that parts, or even beds, are broken in transit.

The American exporter must remember that owing to freight congestion and labor troubles, his machines are liable to have to lie on the docks, exposed to all kinds of weather for days, weeks, or even months.

The exporter should also keep in mind the fact that the present less efficient or more careless labor will soon wreck anything but the very best boxes or crates.

Parts broken on machines sent to England mean from three to six months additional delay in delivery of machines on order. This, added to the original delay in filling an order, may easily amount to from six months to a year.

On machines delayed in this manner, who can blame the foreign buyer if he in the meantime obtains machines elsewhere, if he can, and cancels his American order?

Even if he is compelled by circumstances to accept the American machines after all this delay, due to the exporter's pure ignorance or indifference, he will be in no mood to repeat his experience if he can possibly place his orders with other concerns.

Machines to be exported should be thoroughly "slushed" with some good, easily removed, protective which will not run off when the freight is exposed to the hot sun. Following this the machine should be covered with waterproof paper or cloth, and the box made to withstand the roughest handling.

One firm noted for its careful packing, lines its boxes with tin in addition to the use of slush and waterproof covering.

Each one who values his export business should at once see to it that HIS shipments go out boxed in a foolproof and weatherproof manner.

Editor

EDITORIALS

The F. A. E. S.

THE Joint Conference Committee (of the four founder engineering societies) is at present handling the business of the F. A. E. S. (Federated American Engineering Societies). We quote from a recent paper of this committee: "The Joint Conference Committee is unqualifiedly of the opinion that an opportunity has been created for bringing about a solidarity of the engineering and allied technical professions that has never heretofore been available and that the success of the movement will depend upon the whole-hearted support of each American engineer and of each technologist, who, if determined that this movement shall succeed, will obviously not bother with the details or the form of organization, in his effort to secure the end desired."

There is no doubt that "an opportunity has been created for bringing about a solidarity of the engineering and allied technical professions that has never heretofore been available." As previously explained in these pages, the F. A. E. S. is not the outcome of any individual's ideas, or of any one society's ideals, but is the result from a positive need, made evident during a period of several years—a need felt by individuals and societies alike. Engineering council was a step in the right direction but it has been by no means comprehensive enough.

The individual societies have been convinced of the need for concerted action, they have chosen their delegates,the conference has been held and the organization brought about—the opportunity has been created.

The second part of the quotation is also true—"that the success of the movement will depend upon the wholehearted support of each American Engineer and each technologist." The societies concerned are now receiving reports from their delegates to the organizing conference, examining the work done at Washington and putting to a vote the question of applying for admission to the F. A. E. S.

Among the societies which have taken favorable action are the American Society of Mechanical Engineers, the American Institute of Chemical Engineers and the American Institute of Electrical Engineers.

This brings us up to the last part of the quotation " . . . who, if determined that this movement shall succeed will obviously not bother with the details or the form of organization in his effort to secure the end desired." An amount of inquisitiveness on the part of those who sent their delegates to the conference is pardonable. It is especially pardonable in the engineer, who is, by the nature of his profession, taught to see for himself that which he is going into. For the benefit of engineers at large we are printing on page 220 of this issue, an article entitled "Facts About the F. A. E. S." There are explained the choice of its name, the basis of representation when both state and local organizations exist, operation, and prospective income and expenditures. These are the subjects which, of course, cause most discussion and require most explanation.

Let us not "bother" too much, however, with the details. The delegates did that part of the work by passing their judgment as unanimously approving the constitution and by-laws which are now being presented to the societies; they did the necessary threshing out of details and made any required adjustments of form. It was no meager task which they faced, but they saw it through in a most conscientious way, and with an insistence concerning detail that afforded complete understanding and satisfaction. Such a spirit of "wanting to be shown" was highly commendable at the conference, where all were together and questions could be settled without loss of time. It is to be hoped that it was productive of a dissemmination of information on essential points sufficient to satisfy the societies.

To be too insistent upon detail would be like holding to a small tolerance the dimensions of a part to fit the air. Let us not lose sight of the main issue in quibbling.

L. C. M.

The Need for Frequent Testing of Gages

THE careful and periodical inspection of all shop measuring tools and instruments cannot be too strongly urged.

Most workmen are apt to take it for granted that their "mikes" are right, provided they bear the name of their favorite maker.

Snap gages kept for certain jobs are also usually taken at face value, regardless of their age.

Special measuring machines and precision gage blocks are used year after year and still thought to be correct.

Some shops have all measuring tools carefully inspected at frequent intervals, but how many of these are careful enough regarding their master sets?

The inspection reports of one great company, using a number of sets of precision master blocks, show an average wear of 0.002 in. per set in a five-year period.

Another firm's report shows a wear equal to this, on a frequently used set of six blocks, in three years.

The article on page 209 of this issue reveals some rather startling figures regarding micrometers.

Approximately 63 per cent out of hundreds of micrometers, tested in shops all over the country, were found to be incorrectly set at zero.

Compared with the workman's micrometers, those belonging to the employers showed almost twice as many incorrectly set ones.

A workman naturally takes better care of his own tools, but that is no reason for the employer not keeping his equipment in shape.

Many employers do not realize the poor condition of their gages—but they should—and should take steps to make and keep them correct.

In order to have accurate master reference gages, at least one set should be kept in a safe place, and used only to keep a check on other sets more frequently used.

E. V.

SHOP EQUIPMENT NEWS

Edited by
E. L. DUNN and S. A. HAND

SHOP EQUIPMENT • NEWS •
A weekly review of modern designs and ◦ equipment ◦

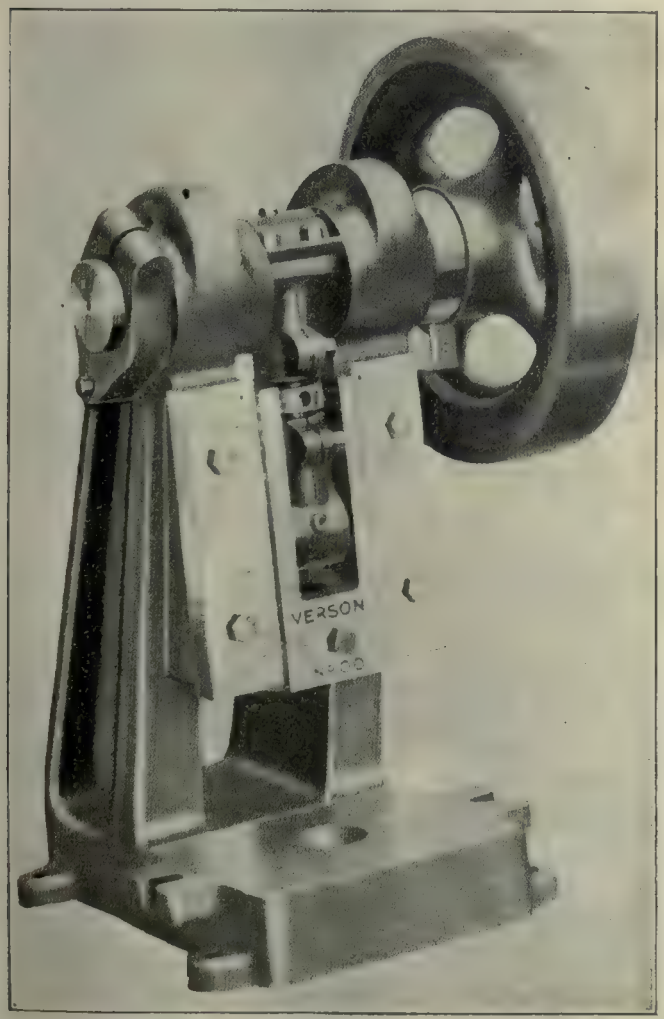
Descriptions of shop equipment in this section constitute editorial service for which there is no charge. To be eligible for presentation, the article must not have been on the market more than six months and must not have been advertised in this or any previous issue. Owing to the news character of these descriptions it will be impossible to submit them to the manufacturer for approval.

• CONDENSED • CLIPPING INDEX
A continuous record of modern designs ◦ and equipment ◦

The Verson No. 00 Power Bench-Press

The La Salle Machine Works, 3013 South La Salle St., Chicago, Ill., is building the Verson No. 00 adjustable power press shown in the illustration. This machine is adapted for blanking, forming and other press operations and can handle such light work as is often done on a larger machine.

The clutch is made of tool steel and hardened. It is simple in construction and of the positive type. It is provided with an automatic safety device which disengages the clutch at each revolution of the press whether or not the treadle is released. If the press is to be used on a job where it is desired to have it repeat, the safety device can be thrown out by loosening one screw and it will then repeat as long as the treadle is pressed down. The machine is of the open-back type, and permits feeding the work either from right to left or from front to back. The press can be furnished with a table and legs if desired.



VERSON NO. 00 POWER BENCH-PRESS

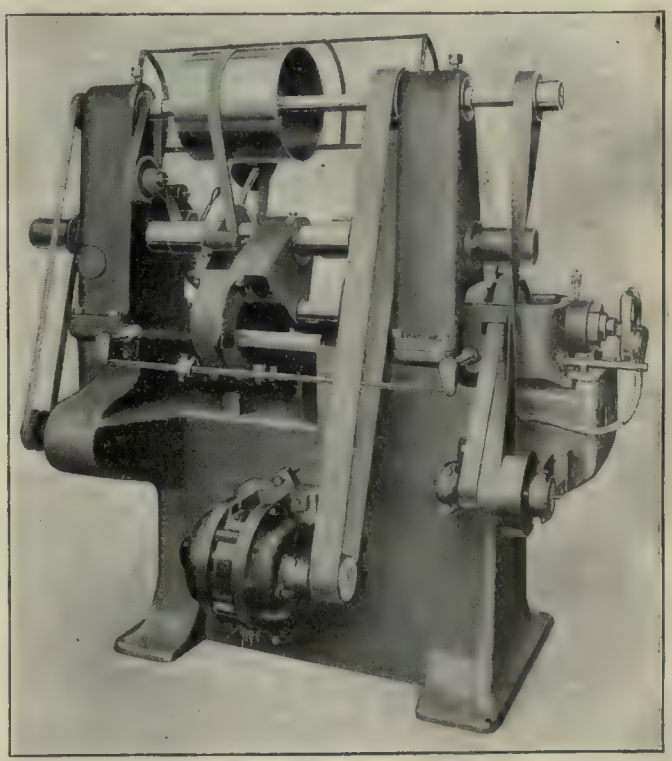
Specifications: Stroke of slide, ¾ in. Adjustment of slide, 1 in. Width of opening through back 3½ in. Finished surface of bed, 7 x 5⅝ in. Diameter of hole in bed 1⅝ in. Diameter of shaft, 2 in. Flywheel, 10 in. diameter; face, 2 in.; speed 250 r.p.m.

Bryant Chucking Grinding Machine

The Bryant Chucking Grinder Co., Springfield, Vt., has recently brought out the grinding machine illustrated herewith.

The machine is self-contained, and is furnished in two types—a single-spindle machine for grinding holes only and a double-spindle machine for both hole- and face-grinding.

The illustration shows a rear view of the No. 15



BRYANT CHUCKING GRINDING-MACHINE

Specifications: Chuck range, 12 in. Grinding length, 9 in. Work spindle, 150 and 300 r.p.m. Wheel-slide travel per revolution of work, $\frac{1}{16}$ and $\frac{1}{32}$ in. Weight, net, 3,000 lb. Floor space, 36 x 84 in. Motor recommended, 3 hp. 1,720 r.p.m.

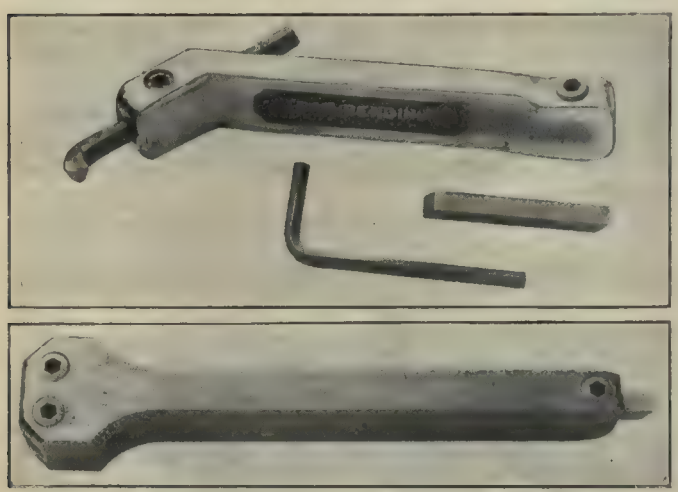
single-spindle machine with motor attached. When it is desired to drive the machine from a line shaft a countershaft with tight and loose pulleys is used.

The work spindle runs in adjustable bronze bearings, the front bearing being 3 in. and the rear bearing 2½ in. in diameter. Two speeds are provided for the work spindle and two traverse speeds for the wheel slide, instantly obtainable by a lever. A graduated plate indicates angular adjustment for grinding tapers up to 30 deg. included angle. The wheel-spindle drive shafts are mounted in ball bearings of inclosed type, requiring only occasional oiling. A pump and piping are arranged to carry coolant to the work through the spindle.

All pulleys and rotating members are dynamically balanced at the speed at which they are to run.

Rouillard Universal Toolholders

Toolholders of the types shown are being marketed by the Rouillard Tool Corp., 608 Chestnut St., Philadelphia, Pa. The offset holder is intended principally for lathe work. It may be used for holding a boring tool as shown in the illustration; for holding tools for either right or left hand facing, or a tool for ordinary turning —hence it is known as the 4 in 1. When used for the opposite hand to that shown, the holder is turned up-



ROUILLARD UNIVERSAL TOOLHOLDERS

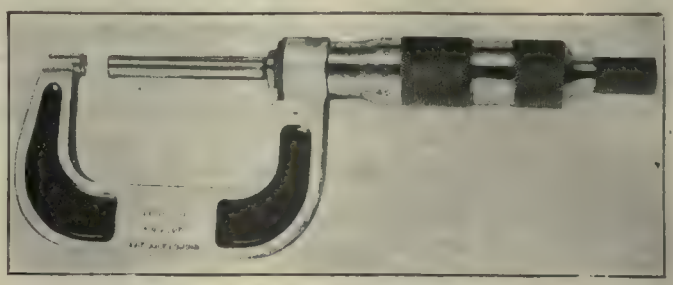
side down, setscrews for holding the cutting tool being provided on the bottom as well as on the top. The opening for the cutters in the offset portion of the holder is parallel with the body of the holder, but the opening in the opposite end has a slant of 8 deg. to provide a slight rake for turning.

The straight holder shown is designed for shaping and planing work and can be used for straight or right-hand or left-hand work. The holes for the cutters in both holders besides being reamed are partially squared with a broach so that they will hold square, round or octagon stock equally well. The setscrews are of the hollow-head type with fine pitch S. A. E. threads, but square-headed screws can be used if preferred. In addition to the regular line of cutters for turning and boring, special attachments such as knurling and goose-neck turning and threading tools, are furnished when required. The toolholders are drop-forged and pack-hardened and are made in seven sizes; the smallest, No. 10 ,is ⅜ x ¾ x 4½ in.; the largest, No. 6, is 1 x 1¾ x 13 in.

Blush Multiple Micrometer

The micrometer illustrated herewith is a product of the A. T. Blush Tool Co., 1145 West 11th St., Erie, Pa., and can be used to measure from 0 to 2 in. without any attachments.

The spindle has a screw of 20 threads per in. while a separate screw of 40 threads per in. is used for traversing the thimble. It will thus be seen that the spindle travels twice as fast as the thimble.



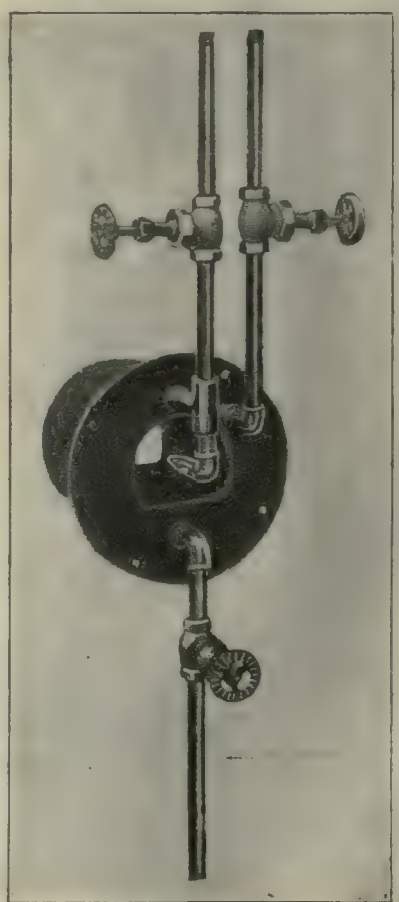
BLUSH MULTIPLE MICROMETER

It is claimed that the graduations are very easy to read and that a simple adjustment is provided to take up the wear on both the anvil and spindle.

The Berg Burner

The Berg Burner is designed to burn oxy-hydrocarbon-gas that it automatically produces from oil and water. Super-heated steam is generated by the burner and combined with the oil flow as it leaves the nozzle. The hydrogen of the steam unites with the hydrogen and carbon of the oil, while the oxygen set free in a super-heated state is said to create perfect combustion when the torch is ignited.

The burner may be started in operation with cold water by burning oil in a preheating dish provided for that purpose, the procedure being similar to starting an ordinary blow-torch, but an independent source of steam supply is preferable. By regulating the supply of oil and steam a flame almost white is created that is said to burn some distance from the point of the nozzle without smoke, noise or vibration. The steam is super-heated in the annular chamber surrounding the nozzle. The upper right-hand inlet pipe supplies either steam or water as the case may be and extends between the walls of the chamber to the rear end. The oil



THE BERG BURNER

pipe, which carries the nozzle is connected to the steam chamber by a close nipple and the steam while flowing along the full length of the chamber becomes superheated before uniting with the oil and leaving the nozzle. The correct mixture of oil and steam, also the proper degree of heat is obtained by manipulating the two needle valves at the top, the lower valve being provided merely as a blow-off. The burner will operate in any position and is designed to consume either the cheapest distillates or refined oils but not gasoline or kindred products. The burner is manufactured by the Berg Burner Co., Inc., 100 Emerson Place, Brooklyn, N. Y.

Pumpless Blow Torch

The Pumpless Blow Torch Co., Phipps Power Building, Pittsburgh, Pa., is making the blow torch illustrated herewith. The torch does not require preliminary pumping and pre-heating. The fuel used is butane, obtained from natural gas and reduced by pressure to a liquid.

The liquid volatilizes in the fuel chamber of the torch, filling the space between the surface of the liquid and the top of the chamber with gas. Two ducts lead from



PUMPLESS BLOW TORCH

the fuel chamber to the burner: one from the top and one from the bottom. To start the torch, the valve in the upper duct is opened, allowing the gas to flow directly to the burner where, upon ignition, it burns with a clear steady blue flame at a temperature of 2,240 deg. F. After burning for a minute or two the burner becomes hot, the valve in the lower duct is then opened and the upper one closed, allowing the liquid fuel to flow to the burner where it is volatized by the heat.

It is claimed that the torch has been tested over a wide range of temperatures, and will work as readily in zero weather as in mid-summer.

The torch is made in one- and two-quart sizes. The one-quart size will burn over three hours on one filling.

Erratum—Merey Stampograph

In the issue of July 15, page 139, we published a description of the "Mery" Stampograph. This machine is manufactured by Julius Merey, 2842 North Maplewood Ave., Chicago, Ill. We regret our error in spelling the maker's name.

"Stazon" Anti-Rust Compound

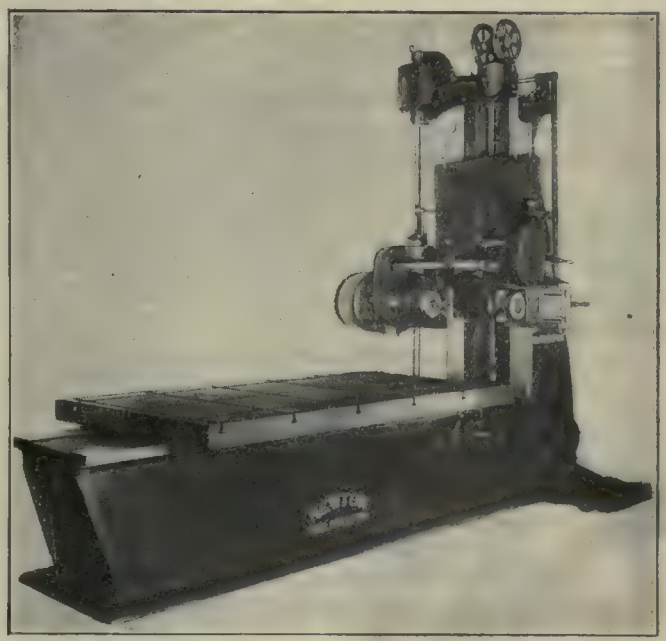
The Conversion Products Corporation, 149 Broadway, New York City, has placed on the market an anti-rust compound known as "Stazon." It is an inert mineral compound having about the consistency of No. 5 cup grease. The base is a petroleum derivative.

It can be rubbed or brushed on the bright parts of machinery destined for storage or shipment and is claimed to be proof against acid fumes and moisture. "Stazon" does not begin to run until 200 deg. F. has been exceeded and contains no free acid. It is not sticky and is readily removed by ordinary wiping cloths. It also has fair lubricating qualities.

Newton Special Milling Machine

The machine shown in the accompanying illustration is a late addition to the line of the Newton Machine Tool Co., Inc., Twenty-third and Vine Sts., Philadelphia, Pa., and was designed for milling slots in motor rotors.

The spindle is driven by a phosphor-bronze worm-



NEWTON SPECIAL MILLING MACHINE

Specifications: Feed of spindle saddle, 24 in. Maximum distance center of spindle to top of table, 24 in. Side adjustment of spindle, 2 in. Center of spindle to face of upright, 12 in. Work table, 54 x 96 in.

wheel and hardened steel worm, the worm having roller thrust-bearings and running in a bath of oil. The spindle is hollow to accommodate a draw-in-rod and the spindle nose has a Morse taper hole and a face keyway.

The spindle saddle is counterweighted and has power rapid traverse in both directions, a safety feed stop being provided so that the downward rapid traverse cannot be carelessly engaged to the injury of cutters or work. The feed motion is provided with automatic stops and the arrangement is such that when the feed is thrown out the spindle rotation stops. The table has a hand-operated movement of 24 in. and is provided with both longitudinal and cross T-slots. All gears are either inclosed or covered by standard guards making the machine absolutely safe for the operator.

The Ambitious Industrial Plans of Czecho-Slovakia

By JOHN B. WOODS

OUT of the mist which buries the political nightmare of the eastern European countries come now and again dispatches dealing with industrial conditions. And these news items indicate that at least one country in that great and, to Americans, little known region is now getting started upon a widespread and very farsighted program of industrial development. The new republic of Czecho-Slovakia, comprising the three important states of Bohemia, Moravia and Slovakia as well as a slice of Carpathian Russia and also a very important slice of Silesia, is a very hotbed of industrial possibilities. If present plans carry through, during the next fifty years the big production of iron and steel goods which gave the region its pre-war prestige and formed the backbone of Austrian resistance during the struggle, will be dwarfed by future development.

It is stated by patriotic citizens of the new war-born Republic that their country is almost ideal in its balance of agricultural and industrial characteristics; the western and northern portions being industrial, while the southern areas are fertile and well handled. Also as a matter of fact, the forest wealth of the country is immense; a forest map indicates at a glance that half of the entire territory is under timber of various ages. And the feature of the whole situation that makes it read like a fairy tale is the fact that the Czechs and Slovaks have acquired a ready-made country, in which they were the silent partners until the fortunes of war turned the tables.

Of course they have much pioneering ahead of them, but it is not the kind of pioneering with which we Americans are familiar. Instead of barren wastes or new country peopled by hostile savages they find long settled regions with industries highly developed and transportation systems well established, although they must change some of their railroads so as to direct them upon cities which they hope to make important centers of commerce. Having their export point on the Danube instead of the Black or the Mediterranean they must go down and deepen its channel from Bratislava (Pressburg) to the Black Sea so as to accommodate seagoing craft. And like the other nations of the World War group they must reconstruct their fabric of commerce on a peace basis.

Being fortunate in coal they have been obliged to supply great quantities to their neighbors, thereby delaying some of their own plans for reconstruction. At present their greatest needs appear to be time enough to get their food production upon an exporting basis; credit to enable them to import raw materials and certain kinds of industrial equipment, and the assitance of financial and technical men to organize their new possibilities.

Production of Raw Materials

Briefly and roughly the mineral resources of the country in the past have centered in Bohemia and Moravia. Annual production of iron ore was about 2,200,000 metric tons. Because iron industry had attained such proportions as to require importation of ores, the mining people of the countries mentioned had long held properties in Norway and Sweden as well as in Bosnia. Something like a half million tons were imported yearly from these countries. Lead and silver, some gold, and even radium were extracted from the hills of old Bohemia before the war. Coal was mined in Bohemia and Moravia of quality suitable for coking, although the coke production was less than a fifth of the annual coal output from these regions, because the greater portion of the fifteen million tons taken out yearly was unsuitable for making coke. In southern Moravia and in Slovakia lignite is mined, and of the 26,000,000 metric tons produced yearly about a third has been exported in the past. Water power is plentiful and is to be developed under the present plans, with electric energy as the product.

Machine Industry

The foundry and machine-shop industry is highly developed in many parts of Bohemia and Moravia. In fact structural steel, railroad and marine equipment, mill supplies and power plants, have long been known throughout the world under the names of some of the old firms. There is a degree of interest in a perusal of the history of such a plant as that of the Witkowitz or Vitkovice Iron Works, founded in 1829 by Archduke Rudolf, Prince Archbishop of Olmütz, who brought in English workmen to handle the first puddling furnaces. Later the S. M. von Rothschild bankers bought the plant, enlarging it and adding many products to the humble beginnings. In 1873 the present association of metallurgical interests bought the plant with its supplementary holdings in foreign lands and continued to enlarge and improve until at the beginning of the war the iron and steel works, chemical plants and collieries employed thirty thousand men, and maintained schools, co-operative stores, hospitals and pension systems to an extent hardly surpassed outside of the German Empire. And Vitkovice was but one of several iron and steel centers.

Other Manufactures

Glassmaking, pottery and brick manufacture, leather working, wood-working, production of agricultural and machine tools, and the textile industry, all are important in the Republic, inherited from the states of the old Empire. And practically all of these highly developed industries were dependent in a measure upon imported raw materials and will be dependent in the future for the same classes of goods. In fact for a while, until the reorganization of facilities from war to peace basis they will require many kinds of machinery and equipment from foreign countres.

In the field of wood-working there already has been progress made in bringing capital and technical skill from America and Western Europe. A company has been formed to build and operate several large furniture factories. It is understood that the leading men in this enterprise are Americans of Czech nativity who have been successful as financiers and manufacturers in the land of their adoption. They expect to obtain considerable equipment of lumbering and furniture-making machinery in America. In general there is a great need of lumbering and wood-working machinery, for the pro-

duction of timber in that country is highly organized and for several generations has been carefully regulated. They have the timber, but their mills and factories have suffered from war-time pressure and require new equipment. In addition to general construction and to the production of agricultural tools and vehicles the wood using industries include toy making as an important member. The paper industry is widely developed, based naturally upon plentiful supplies of pulp wood and catering to a great publishing field in the nation.

Being by the very nature of things a manufacturing medium between raw materials from other countries and the world markets, and having in mind enormous developments of power sources for the future which will enlarge this industry and commerce the present governmental and business interests of the country are devoting much thought and effort to solving the problems of international trade. A plan which has been suggested to revive the glove making industry is of interest. It is based upon the principle that foreign capital shall be protected from fluctuations in the value of money. The foreign interests may be expected to deliver the raw materials in the country, to their agent, who can allot them to manufacturers for working into gloves. As the finished product is turned out it can be handled by the agent for export and sale. The payment for manufacture can be made to the factories in Czecho-Slovak crowns, based upon prices fixed in terms of some stable foreign currency. Thus, both parties will be protected and enabled to forecast profits without the gambling chance that now adheres to trade in central European money. If such schemes meet with widespread approval and support there appears to be no reason why they should not be adapted to other industries until such time as the new Republic finds itself on a stable exchange basis.

Skilled workers in many lines have been trained through long years of industry under the old regime, and certainly they constitute one of the most important resources of the Republic. The temper of her workers is indicated by the situation in the coal fields during the year 1919. In spite of the enormous quantities which were required for export to other states where the need was critical, and which naturally curtailed the progress of industrial reorganization in the country itself, there were no strikes or labor troubles in the coal regions during that year. Of course under the old regime labor was a commodity of no great cost, at least as compared to our American wage scales. And the consciousness of the skilled workman was an inherited thing; he followed in the steps of his father like as not and was known among his friends and by his immediate superiors as a specialist at some trade. To be the son of a blacksmith was to have fairly clear expectations of being yourself a blacksmith. However, with constantly expanding industries, the handing down of trade-lore was not sufficient as a source of workmen and schools were established years ago for the purpose of teaching the trades as well as the arts. The leaders of the new government have been quick to the necessity of such institutions and have fostered them wisely. During the 1919-1920 school year there were about one hundred and twenty-seven thousand students enrolled and attending the arts and crafts and trades schools of the country, or slightly less than one per cent of the total population. Although war losses are severe and the nervous unrest is not entirely lacking in the ranks of labor, yet the better wages of today and the agencies working to supply skilled men certainly will keep the wheels turning in this most fortunate of central European lands.

The coal owning countries of the continent always have had the big advantage of relatively cheaper power, as of course is the case the world over. And this wealth, which has brought Bohemia and Moravia to the fore as industrial centers, is to be expanded and enlarged in the future by a great plan of electric power development. This program, as announced by the Government as long ago as February, comprehends the use of both coal and water as sources of electric energy. The available water has been estimated at 800,000 hp., and it is expected that the harnessing of these streams will result in a saving of fuel equivalent to 6,000,000 tons of coal, or about 15 per cent of the yearly production. It is calculated that the construction of necessary plants and improvements will cost in the neighborhood of two billion of crowns, and that the work will be extended over a period of fifty years before the entire scheme is carried out. At the same time steam generating plants are to be built in the neighborhood of coal and lignite mines to link up with the country wide system. There will be nine large steam using stations, costing five hundred million crowns. It is planned to complete these plants within the next twenty years.. Primary and secondary transmission lines will cost a billion crowns and will cover the entire land in a network of high tension lines and distributing systems. Thus the whole proposition entails the expenditure of three billion five hundred million crowns.

The manner of financing these enterprises is unique. The State is to share with the Provinces the task of installing hydro-electric plants on the large rivers, while the steam installations will be handled by corporations of semi-public nature in which the State, the provinces, smaller political divisions of the country and private parties, will be allowed to hold stock. The National Assembly has voted an appropriation of seventy-five million crowns as a beginning of the general scheme, while several counties have combined to purchase a lignite mine in southern Bohemia with a view to starting construction of the first of the steam using generating plants.

Aside from the business possibilities which well may come from the inauguration of such wide-spread engineering construction, in a country which still has its difficulties on account of lack of raw materials and machinery, there is an added potential field for business relations in the fact that one of the intended steps is the electrification of railroads. American railway equipment made very favorable progress in the electrical field during the war, and more recently has been successful on a large scale in other parts of the world. The extent of our actual participation in the industrial advancement of Czecho-Slovakia depends of course upon many factors, some of which are unfavorable at the present time. However, there is a bond of friendly feeling extending across the ocean, and of course a great many Americans of Czecho-Slovak origin are engaged in forwarding the development of that Republic.

Erratum

Our attention has been called to an error which appeared in our issue of May 27, page 1147, Vol. 52. The number of cubic feet in the tractor crate should be 178 and not 278.

Business Conditions in England

FROM OUR LONDON CORRESPONDENT

LONDON, June 28, 1920.

THE outlook in the machine-tool world continues dull, and the absence of prospective business together with the certainty of heavy taxation, combined possibly with the advent of fine weather and the call of the sea and the countryside, are having a somewhat enervating effect. This has been felt mostly by merchants. The shops remain full of work, for arrears of orders have not yet been wiped out. A number of machines being manufactured are to be exhibited at Olympia, W., in the autumn, but one or two firms at any rate are still doubtful whether they will be represented. The writer has heard of no definite decisions to withdraw, but is aware that this is in contemplation. Probably all the firms taking space will conclude that it will be well to proceed.

The claim for an increase in weekly wages of 23s. 6d. is being made formally, and the present signs are that it will be resisted. It is of course a step on the road to the present ideal of £6 10s. a week for a 44-hour week. The inquiry is almost due. In the Midlands the employing section seem decided to secure payment by results before agreeing to any further concessions. It is rather singular that in this district a provisional agreement, nothing more, has been reached on this subject between the employers' federation and the officials of the chief trade union concerned, for the general introduction of the system into iron foundries. The molders have been among the most determined opponents of payment by results. Some time ago the unions of unskilled labor concerned gave their agreement to the working of the scheme in engineering shops, but so far this has not applied to skilled workers. The new Alamgamated Engineering Union becomes operative this week and at the same time the new National Union of Foundry Workers, also an amalgamation of existing societies, takes the field.

UNEMPLOYMENT NOTED IN MANY INDUSTRIES

Some measure of unemployment has been noted in the engineering industry, abnormal unemployment having been reported in connection with fitters and turners in the Lancashire districts; the same also applies to areas as wide apart as the Newcastle district and the south of England. Slackness, too, has been reported in connection with rubber, soap and tanning, and the tobacco industry has been noticed to be slumping for some time; indeed firms have refused to arbitrate on the question of increase of wages, stating plainly that they are not doing the business they did. The retail trades have been falling away for some time, and this applies particularly to the textiles of Bradford, where by the way on the producing side further wage increases are demanded. The unemployment noticeable remains somewhat closely confined to the semi-skilled and unskilled workers. Most of the skilled trades are at present undermanned and this condition, as applied to machine shops, shows itself particularly in ironfounding, while the general condition of the building trades is notorious.

Views vary somewhat in the industrial fight as to the exact effect of comparatively recent wage increases and reductions of working hours in the engineering industry with relation to foreign trade and competition. But doubts on both sides are growing, and a non-government committee of investigation is in process of formation "to inquire into the economic relation of hours to work and the methods of manufacture in this and foreign countries"; as usual, representatives both of employers and employed form the committee.

EMPLOYERS STARTING A UNION FOR EMPLOYEES

In an attempt to force the bonus system the pianoforte manufacturers are themselves forming a new trade union for workmen, and will re-open their shops and thus end the strike, if the workpeople agree to become members of this new trade union, or to accept the system as named.

At the last weekly meeting of the London iron and steel exchange a fair attendance was officially recorded but "business was practically at a standstill." Cancellations, moderate in quantity, were noted. On the same day the Birmingham motor market was reported as of unrelieved weakness, though this was not quite literally true. More recently Sheffield recorded a drop in new business but big arrears of orders on the book. Scarcity of foundry irons, uncertain supplies of fuel, and insufficient rolling facilities have again been mentioned; also difficulties of settlement of some continental accounts and cancellations owing to the impossibility of firm quotations. All this has a relation to the future. Work in hand is more than ample. The foundries can produce at no higher rate and the writer knows of some with orders that will keep them fully occupied for two years. As to steel plates, one firm is reported as accepting orders for 1924 at current rates. Locomotive builders in the Newcastle and Glasgow districts have been held up for want of materials, and some Scottish shipbuilders appear to think that, if the decline has not set in, the top has now been reached.

The amount of the advances to British exporters under the government credit scheme was at a recent date £2,824,284.

SCANDINAVIAN TRADE CONDITIONS REPORTED FLAT

Trade visitors to Scandinavian countries have returned with the report that conditions there are flat, and that in their view the countries concerned are at present well stocked with American, English and German tools.

Sheffield will not welcome the advent of high-speed steel from France. The samples thus far submitted seem to have satisfactorily passed such tests as were applied. The material itself is of somewhat lower price than British-produced high-speed steel.

Another steel for machining purposes has just been introduced by the Woodward-Weddell Steel and Engineering Co., Birmingham, to take a place between the ordinary carbon steel and best high-speed steel. It is the product of the electric furnace and details of composition are not at present available. Rather mysteriously the steel is said to contain two alloys used in connection with heat-treatment. The price is expected to be about 50 per cent in advance of that of carbon steel, the permissible cutting speed showing an increase of 25 per cent with an increase in the cut of about 50 per cent. The steel will stand up to temperatures of 600 to 700 deg. C. and is hardened by plunging in boiling water. Apart from its use in making cutting tools, the steel can be machined and thus is suggested for ball bearing races.

WELDING FIGURES

Some figures are available respecting output obtained from electric resistance welders manufactured by the A. I. Manufacturing Co., Bradford. Thus, for drums, a special longitudinal welder is available, the upper electrode, in the form of a roller, being carried by a horizontal arm, which, rack-driven, moves over the metal to be welded, the speed being 5 ft. to 10 ft. 6 in. a minute, according to the thickness of metal. Another machine is for circumferential seam welding. For a daily production of about 2,000 drums, each 24 in. long by 14 in. in diameter by 20 S.W.G. (0.036 in.), an average plant contains about five longitudinal welders to nine circumferential machines, with one spot welder for the handles, each machine taking about 10 kw. Drums 16 in. long by 12 in. in diameter by 22 S.W.G. (0.028 in.) can be seam-welded in one-fifth of a minute, the ends being welded in less than a minute and the handles spot-welded on at the rate of eighty to the hour. The machines made by the firm are for single-phase alternating current and include a transformer, made as a

unit. No current is allowed to pass through pivots; this old lesson is apparently not always remembered in the design of electric-heating apparatus.

A Fatigue Research Board

Arising out of work in connection with the health of munition makers, etc., Great Britain has a special Industrial Fatigue Research Board which was appointed about the middle of 1918 by the Department of Scientific and Industrial Research jointly with the Medical Research Committee, now the Medical Research Council. The first annual report has been published. It relates to the period down to the end of March last, but as regards results effected it is not particularly illuminative, several detailed reports having already been issued. One rather interesting conclusion is mentioned, though it is admitted that data available are slender and apply apparently only to women workers, namely that accidents are "largely due to a special susceptibility inherent in the personality of the individual, so that the bulk of accidents occur amongst a limited group of individuals." This investigation is to be continued so as to include men and boys. Owing to the impossibility of eliminating will, a psychological test for fatigue was not successfully determined. A report on fatigue and efficiency in the iron and steel industry awaits further statistical treatment. Among investigations being continued is one to devise vocational tests for different types of engineering work. As regards the causes of accidents, two large engineering firsm have agreed to place their accident records at the disposal of the board if required. An attempt is being made to standardize records. Thus, standard forms dealing with output, lost time, accidents, and labor turnover have been submitted for the criticism of government departments, trade unions and employers, and it is expected that before long definite recommendations will be made. The board proposes that as the scope of the work is enlarged, industries should be invited to contribute to the cost of given investigations.

Engineering Exhibitions

As an adjunct to the Great Victory Exhibition—to quote part of its title—being held at the Crystal Palace, Sydenham, S. E., an engineering exhibition has been organized, but so far in attracting the engineer has proved no sort of competitor, even to the Handel Festival held in the same building. The engineering exhibition concerns itself more or less with gas, electricity and oil; it is largely under the floor of the main building and spreads itself out toward one of the palace approaches, but the section given up to oil and its use in engines, furnaces, and so on, is in a separate building, well away from the rest and, in truth, somewhat difficult to find. On three or four stands the engineer will find something to hold his attention, these stands being mainly those associated with the Armstrong-Whitworth, Beardmore, and Vickers combinations. In each case the named firm has associated with it a series of more or less subsidiary companies, so that the Vickers combination, for example, includes also S. E. Saunders, Lt., East Cowes, builder of motor launches; Centrifugal Separators, Ltd., London, S.W., its products being indicated by the title; Ioco Rubber Co., Glasgow; T. Cooke & Sons, Ltd., York, maker of optical, astronomical and surveying instruments; the British Refrigerating Co., London, S.W.; Robert Boby, Ltd., Bury St. Edmunds, maker of agricultural machinery; Taylor Bros., Leeds, maker of railway wheels and axles; Variable Speed Gear, Ltd., London, S.W., maker of the Janny gear; and Petters, Ltd., and Vickers-Petters, Ltd., Yeovil, maker of semi-Diesel crude oil engines, etc. The other firms associated with Vickers do not seem to be showing. The Vickers exhibits, in fact, range from wooden toys to grooved hardened nickel chrome steel rolls, and include a number of engineers' small tools.

Similarly, Beardsmore & Co. displays models of airships, locomotives and war vessels, together with railway wheels, axles, drop forgings, rolled-steel disk wheel centers, and a valveless two-cycle engine of 320 b.h.p., using crude oil, and to be fitted to the Terra Nova for the next Antarctic expedition.

The Armstrong-Whitworth stand covers more than 2,000 sq.ft. and includes two machine tools; namely, a small surface grinding machine for work, 24 x 6½ x 9½ in., and a vertical milling machine with 2½-in. spindle. Forgings include a four-throw crankshaft weighing 3¼ tons, and a marine thrust shaft weighing nearly 7 tons. A special collection of drop stampings of high-tension alloy steels is noteworthy, the samples being particularly clean, the collection including crankshafts, back and front axles for automobiles, and some locomotive details. A new engine to be made in three sizes—namely, 3 hp., 5 hp. and 10 hp.—is on show in the smallest size. It is intended to use oil, starting with petrol, or will employ gas. The gas interests are making a good display, or will be soon as the stands are complete, but the only electric laundry installation is of American origin.

Situation of the German Machine-Tool Industry

By C. A. Heise

At the recent general meeting of the Association of German Machine Tool Manufacturers it was stated that the industry was seriously affected during the past year by the high cost of raw materials, strikes and incessant wage claims and but for the enormous expansion of the export trade the balance sheets of most concerns would have shown a deficit. This tremendous increase in export was, however, largely due to the enormous depreciation of the German currency which reached its lowest stand in April this year. Concurrent with the improvement in the German exchange since last April a steady falling off in foreign orders has been noticeable and it is feared that with a further improvement in the exchange, export may eventually come to a standstill altogether. In view of the possibility of this event and considering further the decreased demands of the home market, the report continues, the future aspect of the industry was not very encouraging, though the hope was expressed that because of the keen demand for machine tools in the world's markets, the German industry will sooner or later be once more in a position to take its full share in the world's supply of machine tools.

Device For Transferring Centers on Flat and Round Stock

By E. Lytton Brooks

With reference to the device for transferring centers, illustrated on page 630, vol. 52, of the *American Machinist*, by Roy V. Terry, I used a similar tool ten years ago.

If I remember rightly I purchased it from Messrs. Buck & Hickman, of Whitechapel Road, London. This tool in addition to transferring centers on flat stock, would admit of round stock and center it quite accurately.

The pump, or spring, center in the base of the tool was located in the center of a V-block, but was integral with the base. The V-block was removable, being slipped over the spring center and set up to a stop on the base. Different sizes of V-blocks could be inserted to cope with varying sizes of round stock. The V-blocks themselves had wide faces and were accurately finished to insure the flat stock laying properly. The tool otherwise closely followed the construction given in the sketch by Mr. Terry.

SPARKS FROM THE WORK

Valentine Francis

Will Resumption of Trade With Russia Mean Clean-Shaven Bolsheviks?

According to a dispatch to the American Cutlery Bureau of Information, stocks of American safety razors are running low in Russia. The small quantities that have been received have gone mostly to Siberian Russia, where allied influence is strong. This would seem to indicate that the Bolsheviks are not persistent self-shavers. Before the war Russia used to buy many American safety razors every year. These were in part shipped from the United States, but many razors reaching the Russian market came either by way of Germany, France or England. Many of the safety razors sold in Russia as American were really infringements of American patents introduced in Russia by various dealers. The same was the case with blades. As the market has been left practically unsupplied with American goods it is expected that the resumption of trading connections with Russia, now contemplated, will bring a considerable demand for American safety razors.

Peck Spring Co. To Enlarge Plant

With a new one story addition being built that covers 50 ft. of ground and fully double the size of the other section of the factory, the Peck Spring Manufacturing Co. will be in a position to handle the large business and constantly increasing number of orders coming in with greater convenience. At the present time the factory employs 55 hands and was compelled to enlarge the place because of rapid growth of the business. The new section will probably employ 20 hands and is expected to be completed within a month. All that remains to be finished is the roof. Machines have been ordered and will arrive any day to be installed and made ready for operation.

Railroads Going Easy

Railroads are holding back from buying tools, because most of them are short of money. Keen observers, however, do not think there will be any large orders placed until the rate advances are declared. The Norfolk & Western recently bought the larger part of machine equipment it required for early in June, spending close to $200,000. The Chesapeake & Ohio has also bought sparingly within ten days, probably as a feeler for additional purchases.

Coffey Family 'smiths 110 Years for Pratt & Whitney

On July 15 Jeremiah H. Coffey celebrated his fifty-third anniversary as blacksmith for the Pratt & Whitney Co., Hartford, Conn.

This was an event of dual importance, for it marked the completion of 110 years of blacksmithing for this company on the part of the Coffey family. Two sons, Thomas P. and John H. Coffey, share this honor with their father. Another son, Joseph, had served 19 years up to the time of his death last year.

Colleges and the Metric System

By Dr. Alex. C. Humphreys,
President, Stevens Institute of Technology

I feel that college men who have had no experience outside of the college and laboratory, perhaps do not appreciate the situation regarding matters of weight and measurement. It is the manufacturers who come up against the real tests. Having had wide experience as an engineer, manager of industrial plants and as a consulting engineer, I feel that I am competent to look upon the practical side and my opinion is without qualification that a compulsory law in favor of the metric system will be a *fatal mistake* and would place upon the industrial interests of the United States a tremendously heavy and unnecessary burden which would at this time, in view of foreign competition, be particularly inexpedient. It would involve the expenditure of millions and millions of dollars and instead of helping us with regard to exports, it would be hurtful.

To representatives of educational associations and institutions, who may have been led into an endorsement of the metric program, I would say that while naturally appealing to the workers in the laboratory as I am in a position to appreciate, I feel sure that to make a metric law compulsory would be a *great misfortune* to this country.

English Cutlery Trades To Adopt American Manufacturing Methods

A provisional committee appointed by the British Cutlery Trade Research Association recommends the employment of machinery in the cutlery trades. After having proclaimed for many years the superiority of handmade razors and shears, the English cutlery industry now sees itself compelled to withdraw from this position and take up the manufacture of cutlery upon the methods employed generally in the United States. It is admitted, says the report, that machinery is most necessary in the grinding stage, and the committee adds that it has taken up the problem with leading American experts. It seems that it will be difficult to secure the necessary machinery in England and steps have been taken, either to encourage their manufacture by an English machine-tool concern, or to import machinery from the United States. The new machinery will be employed principally in the manufacture of table knives, razors, pocket knives and scissors, but it is expected that machine production finally will be extended over the whole field of cutlery production in England. English cutlery, therefore, will abandon finally the production by hand.

Changes in Johansson Organization

Harry A. Raseley has resigned as sales manager of C. E. Johansson, Inc., Poughkeepsie, N. Y., to become export sales manager for the Nordyke Marmon Co. Before joining the Johansson organization, he represented the General Motors Corporation in the export field for a number of years.

Lawrence G. Spealman, who has been a representative for the C. E. Johansson, Inc., in Michigan for the past year and a half, comes to Poughkeepsie as sales manager for this company. He has had years of practical experience as an expert toolmaker and production engineer with such concerns as the National Cash Register Co., Buick Motor Car Co. and Dayton Engineering Laboratories Co.

The Michigan territory is to be taken over by John K. Murray, at present a member of the sales organization in Poughkeepsie, who will have his headquarters in Detroit. Mr. Murray is an old Michigan man, having previously been connected with several automotive industries in his new territory.

"A smile oils life's bearings."—*Forbes Magazine* (N. Y.).

LD'S INDUSTRIAL FORGE
News Editor

The Cincinnati Strike Situation

Strikers Gradually Returning to Work—Open Shop Gains in Favor—Judge Hickenlooper Renders Important Decision on Big Question

The machinists' strike in Cincinnati continues to drag beyond the tenth week with indications that the men are growing sick of it and only held from wholesale desertion by the efforts of their leaders. As it is, the number of strikers is constantly reducing and shops which only two weeks ago were practically closed down are now running with as much as half of their normal force. This does not apply to all, since a few shops are still practically closed, while others have almost 100 per cent of their men.

However, the average of the shops throughout the city may be considered as running with a force approaching 50 per cent of normal. This is outside of those plants located in what is termed the Oakley colony, which was never badly affected by the strike. There, all shops are now running with their full complement of mechanics. Picketing is increasing as the men begin to sense the chance of failure of the strike. This has led to court action by the employers seeking protective injunctions, and has resulted in a remarkable decision by Judge Hickenlooper of the Superior Court, which decision may have a momentous result in future strikes in Cincinnati and elsewhere.

The Non-Union Agreement

Many of the employers lately determined to run on a strictly non-union shop basis, and have posted notices to that effect. Many have re-employed only those returning employees who sign the non-union agreement. This agreement was drawn up by Dudley Taylor, a Chicago attorney, and was used by many of the members of the National Metal Trades Council, with which most of the manufacturers are affiliated. Following the announcement by the unions last spring of their intention to unionize all non-union shops, the employers arranged to have their loyal employees sign the non-union agreement. This agreement provided that they should not join any union, nor have any dealings nor communications with the officers or agents of any labor union, while remaining in the service of the employing firm.

Later, union pickets sought to induce these non-union employees to join the union and quit work, and this immediately brought about injunction proceedings by nearly a score of employers who wished to prevent interference by the union with their contractural relations with their employees. Accompanying the petitions were affidavits citing instances of threats and violence used by the strikers.

The two cases heard by Judge Hickenlooper were that of the O. J. Shafer Pattern Works against the Pattern Makers' League, and that of the John Douglas Co. against members of the Metal Polishers' Union. In rendering his decision he stated, as published in the Cincinnati *Enquirer* on July 13, that he upheld the agreement between the employers and employees, and decided that the union men have no right to seek to have these employees break that agreement. An injunction was granted preventing them from "initiating or commencing negotiations, dealings, communications or interviews with any employee who has signed the non-union agreement, either in relation to membership by said employee in the union, or in relation to said employee's employment."

Regarding the soliciting of others, the decision says: "As to those who have not signed or entered into the non-union agreement prohibiting such communications and interviews, such employees may be approached upon the subject of terminating their employment and thereafter joining the union."

Peaceful Persuasion Allowed

Judge Hickenlooper found in the case of the John Douglas Co. instances where the picketing of the company's shops "has been attended with frequent acts of violence, threats, abusive language and other coercive and intimidating acts, culminating in a brutal assault upon two of the employees on April 9 by four members of the defendant union." Therefore, the injunction granted is made perpetual against threats, violence, abusive language, coercion and intimidation, and the strikers are enjoined from accosting or from commencing interviews, communications, dealings or negotiations with any of the present employees relative to membership in the union or relative to their employment; from visiting the employees or their families at their homes for the purpose of opening such negotiations, either directly or indirectly.

"Peaceful persuasion of prospective employees" is permitted under the injunction, as also is the exhibition of a banner in front of the place by the striking unions. With respect to the Metal Polishers' Union, Judge Hickenlooper orders that it must pay the costs of the suit.

The most important part of Judge Hickenlooper's decision came in connection with the consideration of the application of the O. J. Shafer Pattern Works. This is discussed in part as follows:

"The exact question in this case is whether, after the plaintiff's shop had been run as a non-union shop for more than four years, the defendants had a right to so conduct their campaign for membership, by the maintenance of pickets and a solicitation of plaintiff's employees, as to injure the plaintiff's business and deprive him of the services of his present employees, and this at a time when no strike was in progress at plaintiff's shop, and no disagreement between plaintiff and his employees as to wages or working conditions, and when all the plaintiff's employees are employed upon the understanding and agreement that they would not join the union while in plaintiff's employ, and if it be decided that the defendants were within their rights in approaching any of the plaintiff's employees, will an injunction issue against soliciting such employees as have signed the non-union agreement referred to?"

Argument upon this question was based largely upon the Federal Court decision in the suit of the Hitchman Coal and Coke Co. against John Mitchell, and others, in which, by arbiter, the Court held that interference with the relationship of master and servant is actionable, and the self-interest of the union is not a justification for enticing an employee.

Says Cases Are Dissimilar

Judge Hickenlooper, while concurring in the principal grounds of this decision, says the present cases are somewhat dissimilar, as it does not appear any effort was made to get employees to join the union and still remain in the company's employ and thereby effect a unionization of the shop, but to induce employees to quit and then join the union. Regarding the salient points, the Court says:

"There cannot now be any doubt of the right of the employer to hire whomsoever he pleases and to conduct his business in such manner as to him seems advisable. Nor is there any doubt of the right of the employee to work for whom he pleases and upon such terms as he may desire. Employees

may organize and, where there is no contract for a definite term, may quit work either singly or in a body. These rights are of equal dignity and are reciprocal, and, at least as far as the rights of the employer and his non-striking employees are concerned, they are interdependent. To hold that the employer has the right to freely employ any servant and to retain the services of such employee as long as the conditions of employment are mutually satisfactory, necessarily implies that the non-striking employee must be left free to accept employment upon the terms offered.

"Both such rights of the employer and the employees are guaranteed by Section 1, Article 1, of the constitution of the state, which insured to all men the right of enjoying and defending life and liberty, acquiring, possessing and protecting property and seeking and obtaining happiness and safety."

RIGHTS OF OTHERS INVOLVED

Under the constitution the defendants claimed the right to freely speak and publish their sentiments as an inalienable right. Of this Judge Hickenlooper says: "Such rights are not absolute, although guaranteed by the constitution. They may not be exercised under any and all circumstances and without qualification, but where the exercise of such rights operates to limit and impair the enjoyment by another of rights of equal dignity there must be justification in order that there may be immunity from liability."

In the absence of a contract for a definite term of employment, Judge Hickenlooper says, "the advantages to society which are claimed for unionism furnish the just cause or excuse for the intentional injury occasioned by a strike. If, therefore, the employment be at will and the advantages of organization constitute just cause and excuse for persuading others to join the labor movement, it follows that picketing is not per se illegal, and it further follows that the Court must reject as unsound dictum of the Hitchman case that inducing a servant to quit his employment, which is at will, may be enjoined where there is no contract restricting the employee's right to enter into attending negotiations. We do not consider, therefore, that it is unlawful for the union to use peaceful persuasion for the purpose of inducing those of the plaintiff's employees who have not signed the non-union agreement or verbally agreed to its terms to quit their employment and join the labor movement.

"But to induce another to breach his contract has never been held to be justified by either social or individual advantages. No guaranteed right of free speech or liberty of action has ever been held to authorize or justify one man in inducing another to break a contract.

"Nor is the alleged non-union contract illegal or contrary to public policy. Any employee has the right to agree with his employer that he will not only refrain from joining a union during the term of employment, but he may also lawfully agree, as was done in these cases, that he will not have any negotiations or communication with others as to such employment, during the period that he is so employed.

BREACH OF CONTRACT

"Inducing such employee to enter into negotiations, or to participate in discussions as to the advantages of the union or as to his employment, is inducing a breach of contract into which he has entered; and such negotiations, conferences or discussions cannot be initiated or started by defendants without liability for inducing such a breach of contract. As has been said before, the advantages of the union cannot be held to be a justification of such act. The most that could be said of those who are employed under the non-union agreement in question is that, if and when their employment has terminated, the union representatives would be glad to discuss with them the advantages of the union. This is a meager and unsatisfactory right for which even the union does not contend.

"Further than this, the Court holds that each day does not constitute a unit of employment, but the contract is in force even when the employees are not at their place of employment, between closing time one day and the commencement of work the next, and it so continues in force until it is terminated by the employee leaving the employment of the employer."

United States Will Not Recognize Soviet Russia

Regardless of any action that may be taken by Great Britain or other Allied Nations with respect to resumption of trade with Soviet Russia, the United States has no intention of going further than its recent action.

Government officials are firm in their stand that there shall be nothing approaching recognition of the Soviet Government. The recent lifting of the embargo on trade with Russia, they point out, is in no sense a recognition of that Government, in view of the fact that the State Department announced it would continue to refuse to issue passports and that there would be no mail communication.

It was also reiterated that the United States will have no part in any conference at London, or other points, relative to resumption of Russian trade, and that whatever action may be taken there will have no bearing upon the attitude of this Government.

Announcement comes from Geneva that a silencer for airplane engines, more highly developed than an automobile muffler, has been invented by the chief engineer of a Swiss airplane firm.

Europe Looks to United States for Steel, Says Howell

The world-wide shortage of iron and steel resulting from the war can only be made good by the United Sates, says Herbert P. Howell, vice president of the National Bank of Commerce in New York, in an article on "The International Market for Iron and Steel," which appears in the July number of *Commerce Monthly*, the bank's magazine of commerce and finance.

Great Britain alone of the European producers is today capable of competition with this country in supplying the four years' cumulative demand, according to Mr. Howell. Neither France, Germany nor Belgium can be regarded as potential rivals of the American iron and steel industry at present.

GERMANY OUT FOR PRESENT

"The world is short of iron and steel," Mr. Howell says. "The United States, Great Britain and Germany produce 80 per cent or more of the total iron and steel output of the world, while Belgium is a considerable factor in the international market. The war had varying effects on the industries of these three European countries. The case of Germany is clear. As a producer of iron and steel for the international market, that country need not be reckoned with at present. French production is dependent on German coal, and lack of fuel and industrial disorganization have thus far kept it much below the pre-war level. The Belgian industry shows encouraging features and exports are increasing, but domestic demand is heavy and the amount Belgium can export will not greatly affect the international market in the immediate future.

"Even assuming a production of pig iron in 1920 equal to that of the best war year, and a rate of export somewhat higher than that of the pre-war years, the exportable surplus of the United States is not likely to equal Germany's annual exports in the years immediately preceding 1914. The United Kingdom is unable at present to recover volume of exports except at a sacrifice of domestic needs. There can be no question, therefore, as to sufficient foreign outlets for all the United States can spare and more."

Government Decree for Control of German Iron Trade

Acting Commercial Attaché Henry F. Grady reports from The Hague, Netherlands, that by a decree of the German National Government, dated April 1, 1920, there was established for the control of the iron trade, an autonomous body with legal standing called the "Eisenwirtschaftsbund" (Iron Trade Control Association) with headquarters at Duesseldorf. A translation of this decree may be perused at the Bureau of Foreign and Domestic Commerce on referring to file No. 42075.

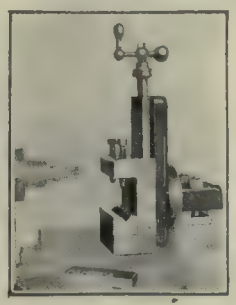
Condensed-Clipping Index of Equipment

Patented Aug. 20, 1918

Milling Attachment, Davis

Hinckley Machine Works, Hinckley, Ill.

"American Machinist," June 26, 1920



This attachment is held on the tool carriage of a lathe and serves as a handy device for doing a great variety of milling such as keyseating, squaring ends of shafts, sawing, splitting bushings, drilling and boring. The illustration shows the attachment in one position on the compound rest of a lathe. By swinging the compound rest it can be brought to any desired angle. Specifications: Vertical hand feed, 7 in., graduated to 0.001 in. Will swivel in vertical plane to 180 deg. Vise jaws, 1⅜ in. deep; 5¼ in. wide; maximum opening, 4 in. Weight, net, 50 lb.; boxed for shipment, 65 lb.

Riveter, Baird Yoke

Baird Pneumatic Tool Co., Kansas City, Mo.

"American Machinist," June 26, 1920

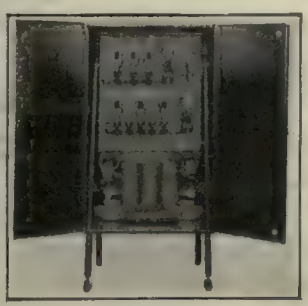


The riveter is supported on a stand instead of being suspended by a bail. The arrangment of the riveter and stand is intended for use in riveting traction plates on the rims of pneumatic tires. The riveter has a 10-in. reach, a 9-in. gap and will deliver a maximum squeeze of 70 tons with 100 lb. air pressure.

Starter, Induction Motor, Automatic

The General Electric Co., Schenectady, N. Y.

"American Machinist," June 26, 1920



This starter is designed to start by push button, or by operation of a float switch, pressure governor or similar accessory. The starter consists of one 5-pole contactor for starting, one 3-pole contactor for running, a current-limit relay for controlling the contactors, two inverse-time-element overload relays and a set of compensator coils. All this apparatus is mounted on a panel and inclosed in a case which can be locked shut when desired. Overload protection is furnished by the two inverse-time-element relays, which are operative during both starting and running. After an overload they may be reset without removing the cover of the inclosing case, by means of handles which project through on the back of panel.

Lathe, 72 In. Adjustable Gap

Fairbairns, Leeds, England.

"American Machinist," (European Edition) June 26, 1920



The 72-in. adjustable gap lathe was designed for turning propellers up to 20 tons in weight. Length of the bed is 12 ft. 6 in. Maximum diameter admitted in pit is 18 ft. Maximum distance between the 9 ft. faceplate and bed is 6 ft. Distance between the centers with the gap open is 13 ft. The headstock is mounted on a separate base. Forged steel spindle runs in phosphor bronze and the front bearing is 14 in. diameter by 21 in. long. Drive is by 30-hp., two-speed squirrel-cage motor. There are three ratios of gearing, all double helical, which, in combination with the motor, give faceplate speeds from 2.6 to 39.5 r.p.m. The tailstock has an 8-in. steel spindle, which is traversed by handwheel. Movement along the bed is through worm gearing, pinion and rack. Length over the headstocks is 25 ft. 6 in. Approximate weight, 36 tons.

Grinding Machine, Twist Drill, Ball Bearing

H. F. Atkins Ltd., Old Fletton, Peterborough, England.

"American Machinist," (European Edition) June 26, 1920

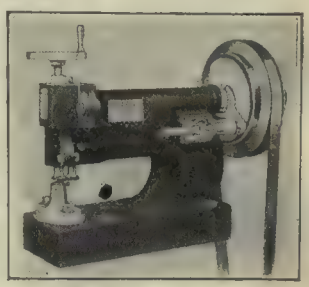


The countershaft is built into the machine and runs on ball bearings. In capacity the machine will grind drills of from ¼ in. to 2½ in diameter. Three-lip drills can be ground readily, provision for them being made by a small screw which limits the motion of the vee arm. As sent out, the appliance produces standard clearance on the drills, but if desired this can be varied, and only two simple adjustments are needed for correct grinding of any drill. The main wheel is a ring 8½ in. diameter and at the rear end of the spindle a point-thinning wheel is mounted. Guards are provided to each and a centrifugal pump, belt-driven is included. Net weight, about 400 lb.

Nibbling Machine, Metal

T. H. Wilson Ltd., Bramley, near Leeds, England.

"American Machinist," (European Edition) June 26, 1920

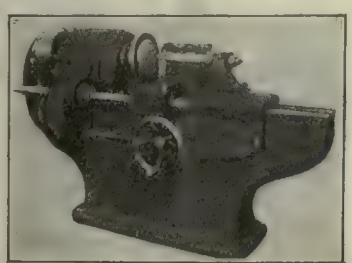


This machine is intended for nibbling or perforating metal or other materials up to ⅜ in. in thickness. The machine is made in three sizes. A special punch is employed in the form of a round cutter, down the center of which is a loose pin projecting beyond the cutting edge, forming a stop for the work. The bottom die is of ordinary form corresponding to the punch and the latter is actuated by an eccentric pin on the end of the spindle. The speed of the machine ranges from 300 to 750 r.p.m., according to the material to be cut.

Lathe, Piston and Piston Ring Automatic

T. Rider & Son Ltd., Bolton, England.

"American Machinist," (European Edition) June 19, 1920

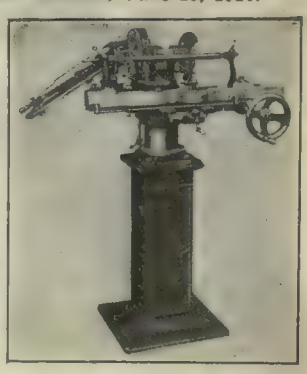


The lathe is specially designed for cast iron work. Turning outside diameters, the tool is bolted direct on a long carriage and it is possible to work to close limits in one cut. For turning pistons roughing and finishing sliding tools are followed by two roller follower rests which take the thrust of back grooving tools. When the outside turning tools have traveled about three-quarters of the length of piston the grooving tools come into operation. On the front slide is a sizing tool or tools, to finish the top lands between the ring grooves. The back forming tools maintain the piston in close contact with follower rests and thus the lands can be sized to within plus or minus 0.002 in. Net weight of machine, about 3,500 lb.

Grinding Machine, Twist Drill and Cutter

S. Holmes & Co., Bradford, England.

"American Machinist," (European Edition) June 19, 1920.



This machine will grind twist drills from ¼ in. diameter, and when arranged to grind milling cutters will take 25 in. between center by 10 in. diameter. Carriage is 34 in. long, has longitudinal motion of 20 in. cross motion of 5 in. and vertical adjustment of 4½ in. One end of spindle is bored No. 1 Morse taper. It will be seen that in this machine the table swings round the head. The grinding wheel for twist drills is 9 in. x 1½ in. Attachments supplied for internal grinding. The machine has a base 21 in. square. Height to center of the spindle 46 in. Weight, about 600 lb.

Clip, paste on 3 x 5-in. cards and file as desired

Leroy S. Starrett (Right) Celebrates Birthday



"Ad astra per ardua," the motto of the British Flying Corps, has become literally true in the case of Leroy S. Starrett, president of the L. S. Starrett Co., of Athol, Mass., who recently celebrated his 84th birthday by a "trip to the clouds" at St. Petersburg, Florida.

Business Items

Dewey, Strong & Townsend announce the entry of Captain William A. Loftus, Thomas Castberg, James M. Abbett and John H. Herring into the firm which will be known as Dewey, Strong, Townsend & Loftus. Mr. Herring will have charge of the trademark and foreign department; Mr. Abbett will specialize in chemical and electrical patent matters, and Mr. Castberg will devote his attention to engineering and industrial patent cases. Captain Loftus, lately in the service abroad and formerly in the patent department of the International Harvester Co., will practice both before the Patent Office and the Federal courts. William H. Bauer, formerly of Washington and lately with the patent department of the Willys-Overland Co., will continue on the staff. Mr. Strong, after more than fifty years of active practice, will retain his association in an advisory capacity. The practice of patent and trademark law will be continued by Chas. E. Townsend at the same address, 909-917 Crocker Building, San Francisco.

The Cooper Hewitt Electric Co. will remove its St. Louis office on Aug. 1 to the Title Guaranty Building. Mr. A. H. Smith is the district sales manager.

Contract has been let to Swift & Co., of Chicago, by the Central of Georgia Railway, for the construction of its new shops and roundhouse at Columbus, Ga. Work is to start in the near future and the contractors promise completion of the shops by March, 1921. Mastermechanic Gross, of Columbus, stated that the work would entail an investment of about $500,000.

Plans for the issue of $25,000,000 8 per cent and participating stock of the British Empire Steel Corporation simultaneously in London and Montreal, with the possibility of a New York connection, are announced. It is expected that Premier Gouin, of Quebec, may retire from the Provincial Cabinet and become chief counsel for the corporation.

The quarterly report of the Lackawanna Steel Co. for the second quarter of this year shows an astonishing gain. For the first quarter of the year this company showed a deficit of $449,720, whereas for the quarter ending June 30 there was a surplus of $1,881,946.

Forthcoming Meetings

The International Railway Master Blacksmiths' Association will hold its next annual convention at Tutwiler Hotel, Birmingham, Ala., on Aug. 17, 18 and 19. The secretary of the association is A. L. Woodworth, Lima, Ohio.

The National Gas Engine Association, Monadnock Bldg., Chicago, Ill., will hold its thirteenth annual convention at the Congress Hotel, Chicago, on Sept. 1, 2 and 3.

The American Steel Treaters' Society and the Steel Treating Research Society will hold their second annual convention and exhibition at the Commercial Museum, Philadelphia, Pa., on Sept. 14 to 18, inclusive. J. A. Pollack, of the Pollak Steel Co., Cincinnati, Ohio, is secretary of the former society.

The American Foundrymen's Asssociation will hold its annual convention and exhibit at Columbus, Ohio, on Oct. 4 to 9. C. E. Hoyt, 1401 Harris Trust Building, Chicago, Ill., is secretary.

An exposition of U. S. manufacturers at Buenos Aires, Argentine Republic, S. A., has been arranged for the month beginning Nov. 15. Information can be obtained from the American National Exhibition, Inc., Bush Terminal Sales Building, 132 West 42nd St., New York.

Personals

DR. T. S. TAYLOR, who has during the first part of the present calendar year, been in charge of the research work for the Magnesia Association of America at the Mellon Institute of Industrial Research, University of Pittsburgh, Pittsburgh, Pa., returned on July 1 to the Research Laboratory of the Westinghouse Electric and Manufacturing Co., East Pittsburgh, Pa., to take charge of their thermal research.

EARL STAFFORD has become a member of the engineering staff of Arthur D. Little, Inc., chemists and engineers, Cambridge, Mass. Mr. Stafford is a graduate of the engineering school of Tufts College, 1908, and for the past twelve years has devoted his attention largely to hydro-electric developments with particular reference to ore treating plants, pulp and paper mills and light and power companies.

W. S. QUIGLEY, president of the Furnace Specialties Co., New York, sailed for France on the Imperator, July 15. Mr. Quigley's trip is for the purpose of furthering the business relations of the Quigley organization in England, France, Belgium, Italy and Spain.

C. N. LEO, formerly with the W. M. Pattison Supply Co., has resigned and is now with the Hess, Schenck Co., Cleveland, Ohio.

C. R. SYME has resigned from the W. M. Pattison Supply Co. and will represent the Hess, Schenck Co., of Cleveland, Ohio, in Dayton and Southern territory.

FRANK J. FARRELL has been appointed Eastern representative for the Precision and Thread Grinder Manufacturing Co., of Philadelphia, Pa., manufacturer of the multi-graduated precision grinder.

THOMAS P. ORCHARD has resigned as secretary and sales manager of the Service Engineering Co., Inc., to accept an appointment as director of sales with the Arthur Knapp Engineering Corporation of New York and Detroit.

JAMES L. GOUGH has disposed of his interests in the Federal Machinery Sales Co., Chicago, Ill.

W. D. CREIDER, who was formerly president of the Saxer-Creider Machinery Co., Erie, Pa., and who for the past two years was manager of the Modern Tool Co., has become sales manager of the Chicago branch of the Reed-Prentice Co., Becker Milling Machine Co., and the Whitcomb-Blaisdell Machine Tool Co. This branch will be located at 28 North Clinton St., after Aug. 15.

ROBERT R. LASSITER, formerly mechanical superintendent of the Richmond Forgings Corporation, Richmond, Va., has recently joined the Dale-Brewster Machinery Co., Inc., New York. Mr. Lassiter is assistant to the president, in charge of engineering sales, and is also part owner of the company.

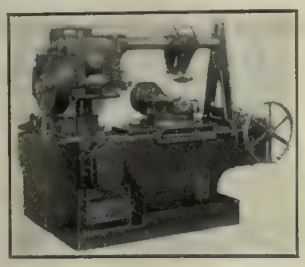
Condensed-Clipping Index of Equipment

Patented Aug. 20, 1918

Hobbing Machine, Cincinnati 16-In. Gear

Cincinnati Gear Cutting Machine Co., Cincinnati, Ohio

"American Machinist," July 15, 1920



Specifications: Rated capacity; diameter, 16 in.; face, 12 in. Actual maximum gear diameter, 17¼ in. Rated capacity; spur gears, 3 D.P.; cast-iron helical gears, 3 D.P.; steel helical gears, 3½ D.P. Maximum distance, center of hob to nose of spindle, 19⅝ in. Maximum diameter of hob, 4½ in. Diameter hob arbor, 1¼ in. Taper hole in work spindle, No. 12 B. & S. Hob speed, 8 changes, ranging from 50 to 200 r.p.m. Hob feeds, 26 changes, ranging from 0.015 to 0.250 in. per rev. of work. Driving pulley, 15 x 3¼ in.; speed, 400 r.p.m. Over-all dimensions; covers closed, 52 in. x 82 in.; covers open, 56 in. x 103 in. Net weight of machine with electrical equipment, 5,600 lb.; domestic shipping weight, 5,900 lb.; export shipping weight, 6,600 lb. Contents boxed for export, 210 cu.ft.

Toolpost, Lovejoy Turret

Lovejoy Tool Co., Inc., Springfield, Vt.

"American Machinist," July 15, 1920



The turrets are made of hardened steel and are interchangeable with any base. This feature permits the use of a number of turrets carrying tool combinations for various jobs so that a job can be changed without changing the tool set-up. Two types of turrets are regularly made, one for turning and the other for boring. The turning toolholders have shanks 1 in. in diameter and are fitted with ⅝-in. high-speed steel cutters. The round shanks permit the holders to be rotated to give side clearance to the tools. The boring bars are 1 in. in diameter and will cut to the bottoms of holes that are only slightly larger than the bars. Bars of other sizes with bushings to fit holes in turrets can be furnished to order. The turrets can be used on lathes having a center distance above the tool block as small as 1⅞ inches.

Truck, "Automatic" Lifting and Tiering

Automatic Transportation Co., Buffalo, N. Y.

"American Machinist," July 15, 1920

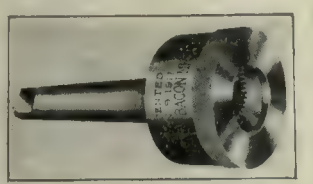


The function of this truck is to pick up and elevate loads with its own power, to suitable heights for placing material in box cars, on trucks, wagons, etc., without rehandling. It has a capacity to lift a load of 4,000 lb. any distance from 1 in. to 6 ft., and at the rate of 1 ft. in 15 seconds. The overhanging platform is supported on two sturdy uprights. It is provided with substantial guide rollers, and is raised and lowered by a single screw of large size revolving in a heavy bronze nut carried in a trunnion. An oil reservoir furnishes ample lubrication to the screw. The platform may be started and stopped at any point in its travel, and automatic limit cutouts are provided to prevent overrun at either extreme.

Chuck, Gustin-Bacon Reversible Driving

Gustin-Bacon Manufacturing Co., 1416-18 West Twelfth St., Kansas City, Mo.

"American Machinist," July 15, 1920

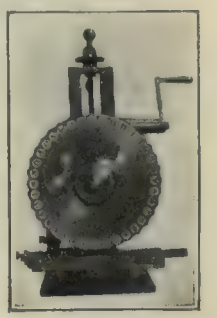


The chuck grips when driven in either direction, being especially designed for service when it is desirable to reverse the direction of rotation, as in running staybolts in fire boxes and in driving straight-shank taps. The jaws shown are used for holding round bars; one size, suitable for accommodating bolts from ⅛ to 1¼ in., being carried in stock, while other sizes can be furnished upon order. Jaws for holding square heads can be furnished, the stock size accommodating square heads from ⅝ to ¾ in. The jaws are tool steel, and can be easily replaced when worn out. It is claimed that the chuck grips the bolt centrally, so that it runs true. The base of the chuck shank is squared to 1¼ in., so as to permit the setting of a staybolt with a wrench when desired.

Stampograph, Merey Rotary

Julius Merey, 2842 North Maplewood Ave., Chicago, Ill.

"American Machinist," July 15, 1920

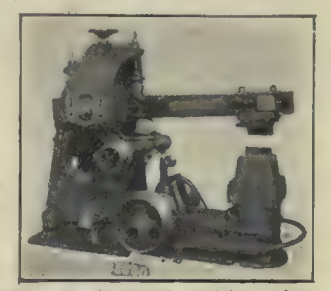


The machine is designed to stamp letters, characters, etc., in metal or other material while it is in a soft or plastic condition, and is ordinarily furnished for hand operation, but can be arranged for power operation when required. The machine is self-contained and has a stamping capacity of thirty-five characters, as indicated on the face of the dial. Provision is made, however, for changing the size of the characters to suit the work being stamped. Adjustment for work of different thickness is accomplished by means of the ball crank at the top of the machine and incidentally this regulates the depth of the impression. The hand-power machine weighs about 200 lb. The power-operated machine weighs 350 lb. and occupies a bench space about two feet square.

Hammer, American Helve

Long & Allstatter Co., Hamilton, Ohio

"American Machinist," July 15, 1920

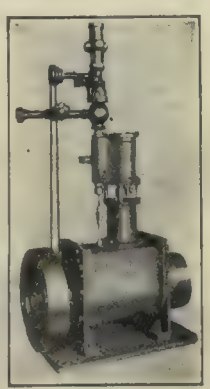


The hammers are made in five sizes, ranging from 25 to 100 lb. capacity. It is claimed that all connections and parts that have a tendency to work loose are carefully protected against such trouble. The treadle is arranged to prevent lost motion between it and the belt tightener and is said to be sensitive and smooth acting in regulating the force and rapidity of the blows. The steel brake-band with its friction lining passes almost entirely around the brake wheel and, owing to its great area of friction surface, assures quick stopping of the hammer with the helve in the "up" position when the treadle is released. A pair of ordinary dies having faces partly flat and partly round is furnished as part of the regular equipment.

Engine, Underwood Steam or Air

H. B. Underwood Corporation, 1015-25 Hamilton St., Philadelphia, Pa.

"American Machinist," July 15, 1920

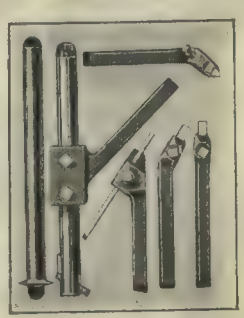


The engine is built in both a 3- and a 5-hp. size, and is designed for driving portable tools such as boring bars and drilling machines. The cylinder of the 3-hp. engine is 3½ in. in diameter and that of the 5-hp. is 4½ in. in diameter, both engines having a 3½-in. stroke. The working parts are inclosed in an oil-tight case which is formed in the base of the engine and serves to exclude dirt. The crankshaft is a steel forging with a 1½-in. finished diameter. A piston valve is used, and the engine is fitted with a governor on the supply line. The engine runs at 250 r.p.m. with 70 to 125 lb. supply pressure. The floor space required is 12 x 21 in., and the height to the top of the governor is 46 in. Net weight, 270 lb.

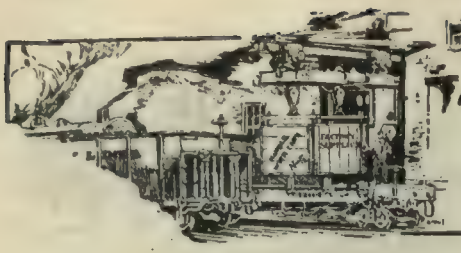
Tool Set, "Red E" Garage Lathe

Ready Tool Co., Bridgeport, Conn.

"American Machinist," July 15, 1920



The set is intended for use in small machine shops and garages. It comprises tools for both inside and outside turning and threading, also a cutting-off tool. The tool board furnished with the tools has a place routed out for each individual tool, making it easy to keep the tools in their proper places and to note whether any are missing.



THE WEEKLY PRICE GUIDE

IRON AND STEEL

PIG IRON—Quotations compiled by The Matthew Addy Co.:

	Current	One Year Ago
CINCINNATI		
No. 2 Southern	$45.60	$29.80
Northern Basic	42.80	27.55
Southern Ohio No. 2	46.80	28.55
NEW YORK—TIDEWATER DELIVERY		
2X Virginia (Silicon 2.25 to 2.75)	49.65	31.90
Southern No. 2 (Silicon 2.25 to 2.75)	49.70	33.95
BIRMINGHAM		
No. 2 Foundry	42.00@44.00	25.75
PHILADELPHIA		
Eastern Pa., No. 2x, 2.25-2.75 sil.	46@48.25*	30.65
Virginia No. 2	45.00*	30.85
Basic	44.50†	29.90
Grey Forge	43.50*	29.90
CHICAGO		
No. 2 Foundry local	44.25	27.25
No. 2 Foundry, Southern	47.00	31.75
PITTSBURGH, INCLUDING FREIGHT CHARGE FROM VALLEY		
No. 2 Foundry	45.65	28.15
Basic	44.40	27.15
Bessemer	44.90	29.35
MONTREAL		
Silicon 2.25 to 2.75%	43.25	.....

* F.o.b. furnace. † Delivered.

STEEL SHAPES—The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses at the cities named:

	New York			Cleveland		Chicago	
	Current	One Month Ago	One Year Ago	Current	One Year Ago	Current	One Year Ago
Structural shapes	$4.47	$3.97	$3.47	$5.00	$3.37	$3.97	$3.47
Soft steel bars	4.62	4.12	3.37	4.50	3.27	3.87	3.37
Soft steel bar shapes	4.62	4.12	3.37	.....	3.27	3.87	3.37
Soft steel bands	6.32	5.32	4.07	6.25	.....	.....	.....
Plates, ¼ to 1 in. thick	4.67	4.17	3.67	4.50	3.57	4.17	3.67

BAR IRON—Prices per 100 lb. at the places named are as follows:

	Current	One Year Ago
Mill, Pittsburgh	$4.25	$2.75
Warehouse, New York	4.57	3.37
Warehouse, Cleveland	3.52	3.22
Warehouse, Chicago	3.75	3.37

SHEETS—Quotations are in cents per pound in various cities from warehouse; also the base quotations from mill:

Blue Annealed	Large Mill Lots Pittsburgh	New York Current	New York One Year Ago	Cleveland	Chicago
No. 10	3.55-7.00	7.12@8.00	4.57	8.10	7.02
No. 12	3.60-7.05	7.17@8.05	4.57	8.15	7.07
No. 14	3.65-7.10	7.22@8.10	4.67	8.20	7.12
No. 16	3.75-6.20	7.32@8.20	4.77	8.30	7.22
Black					
Nos. 18 and 20	4.20-6.20	7.80@9.50	5.30	8.70	7.80
Nos. 22 and 24	4.25-6.25	7.85@9.55	5.35	8.75	7.85
No. 26	4.30-6.30	7.90@9.60	5.40	8.80	7.90
No. 28	4.35-6.35	8.00@9.70	5.50	8.90	8.00
Galvanized					
No. 10	4.70 8.00	8.55@11.00	6.20	9.00	8.15
No. 12	4.80 8.10	8.65@11.00	6.25	9.10	8.20
No. 14	4.80-8.10	8.65@11.10	6.30	9.10	8.35
Nos. 18 and 20	5.10-8.40	8.90@11.40	6.60	9.40	8.65
Nos. 22 and 24	5.25 8.55	9.05@11.55	6.75	9.55	9.05
No. 26	5.40-8.70	9.20@11.70	6.90	9.70	9.20
No. 28	5.70-9.00	9.50@12.00	7.20	10.00	9.50

Acute scarcity in sheets, particularly black, galvanized and No. 16 blue enameled.

Automobile sheets are unavailable except in fugitive instances, when prices are 9.45c per lb. for No. 16; 9.50 for Nos. 18 and 20, and 9.55c for Nos. 22 and 24.

COLD FINISHED STEEL—Warehouse prices are as follows:

	New York	Chicago	Cleveland
Round shafting or screw stock, per 100 lb. base	$6.25	$5.80	$6.00
Flats, square and hexagons, per 100 lb. base	6.75	6.30	6.50

DRILL ROD—Discounts from list price are as follows at the places named:

	Per Cent.
New York	50
Cleveland	50
Chicago	50

SWEDISH (NORWAY) IRON—The average price per 100 lb., in ton lots is:

	Current	One Year Ago
New York	$20.00	$21.00-26.00
Cleveland	20.00	20.00
Chicago	21.00	16.50

In coils an advance of 50c. usually is charged.
Domestic iron (Swedish analysis) is selling at 12c. per lb.

WELDING MATERIAL (SWEDISH)—These prices are the best we have been able to obtain for Swedish welding materials, of which it is reported that very little are on the market.

Welding Wire		Cast-Iron Welding Rods	
1/8, 11/64, 5/32, 3/16, 7/32, 1/4, 9/32, 5/16 No. 8, 11/32 and No. 10	21.00 to 30.00	1/8 by 12 in. long	14.00
No. 12		1/4 by 19 in. long	12.00
3/8, No. 14 and 7/16		3/8 by 19 in. long	10.00
No. 18		1/2 by 21 in. long	10.00
No. 20		**Special Welding Wire, Coated**	
		1/4	33.00
		5/16	30.00

Domestic—Welding wire in 100-lb. lots sells as follows, f. o. b. New York: 5/32, 8½c. per lb.; 1/4, 8c.; 5/16 to 1/2, 7½c.

MISCELLANEOUS STEEL—The following quotations in cents per pound are from warehouse at the places named:

	New York Current	Cleveland Current	Chicago Current
Openhearth spring steel (heavy)	7.00	8.00	9.00
Spring steel (light)	10.00	11.00	12.25
Coppered bessemer rods	9.00	8.00	6.75
Hoop steel	6.57	6.50	5.32
Cold-rolled strip steel	12.50	8.25	10.75
Floor plates	6.80	6.00	6.77

PIPE—The following discounts are to jobbers for carload lots on the Pittsburgh basing card, discounts on steel pipe, applying as from January 14, 1920, and on iron pipe from January 7, 1920.

BUTT WELD

Steel Inches	Steel Black	Steel Galvanized	Iron Inches	Iron Black	Iron Galvanized
¼ to 3	54-57½%	41½-44%	⅜ to 1½	24½-34½%	8 -18½%
LAP WELD					
2	47 -50½%	34½-38%	1¼	.....	.....
2½ to 6	50 -53½%	37½-41%	1½	.....	.....
7 to 12	47 -50½%	33½-37%	2	20½-28½%	6½-14½%
13 to 14	37½-41 %	.....	2½ to 6	22½-30½%	9½-17½%
15	35 -38½%	.....	7 to 12	19½-27½%	6½-14½%
BUTT WELD, EXTRA STRONG PLAIN ENDS					
¼ to 1½	52 -55½%	39½-43%	⅜ to 1½	24½-34½%	9½-19½%
2 to 3	53 -56½%	40½-44%			
LAP WELD, EXTRA STRONG PLAIN ENDS					
2	45 -48½%	33½-37%	1¼	.....	.....
2½ to 4	48 -51½%	36½-40%	1½	.....	.....
4½ to 6	47 -50½%	35½-39%	2	21½-29½%	8½-16½%
7 to 8	43 -46½%	29½-33%	2½ to 4	23½-31½%	11½-19½%
9 to 12	38 -41½%	24½-28%	4½ to 6	22½-30½%	10½-18½%
			7 to 8	14½-22½%	2½-10½%
			9 to 12	9½-17½%	5½-+2½%

	New York Black	New York Galv.	Cleveland Black	Cleveland Galv.	Chicago Black	Chicago Galv.
⅜ to 3 in. steel butt welded	40%	24%	40%	31%	54%40%	40½@30 %
2½ to 6 in. steel lap welded	35%	20%	42%	27%	50@40%	37½@27 %

Malleable fittings. Classes B and C, banded, from New York stock sell at plus 32%. Cast iron, standard sizes, net.

METALS

MISCELLANEOUS METALS—Present and past New York quotations in cents per pound, in carload lots:

	Current	Month Ago	Year Ago
Copper, electrolytic	19.00	19.25	21.75
Tin in 5-ton lots	49.50	61.50	70.00
Lead	9.25	9.00	5.50
Zinc	8.25@8.75	8.70	8.00
ST. LOUIS			
Lead	8.90	8.87½	5.25
Zinc	7.90@8.40	8.37½	7.65

At the places named, the following prices in cents per pound prevail, for 1 ton or more:

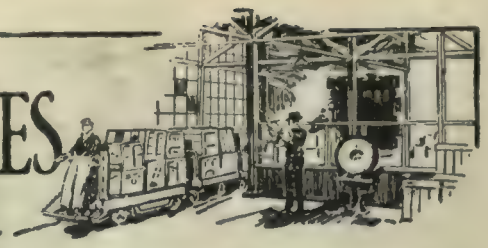
	New York Current	New York Month Ago	New York Year Ago	Cleveland Current	Cleveland Year Ago	Chicago April 8 Current	Chicago April 8 Year Ago
Copper sheets, base	33.50	33.50	29.50	32.00	33.50	36.00	36.50
Copper wire (carload lots)	31.25	31.25	26.50	29.50	29.50	27.00	25.00
Brass sheets	28.50	28.50	23.00	29.00	29.00	27.00	28.00
Brass pipe	33.00	33.00	34.00	34.00	36.00	35.00	37.00
Solder (half and half) (case lots)	38.00	33.00	45.00	40 50	41.00	38.00	41 00

Copper sheets quoted above hot rolled 16 oz., cold rolled 14 oz. and heavier, add 2c.; polished takes 5c. per sq.ft. extra for 20-in. widths and under; over 20 in., 7½c.

BRASS RODS—The following quotations are for large lots, mill. 100 lb. and over, warehouse; net extra:

	Current	One Year Ago
Mill	25.00	19.00
New York	27.00	21.50
Cleveland	27.00	30.00
Chicago	26.00	30.00

SHOP MATERIALS AND SUPPLIES



ZINC SHEETS—The following prices in cents per pound prevail:

Carload lots f.o.b. mill..... 12.50

	—In Casks—		— Broken Lots —	
	Current	One Year Ago	Current	One Year Ago
Cleveland	15.00	12.95	15.50	13.30
New York	14.00	12.00	14.50	13.00
Chicago	15.00	16.50	15.00	16.00

ANTIMONY—Chinese and Japanese brands in cents per pound, in ton lots for spot delivery, duty paid:

	Current	One Year Ago
New York	8.00	8.37½
Chicago	9.50	10.00

OLD METALS—The following are the dealers' purchasing prices in cents per pound:

	— New York —			
	Current	One Year Ago	Cleveland	Chicago
Copper, heavy, and crucible	16.00	16.75	15.50	15.50
Copper, heavy, and wire	15.25	15.75	15.00	15.00
Copper, light, and bottoms	13.00	13.50	13.00	14.00
Lead, heavy	7.00	4.62½	7.00	7.00
Lead, tea	5.00	3.75	5.00	6.00
Brass, heavy	10.25	10.00	11.00	15.50
Brass, light	7.50	8.00	8.00	9.50
No. 1 yellow brass turnings	8.50	9.00	8.50	9.50
Zinc	5.25	4.25	4.50	9.50

ALUMINUM—The following prices are from warehouse at places named:

	New York	Cleveland	Chicago
No. 1 aluminum, 98 to 99% pure, in ingots for remelting (1-15 ton lots), per lb	33.00	34.00c.@35.00c.	33.50

COPPER BARS—From warehouse sell as follows in cents per pound, for ton lots and over:

	Current	One Year Ago
New York (round)	38.00	25.00
Chicago	29.00	28.00
Cleveland	32.00	33.00

BABBITT METAL—Warehouse price per pound:

	—New York—		—Cleveland—		— Chicago —	
	Current	One Year Ago	Current	One Year Ago	Current	One Year Ago
Best grade	90.00	90.00	74.00	80.00	60.00	75.00
Commercial	50.00	50.50	21.00	18.50	15.00	15.00

SHOP SUPPLIES

NUTS—From warehouse at the places named, on fair-sized orders, the following amount is deducted from list:

	— New York —		— Cleveland —		— Chicago —	
	Current	One Year Ago	Current	One Year Ago	Current	One Year Ago
Hot pressed square	+ $6.00	$3.25	$ .50	$2.25	$ .50	1.05
Hot pressed hexagon	+ 6.00	2.70	.50	2.25	.50	.85
Cold punched hexagon	+ 6.00	3.25	.50	2.25	.50	1.00
Cold punched square	+ 6.00	2.70	.50	2.25	.50	1.00

Semi-finished nuts, ⅞ and smaller, sell at the following discounts from list price:

	Current	One Year Ago
New York	30%	50–10%
Chicago	50%	50%
Cleveland	50%	60-10-10%

MACHINE BOLTS—Warehouse discounts in the following cities:

	New York	Cleveland	Chicago
½ by 4 in. and smaller	+ 20%	20%	20%
Larger and longer up to 1½ in. by 30 in.	+ 20%	20%	10%

WASHERS—From warehouses at the places named the following amount is deducted from list price:

For wrought-iron washers:

New York..... list Cleveland..... $2.50 Chicago..... $3.00

For cast-iron washers, ⅜ and larger, the base price per 100 lb. is as follows:

New York..... $7.00 Cleveland..... $4.50 Chicago..... $4.75

CARRIAGE BOLTS—From warehouses at the places named the following discounts from list are in effect:

	New York	Cleveland	Chicago
½ by 6 in. and smaller	+ 20%	35%	10%
Larger and longer up to 1 in. by 30 in.	+ 20%	20%	5%

COPPER RIVETS AND BURS sell at the following rate from warehouse:

	Rivets		Burs	
	Current	One Year Ago	Current	One Year Ago
Cleveland	20%	20%	10%	10%
Chicago	net	20%	net	20%
New York	25%	40%	net	20%

RIVETS—The following quotations are allowed for fair-sized orders from warehouse:

	New York	Cleveland	Chicago
Steel ⅞ and smaller	List Net	40%	30%
Tinned	List Net	40%	30%

Boiler, ¼, ⅜, 1 in. diameter by 2 to 5 in. sell as follows per 100 lb.:

New York..... $6.00 Chicago..... $5.62 Pittsburgh..... $4.50

Structural, same sizes:

New York..... $7.10 Chicago..... $5.72 Pittsburgh..... $4.60

MISCELLANEOUS

SEAMLESS DRAWN TUBING—The base price in cents per pound from warehouse in 100-lb. lots is as follows:

	New York	Cleveland	Chicago
Copper	34.00	34.00	35.00
Brass	33.00	34.00	34.00

The prices, of course, vary with the quantity purchased. For lots of less than 100 lb., but not less than 75 lb., the advance is 1 c.; for lots of less than 75 lb., but not less than 50 lb., 2½c. over base (100-lb. lots); less than 50 lb., but not less than 25 lb., 5c. should be added to base price; quantities from 10-25 lb., extra is 10c.; less than 10 lb., add .15–20c.

Double above extras will be charged for angles, channels and sheet metal mouldings if ordered in above quantities. Above extras also apply to brass rod other than standard stock sizes—stock sizes being considered as ⅛-2 in. inclusive in rounds, and ⅛-1½ in., inclusive, in square and hexagon—all varying by thirty seconds up to 1 in. by sixteenths over 1 in. On shipments aggregating less than 100 lb., there is usually a boxing charge of $1.50.

LONG TERNE PLATE—In Chicago No. 28 primes from stock sell, nominally, for $12.50 per 100 lbs.

In Cleveland—$10 per 100 lbs.

COTTON WASTE—The following prices are in cents per pound:

	— New York —			
	Current	One Year Ago	Cleveland	Chicago
White	15.00@17.00	13.00	16.00	11.00 to 14.00
Colored mixed	9.00@14.00	9.00–12.00	12.00	9.50 to 12.00

WIPING CLOTHS—Jobbers' price per 1000 is as follows:

	13½x13½	13½x20½
Cleveland	55.00	65.00
Chicago	41.00	43.50

SAL SODA sells as follows per 100 lb.:

	Current	One Month Ago	One Year Ago
New York	$3.00	$3.00	$1.75
Philadelphia	2.75	2.75	1.75
Cleveland	3.00	2.50	2.75
Chicago	2.25	2.50	2.00

ROLL SULPHUR in 360-lb. bbl. sells as follows per 100 lb.:

	Current	One Month Ago	One Year Ago
New York	$3.90	$3.90	$3.65
Philadelphia	3.65	3.65	3.62
Chicago	5.00	5.00	4.12½

COKE—The following are prices per net ton at ovens, Connellsville:

	July 8	July 1	June 24
Prompt furnace	$17.50@$18.50	$17.50@$18.50	$15.00@$16.00
Prompt foundry	18.00@19.00	18.00@19.00	16.00@17.00

FIRE CLAY—The following prices prevail:

		Current
Ottawa, bulk in carloads	Per Ton	$8.00
Cleveland	100-lb. bag	1.00

LINSEED OIL—These prices are per gallon:

	— New York —		— Chicago —	
	Current	One Year Ago	Current	One Year Ago
Raw in barrels (5 bbl. lots)	$1.53	$2.15	$1.95	$2.53
5-gal. cans (without cans)	1.56*	2.28	2.15	2.73

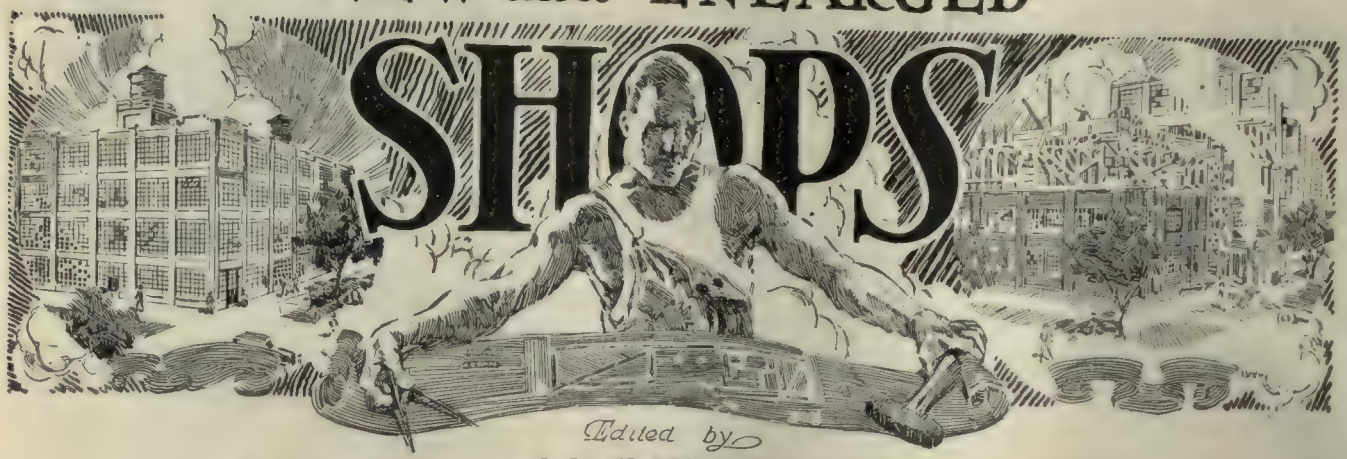
*To this *oil* price must be added the cost of the cans (returnable), which is $2.25 for a case of six.

WHITE AND RED LEAD—Base price per pound:

	— Red —				— White —	
	Current		One Year Ago		Current	One Year Ago
	Dry	In Oil	Dry	In Oil	Dry and In Oil	Dry and In Oil
100 lb. keg	15.50	17.00	13.00	14.50	15.50	13.00
25 and 50-lb. kegs	15.75	17.25	13.25	14.75	15.75	13.25
12½-lb. keg	16.00	17.50	13.50	15.00	16.00	13.50
5-lb. cans	18.50	20.00	15.00	16.50	18.50	15.00
1-lb. cans	20.50	22.00	16.00	17.50	20.50	16.00

500 lb. lots less 10% discount. 2000 lb. lots less 10–2½% discount.

NEW and ENLARGED SHOPS



Edited by
L·V·FLETCHER

Machine Tools

The following concerns are in the market for machine tools:

Conn., Hartford—The city of Hartford—machine shop equipment.

Conn., Hartford—The Puritan Motor Sales Co., 334 Pearl St.—repair shop equipment.

Mass., Boston—The Roxbury Motor Co., 133 Humboldt Ave.—repair shop equipment.

Mass., Everett—L. Albaum, 49 Malden St.—repair shop equipment.

Mass., New Bedford—The Manomet Mills—miscellaneous machine tools.

N. Y., New York (Borough of Manhattan)—A. Stroud, 327 Bway.—Five boring mills, 42 in., one turret head, swivel head.

Three 24 in. Bullard boring mills.

Two Cleveland, model "A," 2 in. standard automatic screw machines.

Three Cleveland, model "A," 4¼ in. standard automatic screw machines.

One Cleveland, model "A," 6¾ in. standard automatic screw machine.

Twelve porter cable lathes.

One 16 in. Lees Bradner, G & E, or Adams, spiral gear hobber.

One Potter & Johnson, 7 in. turret lathe.

One 2 spindle, Henry & Wright, class "B," drill.

One Briggs, model "B," 42 in. table feed miller.

One Fisher oil groover.

One Landis 12 x 96 plain grinder.

N. Y., New York (Borough of Manhattan)—The United Machine Works, 55-57 West 3rd St.—One 36 or 42 in. triple geared belt driven heavy duty lathe, 20 in. between centers, with compound slide rest, change gears, steady rest, countershaft and clutch, etc.;

One belt driven lathe as above, 18 x 12 in. between centers;

One portable cylinder boring bar for sylinder up to 26 in. diameter x 72 in. long;

One portable cylinder boring bar for cylinder 4 to 8 in. diameter x 48 in. long;

One belt driven power hammer head, about 500 lbs.;

One 6 to 7 in. belt driven Sullivan air compressor;

One reversible air drill for drills up to 2¾ in.;

One 60 or 72 in. belt driven radial drill;

One belt driven 24 in. or 30 in. crank shaper with table vise;

One 300 to 400 ton belt driven hydraulic press to take up to 48 in.;

One belt driven plate bending machine for plates ⅜ to 12 in. long;

One heavy work blast forge with blower, size of pan 48 in.;

Three 300 lb. cast steel anvils;

Taper shank twist drills, from ½ to 2 in. in 64ths;

Taper sockets for above drills;

One belt driven twist drill grinder with counter shaft on column;

One belt driven grindstone about 48 in.;

One No. 2 universal milling machine;

Milling cutters for three 16 to 6 in. diameter and face;

Milling cutters for involute gears;

Milling cutters for epicycloidal gears;

One foundry cupola for about 6 or 7 tons;

One belt driven rotary blower;

Two combined crane and truck ladles, about 6,000 lbs. each;

Two wrought bull ladles about 200 lbs.;

Two crane ladles with shank and rail about 800 lbs.;

One 10 ton traveling crane, span about 25 ft.;

One circular saw sharpener;

One hand saw filer and setter;

One hundred feet of 2 15/16 steel shaftings.

Ring oilers, 18 x 18 in.

Drop hangers, 2 15/16 in. bore.

N. Y., New York (Borough of Manhattan)—The Williams Valve Co., 62 Front St.—one 24 in. universal turret lathe.

Pa., Germantown (Philadelphia Station)—The Queen Gray Co., 70 West Johnson St.—general machine tools.

Pa., Philadelphia—The Congoleum Co., Inc., Morris Bldg.—one 16 in. x 8 ft. engine lathe.

Pa., Philadelphia—H. D. Dougherty & Co., 17th and Indiana Sts.—one manufacturer's lathe, capacity up to 2 in.

Pa., Philadelphia—The Hartford Sterling Co., 24th and Locust Sts.—buffing and polishing lathes.

Pa., Pittsburgh—The Electric Welding Co., Riverbank—one alligator shear, capacity 1½ in. sq. steel, electric drive (used).

Pa., West Chester—The Sharples Specialty Co.—heavy duty drill presses.

Ala., Birmingham—The Manufacturers Selling Agency, Brown Marx Bldg.—one 1 in. single head bolt cutter, motor driven.

Ind., Terra Haute—The Amer. Car and Fdry. Co.—additional equipment for expansion, including lathes, foundries, etc.

Ind., Terra Haute—The Indiana Milling Co.—$50,000 worth of miscellaneous milling machinery.

Mich., Caro—Cooper & Striffler—garage equipment.

Mich., Detroit—The Elwood Machine and Tool Co., Sherman and Rivard Sts., W. T. Elliott, Mgr.—machine tool equipment for manufacture of dies.

Mich., Detroit—The C. E. Fales Mchy. Co., 100 Beaubien St.—one DDG No. 56 Darracute double action, 100 ton draw press (new or used).

Mich., Detroit—The Hayes Mchy. Co., East Larned St., A. Sprague, Purch. Agt.—large squaring shears.

Mich., Detroit—The James Machine Co., 427 Bellevue Ave.—miscellaneous machine shop equipment.

Mich., Detroit—The Pere Marquette Ry., Union Depot Bldg., J. Tuthill, Ch. Engr.—miscellaneous engine house equipment.

Mich., Detroit—The Walker Saxe Motor Car Co., 1525 Gratiot Ave.—garage repair equipment.

Mich., Detroit—Water Bd., 232 Jefferson Ave., H. S. Starkey, Secy.—repair shop equipment including lathe, cold saw, milling machine, etc.

O., Columbus—The Amer. Water Motor Co., 796 East 11th Ave., L. Lewis, Purch. Agt.—one lathe, about 24 in., one drill press, etc.

O., Warren—The Bd. Educ., c/o J. Buckwalter, Trumbull Blk.—equipment for manual training shop.

Wis., Milwaukee—The All Tite Chain Co., 231 27th St., F. Hoya, Purch. Agt.—punch presses, lathes and drill presses.

Wis., Milwaukee—The Bd. of Industrial Educ., 800 Manufacturers' Home Bldg., F. French, Secy.—watchmakers' lathes, precision bench, chucks, and screw cutting attachments.

Wis., Milwaukee—Greenfield & Co., 120 Wisconsin St.—machine tools for manufacture of printers' tools.

Wis., Milwaukee—The Petit Mfg. Co., 1439 14th St., A. Faudrich, Purch. Agt.—one medium sized miller and one large shaper.

Wis., Milwaukee—J. Wilging, 1358 33rd St—one 30 in. planer.

Mo., St. Louis—The Missouri, Kansas and Texas Ry., Ry. Exch. Bldg., G. E. Scott, Purch. Agt.—about $42,000 worth of machine tools including drill presses, lathes, planers, power hammers and pneumatic tools.

Mo., St. Louis—The Pierre Investment Co., c/o R. S. Price, Arcade Bldg.—repair shop equipment.

Mo., St. Louis—The Terminal Ry. Assn. of St. Louis, Union Station, W. G. O'Fallon, Purch. Agt.—miscellaneous machine tools for Brooklin, Ill., machine shops, including lathes, milling machines, pneumatic tools, etc. Estimated cost, $12,000.

Tex., Palestine—G. E. Dilley & Son—one set of hand rolls for handling 48 in. sheets of 10 to 18 gauge blue annealed steel (used).

Cal., Los Angeles—A. J. Taussig, 827 Union Oil Bldg.—automatic press for manufacture of pencil caps.

Que., Montreal—J. Gilston & Co., Ltd., Wilson Ave.—garage equipment.

Que., Montreal—The Grand Trunk Ry., McGill Bldg., G. W. Caye, Purch. Agt.—machine tool equipment for new shop.

Machinery

The following concerns are in the market for machinery:

Ky., Louisville—The Kentucky Tire and Rubber Co., W. R. White, 502 Realty Bldg., Vice Pres.—machinery for manufacture of automobile tires.

La., New Orleans—The Arabi Packing Co.—complete equipment for packing house.

La., New Orleans—The Rex Motor Car Mfg. Co., 628 Gravier St.—wood and iron working machinery for Shrewsbury plant.

Ill., Chicago—The LaSalle Iron Wks., 2205 South Halsted St.—equipment for West Hammond, Ind., plant, including rolling mill, heat treating outfit and pickling equipment.

Ill., Chicago—The Chicago, Milwaukee and St. Paul Ry., Ry. Exch. Bldg., W. A. Lynn, Purch. Agt.—one 10 ton traveling crane for West Milwaukee, Wis., shops.

Ill., Chicago—A. Finkel & Sons, 1326 Cortland St.—machinery for heat treating plant.

Ill., Chicago—D. Levi & Co., West 40th St. and Packers Ave.—equipment for packing plant.

Ill., DeKalb—The Vassar Swiss Underwear Co., 2545 Diversey St., Chicago—knitting machinery.

Ill., Urbana—W. A. Conklin, 207 East Illinois St.—one doughnut machine with stove kettle and mixing bale.

Ind., East Chicago—The General Amer. Tank Car Corp.—foundry equipment.

Ind., Gary—The Universal Slag Brick and Tile Co.—$50,000 worth of machinery for new plant.

Ind., Indianapolis—The Parker Cord Fabric Mills—$50,000 worth of miscellaneous machinery for manufacture of fabric cord, including spinning and weaving machines.

Ind., Kendalville—The Wert Mfg. Co.—machinery for new plant.

Mich., Detroit—The Dept. of Pub. Wks., c/o Comm. of Purchases and Supplies—one 3 motor, electric traveling crane with trolley complete.

Mich., Detroit—The Ford Motor Car Co., Highland Park—sawmill and woodworking machinery for Iron Mountain plant.

O., Cincinnati—The Julian & Kokenge Co., 4th and Lawrence Sts., F. B. Dopp, Purch. Agt.—miscellaneous machinery.

O., Cleveland—The Independent Brick and Tile Co., The Arcade—one locomotive crane.

O., Columbus—The Atlas Bros. Fdry. Co., 980 South Park St., E. Wittman, Mgr.—miscellaneous foundry equipment.

O., Columbus—The C. & E. Shoe Co., 129 East Noble St., W. A. Hamilton, Purch. Agt.—miscellaneous equipment for shoe factory.

Wis., Milwaukee—The Badger Brass Co., 243 Lake St.—equipment for brass foundry.

Wis., Milwaukee—The Duplex Storage Battery Co., 537 Edison St., A. Schickel, Purch. Agt.—woodworking machinery.

Wis., Milwaukee—The Milwaukee Commercial Auto Body Co., 642 7th St., M. Schuster, Purch. Agt.—woodworking machinery.

Wis., Sheboygan—The Phoenix Furniture Co., South 12th St.—one monorail crane.

Wis., Wauwatosa—The Wauwatosa Sheet Metal Wks., 81 Vine St.—one stove pipe folder.

Ia., Davenport—A. B. Johnson Co., Brady St.—one hand power crane.

Cal., Georgetown—The Georgetown Lumber & Supply Co.—machinery for planing mill.

Ont., Ft. William—The Ft. William Pul and Paper Co.—equipment for mill.

Ont., Port Arthur—The Kaministiquia Pulp & Paper Co.—pulp mill machinery.

Ont., Toronto—The Grinnell Co., Ltd.—foundry equipment, including crane.

Metal Working

NEW ENGLAND STATES

Conn., Bridgeport—The Amer. Tube and Stamping Co., 471 Hancock Ave., will build a 1 story, 55 x 60 ft. factory with 30 x 40 ft. ell on Stratford Ave., for the manufacture of hot and cold rolled steel. Estimated cost, $14,000.

Conn., Bridgeport—The Bridgeport Machine Co., Beardsley St., will soon award the contract for the construction of a 1 story, 40 x 80 ft. machine shop. Estimated cost, $20,000. J. E. Stone, Canaan Rd., Stamford, Archt. Noted June 17.

Conn., Bridgeport — The Economy Mfg. Co., 886 Main St., plans to build a factory for the manufacture of spark plugs, on Brewster St. Estimated cost, $75,000.

Conn., Hartford — The city will soon award the contract for the construction of a 2 story, 50 x 125 ft. machine shop on John St. Estimated cost, $125,000. Whiton & McMahon, 36 Pearl St., Archts.

Conn., Hartford—The Hartford Automobile Club Garage Co., 36 Pearl St., will build a 7 story, 147 x 150 ft. garage, etc., on Hicks and South Ann Sts. Estimated cost, $500,000. Noted June 10.

Conn., Hartford—The Puritan Motor Sales Co., 334 Pearl St., will soon award the contract for the construction of a 1 story 50 x 140 ft. garage on Farmington Ave. Estimated cost, $40,000. Butler & Provoost, 292 Main St., Stamford, Archts. Noted July 1.

Conn., New Haven—The Fritzell Brass Fdry. Co., 33 Chestnut St., will soon award the contract for the construction of a 1 story, 50 x 150 ft. factory. Estimated cost, $40,000. Fletcher Thompson, Inc., 1089 Broad St., Archts. and Engrs.

Conn., New Britain—The Mendel Sicklick Co., 117 Willow St., will soon award the contract for the construction of a 2 story garage on Arch St. Estimated cost, $35,000. F. C. Walz, 348 Trumbull St., Hartford, Archt. Noted July 1.

Conn., Plainville—The Peck Spring Co., 68 Broad St., has awarded the contract for the construction of a 1 story, 40 x 50 ft. addition to its plant for the manufacture of springs. Noted Apr. 8.

Conn., Stamford—The Petroleum Heat and Power Co., Selleck St., has awarded the contract for the construction of a 1 story foundry at its plant. Estimated cost, $15,000.

Conn., Stamford—The Yale & Towne Mfg Co., 548 Pacific St., has awarded the contract for the construction of a 1 story, 60 x 262 ft. factory on Canal St., for the manufacture of hardware. Estimated cost, $16,000.

Conn., Stratford—The Spring Perch Co., Longbrook Ave., will build a 1 story, 30 x 100 ft. factory for the manufacture of automobile springs. Estimated cost, $10,000.

Conn., Waterbury—The E. J. Manville Machine Co., 574 East Main St., has awarded the contract for the construction of a 2 story, 50 x 200 ft. addition to its plant for the manufacture of machinery. Estimated cost, $65,000. Noted July 8.

Conn., Waterbury—The Waterbury Farrel Fdry. and Machine Co., 425 Bank St., will build a 1 story, 45 x 180 ft. addition to its plant for the manufacture of machinery. Estimated cost, $45,000.

Conn., Westport—The Westport Auto Sales Co. will soon award the contract for the construction of a 1 story, 65 x 165 ft. garage and sales room on Post Rd. Estimated cost, $45,000. J. E. Stone, Canaan Rd., Stamford, Archt.

Mass., Allston (Boston P. O.)—Tuck, Gilman & Sneider, c/o Tuck & Gilman, Archts., 34 School St., Boston, have awarded the contract for the construction of a 2 story 75 x 200 ft. garage and sales building, etc. on Fordham Rd. Estimated cost, $175,000.

Mass., Cambridge—The Mack Motor Truck Co., 185 Massachusetts Ave., will soon award the contract for the construction of a 1 story, 25 x 110 ft. addition to its garage. Estimated cost, $22,000. Warren & Gerrish, Cambridge, Archts.

Mass., Dorchester—The Byrne Realty Co., 435 Geneva Ave., will soon award the contract for the construction of a 1 story, 95 x 165 ft. garage on Holmes Ave. Estimated cost, $50,000. M. H. Maney, 16 Paisley Park, Archt. Noted July 15.

Mass., Everett—L. Albaum, 49 Malden St., will build a 1 story garage on Main St. Estimated cost, $20,000.

Mass., Holyoke—K. R. Charlton, Inc., 118 Race St., has awarded the contract for the construction of a 1 story, 110 x 110 ft. garage on Suffolk and Elm Sts.

Mass., New Bedford—J. C. Rhodes & Co., Inc., 123 Front St., has awarded the contract for the construction of a 4 story, 70 x 200 ft. factory on Front and 4th Sts., for the manufacture of eyelets. Estimated cost, $200,000. Noted July 22.

Mass., Springfield — The Brightwood Brass and Bronze Fdry., 365 Birnie Ave., will build a 1 story, 53 x 72 ft. addition to its foundry. Estimated cost, $20,000. Noted May 20.

Mass., Springfield—The M. S. Converse Co., 17 Harrison Ave., has awarded the contract for the construction of a 2 story, 40 x 62 ft. garage on Armory St. Estimated cost, $30,000.

Mass., West Springfield—The Springfield Automatic Screw Machine Corp. plans to build a factory. Estimated cost, $250,000. I. P. McGregor, Treas.

Mass., Whitinsville—The Whitin Machine Wks. will soon award the contract for the construction of a 5 story, 90 x 400 ft. addition to its plant, for the manufacture of machinery. Estimated cost, $600,000. J. D. Leland, 185 Devonshire St., Boston, Archt. Noted Apr. 22.

Mass., Worcester—The Worcester Pressed Steel Co., Barber Ave., will build a 2 story addition to its plant. Estimated cost, $25,000.

R. I., Pawtucket — The Pleasant View Realty Co., 400 Bway., has awarded the contract for the construction of a 1 story, 60 x 150 ft. garage on Bway. and Lupine Sts. Estimated cost, $35,000.

R. I., Woonsocket—The Bresnahan Grocery Co. has awarded the contract for the construction of a 1 story, 55 x 90 ft. garage on Pond St. Estimated cost, $25,000.

MIDDLE ATLANTIC STATES

Md., Baltimore—L. Blaustein, 612 Water St., has awarded the contract for the construction of a 2 story, 57 x 134 ft. garage at 609-613 North Fremont Ave. Estimated cost, $40,000. Noted April 1.

N. J., Kearney—L. Weil, Kearney Ave., will soon award the contract for the construction of a 1 story, 50 x 100 ft. garage. Estimated cost, $10,000. M. B. Silberstein, 119 Springfield St., Newark, Archt.

N. J., Newark—Koller & Goldstein, c/o H. Rosensohn, 188 Market St., has awarded the contract for the construction of a 1 story, 45 x 100 ft. garage at 294 Sussex Ave. Estimated cost, $10,000.

N. J., Newark—M. J. McGowan, 320 Market St., will soon award the contract for the construction of a 1 story, 50 x 100 ft. garage at 263 Lafayette St. Estimated cost, $10,000. R. Botelli, 207 Market St., Archt.

N. J., Newark—The Silidika & Shaftman Co., Lawrence and Commerce Sts., will soon award the contract for the construction of a 3 story, 60 x 100 ft. garage. Estimated cost, $15,000.

N. J., Trenton—The Orr Machine Guarding Co., East State St., has awarded the contract for the construction of a 2 story, 50 x 75 ft. factory on Calhoun St. Estimated cost, $30,000.

N. Y., New York (Borough of Queens)—The Hellman Motor Corp., c/o McEvay & Smith, Archts., Queens Plaza Court, L. I., has awarded the contract for the construction of a factory on Ely and Sunswick Aves. Estimated cost, $75,000. Noted June 17.

Pa., Philadelphia—The Electric Storage Battery Co., Allegheny and 19th Sts., has awarded the contract for the construction of several 1 story buildings on Rising Sun St. and Adams Rd.

Pa., Scranton — The Bour Refractories Co., Laurel Line and Front St., plans to build a 3 story, 90 x 200 ft. refractory on Stafford Ave. Estimated cost, $300,000.

SOUTHERN STATES

La., Shrewsbury (New Orleans P. O.)—The Rex Motor Car Co., 628 Gravier St., New Orleans, plans to build a 1 story plant here, to cover 7 or 8 acres. R. D. Soule, 429 Corondelet St., New Orleans, Archt.

MIDDLE WESTERN STATES

Ill., Chicago—The Ajax Forge Co., 2503 Blue Island Ave., has awarded the contract for the construction of a 1 story, 80 x 400 ft. and 65 x 200 ft. forge plant and a small boiler shop. Estimated cost, $300,000.

Ill., Chicago—The Delta Star Electric Co., 2437 Fulton St., will soon award the contract for the construction of a 1 and 2 story, 100 x 110 ft. addition to its plant on Fulton St. and Artesian Ave. Estimated cost, $40,000. R. G. Pierce, 10 South La Salle St., Archt. N. Ronneberg, 10 South La Salle St., Engr.

Ill., Chicago—A. Finkel & Sons Co., 1326 Cortland St., has had plans prepared for the construction of a 1 story, 32 x 98 ft. heat treating plant. Estimated cost, $20,000.

Ill., Chicago—H. S. Olson, 2056 Irving Park Blvd., has had plans prepared by E. N. Braucher, Archt., 6 North Clark St., for the construction of a 1 story, 50 x 125 ft. garage. Estimated cost, $25,000.

Ind., East Chicago—The General Amer. Tank Car Corp. plans to build a large addition to its brass foundry.

Ind., Hammond — The Union Railroad Equipment Co., 332 South Michigan Ave., Chicago, is having plans prepared for the construction of a 1 story, 75 x 125 ft. forge shop. Estimated cost, $125,000. D. Chase, Inc., 645 North Michigan Ave., Chicago, Engr.

Ind., Terre Haute—The Amer. Car and Fdry. Co. plans to enlarge its place.

Mich., Caro—Cooper & Striffler has awarded the contract for the construction of a 1 story, 75 x 140 ft. garage and sales room. Noted June 24.

Mich., Detroit—The General Forgings Corp., c/o J. D. Edwards, 54 Lafayette Blvd., plans to build a 2 story, 65 x 210 ft. drop forging shop.

Mich., Detroit—The Walker Saxe Motor Car Co., 1525 Gratiot Ave., has awarded the contract for the construction of a 1 story, 119 x 135 ft. garage on Gratiot Ave. Estimated cost, $50,000. Noted June 3.

Mich., Detroit—The Water Bd., 232 Jefferson Ave., will soon award the contract for the construction of a 1 story, 90 x 120 ft. machine shop. H. S. Starkey, Secy., G. H. Fenkell, 232 Jefferson Ave., Engr.

Mich., Kalamazoo—R. E. Fair, Rose and Water Sts., has awarded the contract for the construction of a 2 story, 100 x 175 ft. Ford service station and storage building. Estimated cost, $110,000.

Mich., New Buffalo—The Pere Marquette Ry., Union Depot Bldg., Detroit, plans to build a 1 story engine house here, to have 16 stalls. J. Tuthill, Detroit, Ch. Engr.

O., Cleveland—The Laronge Co., c/o J. H. Dickman, 214 Williamson Bldg., is having plans prepared for the construction of a 1 story, 50 x 120 ft. garage on East 16th St. and St. Clair Ave. Estimated cost, $75,000. J. L. Weinberg, Schofield Bldg., Archt.

O., Cleveland—The Natl. Lamp Co., Nela Park, has awarded the contract for the construction of a 1 story, 50 x 100 ft. garage on East 45th St. and Hough Ave. Estimated cost, $75,000.

O., Cleveland—W. D. Sixt, c/o S. H. White, Archt., 1032 Schofield Bldg., has awarded the contract for the construction of a 2 story, 60 x 110 ft. garage and sales room at 6820 Euclid Ave. Estimated cost, $100,000. Noted July 1.

O., Cleveland—The Waite Taxicab and Livery Co., 1467 East 6th St., will soon award the contract for the construction of a 2 story, 66 x 280 ft. garage on Superior Ave. near East 12th St. Estimated cost, $200,000. W. G. Ferguson Co., 1900 Euclid Ave., Archts. Noted May 13.

O., Warren—The Bd. Educ., c/o J. Buckwalter, Trumbull Blk., will soon award the contract for the construction of a 2 story, 125 x 150 ft. addition to the East Technical High School, to include a manual training department. Estimated cost, $400,000. R. J. Keich, Warren, Archt. Noted April 22.

Wis., Fort Washington—The Turner Mfg. Co. is having plans prepared for the construction of 1 story foundry. Estimated cost, $75,000. F. D. Chase, Inc., 645 North Michigan Ave., Chicago, Archt. and Engr.

Wis., Janesville—The Standard Oil Co., Waldheim Bldg., Milwaukee, is having plans prepared by B. M. Burt, Archt., c/o owner, for the construction of a 1 story, 60 x 120 ft. garage and warehouse on North Main St., here. Estimated cost, $40,000.

WEST OF THE MISSISSIPPI

Ark., Paragould—The Missouri Pacific Ry., 1055 Ry. Exch. St., St. Louis, Mo., has awarded the contract for the construction of a 1 story, 40 x 200 ft. car repair shop here. Estimated cost, $10,000.

Ia., Marshalltown—The C. A. Dunham Co., 343 South Dearborn St., Chicago, plans to build a 2 story, 40 x 150 ft. addition to its heating apparatus factory. Estimated cost, $150,000.

Minn., Minneapolis—The Russel Grader Mfg. Co., 2037 University Ave., S. E., is having plans prepared by E. R. Ludwin and Sund & Dunham, Archts., 512 Essex Bldg., for the construction of a 1 story, 424 x 600 ft. factory on Kennedy St. and Stinson Blvd. Estimated cost, $250,000. Noted Apr. 8.

Mo., St. Louis—The Pierce Investment Co., c/o R. S. Price, Archt. and Engr., Arcade Bldg., is having plans prepared for the construction of a 1 story, 175 x 200 ft. garage. Estimated cost, $150,000.

Tex., San Antonio—E. B. Flores, 112 East Mistletoe St., is building a 3 story garage on Travis St. Estimated cost, $75,000.

CANADA

Que., Montreal—J. Gilston & Co., Ltd., Wilson Ave., will soon award the contract for the construction of a garage. Estimated cost, $25,000.

Que., Montreal—The Hudon Hebert Co. Ltd., 18 De Bres St., will soon award the contract for the construction of a 2 story, 40 x 72 ft. garage on Papineau Ave. Estimated cost, $50,000. C. Dufort, 195 St. Catherine St., Archt.

General Manufacturing

NEW ENGLAND STATES

Conn., Hamden—The Yale Tire and Rubber Co., 961 Dixwell Ave., has awarded the contract for the construction of a 1 story, 40 x 90 ft. factory addition. Estimated cost, $15,000.

Conn., Rockville—The J. J. Regan Mfg. Co., 74 West Main St., has awarded the contract for the construction of a 1 story, 21 x 70 ft. addition to its finishing plant and a 1 story, 40 x 80 ft. dye house. Estimated cost, $16,000.

Mass., Chelsea (Boston P. O.)—The Walker Bros. Dyeing & Bleaching Co., Clinton St., plans to rebuild its bleachery on Bway. and Clinton St. Estimated cost, $50,000.

Mass., Chicopee Falls—The Chicopee Mfg. Co., West Main St., has awarded the contract for the construction of a 1 story, 150 x 250 ft. weave shed at its plant. Estimated cost, $130,000.

Mass., Fall River—The New England Oil Co. will build additions to its plant to consist of a 1 story, 17 x 25 ft. oil receiver house, 32 x 74 ft. oil condensers, 45 x 181 ft. oil stills, etc., along the Taunton River here. Estimated cost, $100,000.

Mass., Holyoke—The Hampden Glazed Paper and Card Co., Riverside, has awarded the contract for the construction of a 4 story, 92 x 291 ft. factory on Water St. Estimated cost $165,000.

R. I. Providence—The Franklin Process Co., 29 Promenade St., will soon award the contract for the construction of a 2 story, 110 x 175 ft. dye house. Estimated cost, $150,000. Lockwood, Greene & Co., 60 Federal St., Boston, Archts. and Engrs. Noted May 27.

R. I., Woonsocket—The Lafayette Worsted Co., Hamlet Ave., will soon award the contract for the construction of a 2 story, 140 x 250 ft. spinning mill. Estimated cost, $200,000. W. F. Fontaine, Federal Bldg., Archt. Noted July 22.

MIDDLE ATLANTIC STATES

N. J., Monmouth Junction—The Alcoholic Products Corp. has awarded the contract for the construction of an addition to its plant. Estimated cost, $50,000.

N. Y., New York (Borough of Brooklyn)—W. Wrigley, Jr., Metropolitan Ave., manufacturer of chewing gum, has awarded the contract for the construction of an 87 x 380 ft. addition to his plant. Estimated cost, $100,000.

N. Y., New York (Borough of Manhattan)—The Hill Ware Baking Co., 165th St. and Park Ave., has awarded the contract for the construction of a bakery. Noted July 1.

Pa., Johnstown—The Peris Products Co. plans to build a 2 story, 47 x 167 ft. factory on Sheridan Ave., for the manufacture of soap products. Estimated cost, $150,000. A. Peris, Ft. Stanwix Hotel, Pres.

Pa., Philadelphia—The E. B. Steinmetz Co., Inc., Huntingdon and Hancock Sts., will soon award the contract for the construction of a 2 story, 48 x 105 ft. yarn factory on Sedgely St. Peuckert & Wunder, 310 Chestnut St., Archts. and Engrs.

Pa., Scranton—The Edison Lamp Co. plans to build a 3 story, 100 x 100 ft. bulb blowing plant on Washington Av. Estimated cost, $200,000.

Pa., Scranton—The Scranton Button Co., 409 Cherry St., has awarded the contract for the construction of a 1 story, 85 x 85 ft. factory on Washington Ave. Estimated cost, $50,000.

SOUTHERN STATES

Ky., Louisville—The Kentucky Tire and Rubber Co. will soon award the contract for the construction of a factory for the manufacture of automobile tires. W. R. White, 502 Realty Bldg., Vice Pres.

La., New Orleans—The Arabi Packing Co. will soon award the contract for the construction of a packing plant, to consist of a 2 story, 100 x 198 ft. main building, 1 story, 57 x 67 ft. power house and a 2 story, 24 x 36 ft. reduction plant. Estimated cost, $400,000. The Packers Architectural Eng. Co., 431 South Dearborn St., Chicago, Archts. and Engrs.

La., New Orleans—The Presto Lite Co., 30 East 42nd St., New York City, has purchased a site on Anthony and St. Louis Sts., here, and plans to build a 2 story acetylene plant. Estimated cost, $200,000.

MIDDLE WEST STATES

Ill., Chicago—The Abbott Laboratories, 4753 Ravenswood Ave., will build a chemical manufacturing plant, including ten 1 story buildings, at 4800 Ravenswood Ave. Estimated cost, $225,000.

Ill., Chicago—D. Levi & Co., West 40th St. and Packers Ave., will soon award the contract for the construction of a 3 story, 115 x 170 ft. packing plant on West 39th St. and Emerald Ave. Estimated cost, $350,000. Henshein & McLaren, 37 West Van Buren St., Archts.

Ill., De Kalb—The Vassar Swiss Underwear Co., 2545 Diversey St., Chicago, is having plans prepared for the construction of a 1 story underwear factory. Estimated cost, $50,000. F. D. Chase, Inc., 645 North Michigan Ave., Chicago, Engr.

Ind., Indianapolis—The Parker Cord Fabric Mills plans to build a plant for the manufacture of fabric cord tires.

Mich., Detroit—The Michigan Creamery Co., c/o S. Raboniwitch, Ford Bldg., is having preliminary plans prepared by T. A. Hyland, Archt., 307 Moffat Bldg., for the construction of a 7 story creamery on Grand River St.

O., Cleveland—The U. S. Leather Co., c/o E. B. Cassett, East 13th St. and Euclid Ave., plans to build a 1 story, 100 x 300 ft. factory on Broadview Rd. Estimated cost, $100,000.

O., Cleveland—The Walter Ice Co., c/o A. C. Bishop, Archt. and Engr., Guardian Bldg., is having plans prepared for the construction of a 1 story, 45 x 146 ft. ice plant on West 25th St. Estimated cost, $75,000.

O., Middletown—The Advance Bag Co., 155 North Bway., has awarded the contract for the construction of a 3 story, 65 x 300 ft. paper mill. Estimated cost, $150,000.

Wis., Merton—The Merton Dairy Products Co. has had plans prepard by M. Tullgren & Sons, Archts., 425 East Water St., Milwaukee, for the construction of a 1 story, 45 x 70 ft. addition to its laboratory. Estimated cost, $35,000.

Wis., Pickett—A. H. Fortnum, c/o State Bank of Ripon, Ripon, plans to build a 3 story, 50 x 100 ft. canning factory and 2 story, 100 x 100 ft. warehouse here. Estimated cost, $75,000.

WEST OF THE MISSISSIPPI

Mo., Kansas City—The Kansas City Macaroni Co., 4015 Grand Ave., will soon award the contract for the construction of a 4 story, 50 x 100 ft. factory on Pacific and Campbell Sts. Estimated cost, $50,000. H. F. Brandenburger, 15 West 9th St., Archt.

Tex., San Antonio—E. Steves & Son, 704 East Commerce St., manufacturers of lumber, are building a 2 story factory. Estimated cost, $76,000.

Tex., Yoakum—The Yoakum Mill and Elevator Co. is building a 11 story mill and elevator. Estimated cost, $18,000.

WESTERN STATES

Cal., Georgetown—The Georgetown Lumber & Supply Co. plans to build a saw mill. J. L. Hasler, Mgr.

CANADA

Ont., Ft. William—The Ft. William Pulp and Paper Co. has awarded the contract for the construction of a 2 story, 400 x 600 ft. pulp and paper mill at the mouth of the Million River. Estimated cost, $1,000,000. Noted July 27.

Ont., Hamilton—The Firestone Tire and Rubber Co., Sherman Ave., has awarded the contract for the construction of a 4 story factory. Estimated cost, $500,000.

Ont., Port Arthur—The Kaministiquia Pulp & Paper Co. plans to build a pulp mill with 30 ton daily capacity. Estimated cost, $1,000,000. C. D. Howe, Port Arthur, Engr.

Ont., Sudbury—The Canada Creosoting Co. will build a 1 and 2 story plant. Estimated cost, $50,000.

SEE SEARCHLIGHT SECTION
Pages 277-213

Aug. 5, 1920 American Machinist Vol. 53, No. 6

Stamets Crankshaft Milling Machine

By Ethan Viall
Editor, *American Machinist*

Machines of this type are always suggestive of other applications for special purposes. Many large firms refuse to build such special machinery, as they prefer to stick to their standard line. The concern building this machine, however, has been very successful in the designing and building of machines to meet difficult problems of mass production which are becoming quite frequent.

OWING to its irregular form and springy nature, the multiple-throw crankshaft has always presented serious machining difficulties. Numerous special machines have been designed and built from time to time, in order to increase the output and reduce the cost of such work. A majority of these machines have been for work on the bearings and crankpins. Others are used to finish the sides or cheeks, but very few, if any, have been heretofore made to machine the outside or periphery, of the webs. In cases where such work has been required, grinding and polishing have usually been resorted to. On the late types of counterbalanced crankshafts however, grinding and polishing do not produce sufficiently accurate results, and where the webs are of the flat-sided, irregular outline type, some form of real machining is necessary to secure the proper balance. It is for an especially difficult job of such crankshaft work that the machine described in this article has been designed and built by William K. Stamets, Pittsburgh, Pa.

Fig. 1 shows a full front view of the machine and Fig. 2 a close-up of the cutters and work. A line drawing of the crankshaft upon which the machining is done is shown in Fig. 3, from which it will be seen that the machining of the peripheries of the various webs is practically a cam cutting job. Webs like *A* and *C* might possibly be machined with a turning tool, but to machine web *B* in that way would be impractical. In any case, milling cutters offer the best means of removing the surplus metal from the peripheries of the various webs in this particular instance.

It is inadvisable to attempt to machine all the webs at one setting, so two different machines are used, each machine milling the peripheries of four webs. The cutter lay-out for assembly "A" is shown in Fig. 4 On the machine with this cutter arrangement, the master

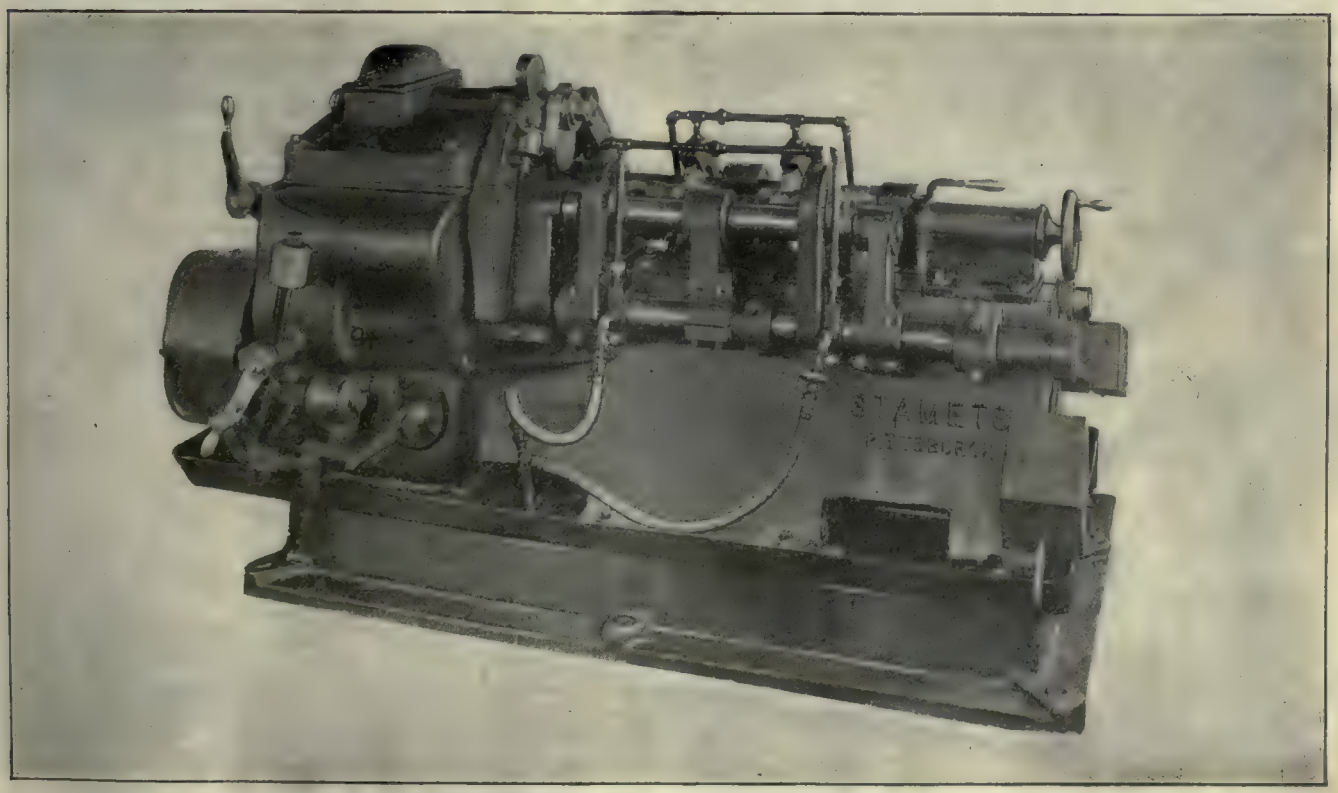


FIG. 1. STAMETS AUTOMATIC CRANKSHAFT MILLING MACHINE

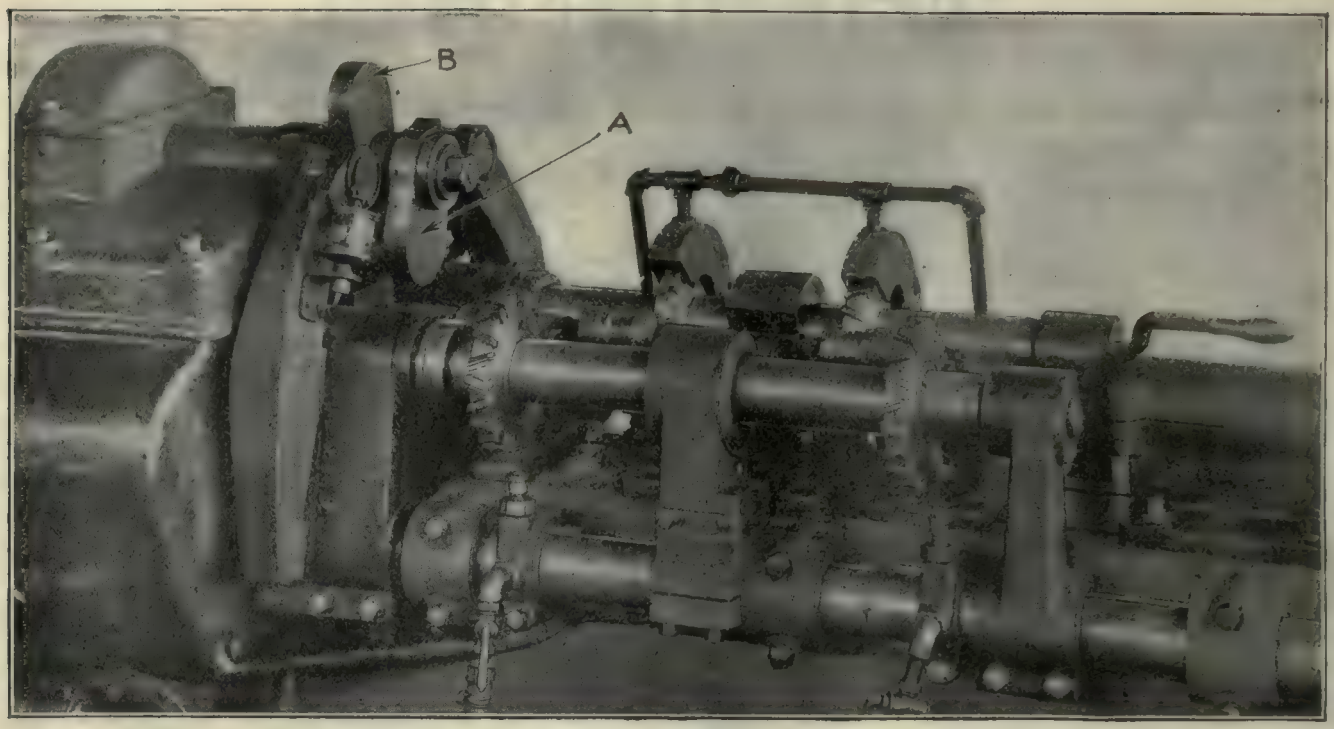


FIG. 2. CLOSE-UP OF THE WORK AND CUTTERS

forms are shaped as shown at *A* and *B*, Fig. 5. *A* top view of the machine with set-up *B*, is shown in Fig. 6.

Operation of the Machine

Keeping the illustrations referred to in mind, we will now go back to Fig. 2 and describe the operation of the machine in detail. After the driving disk and bearings of the crankshaft are machined it is ready to be placed in the milling machine. Here the turned bearings rest in journals and the driving disk is pinned to the spindle faceplate, the tail center supporting the outer end. The crankshaft must, of course, be located correctly in relation to the master cams, *A* and *B*. As there are six jig-drilled holes in the crankshaft driving disk, this locating is simply a matter of slipping the disk over pins in the spindle faceplate.

The milling-machine spindle and crankshaft turn so as to give a feed of about 4½ in. per min. The cutters which are 7 in. in diameter for the large webs and 9 in. in diameter for the smaller ones, run so as to give a surface speed of about 75 ft. per min. It will be seen from the illustration that the milling cutter teeth are set at a considerable angle to give a shearing cut in the tough steel of the crankshaft.

Means are provided for changing the spindle speed in order to compensate for the irregular shape being milled, so that the feed remains approximately 4½ in. per min. on the outside surface of the webs throughout the cut. This is done by means of an automatic gear shift in the spindle drive.

The milling cutters are carried on arbors supported by rocker arms as shown, three rocker arms being provided for each arbor. The rocker arm next to the head carries the arbor-driving spindle into which the

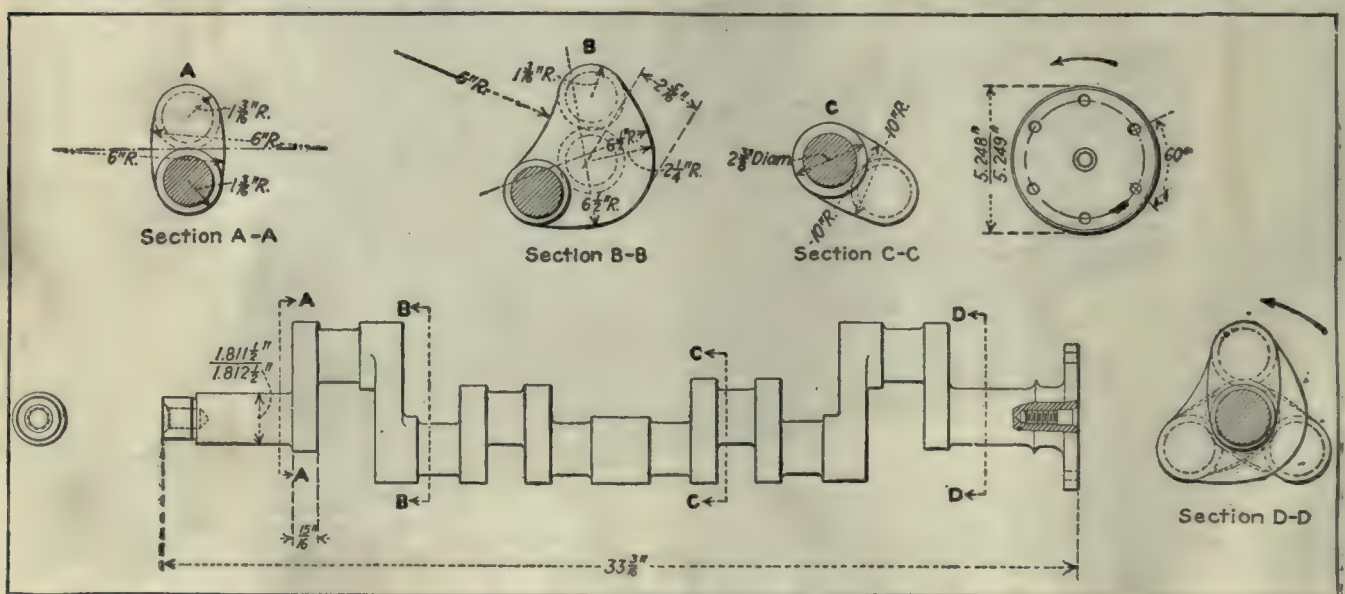


FIG. 3. TYPE OF CRANKSHAFT MILLED

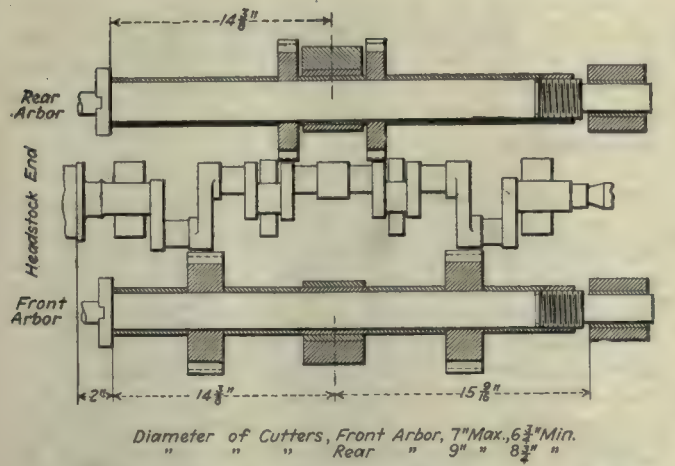


FIG. 4. CUTTER LAY-OUT FOR ASSEMBLY "A" MACHINE

taper shank of the arbor is fitted. A keyed shoulder on the spindle fits into a slotted collar on the arbor for driving purposes.

To make it easy to take out or replace an arbor, the middle rocker arm is made with a removable cap on the lower end. By removing this cap and sliding back the end rocker arm, the arbor and cutters may be removed from the driving spindle intact. Another duplicate set of cutters is put in place while the removed set is being ground.

As cutters are ground, they of course become smaller in diameter and some adjustment must be made in order to bring the cutting edges far enough into the work to remove the necessary amount of metal. This is provided for by means of an adjustable eccentric bearing for the cam roller. The adjustment will make allowance for about ¼ in. difference in the dimeter of the cutter.

Counterweighted levers keep the cam rollers in steady contact with the surfaces of the cams as the machine operates. A peculiar pointed projection or "rise" may be seen on the master cams. This is to throw the cutters free of the work so as to not interfere with its removal or replacement.

In order to make it possible to machine the entire periphery of the web and still throw the cutters back

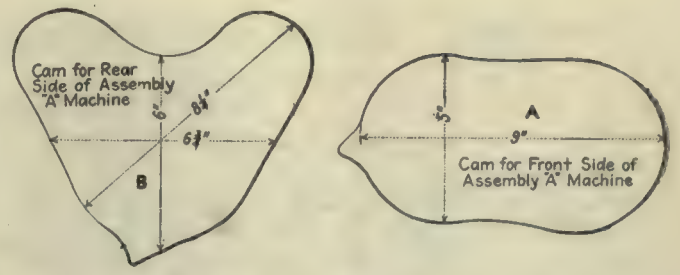


FIG. 5. CAMS FOR ASSEMBLY "A" MACHINE

clear of the work for removal, the work is made to travel ⅛ of a turn more than the cam. Then when the next crankshaft is put in the machine, it is set ⅛ of a turn further back than the previous one, which is easy to do on account of there being six equally spaced holes in the driving disk. By this plan no running or setting back of the cam or spindle is necessary.

The cutter spindles are driven through a series of gears so arranged as to allow the necessary movement of the rocker arms without disturbing the mesh of the gears.

One of the very difficult problems connected with the use of milling cutters on work of this character, is to eliminate all tendency to chatter. Few engineers who have not been up against just such a proposition, know how hard it is to solve. That the problem has, in this case, been successfully solved is proved by the smoothness and absence of chatter marks on the milled surfaces of the webs. This is especially remarkable considering the hardness of the metal, the natural springness of the crankshaft and the necessarily flexible drive through a series of gears.

Difficulties of this kind explain to some extent why the average maker of a standard line of machines does not care to build machines for special purposes. Only with a staff of engineers having special aptitude for the solution of unusual machinery problems and long experience in this field, will allow a firm to undertake such work without a cost almost prohibitive to the buyer.

The Lubricating System

The pumping arrangement supplying the lubricating and cooling systems, is shown in Fig. 7. Three Fulflo

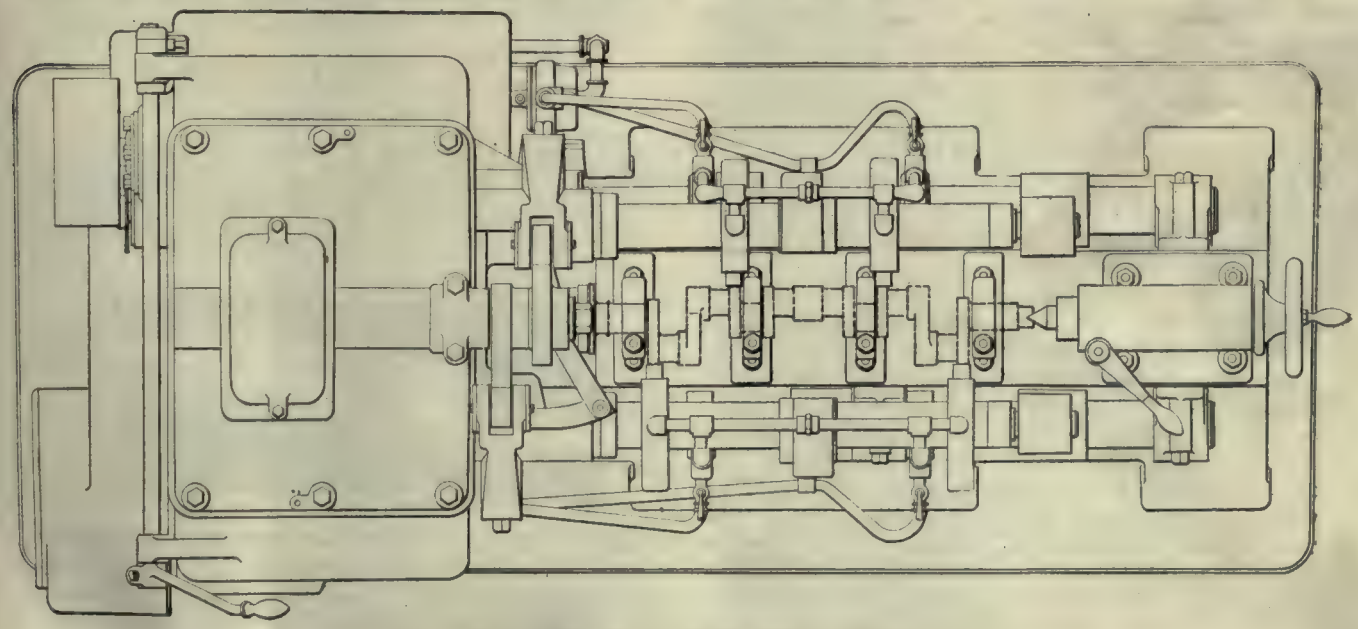


FIG. 6. TOP VIEW OF MACHINE WITH ASSEMBLY "B"

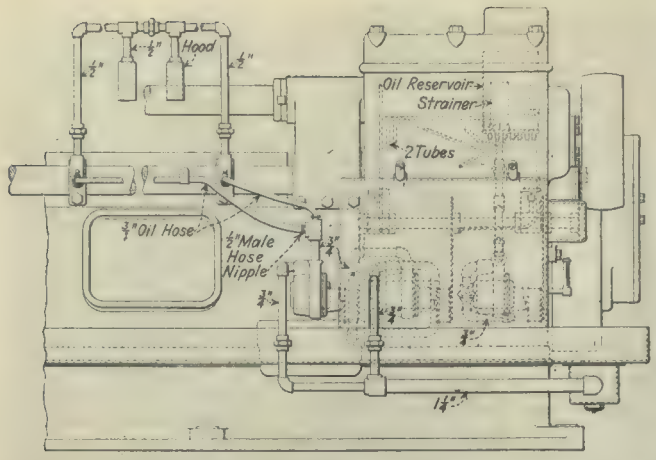


FIG. 7. DETAILS OF THE OILING AND COOLING SYSTEMS

pumps are used, each with a capacity of 15 gal. per min. This provides a pump for each two cutters and one for the lubricating system. The guards or hoods over the milling cutters are so made that the cutters are kept flooded with a large amount of coolant during the cutting operation. The lubricating oil is first pumped to a tank in the headstock from which it is distributed to the various bearings.

The machine has a shear pin in the driving pulley to prevent extensive damage should anything serious go wrong with the operating parts.

The machine occupies a floor space of 3½ x 8 ft., is 4 ft. high to the top of the headstock cover and weighs 8,000 lb.

What Is an Engineer Worth?

By Entropy

If we are to accept the usual standard of valuation of the man who makes grow two blades of grass where but one grew before, the engineer should be considered on the same footing as the farmer. Does he get the proper reward for his services and if not, why not?

Apparently we are all of the opinion that he does not, but we are by no means unanimous as to why, nor as to how he is to get it. Workmen whose work would be much misdirected if it were not for the engineer have not allowed the smaller dollar to keep them from prosperity. Are we less smart than the bricklayer who makes our dreams visible? Why is it that a plasterer, a brakeman, or a horse shoer can demonstrate his value to the community and the engineer cannot?

One reason is that there is an over supply of engineering talent in the country. That is, there are more men who style themselves engineers than there is work for them to do.

How can the layman tell whom to employ? He sees some thousands of men of all ages wearing the A. S. M. E. pin. He sees engineering schools of good reputation turning out thousands of graduates. He knows that some of the members of the A. S. M. E. are high-grade engineers, and he knows that a good percentage of the graduates of the schools do well. He knows that a good engineer is not necessarily an old man, and he knows that if the young men do not get a chance that no new good engineers will develop, so he hires a graduate and puts him in a humble position in the drafting room. By and by the young man is given a real job to do and he comes through in good shape. He is well thought of, but only as a draftsman. He goes on in this way doing more and better work but not getting beyond the stage where he is looked upon as a cub engineer. His salary does not mount by leaps and bounds even though his ability is demonstrating itself very plainly.

So long as there are men in the ranks who are having a hard time to make a living wage we are not likely to see the average income go up a great deal. Frankly I feel that every man who has it in him to become an engineer should have the means to secure the necessary education and try it out, but I do not believe that all the graduates should stick to engineering after they have discovered that they are not likely to be successful at it.

Moreover it seems as if there should be more of a distinction between members of the engineering societies. There is I believe a grading of members of the A. S. M. E. but it is not indicated by any special insignia that is well known to laymen. If a man states truly that he is a member there is but slight concealment if he fails to qualify his statement by saying he is a *junior* member. The average employer of engineers, who is not himself a member of the society does not realize the difference and usually the question is not asked at all.

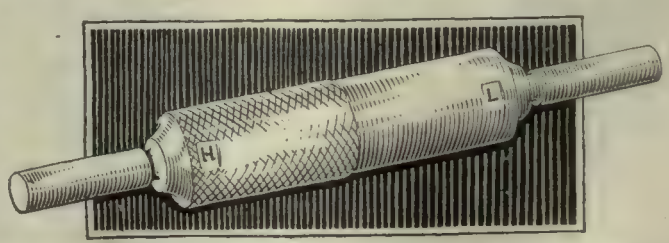
The Remedy—?

What are we going to do about it? Press agents cost money. We will have to learn press agentry and business management. We will have to learn that the treasurer is usually willing to pay for services that produce profit, but that he is neither an engineer nor a mind reader and he does not know when an engineer turns the tide of profits his way, nor does he know when we think we have done it unless we tell him. There is no reason for letting our light shine only in the bushel measure of the engineering societies. The good opinion of our fellow engineers is fine but it butters only an occasional parsnip. In fact it may be the very best advice to an engineer to occasionally get away from his kind and go out and look the world over. It is this outside world that has the money to pay for engineering and it has good jobs to offer while engineers have only the leavings, the undesirable jobs, to hand to each other.

A Plug Gage Easy to Use

By W. A. Anderson

The sketch illustrates a method of facilitating the use of a high- and low-limit plug gage. The high-limit end of the gage handle is knurled and the low-limit end is left smooth. This, of course, enables the inspector



to tell by the feel of the gage which is the high limit and which the low limit end without referring to the markings on the gage. This method has proven very successful in actual practice.

Keeping Workers Contented with Two-Pay Envelopes

By FRANK C. HUDSON

This article tells of a plan which automatically takes care of the advance or decline in the cost of living, based on Bradstreet's reports. It leaves the basic wage as before and meets increased costs of living by special payments.

ONE of the great objections of many managers to the large increases in wages which have taken place during the past four years has been the setting of a new standard which will naturally linger in the minds of the workers, even should the cost of living again resume somewhere near its normal level.

The Oneida Community, Ltd., Oneida, N. Y., considered this phase of the problem during the early part of the war period, and decided to adopt a two-envelope plan of paying wages. The basis for this was the contention that the value of the work done was no greater than before, and consequently the price paid should remain the same. They recognized, however, that workers must have more money to meet the increasing expenses, and the second envelope, known as the H.C.L. envelope, contained an amount sufficient to make up the difference in the cost of living between pre-war times and the date at which the payment was made.

A careful estimate, applied to the living expenses of a large number of families of differing size and income, indicated that the increase in the cost of living in their community during the year 1916 was 16 per cent. They therefore announced that during the war and until a period of settled prices had been reached, basic wages would be left as at that time; that additional payments would be made equal to 16 per cent of the regular wage, but that this would change each month, according to Bradstreet's index numbers of about 100 commodities, on the basis that every 20-point change would mean a change of 1 per cent in the cost of living.

Every Man Knows What to Expect

These index numbers were posted each month on the factory bulletin board, together with the change of wages indicated for the following month. These fluctuated somewhat, but there has been a constant increase (with a few downward fluctuations) from 16 per cent in January, 1917, to 49½ per cent for February, 1920. It is not contended that this is an absolutely perfect system, but the fact that more than 2,000 workmen, after three years' experience, agree that the H. C. L. envelope has fully covered increases in their living cost, adds confidence to the practical value of this method and the figures used.

One great advantage of this plan has been to do away with all periods of wage discussion, which are both disorganizing and depressing when left to ordinary methods. This plan takes care of all changes in living costs automatically, relieving the minds of the workers of all anxiety and controversy from this source. The result has been to combine security and contentment for employee with financial safety for the firm itself. This plan has proved beneficial in securing the spirit of enthusiastic co-operation from the employees who feel sure that no matter how high living costs go, the wage increase will automatically keep pace with them.

Those who contend that while such a plan might work in a period of advancing costs it would be resented when any lowering of the total payment became necessary, will be disappointed to learn that this is not the case. There have been several changes downward, and the attitude toward this automatic reduction is reliably reported to be everything which the most enthusiastic believer in industrial partnership could desire.

As originally worked out, both employees and managers who received more than $2,000 per year received the H. C. L. percentage upon only $2,000. This, however, was shown to work a hardship on some, since their expenses were increased on a basis more nearly proportionate to previous expenses than at first appeared. This was therefore revised to meet the H. C. L. percentage on $2,000 plus one-half of the balance of their salaries.

Increased Product Per Man

While it is probably true that many of the employees do not thoroughly understand the exact significance of the index number as published by Bradstreet, they do realize that the changes in the index number, and consequently in the amount in the H. C. L. envelope from month to month, correspond very closely to changes in living expenses. Furthermore, they understand that the managers of the company have absolutely nothing whatever to do with determining the index figures, and consequently that they are not responsible for any increases or decreases which may come.

The great test, both of the plan and of the way in which the plant is managed, is that in spite of the general unrest there has been no labor trouble, and the industrial family has pulled together even better than ever before. In distinct contrast with those who claim that their men are producing less than during the period of lower wages, the product per man of the Oneida factories has increased. It is also interesting to note that there is less spoiled work due to the human element within the control of their own co-operative effort. They do, however, find it more difficult to get pre-war standards of workmanship and quality in some supplies and raw material.

The H. C. L. envelope was not designed as a permanent institution. It has served as a bridge to carry a much more ambitious plan of industrial partnership across the difficult period of the war. Whether, as some hope, it will form the basis for a permanent system of automatic wage readjustment, remains to be told. The words of the general manager, A. M. Kinsley, are particularly significant:

"All in all, it isn't what you do any more than it is the spirit in which you do it."

A Mutilated Gear Feed

By WILLIAM GUMPRICH, M. E.

The Geneva stop, both in its original and modified forms, has long been used for intermittent motion. A modification that appears to be novel is described and illustrated in this article. The method of arriving at the angles of intermittence is also given.

MANY different mutilated gear motions have been designed and applied practically on various machines in order to give a definite amount of repeated motion in the same direction to some mechanism. To such motions the engineer generally has recourse when neither Geneva nor ratchet motion, derived either from a crank or a quick return motion, will just fill the conditions required by the problem on hand.

To my knowledge this problem has in the past been only partially solved. Either the motion was designed for speed, and then of necessity very weak, and could not be called upon to deliver great power, or else it was constructed for power and had to be made so strong that the weight made high speed prohibitive. In the first instance the motion is generally picked up and brought to rest by letting the gear teeth get in and out of mesh, using some locking arrangement to hold the driven gear in position during the dwell for a correct pickup on the next cycle. It is readily to be seen that this design is only applicable for lightest constructions, because the gear teeth which take the shock of the pickup would hardly stand up under severe conditions.

In the second case the pickup is always aided by some starting cams which mostly take their basis of design from gear tooth action. The sliding friction as inherent to this action is of course still present and the starting angle cannot be very much increased. In order to insure against the inevitable wear of a light construction, these gears and cams are always made very heavy.

The Geneva motion is limited to a minimum of four slots. The lower the number of slots chosen, the greater is the decrease in the power of efficiency. This is due to the fact that the length of the slot changes the leverage from maximum at the beginning of the motion to a minimum which is reached when the driving roll passes the common center line or when the acceleration has reached the highest point.

The construction shown overcomes these bad features to a great extent. The assembly Fig. 1 shows a mutilated gear drive with a modified Geneva motion of ⅓ index of the gear to every revolution of the driver.

Let us consider as assumptions in this case:

Center distance 7 in. and ratio of r.p.m. of driver to r.p.m. of gear as 3 to 1. The requirements call for a powerful yet speedy drive and a lock during the dwell sufficiently accurate as not to require any additional gaging devices outside the mechanism itself. A Geneva motion is out of the question on account of the power loss at maximum speed; even if the physical solution were possible.

In order to determine the correct data it is necessary to assume a preliminary angle for the starting roll which we will take at 60 deg. In order to make the starting motion as easy as possible we next discard the customary practice of letting the center line of the Geneva slot run through the center of the gear. We shift the position of the driving roll enough toward the center of the driver to have the long cathede of the triangle (formed by the common center line, the center line of the driver and roll, and the center line of the Geneva slot) run past the center of the gear in advance of the direction of motion. Let us further assume that other operations make a dwell of 150 deg. necessary. Then we will have the following preliminary timing:

Driver:	
60 deg	Starting
60 deg	Stopping
150 deg	Dwell
90 deg	Gear feed
360 deg.	

The pitch line speed during gear feed has, of course, to be high enough to revolve the driven gear so as to leave it in position to bring it gradually to rest again after ⅓ revolution. From the preliminary layout it can be seen that the starting angle of the gear is less than 30 deg. on account of the angularity of the slot. We therefore will assume an approximate timing for each cycle of the

Mutilated gear:		
	25 deg	Starting
	25 deg	Stopping
Leaving	70 deg	Gear feed
	120 deg.	

This gives us a ratio for the actual gear drive of 9 to 7.

The next factor to be settled is the pitch of the gear-teeth. We will choose six pitch as strong enough to carry most mechanical motions that do not call for an excess of strength in construction.

With the center distance already established as 7 in. the ratio of 9 to 7 does not prove practical with six pitch gears. We therefore readjust our ratio and select the nearest suitable one, which will be 8 to 6. We will now proceed to make the necessary correction on our assumptions based on this new ratio:

Our pitch circles are now

Driver 6 in. with 36 teeth in whole circumference
Gear 8 " " 48 " " " "

With this we have established an absolute basis from

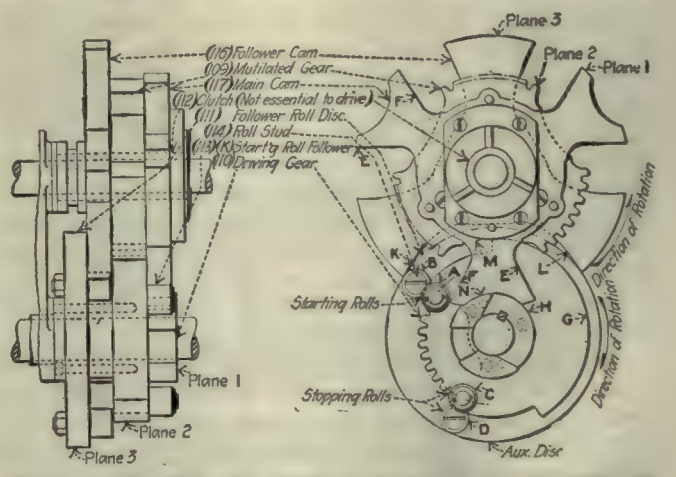


FIG. 1. ASSEMBLY OF GEARS GIVING AN INTERMITTENT MOTION OF THREE INDICES

which the entire problem can now be worked out successively.

Since the mutilated gear has to be brought from rest to pitch line speed and vice versa, it is advisable, even

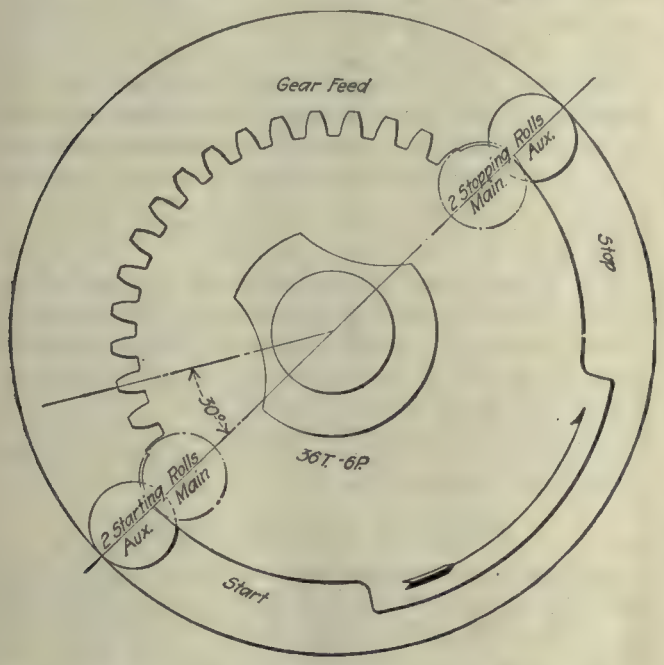


FIG. 2. DRIVER FOR INTERMITTENT MOTION OF TWO INDICES

necessary, to mount the main rolls *A* and *C*, with starting and stopping functions respectively, on the pitch circle of the driver. Furthermore, since the starting and stopping speed of the gear has been decreased through the angularity of the Geneva slots, giving a value of practically zero for the first 5 deg. of starting and the last 5 deg. of stopping, the starting and stopping time of the driver can be reduced to 55 deg.

With the starting roll *A* at 60 deg. from the common center line, next complete a rectangular triangle with the center line as hypotenuse. The long cathede of this triangle will cut the pitch diameter of the mutilated gear at a point which, upon inspection, will be found to be 22 deg. 30 min. We have now established the following timing:

Driver		Mut. Gear	
55 deg.	Starting	22 deg., 30 min.	Starting
100 deg.	Gear feed	75 deg.	Gear feed
55 deg.	Stopping	22 deg., 30 min.	Stopping
150 deg.	Dwell		
360 deg.		120 deg.	

which is the timing required.

The next consideration is how to escape from the Geneva slot after pitch line speed is attained, and how to pick up with the Geneva slot at the end of the gear feed and bring the gear to rest. Naturally we will want to keep our mechanism controlled at all times to enable us to turn forward or backward without losing our timing, and also to prevent any damage which is liable to occur with a motion that is not positively controlled. If it were not for this, just a half Geneva slot as represented by faces *E* and *F* would satisfy the other conditions.

It is evident that the farther a given point is removed from its center of motion the greater will be the distance it travels for each given amount of angular speed. Therefore we put a second set of rolls at the same angles as the starting and stopping rolls, but a certain distance farther from center and describe cam curves tangent to the travel of their outside during the starting and stopping motion. We thus obtain surfaces which practically constitute second sides to the already existing halves of the Geneva slots *E* and *F*. Since these outer rolls travel at greater surface speed than the pitch line velocity, they will travel away from their cams when the gear teeth pick up the motion. It is only a question how far to bring them out in order to clear the outer edges of the cams after the gear teeth have engaged. This interference will occur at approximately 50 deg. of travel under gear feed. In our case the distance between inner and outer rolls is exactly 1 in. and the outer rolls will clear the cams by approximately $\frac{1}{8}$ in.

The operation of the mechanism as shown in the assembly is as follows:

The dwelling cams *G* and *H* are just releasing the mutilated gear at the circular cut-outs *M* and *N*, their rear edges just passing over the center line. This is taken as the zero point. Rollers *A* and *B* are just making contact with the starting surfaces. During the next 55 deg. the mutilated gear is gradually brought up to pitch line speed. When the rolls pass over the center line, the first tooth of the driver picks up the first tooth of the gear. Theoretically the rollers leave their surfaces at this point. Under practical construction, however, this will not take place until the next teeth also have engaged, lending their strength to the drive. The gears alone now do the work until rollers *C* and *D* pass over the center line and pick up their cams just when the last teeth lose contact. During the

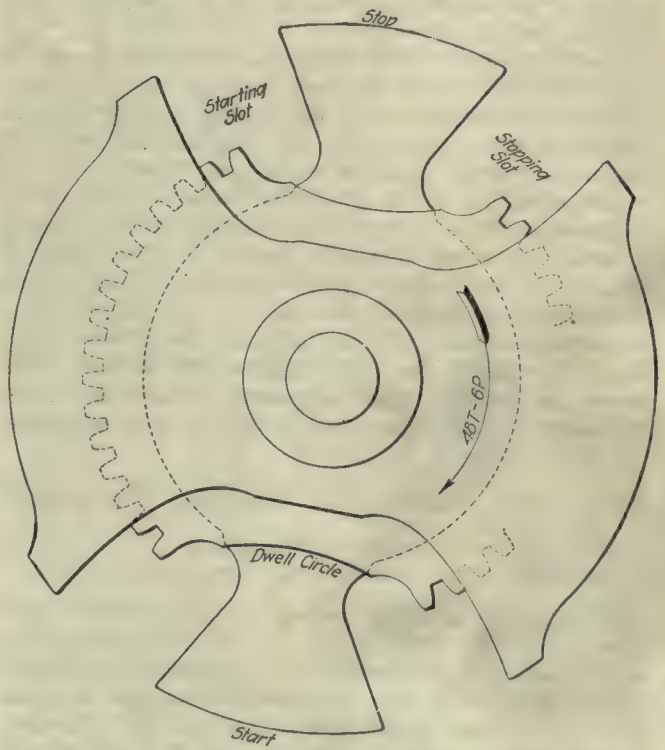


FIG. 3. MUTILATED GEAR FOR INTERMITTENT MOTION OF TWO INDICES

next 55 deg. the mutilated gear is gradually brought to rest again and then the dwelling cams *G* and *H* will hold the gear at rest during the dwell of 150 deg. It is advisable to have the double-dwelling lock this construction affords, partly on account of accuracy, partly on account of better wear resistance.

The hubs of the driver have, of course, to be cut out for clearance for the cam edges of the mutilated gear.

The construction is arranged in three main planes. Plane 2 in the center represents the two gears carrying the teeth and one of the dwell locks, *G* and *M*. Fastened to the driving gear 110, but in plane 1, are the main rolls *A* and *C*. Here it may be noticed that all teeth have been left off, both on the driver and on the gear that would have given interference; and the remaining gear teeth were so located as to allow a maximum of metal for the insertion of the roll stud 115. Plane 2 also takes in the main cam 117 with the second dwell lock consisting of cam *H* and dwelling circle *N*.

Attached to the rear of the driver is the follower disk 111, separated from it by a hub. This disk carries the two follower rolls *B* and *D*. These rolls lie in plane 3, together with the follower cam 116, with surfaces *K* and *L*.

Both units are machined separately in their several component parts, and then securely fastened together by means of dowels and filister-head screws reaching completely through. The driver is keyed in its entirety to the shaft. The mutilated gear here is shown assembled on one bushing and transmits power to its shaft by means of a clutch. This unit can of course also be keyed to its shaft instead.

This motion has successfully been run as high as 400 r.p.m. of the driver without undue vibration or knock, and the writer believes if very carefully fitted, that this speed can be bettered.

Its greatest advantage is the flexibility in design, as almost any combination in timing is possible, its strength and speed, and the accuracy possible in the locking during the dwell.

The flexibility of the design is somewhat shown in Figs. 2 and 3 where we have a driver and mutilated gear for two indices, where the smaller amount of dwell and the greater amount of gear feed are the only differences in detail from the three-index type.

In concluding, let me add a few words regarding the modification of the Geneva stop motion, which I believe is novel. It is not generally known that by inclining the slots in the direction of motion of the Geneva disk, the starting motion can be retarded and the stopping motion accelerated, and that naturally the reverse holds true by inclining the slots against the motion. The writer has availed himself repeatedly of this fact when particular reasons made a quick start or stop advisable.

Why Not Industrial Motion Pictures?

By John A. Honegger
President of the Production Engineering Co., New York

Recently the writer witnessed a motion picture, produced by the Ford Motor Car Co., which illustrated the various occupations taught to the inmates of the Federal Prison at Atlanta, Ga. The picture brought to mind the question used as the title of this article. Further, why not have a center in every city where technical men could gather to witness the various manufacturing processes of, say, motor cars, cash registers, typewriters or of any other product that might interest them?

The pictures could be produced and distributed in the same manner as present-day photoplays are. There would be the producing company, which would visit the various plants and photograph the processes or machines. The films would then be turned over to the distributing agencies, which in turn would distribute them to the various cities for use. The theaters exhibiting the pictures would charge an admission fee, just as is done for pictures at present.

The writer believes that there is a sufficient number of technical men in the various cities to enable the owners of theaters to receive a good return on their investment. If the admission charges did not cover the expenses of the theater, considerable income could be derived by advertising the various machines, tools, and other mechanical devices now on the market. Stereopticon slides, such as are still in use in the majority of theaters for announcing the following week's entertainment, could be used for this purpose.

It is a well-known fact that motion pictures of machines in action have often influenced the purchaser toward buying. In country places far distant from the home plant, motion pictures have accomplished more toward selling machines than a whole staff of salesmen. The reason for this is obvious. The motion picture is the eye of the world and it records truthfully the actual performance of an act.

Benefits of Industrial Movies

With reference to industrial motion pictures the advantages to be gained by technical men, shop men, and the engineering profession in general by their use are many.

For the manufacturer, they would advertise his products more extensively without additional cost and would reach the people most interested. The engineer would be able to study at leisure the various processes of manufacture, routing, sequence of operation and the machines and tools used. In addition to this, he would see what his fellow engineers have accomplished.

Like the engineer, the designer would become mechanically more broad minded. He would be able to study and analyze the why and wherefore of the various mechanisms and operations. The production engineer, factory manager, superintendent and foreman would all find things of value in the pictures. The man at the bench or machine would learn new kinks in his work and through that become a more efficient and productive worker.

Possibly the apprentice would be the one that would gain the most, for the reason that we become adapted to doing certain things by seeing them done and then trying to imitate the operations. If the studies in technical schools and colleges would be co-ordinated with motion-picture lectures, the students could gain a far better fundamental understanding of the subjects and be in a better position to tackle the every-day problems encountered in actual practice.

All this will tend to knit the engineering profession together into a great organization of more efficient and productive workers. The public in general, who are the actual consumers of the products manufactured, would gradually come to understand that there are very few products manufactured which at some time or other have not been in the hands of an engineer. As for foreign trade, if salesmen were equipped with reels showing the activities of industry in America, it would not be a very hard proposition for manufacturers to sell their products in every country in the world. The writer would like to hear what other subscribers to the *American Machinist* think of this idea.

Elements of Gage Making—X*

By C. A. MACREADY

Angular gages as a rule are required to be much more accurate than the usual run of angular work done in the toolroom. The use of the sine bar facilitates the handling of such gages to the required high degree of accuracy.

(Part IX was published in our July 22 issue.)

THE sine bar, *A*, Fig. 120, shown in two different positions at *B* and *C*, becomes the longest side of a right-angle triangle and as the center distance between the two 0.5-in. cylindrical plugs *X* and *Y* can accurately measured, this distance is what is known as a constant. This constant multiplied by the sine of the desired angle gives the vertical height that one of the cylindrical plugs *X Y*, must be above the other. The center to center distance *X Y* in the sine bar *A*, is 5.00 in., but it might have been 5.0012 in., 3.10 or 1.0 in. Whatever the center to center distance is it becomes the constant to be multiplied by the sine of the desired angle. Often because of limited space short sine bars have to be used. Such sine bars, if temporary, are made by attaching the buttons shown in Fig. 19 to a square and parallel piece which is not necessarily hardened. These buttons must be placed accurately parallel to the edges of the bar but they need not be central between the edges. This facilitates setting the buttons by using a parallel piece to rest them on when tightening the holding screws. As stated before, their center to center distance becomes the constant to use and this distance should be, if possible, a unit in order to have as few figures used as possible and thus save time. For instance, 5.0 in. is preferable to 5.0012 in. and 1.10 is better than 1.1125 in.

For a permanent bar the one illustrated at *A* in the top view, is a convenient one to use. The $\frac{3}{8}$-in. slots and holes provide means of attaching it to an angle iron and permit the use of magnetic force to hold the work without clamping. When grinding the bar the principles described in Fig. 78 *A* are used. When fitting the plugs they should be able to take the "set" described in article III, to hold them in place. The setting of the sine bar will be taken up later.

Magnetic Angle Irons

When duplicating work the use of clamps is often the cause of errors. The pressure of the clamps being local and variable causes a variation in seating the work. Magnetic pull being practically unvarying upon all surfaces in contact with the poles provides a very uniform holding medium and should be taken advantage of whenever possible. The principle used was described in Article V, Fig. 75, and the originating of the master angle *A*, in Fig. 75, can be used in place of the hexagon which will be described later.

The angle iron *A*, in Fig. 121, is a very handy one and should be hardened, ground and lapped 90 deg. upon the edges and faces as described in connection with making a proved 90 deg. angle in Article VI. This permits the use of the edges when setting the sine bar to an angle greater than 45 deg.

It will be noticed in Fig. 120 that the sine bar is set in two different positions or angles. The fact that the differences between the sines of the angles becomes less and less as 90 deg. is approached makes the use of the cosine of the angle a more accurate function to use than the sine. It also permits the use of shorter measuring seats for the sine bar plugs to rest upon. As the edges of the angle iron are at 90 deg. to its base this permits the angle to be proved by using both the sine and cosine of the angle to be set up. It will be noticed that the seat *B*, Fig. 121, held by the brass screws, is only finished upon the bottom and top which are ground parallel, the surface of the work seat is then finished to 90 deg. and to approximately the angle wanted. No attention is paid to the other surfaces as they are not used. The sine bar is placed so that either an edge or the bottom of the angle iron can be used to seat upon a surface plate. Two "Planer tool-setting gages" illustrated in Fig. 4, are adjusted to the proper height upon which to rest the 0.50-in. plugs in the sine bar. Then the sine bar is attached by screws through the slots in it and the angle iron. The sine bar is now in the position shown at *C*, Fig. 120. The angle iron is placed upon one of its sides to use the cosine of the angle wanted to prove that angle. The sine of 30 deg. is now multiplied by the center to center distance of the plugs *X Y*, giving us the measurement in diagram *B*.

The distances given in *B* and *C* are from the centers of the 0.5-in. plugs. As these plugs must be the same size their bottom surfaces can be used to seat upon the planer gages *FF* and *F'F'*. One of the pair of planer gages used should be set approximately to the lowest distance that can be used, in this example 0.5 in. This added to the required vertical height, 2.50 in., makes the other gage measurement 3.0 in. The vertical height of 4.83015 in. in the diagram *C* is the sum of 4.33015 in. plus *F* (0.5 in.) = 4.83015 in.

The clinging of two smooth surfaces in contact such as the bottom of the planer gages *FF* and the surface plate often gives a false feeling of contact with the

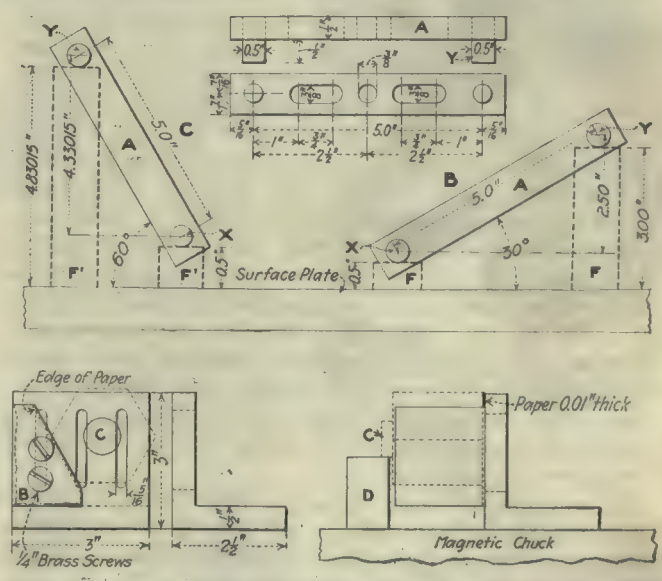


FIG. 120. THE SINE BAR AND ITS USE. FIG. 121. SET-UP FOR MAKING A HEXAGONAL GAGE

*Prepared for the Author's forthcoming book, "Elements of Gage Making."

0.50-in. plugs when testing their height. After setting and attaching the sine bar to the angle iron, the planer gages *FF* are removed and set 0.0002 in. full, i.e., 3.0002 and 0.5002 in. A reading is set at zero over the 0.5-in. sine bar plugs after the planer gages are withdrawn. When the planer gages are replaced under the plugs, this 0.0002 in. should show if the gages *FF* are properly in contact with the 0.5-in. plugs.

Having proved the angle the bedding piece *B*, Fig. 121, is now attached to the angle iron and in contact with the sine bar which is then removed. With all the precautions that can be taken when setting the sine bar, errors will creep in when grinding work. If one depends altogether upon the setting of the bedding piece *B*, and the work seating itself properly, errors will be found if the angles are tested with a knife edge straightedge set at the proper angle as shown in Fig. 122 at *B'*.

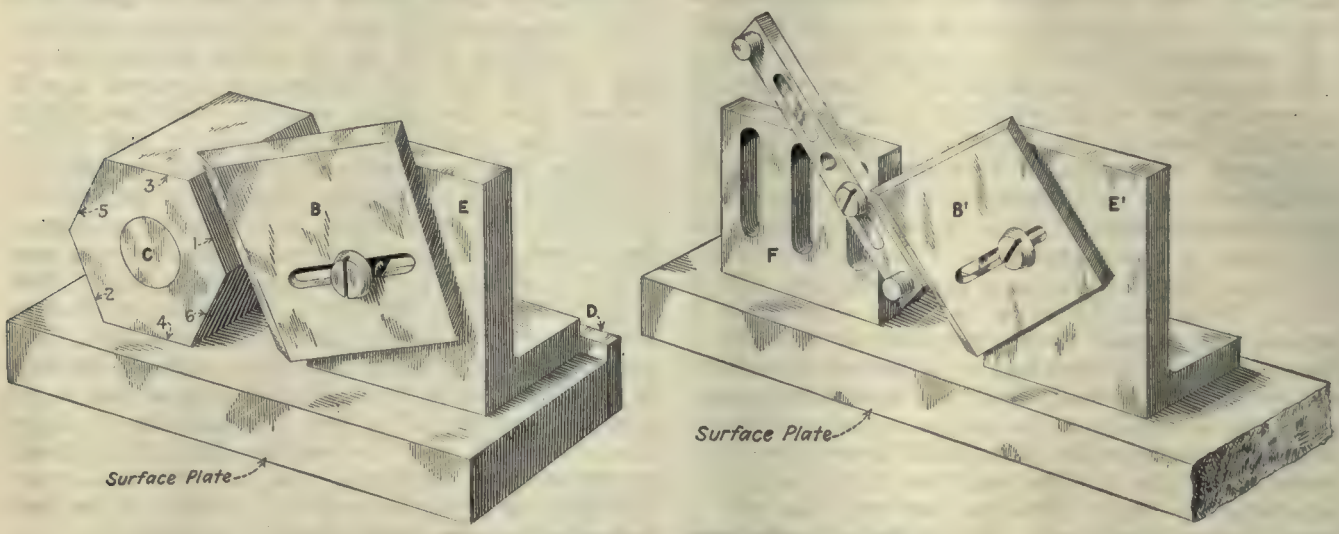


FIG. 122. MAKING A HEXAGONAL GAGE

The hexagon shown with numbered sides in Fig. 122 and in dotted lines in grinding position in Fig. 121, is required to be as near perfect as it is possible to make it. It provides an excellent example of grinding angles and locating seats. The bed *B*, Fig. 121, is very plain, the cylindrical seat *C* resting upon the bedding block *D* is used to measure from, so that the angular sides will be equidistant from the center. The piece *C* may be a plug in a hole, or a disk soldered on the end of the work.

The start of this hexagon is made from the sides marked *1* and *2* in Fig. 122. These are ground parallel to each other and the proper distance from C. The side *2* is then placed against the bed *B* in Fig. 121, and the side *3* is then ground. Side *4* is now ground parallel to side *3* and the proper distance from *C*. Either side *3* or *4* can now be used against the bed *B* to grind sides *5* or *6*, which are made parallel to each other and so finish the grinding of the angles. As the top and bottom surfaces have been made parallel they are used to prove the sides 90 deg. vertically. The top and bottom surfaces are also used to locate the hexagon when being tested with the knife-edge *B*, in Fig. 122. The principle used is one that is often used when originating a 90-deg. angle block. That is: all angles if alike will prove themselves from any side.

To use this principle the angle tester must be maintained at a constant angle when testing angles below or above 45 deg. This is accomplished with a surface plate that has a parallel *D* attached to it. This parallel is used to locate the work and testing fixture at a constant angle. To set the straightedge *B'* at the proper angle the sine bar is set in a position and at the proper angle to expose an unobstructed view to set the straightedge *B'*, as shown in the view at the right. The front and back edges of the angle iron *F* must be parallel. The front and the back edges of the angle iron *E'* need not be parallel as both angle irons are placed against the parallel *D* when adjusting the straightedge *B'* to the sine bar. If the edge of the angle *F* is not parallel with the face a compound angle will be the result of the angle copied from the sine bar by the edge of *B'*. As the angle iron *E'* is maintained at a constant angle by the parallel *D*, when the straightedge *B'* is adjusted it is obvious that it will maintain that angle and be a duplicate of the setting of the sine bar.

To test the hexagon it is placed against the parallel *D*, as shown in Fig. 122, and the straightedge *B* is placed in contact with each side in succession. The hexagon is then reversed, using the opposite face to bed against the parallel *D*. If the angles are correct they will, when reversed, shut out light when tested from each angular surface. For a temporary fixture a micrometer head can be attached to the surface plate and used as described in connection with Fig. 124. The micrometer head holder shown in Fig. 123 can be attached to different machines and measurements taken of the movement of the tool or carriage when desired.

The angle comparator and originator illustrated with details in Fig. 124 shows the completed design of the

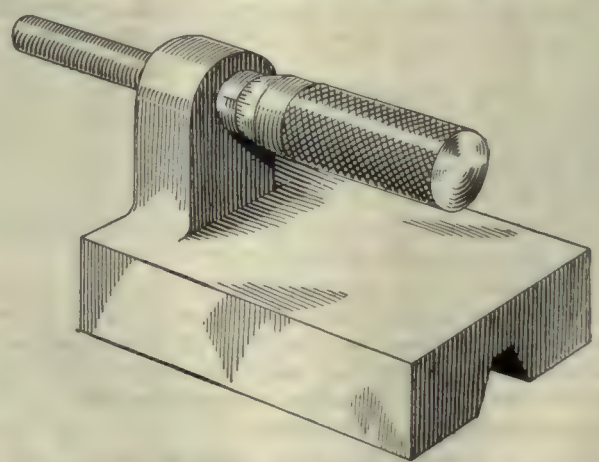
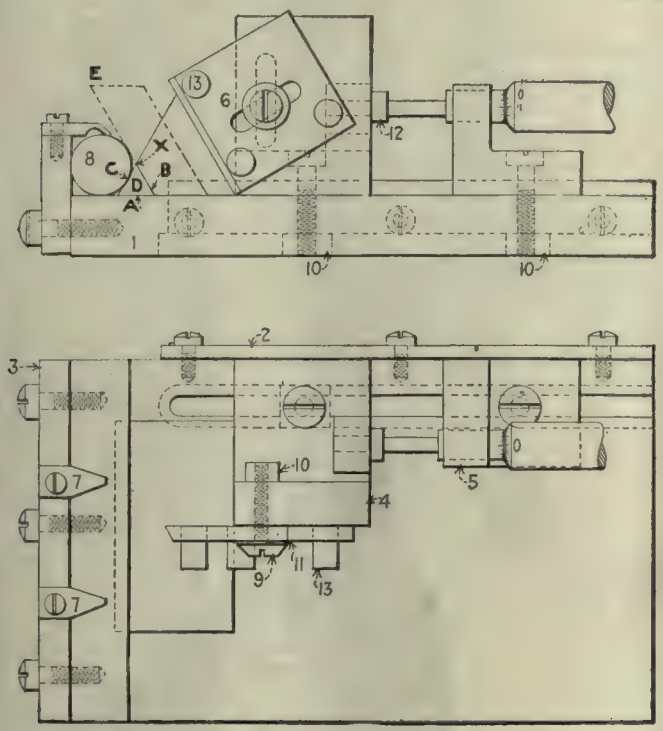


FIG. 123. HOLDER FOR MICROMETER HEAD

temporary device illustrated in Fig. 122 at *A*. The addition of the cylindrical plugs *13*, Fig. 124, and the micrometer head allows the angle to be found by using the sine bar principle, described in connection with the sine bar. This device will also determine the parallelism of the angular sides to the axis of the piece. The use of the micrometer prevents wear of the straightedge when the angles are tested for parallelism. An indicator can be used but this will not show the *amount*, which often is small, that the sides are out of parallel. The use of parallel cylinders, or rolls of different sizes, allows an unknown base of a triangle to be computed from the size of the cylinder used in contact with one of its sides. The cylindrical parallel is also used as a direct seat for the work when testing the other side of an angular piece for parallelism. The cylinder should be long enough to locate the work positively. The diameters of the cylinders should increase by even decimals, about 0.062 in. between sizes up to 0.374 in. to facilitate computing and movement of the micrometer screw. Let us take the triangle *D* in the assembly drawing of Fig. 124, as an example to demonstrate the accuracy of this method of measuring the height of the apex *X* above the base *A* of the triangle *D*, one side being in contact with the parallel cylinder *8*. Any diameter of cylinder may be used provided it is not greater in diameter than twice the altitude of the triangle being measured. However a cylinder just twice the altitude is the ideal cylinder, but smaller ones can be used.

Taking the foregoing empirically and the following also: When the apex or altitude of the triangle *D* is at the right height, if the side *B* is projected in the direction *E* it will touch the circumference of the cylinder *8* and the point of contact will be vertically above *C* and the same distance above the center of the cylinder *8* that *C* is below it. A knife edge straightedge, shown in dotted lines, can be used for this test if the fixture is not to be had. When using the sine bar fixture, Fig. 124, with the correct cylinder the sine bar straightedge *6* is set at the angle wanted and in contact with the cylinder. The micrometer is set to read zero when in contact with the straightedge holder *4* and direct readings can then be made upon the micrometer scale. As an example: The prism *D* has been roughed down to size and the amount to take off to finish it to size is found by placing it in contact with cylinder *8*, which is 1 in. in diameter. The micrometer having been adjusted to read zero with the straightedge in contact with the cylinder, the amount that the prism is large in a line parallel to the base can be read directly upon the micrometer when the prism is placed in contact with the cylinder. This amount can be taken from any side of the prism to make the apex the right height. To prove that too much has not been taken off a known thickness is placed between the prism and the cylinder and it should show the same thickness when measured by the increased size of the prism.

The straps *7*, should be placed to give a pressure towards the back piece *3*. The "goose neck" should be strong enough to resist the wedging and lifting effect of the angle of the prism. The more acute the angle the greater will be the wedging effect which will tend to raise the cylinder from its seat upon the bedding piece *1*. End plate *3* must be at right angles to side plate *2*.



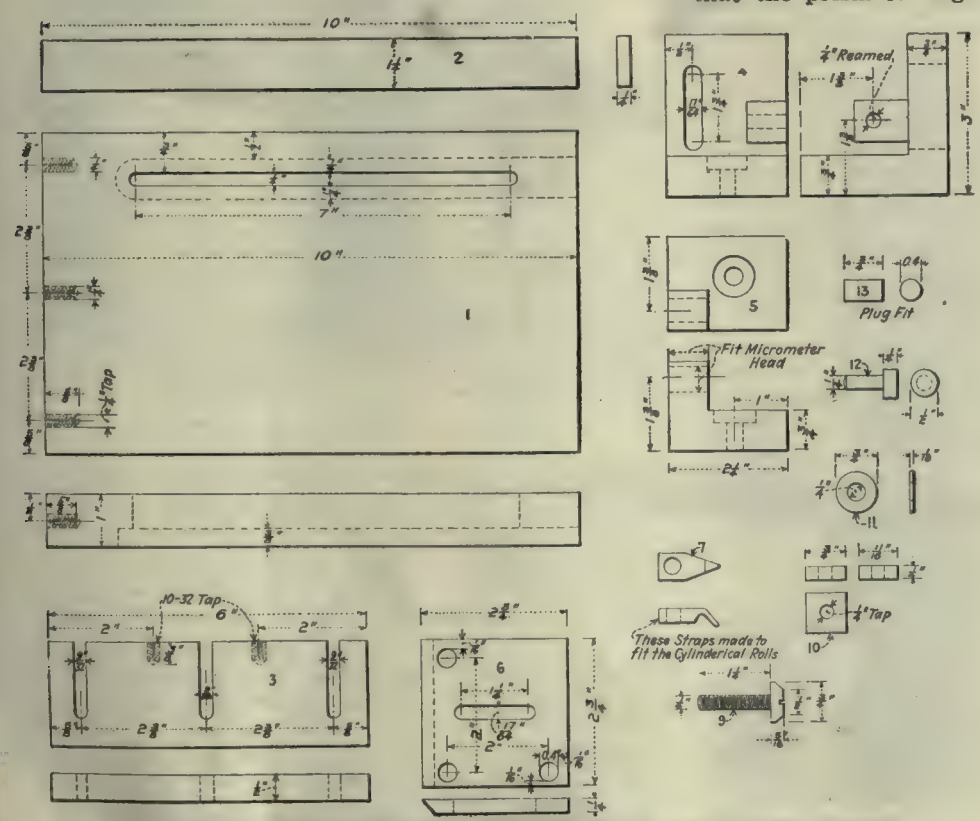


FIG. 124. DETAIL AND ASSEMBLY OF ANGLE COMPARATOR

Metalwood Crankshaft-Straightening Presses

By J. V. HUNTER
Western Editor, *American Machinist*

The automotive-engine crankshaft is forged to fairly close limits, thus saving both stock and machining time. It is essential that, before machining, it be carefully straightened, and the presses here described are built to expedite this work.

A LINE of hydraulic power presses for straightening drop-forged automotive-engine crankshafts has been developed by the Metalwood Manufacturing Co., Detroit, Mich. These presses are now built in several types and range in capacity from 20 to 65 tons working pressure, with table lengths suitable for the size of the work upon which the press will be used.

The character of the press used for crankshaft straightening depends somewhat upon the method employed in the drop-forge shop. The flanging operation in forging is usually followed by reheating and straightening of the crankshaft under a 2,500-lb. steam-operated drop hammer; and then the shaft goes through the regular heat treatment. The centering operation follows, and the crankshaft is then ready for straightening.

The straightening machines employed for this work are of several types, both power- and hand-operated presses being extensively used. The former type is used principally in the larger shops where large quantities of work are handled, or in cases where peculiar shapes of crankshafts require considerably more straightening due to greater distortion during heat treatment. The more simple forms of shafts come from the re-strike operation of forging so true that they require comparatively little straightening, provided they have been subjected to proper methods of heat treatment. For such cases the hand-operated type of straightening press is entirely suitable. The usual limit of eccentricity allowable, when correcting the irregularities of a rough-forged shaft on the straightening press prior to the machining operations, is only $\frac{1}{32}$ inch.

Fig. 1 shows a No. 191 Metalwood straightening press, equipped as a self-contained, motor-driven unit. This type is built in two other forms, either belt-driven from a line shaft or for connection with an accumulator pressure supply as shown in Fig. 2.

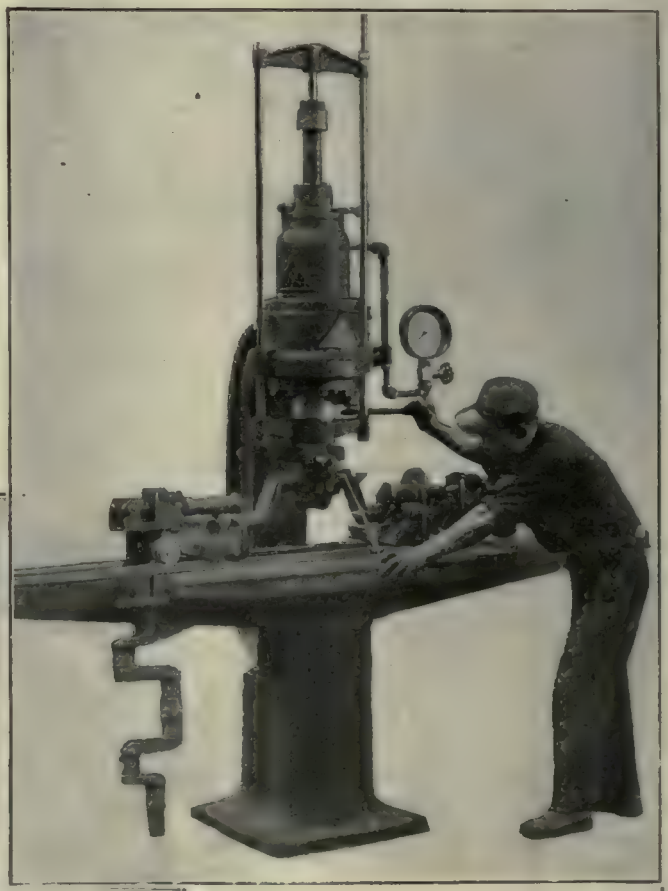


FIG. 1. METALWOOD NO. 191 MOTOR-DRIVEN CRANKSHAFT-STRAIGHTENING PRESS

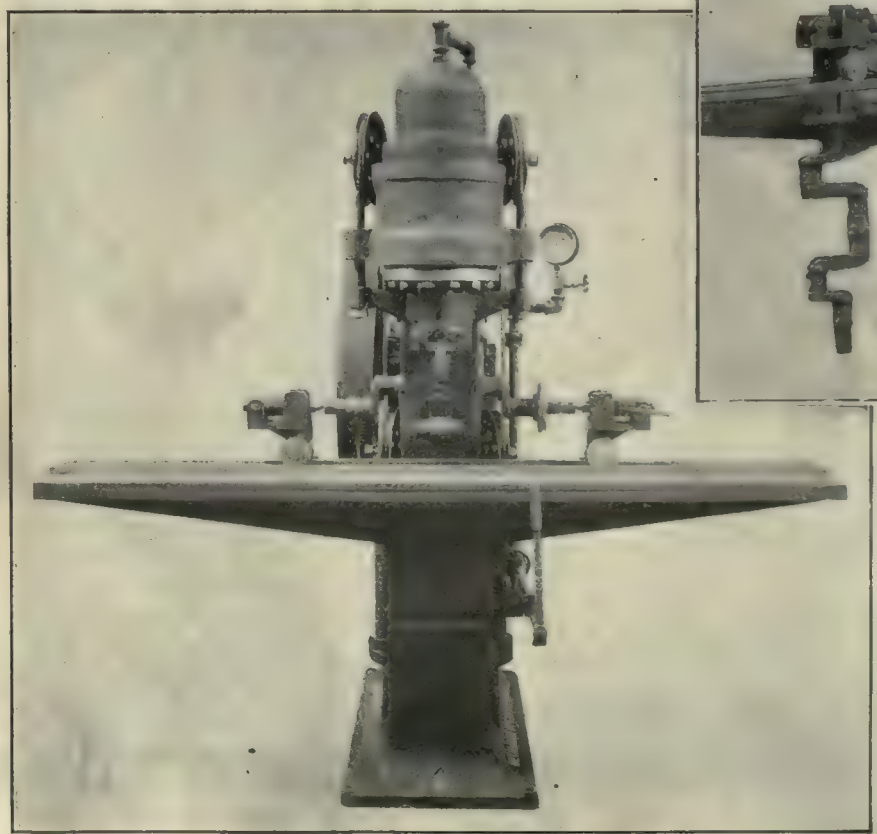


FIG. 2. STRAIGHTENING PRESS FOR USE WITH AN ACCUMULATOR SYSTEM

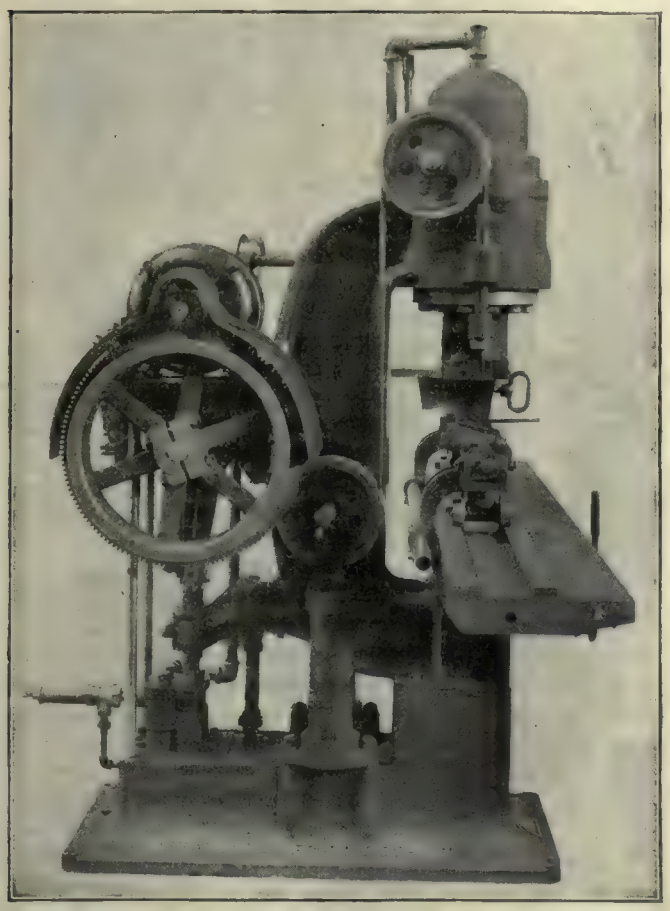


FIG. 3. SIDE VIEW OF MOTOR-DRIVEN MACHINE

The drive motor of the unit, see Fig. 3, operates through reduction gearing, an hydraulic pump, which produces the pressure necessary for actuating the ram. The oil is stored in the pump-tank in the base of the machine and the lever for controlling the valves is located in front of the table. To raise the ram and to return it automatically to its starting position after each working stroke, vanadium steel coil springs enclosed in retaining cylinders on each side of the machine are provided. These springs so act through cables and sheaves that their elongation is only half of the travel of the ram. The lower end of the ram is provided with a nose having two steps and made in the proper shape to suit the design of the shaft being straightened. This nose is dovetailed into the ram, so that it may be readily slipped forward and back by means of the small handle at the front. This permits of bringing the proper step of the nose over the shaft and under the center of the ram.

A carriage, which has centers for supporting the crankshaft, is provided on the bed of the press, and it should be noted that the shaft remains in position on the centers through all the straightening operations. The carriage can be moved longitudinally, so that the different bearings can be brought successively under the ram. The center heads of the carriage are joined in the rear by a heavy bar, on which they may be moved so as to suit different lengths of the crankshafts. This bar shows at the rear of the bed (Fig. 3), the advantage of this position being that it in no way interferes with the placing of the work in the machine.

Whenever pressure is applied to the crankshaft the centers are relieved of the load by placing wedge-shaped blocks between the shaft and the bed on each side of the ram. These blocks, which are seen in position in Fig. 4, can be placed in any position along the entire length of the shaft. When applying pressure to a portion of a shaft the outer ends beyond the wedge blocks are sprung upward as indicated in Fig. 5, thus lifting the carriage off the bed. To prevent injury to the centers in case of excessive downward pressure on them, the points are mounted in housings which can be swung downward and which are held in place by coiled compression springs. This construction, which can be seen in Fig 5, also provides ample cushioning of shocks.

Rate of Production

In practice the average number of strokes obtained from this press is 15 per min., the average length of stroke being 6 in. The maximum pressure required for the average crankshaft job is 35 tons. Actual production records vary widely with the class of work and the skill of the operator. However, it is interesting to note the statement of the manufacturer that the figures from a number of shops straightening 4-throw crankshafts show an average production per 10-hr. day of 300 shafts per man. A similar average obtained on 6-throw crankshafts gives a production of 250 shafts per 10-hr. working period.

The machine built for use in connection with a pressure accumulator system, Fig. 2, is similar in general construction and operation; but it is provided with a small hydraulic constant-pressure ram for returning the main ram to its highest position, instead of using springs. All operation is controlled by a single three-way valve.

Machine for Straightening Tractor Crankshafts

The No. 597 machine, Fig. 6, has been designed for extra heavy work, particularly for straightening heavy tractor-engine crankshafts. The center heads are carried on a sliding carriage which can be racked along a heavy bed made of a steel I-beam. The design provides for handling forged shafts up to 3-in. diameter on the main bearings and with a maximum length of 7 ft. 6 in. The brackets holding the rollers on which the carriage rests are so constructed and mounted on springs that the table comes down to a full bearing on the bed when pressure is applied on the work. The same type of wedge blocks as already described for the other machine are used between the shaft and the table for taking the thrust of the ram off the centers, which are spring cushioned, but of different design than used on the smaller machine.

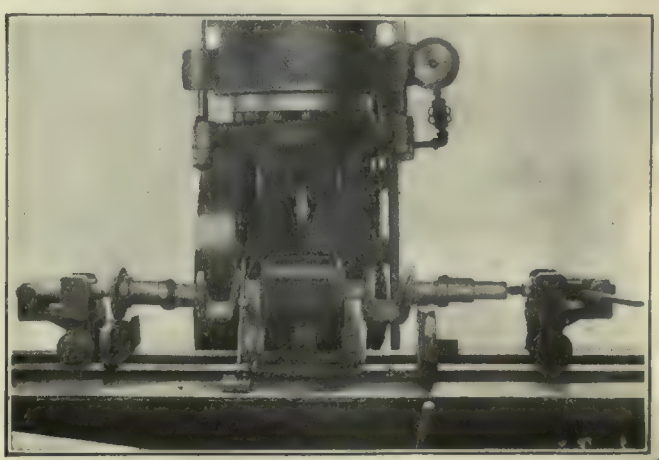


FIG. 4. METHOD OF HOLDING CRANKSHAFT DURING STRAIGHTENING OPERATION

The pressure is furnished by a two-cylinder hand-operated pump conveniently located on the front of the bed. The ram is brought down until the nose reaches the work by means of a hand-operated gear, which engages a rack attached to the ram. The movement of the ram draws oil into the cylinder from the reservoir

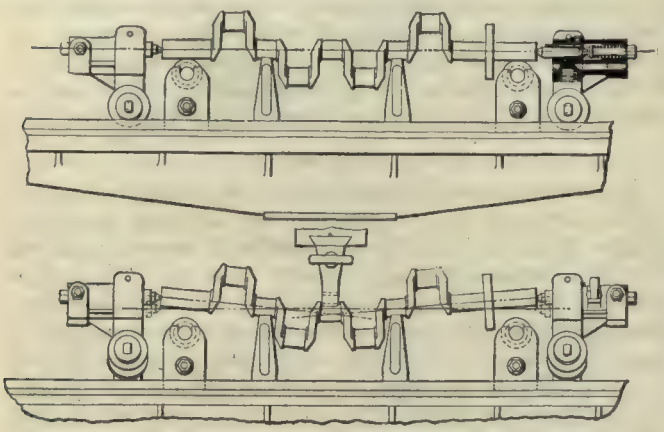


FIG. 5. ACTION OF SHAFT IN THE PRESS DURING APPLICATION OF PRESSURE

above, and after the check-valve has automatically closed, the pressure can be built up by means of the pump. The high- and the low-pressure cylinders of the pump are operated by separate hand levers. A by-pass valve operated by a treadle releases the pressure, thus allowing free movement of the liquid. The return movement of the ram is affected by means of a weight connected to a cable which passes over a sheave on the same shaft as the pinion engaging the rack on the ram.

Many forge plants give preference to hand-operated straightening presses for work where the pressure necessary to deflect the shaft is always a known factor and can be obtained by the operator by the aid of the pressure gage. The skilled workman, after determining the amount of eccentricity of the shaft by revolving it, is able to note and regulate the tonnage of each stroke, and he thereby avoids giving unnecessarily large applications of pressure. With hand-power pumps a further advantage is attained through the sensitiveness of the feeling of the operator, who is able to discover the yielding of the shaft through the change in its resistance. This enables him to avoid carrying the bending action too far.

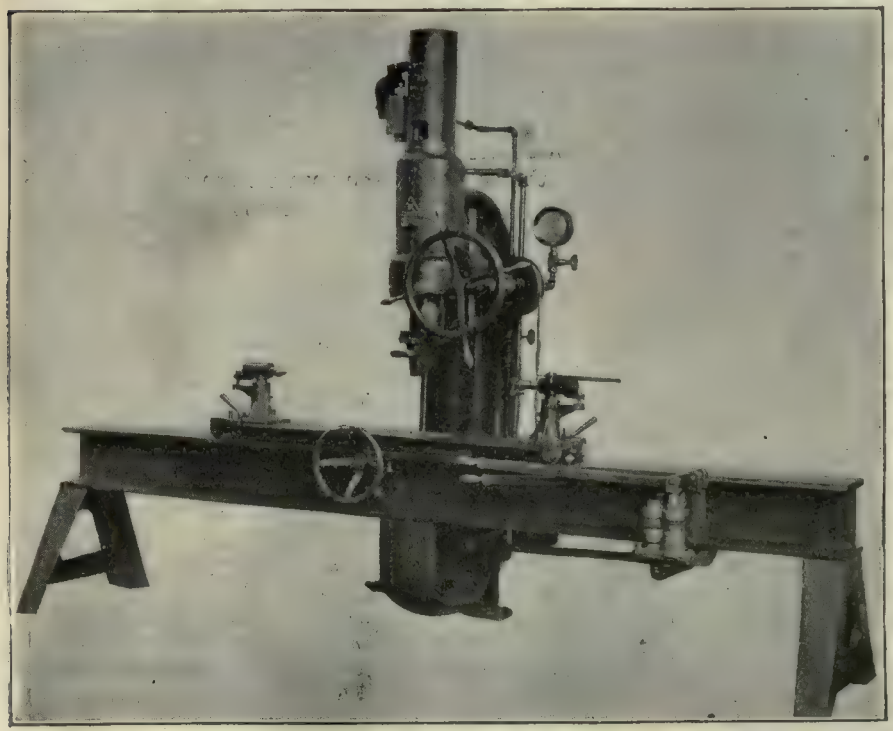


FIG. 6. METALWOOD NO. 597 PRESS FOR HEAVY DUTY ON TRACTOR-ENGINE CRANKSHAFTS

Pipe Dreams of a Tramp Machinist —How Dave Became a Baptist

By Glenn Quharity

The drafting room at the Brookdell shop is a long and rather narrow room with windows on only one side—the north—and is reached by a flight of steps (or maybe I should say, a stairway) from the machine shop. The part of the building which it occupies is a comparatively recent addition to the Brookdell factory.

Perhaps the meaning that I attach to the word "recent" would be better appreciated if I admitted that anything happening since the days of my apprenticeship, about forty years ago, is recent to my grey whiskered memory. The room, though conveniently situated, is sufficiently detached from other parts of the shop, where noise is a part of the production, to be reasonably quiet and conducive to that concentration of mind in which designers and draftsmen are popularly supposed to do their work.

Walking up the length of the cool pleasant room one of these warm June mornings, it is difficult to visualize the little, dark, corner room up under the roof that was the "drafting room" of my boyhood days. This room was three long flights above the machine room, was lighted by two small cobwebby windows, and the ceiling overhead was the floor of a low, almost inaccessible, attic.

It was not ideally situated for a drawing office. One of the windows facing south and the other west, let in plenty of sunlight in the summer; especially in the afternoon. With a blazing July sun pouring down directly upon the metallic roof, it was never uncomfortably cold at this season of the year; but in December, when the sun got down behind the woods to the south, a great responsibility rested upon the one little coil of steam pipes that was supposed to keep the place warm.

The drafting room of the old days was not always, and indeed not frequently inhabited. Charlie Pratt, and later, Tom Jones, were pretty well posted in the art of drafting, and Charlie in particular, for a man who looked like a well-to-do farmer, could make a remarkably neat drawing when he chose to do so, but they were both too busy thinking up ways to keep things moving to spend much time "up attic." They were much more likely to make pencil scratches on a pad or the back of an envelope and pass them over with mysterious but meaningful gestures and fragmentary explanations to Dave.

Dave was a specimen of the genius "all round mechanic" now apparently extinct, but once plentiful. He could do stunts on lathe and planer that would make the apprentices green with envy. Although milling machines were not then what they are now he could



perform feats of wizardry upon them that would bother some of the modern "experts." He could wash his hands, take off his jumper, walk up three flights of stairs and be transformed into a pretty good all round designer and draftsman.

Dave was by no means the only one of the Brookdell force that could do these things, but he, perhaps, put in more time than anybody else in the little drawing room, and he it was that sat at the board on the afternoon of the Great Storm.

Everybody who lived in Brookdell remembers that storm; they remember how the lightning crashed in the woods; how the howling wind uprooted trees and threatened to take the roofs off the buildings, how the heavenly aqueduct busted all to smash and let the celestial water supply down on Brookdell in a lump.

Dave was not a hysterical individual. If he had a temperament he had never found it out, and he wouldn't have let it worry him if he had. Just now he didn't even know it was raining until a drop of water about the size of a marble splashed down on the drawing in front of him, narrowly missing his nose.

He glanced hastily upward and saw suspended over his head another drop that looked as big as a base ball. Without a doubt the roof was leaking. Here was something that called for instant action and he was equal to the emergency.

In a corner of the room stood a large brass shell, the first or second draw from a set of drawing dies recently completed. Dave hastily grabbed up the shell, also some screw eyes and a piece of string from the shelf, drew a sheet of heavy wrapping paper over his drawing and climbed up on the board.

Fortunately it was not a twentieth century drawing table or Dave would have met with disaster then and there. The home-made bench was strong and sturdy and from its vantage Dave had no difficulty in driving three screw eyes into the ceiling, punching three holes in the edge of the shell with an awl that had been lying on his board, and with the string he soon had the shell hung up in position to catch the drops of water as they oozed through the planking.

A temporary solution? Of course it was, but Dave had never seen *that* storm before, and upon the immediate relief from the disagreeable features he went back to his drawing and again forgot that it was raining.

Nature, however, does not forget. The drops continued to fall into the shell and they soon became a rivulet. There was a limit to the amount of water that the shell would hold, but there was also a limit, slightly lower, to the amount of weight the strings would bear.

Just as Dave was rounding out the curves of a particularly crooked cam or brushing away the last difficulty from the path of a complicated mechanical movement, one of those strings broke.

It doesn't require a college educated M. E. to discover that from a body suspended in equilibrium that shell had become a lever of the first class in which P = several gallons of water, F = the short edge of the shell bearing against the planks, and W = a darn sight more than the remaining two strings could stand.

There is no hesitancy about the working of natural laws. From the breaking of the first string to the completion of the cycle of mechanical movement there elapsed only sufficient time for Dave to turn his face upward and meet with a veritable Niagara. For the first time in his life Dave was "soused." Pens, bottles of ink, and everything else movable was swept off the



board, the drawing was ruined, and Dave himself resembled a scarecrow that had been out in the rain all night.

Though no one but Dave was present and his own later account of the incident was prosaic and uncolored as befitted a modest and self-respecting mechanic, it was understood by his friends to have been a moment of religious rite and solemn incantations.

Dave had become a Baptist.

Some Present-Day Research Problems in Electrical Engineering*

By PROF. VLADIMIR KARAPETOFF
Cornell University

While the title would indicate an electrical treatise there are no technical developments and the general nature of the subject matter renders the assertions applicable to research in all lines.

THE most natural division of unsolved problems would be according to the types of apparatus, for example, into problems in the design and operation of large turbo-alternators, improvements in lamps, circuit breakers for larger currents and higher voltages, etc. Such problems may be multiplied ad infinitum, and I should not venture to express my personal opinion upon their relative importance. For the last three years the *Electrical World* has had a research page on which anyone interested in the subject will find hundreds of opinions expressed by competent men as to the specific needs for theoretical or experimental research in practically every branch of the electrical industry. I wish to offer another and somewhat unusual classification for the pending research problems which may be more helpful to those interested only in the broader aspects of research.

Caliber of Investigator

One division of research problems that seems to me to be quite essential is based upon the caliber and mental equipment of the investigator himself. There are problems of great practical importance which can and will be solved by the expenditure of a sufficient amount of money and time. Thus, during the war the shortage of certain materials led to a large number of tests on substitutes, and in some cases satisfactory materials were found by men of average ability and education. A large number of such tests, sometimes dignified by the name of research, is being carried on all the time. For example, there are certain varieties of mica on the market, or lubricating oils offered by the principal concerns, and comparatively simple tests permit determining the kind best suited for a given purpose, without employing men of unusually high caliber.

At the other end of the scale we have researches which require men of exceptional intellectual power and of wide erudition; researches which have baffled the most persistent efforts of many years, and problems which remain unanswered in spite of the most alluring financial inducements. A reliable high-tension insulator and a simple variable speed alternating current motor may be mentioned as two such examples. In between these extremes there are innumerable gradations of mental caliber required for the solution of different kinds of research problems, and a clear realization of this fact is of utmost importance in the cultural development of the country. The tendency is to lay too much stress on material resources, equipment, and other external factors. A few men of superior caliber and thoroughly trained will accomplish results on which thousands of less gifted and not so thoroughly trained investigators may work for many years without much progress.

The necessity for better care of persons of exceptional scientific intellect is so urgent that it is legitimate to ask ourselves what our Government, leaders of industry, educational institutions, or any other agencies are doing in this direction. The answer is *next* to nothing. Moreover, in this imperfect world of ours it is no one's particular business to attend to the proper development of geniuses.

I do not have in mind a somewhat utopian scheme of breeding a race of intellectual giants by careful mating. I have in mind a perfectly feasible scheme of detecting exceptional children by suitable mental tests and then guiding them year after year to the full development of their mental powers. This is a proper function of the state and some day will become a reality.

Pure and Applied Research

Another classification of research problems is in accordance with their proximity to or remoteness from the direct industrial applications. A certain physical phenomenon, a mathematical formula, a peculiar alloy, etc., may, up to a certain time, possess no practical importance and be merely a subject of personal interest to a few investigators. Then one day someone discovers that that particular alloy or formula offers great practical possibilities and it becomes the subject of extensive industrial researches.

While such a state of affairs may seem perfectly natural and unavoidable, it has certain serious drawbacks for the best development of the art. The electrical industry owes many of its triumphs to so-called pure physical research, but until recently this industry offered mighty little encouragement to such research or to its exponents. Had the leaders of the electrical industry realized, earlier, the tremendous possibilities of physical research in improving commercial apparatus, then, instead of sneering at "doctors," they would have used their talent long ago, and we would have been much further advanced in the applications of electricity than we are now.

But it may be retorted, the scope of physics is infinite, and how can an industrial concern keep on sinking hundreds of thousands of dollars year after year on the mere possibility that some of the results of physical research may at some time prove to be of use to it. The real situation is this: Physical, chemical, or mathematical research involves first of all a method of approach, a method of attack of a certain group of related problems, based on a thorough familiarity with the resources of that particular science. Promotion of research, therefore, consists primarily in the encouragement of the study and further development of such methods and not in the acquisition of a large number of unrelated facts. A scientist trained, say, in alter-

*Address delivered before the Erie, Pa. Section of the A. I. E. E. on May 17, and the Cleveland Engineering Society on May 18, 1920.

nating currents will be prepared to approach a new problem in this field with much better chance of success than one who has had merely general practical experience and beats about the bush in an effort to discover a short cut by luck.

Thus the promotion of pure research is another national problem and the first aim must be the training in the methods of analysis, general laboratory methods, the ability to find what is already known, the use of mathematics, the use of methods borrowed from other branches of science, general accuracy of measurements, of computations, of statements, and last, though not least, that loving attitude toward nature and the intuition that comes only from a first-hand contact and observation of actual physical phenomena without any preconceived theory or utilitarian thought.

In the early development of our industry we sneered at all research, then we called plain testing research, later we grudgingly tolerated industrial research, that is, an investigation of a particular piece of apparatus in its complexity. Finally, it began to dawn upon some of us that an investigation of the very physical elements which enter into that particular piece of apparatus may lead to interesting discoveries. In this way it gradually became clear that a thorough investigation of the physical laws governing this or that branch of industry may be the quickest and the surest way toward remedying the difficulties in the operation and construction of certain pieces of apparatus. I should not be surprised if in a few years we should make a fad of pure research in industrial establishments and overdo it as we overdid safety, efficiency, patriotism and many other good things.

Experimental and Theoretical Research

The next division of research problems is into experimental, mathematical, inventive, critical, indicative of new fields, etc. A clear understanding of this division on the part of investigators themselves and of their business managers will help scientific progress materially in that it will allow each one to apply his effort, imagination, and inspiration where it will bear the best fruit and it will enable two or more investigators to combine their efforts without jealousy or duplication.

Almost any big research problem involves some theoretical study as well as experimental skill, inventive ability, and patient search for the work of other investigators and its critical analysis. Only a very few investigators possess all these accomplishments to the same degree, and it is in the hands of a harmoniously organized group of scientific workers of different talents that research leads to gratifying results.

A chain is as strong only as its weakest link. Many a research worker struggled in vain with a problem for which he was eminently fitted, just because he failed to recognize this one weak link in himself or was too proud to ask for help on some particular point of difficulty.

The Anglo-Saxon race is individualistically inclined perhaps to a greater degree than the other civilized races. The Americans among the Anglo-Saxons are especially prone to exhibit the Western pioneer spirit in research with all its virtues and shortcomings of which the utter disregard of the work of preceding investigators is perhaps the most characteristic one.

I do not mean to imply for an instant that an original thinker should be hampered in the flight of his fancy by laboratory assistants or by skilled mediocrities, in the name of a misapplied principle of co-operation. I mean two other things. First, to clear a big idea in his mind, he ought to know how to let go of it and allow his assistants to play with it for a while and see how it shapes itself in detail. Secondly, if in the preliminary molding of his ideas, he should be handicapped by his lack of mathematical ability or of foreign languages (two handicaps common in this country) let him not try to solve the problem in an imperfect manner alone without first having exhausted the possibilities of associating with other gifted and congenial minds who may furnish the missing needs of the problem.

An outsider and often a manager think that research men specialize by subject, so that one knows all about direct-current machines, another all about transformers, etc. While to some extent this is true, yet there is a much more thorough-going and desirable specialization according to the nature of the man's talent. One is especially gifted in arranging ingenious methods for accurately measuring difficult quantities, whether it be in a.c. or d.c. machinery, another can skilfully present a phenomenon or a relationship in a mathematical form, a third is particularly adept in finding out quickly and accurately all the preceding contributions on the subject and in assigning the proper relative value or trustworthiness to each.

Possibilities of Co-operation

The possibilities of co-operation in research on the part of persons of different temperament and ability go far beyond the confines of one industrial organization or even one country. International co-operation in research is just as important in view of the favorable and unfavorable racial idiosyncracies. Anyone who follows European scientific magazines cannot fail to notice these racial distinctions in the treatment of distinctions in the treatment of identical subjects.

A student of the history of science can easily recall cases in which a scientific idea is born in one country and then is taken up by someone in another country and finally brought to a fruitful development in a third country.

Perhaps the best-known example in our line is that of Hertz, a German, who acted as an intermediary between Maxwell, an Englishman and Marconi, an Italian. A biologist could easily get examples of living organisms which have to live under different conditions at the various stages of their development. Thus the rust of wheat must live on barberry before it can live on wheat. We in this country, with its polyglot population, have had an exceptional opportunity to observe and to benefit by this co-operation right in our midst, even though in our Anglo-Saxon arrogance we are apt to look down upon our brothers from across the seas. There is hardly an organized institution for research in this country that cannot point to benefits derived from associates of foreign birth and training and point of view.

In conclusion I wish to point out that while first-class original investigators are born and not made yet there is a great problem before our leaders in politics, industry, and education, to facilitate the work of such men by granting favorable conditions for their creative activity. We ought to do this for our sake and for that of the coming generations. It is in the hope of contributing to the clear understanding of the conditions

that promote the welfare of research workers that the preceding remarks are made.

(During the address Professor Karapetoff gave examples of electrical research done or suggested by various prominent investigators. These illustrations were mostly from the items published on the Research Page of the *Electrical World*.)

Trade Papers

By E. F. Creager

[How I Read Mine and How I File the Information for Reference.]

Being away from home I purchased at a news stand a copy of a trade paper that I am a subscriber for. The salesman said, "Heluva lot of advertising in that there magazine. It will take you a long time to dig down to something interesting." He, like many readers, just viewed the advertising pages as an extra. I do not feel that I have done full justice to myself if I do not carefully scan the advertising section for something new. With pencil in hand I glance through the index of reading matter and find several articles of interest to check up. One appears exceptionally interesting since I have been preparing an article on that particular subject so I read and mark it for my files and feel that I have my money's worth from this one article. Another article shows how one plant makes something similar to our product and I compare and criticize but see no reason for changing our methods. We get more pieces at a lower cost for tooling up, produce faster from a less expensive and simpler machine tool and do at one operation what requires two in theirs. Of course I feel elated and will grab my notes when I get home and clear up some points that seem vague and give the other fellow a chance to see if he is as well pleased after reading my article. (Of course you all try to give back something from your own experience in exchange for what you get from the other fellow, don't you? If not, why not? 'Tis only fair). Here is an article on a common every day tool and its life. I mark it up and will prove it out later by trial.

Here is another on metals which I read with interest and mark for filing. Now here is a punch and die and that "wrinkle" on it is just what we want and I'll bet "Jack" will be pleased when I show it to him. The Ideas and Sketches by Practical Men are always interesting, and usually yield something for the files.

The description of new tools is gone over, and I am well satisfied with my purchase. Got more this time than usual, but never fail to get something. Now I read the advertisments and begin to cull the book. These advertisements are to me the most up to date catalog I can get. Each advertiser is trying to impress the reader with the advantages and economies of his machine and unconsciously calling attention to the weaknesses of others. This machine has good points in design that I will suggest to our designer. That one shows a new idea in tooling up.

Here is a fixture, first time I ever saw it illustrated, I will write for description and prices. Another advertiser tells of the output he is getting and as the piece is similar to one we are making, and I am either "chesty" if we are getting more or depressed if we are getting less.

Here is an advertisement which answers a question asked by one of our engineers just yesterday, and as a result the advertiser will get another order. So on through the book, I mark those I desire to save and these are torn from the book and are readily filed in my vertical filing cabinet scrap-book.

I use a standard steel filing cabinet that will take a full size letter sheet and make my folders shown in the illustration from a sheet of gray fiber "Fish Paper" 12 in. x 24 in. From this I make a folder 12 in. wide, 9½ in. deep with a 5-in. flap. This will just take a page of the regular trade journal and the flap prevents it from flying open and gives a splendid place to mark the title or contents.

I find this an ideal way to file the various leaflets and pamphlets describing various articles which are ordinarily so hard to locate in the usual catalog file. In this way I get all my notes and data indexed with the minimum of effort, and have an up to date general



THE LOOSE-LEAF FOLDERS

catalog of information on subjects appealing to me. I have purchased many machines first brought to my attention in this way and frequently have been able to sell the "powers that be" when in doubt, by having the data and illustrations at hand.

At the present time, I have over two hundred subjects and folders in use, many of them cross indexed, and I can assure you that they are in frequent use by myself, my tool designers and the purchasing department and have earned many dollars for the firm. I consider them the most valuable section of my rather comprehensive mechanical library. I can pull out the folder on the subject I desire and have before me practically all the live articles on that particular item. A suggestion from this one and another from that one and a few more added and I have data for a new and original (?) machine which sometimes works as anticipated.

I may say in closing that a few former contributors to the *American Machinist* are conspicuous by their absence. Prof. John Sweet with his common sense articles and Chordal whose letters will be sadly missed by many, especially the old timers.

Accurate Lapping

By L. J. VORHEES
Industrial Engineer

Accurate lapping is an art practiced by tool and gage makers. Very few machinists of the present-day school know much about it. The author of this article gives detailed instructions for gage lapping as well as for making the laps.

IN THE larger and better equipped toolrooms there is usually at least one man experienced in lapping so that this work is handled in a satisfactory manner. But in the average, and larger majority of shops each toolmaker does his own lapping, and this, in many cases, is far from satisfactory. Many times work is either sent out of the shop on account of the trouble experienced in lapping, or an inferior grade of work is tolerated.

It is not the purpose of this article to start a controversy on the subject of lapping, or to infer that any method in use at the present time is not all right in every respect. What I desire is to explain a method of lapping in detail and with such clearness that any toolmaker, by following it, can produce gages that no shop need be ashamed of.

As plug gages under one inch in diameter are the most common, they will be taken as an example, and the method by which they are lapped can be applied to most other forms. As this class of work does not require the accuracy which is sought by aging the steel after it is hardened, this will not be considered. Whether the gages are made of tool steel and hardened, or of machinery steel and casehardened, will not affect the operation of lapping, so we will assume that the gages have been turned and hardened. If they are boiled in water for several minutes after they are hardened it will tend to remove the strain and lessen the danger of their cracking.

The centers should be carefully lapped, or ground out, making sure that all scale is removed and that they are left round and smooth so as to fit the centers on the grinding machine. A wet grinding machine is better than a dry for this purpose. A fairly fine, free cutting wheel should be used, its cutting face should be trued with a diamond, and the width of the face reduced until it will pass off the portion of the gage that is being ground at each end of the stroke of the grinding machine table, or wheel, whichever moves. The machine must be adjusted until it grinds straight, that is, grinds the plug the same size at each end, *and this should be as accurate as you can measure.*

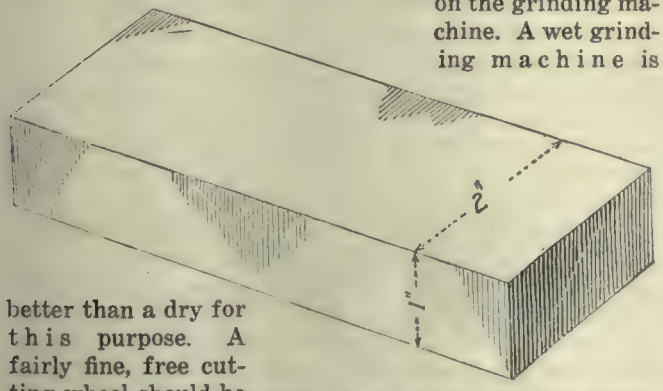
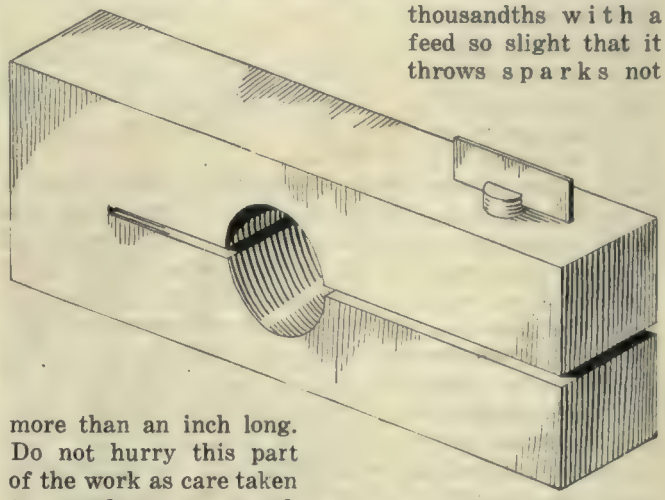


FIG. 1. THE BABBITT BAR FROM WHICH LAPS ARE CUT

Leave no inaccuracy to be removed or corrected by lapping. The lapping should remove the marks left by the grinding wheel and no more. If the grinding is properly done two ten-thousandths of an inch is enough for this. If you leave more it will require elbow grease to remove it. If you cannot remove the wheel marks in two ten-thousandths, improve the quality of the grinding until you can. Let the wheel travel over and over the plug in removing the last one or two ten-thousandths with a feed so slight that it throws sparks not more than an inch long. Do not hurry this part of the work as care taken to produce a round, finely ground gage, with just ten-thousandths left for lapping, will save time later on. With the gage in this condition you should do the lapping in a few minutes.


FIG. 2. A COMPLETED LAP

Use Babbitt for Laps

Use common babbitt metal for the lap. For plug gages a half inch in diameter, or under, it is convenient to use a bar about one by two inches so that the lap blanks can be sawed off from this end as in Fig. 1. The lap blank should be sawed off so it will be about as thick as the diameter of the plug, but this never need be less than one-quarter of an inch for any plug, no matter how small the diameter.

Drill a hole through the center of the blank the size, or slightly smaller, than the diameter of the plug to be lapped. Start a saw cut in the center of one end, parallel to the drilled hole, and saw down through the drilled hole and out half way to the opposite end. This will permit the hole to be closed around the plug. In the end in which the saw cut was started, about half way between the hole and the end of the lap and at right angles to the hole, drill through with a drill that is the tap size for a No. 10 machine screw, for instance. Enlarge the hole from one edge down to the saw slot with a drill that is the body size for a No. 10 machine screw, and tap the other side with a No. 10 tap. By screwing a No. 10 screw in this hole from the side that is not tapped it will tend to draw the sides together, which later will close the lap around the plug. For convenience a piece of flat stock may be soldered

in the slot of the screw so it can be tightened with the fingers. Fig. 2 shows a lap ready to use.

Assuming that you have turned the handle and body of the plug in one piece, place the handle of the plug in a spring collet of a bench lathe, preferably, and leave a space between the body of the plug and the spring collet equal to half the diameter of the plug. Loosen the screw in the lap and open it until it will slide over the plug easily. Place it over the body of the plug. Remove the center from the tailstock and move it up until there is the same space between the plug and the tailstock as there is between the plug and the collet.

Secure a shallow dish that will set on the bed of the lathe and is large enough to catch the oil and abrasive that drops from the plug and lap. *Do not use abrasive flour, or powder. Do not think that the finer the abrasive, the finer the finish.* Grains, or size, *160* to *190* are about right. Mix a small quantity with common light machine oil, using enough oil to cover the abrasive well. Adjust the lathe belt until the lathe runs quite slow, not more than two or three hundred r.p.m. and stop the lathe while you charge the lap. This is done by working a layer of oil and carborundum in between the plug and the lap, the lap being opened until it is very loose on the plug, and then tightening the lap on the plug by means of the screw. The abrasive that is between the plug and the lap will be *imbedded in the lap.* If the abrasive is too fine, or the lap too hard this imbedding cannot take place. Fig. 3 shows the way the lap is used.

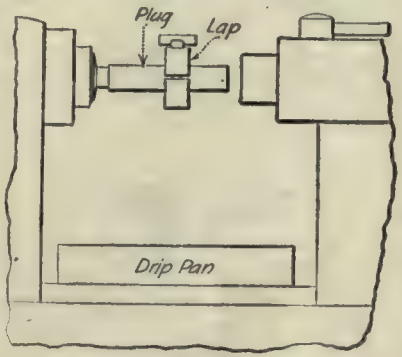


FIG. 3. PROPER POSITION OF WORK FOR LAPPING

Now to start the lathe, stand close to the tailstock, reach over the lathe with one hand so you can hold one end of the lap in each hand. As you push on the lap gently it will travel from one end of the plug to the other. The collet preventing it from slipping off at one end and the tailstock at the other, though they allow about *half of the lap to project over each end of the plug,* before it is stopped by butting against them. As you are now sure there is no danger of the lap slipping off the plug, try to hurry it, that is, make it travel faster from one end of the plug to the other. As you use more pressure you will reach a point where the lap seems to let loose and slides rapidly the length of the plug until stopped by the collet or tailstock. *This is the action of the lap you should maintain at all times.*

Run Work Slowly—Move Lap Fast

One of the chief points of good cylindrical lapping is to *run your lathe slowly and move your lap fast.* Jerk it rapidly from one end of the gage to the other. When the slight scratches on the plug, produced by the lap, cross the plug at an angle of about 45 deg. you will know that the speed of your lathe and lap is about right. With this method of lapping it will not be necessary to leave a projection on the plug to be removed after it is lapped in order to prevent the end from being rounded off. This method gives you ends that are full size and square. Keep plenty of oil on the lap and when it seems to have stopped cutting charge it again the same as you did the first time.

Never add fresh abrasive or try to charge the lap until you have stopped the lathe and opened the lap until it is loose on the plug. Pry the lap open with your screwdriver until it is $\frac{1}{32}$ *of an inch larger than the plug.*

Keep a dish of gasoline that is about room temperature near the lathe and each time before you measure the gage dip it in the gasoline, and leave it until it has cooled to the temperature of the gasoline and room. As it gets nearer the finished size take more pains with this cooling.

Do not freshly charge the lap to finish the gage. Arrange to do the last lapping, and finishing, with a dull lap. When the gage is lapped almost to size, wash both it and the lap in gasoline, put on a little oil, and finish the lapping with oil only; this will give a smooth finish. If you want to still further improve the looks of the gage, after it is lapped to size, wash it and the lap in gasoline until they are free from oil and put the gage back in the lathe and start lapping while still wet with gasoline. Watch the gage as you lap and you will see it dry off leaving a slight film which the lap will pick up, when dry enough. Keep on lapping after this film is picked up and you will produce a high polish almost entirely free from scratches. This description sounds long but when you become familiar with it you will lap a gage in just a few minutes.

To lap a ring gage prepare a lap of babbitt metal as described in almost any treatise on lapping, charge it with abrasive that is not too fine, revolve the lap slowly but move the work over it with a rapid reciprocating motion, in other words, grasp the work in both hands and jerk it from one end of the lap to the other rapidly. I want to emphasize this fact strongly because it is usually the custom to revolve the work rapidly, as where a plug is held in a chuck, and to move the lap back and forth slowly.

Dry Lap for Flat Surfaces

In lapping flat surfaces run a lap of babbitt on a backing of cast iron. Any convenient metal may be used in place of the cast iron as its purpose is merely to stiffen the lap. Plane the surface of the lap as smooth as possible. Sprinkle abrasive over the surface *and rub it in* with a piece of hardened steel, which may be ground flat and smooth and kept for the purpose. Don't use too much abrasive, as a little will rub into the lap, and charge it, better than a larger quantity. After rubbing over the surface of the lap twice, using short strokes and considerable pressure, brush off all free abrasive and carefully rub the work to be lapped over this surface. It is not necessary to use oil on a flat lap, in fact, I believe it works better dry.

Now here is a point to be remembered by the inspector as well as the workman. Everyone familiar with lapping knows that a soft spot in the gage will pick up the abrasive used in lapping and leave a dark, dirty looking, spot. A visual inspection for hardness is all the gages usually receive, as it is assumed that if they were not properly hardened that these black spots would surely show. But such is not the case.

After a man has carefully made a gage and during the process of lapping finds there is a soft spot in it, he dislikes to throw it away. Therefore he will try to save it, if he possibly can, which means that he will try to cover up, or remove, the spot so it will not be

noticed. He can do this too; as a little careful rubbing with a piece of crocus cloth will remove the imbedded abrasive and make this black spot look just like the remainder of the gage so that a visual inspection will not disclose it.

Therefore when you inspect a hardened and lapped gage go over the surface carefully with a very hard, sharp pointed, instrument. Do not use pressure enough to scratch the hardened surface of the gage. You can easily tell the soft spots by the way the instrument cuts into the surface, and drags, instead of slipping easily.

Regardless of the means employed to determine the size of the gage you will find that this method, if followed carefully, will give all the accuracy and finish required.

High-Speed-Steel Tools for Turning Tires

By Frank A. Stanley

The practice of the Southern Pacific shops at Sacramento in respect to the making of high-speed formed tools for turning tires is represented by the illustrations herewith.

The solid or one-piece formed tire tool of high-speed steel has of course been long out of the question, leaving as an alternative the built-up tool with a section of high-speed steel secured to the body of carbon steel. At the shops noted the cutting-tool proper is forged to approximate outline of the contour required and very little material has theretofore to be removed to shape the tool to exact form.

In Fig. 1 a high-speed-steel cutting tool forged closely to shape is shown in the lower left-hand corner of the group. Directly over this or in the upper left-hand corner is a carbon-steel block which is milled out to form the holder or base for the high-speed tool. The appearance of the holder after it has been cut out for the welding in of the cutting tool is seen at the right, and in the lower right-hand corner is the finished tool ready for service.

A group of tools with the high-speed portions welded on is shown in Fig. 2, this illustration showing the tools before any machining cuts have been taken in finishing the working surfaces of cutting-edge proper.

The sketch in Fig. 3 shows the manner in which the holder is cut away in step fashion to provide liberal

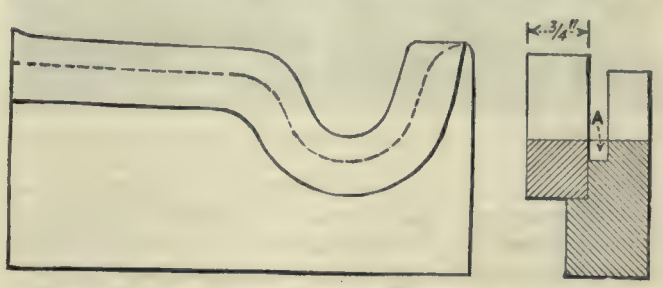
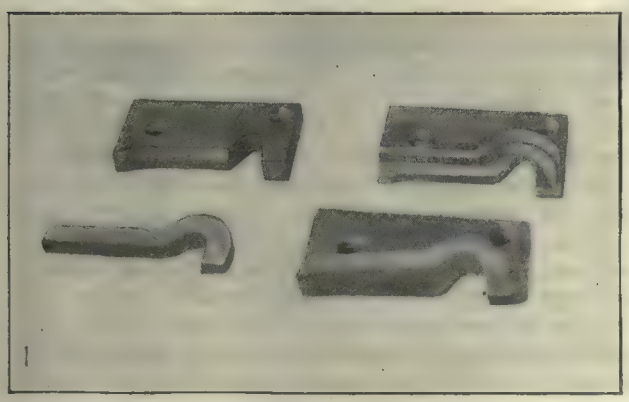
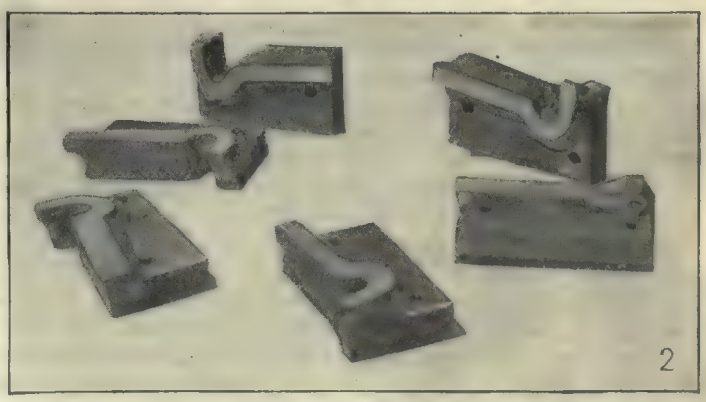
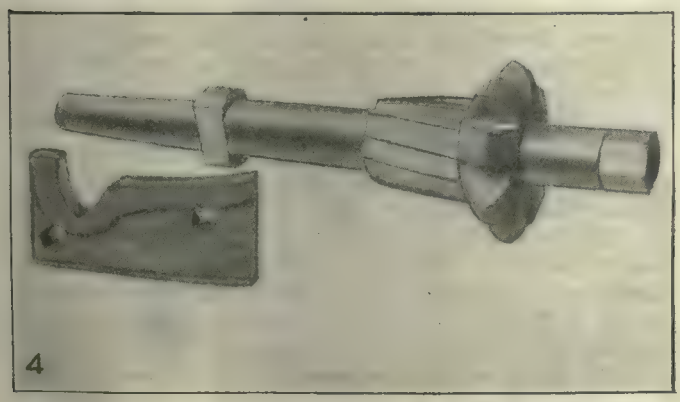


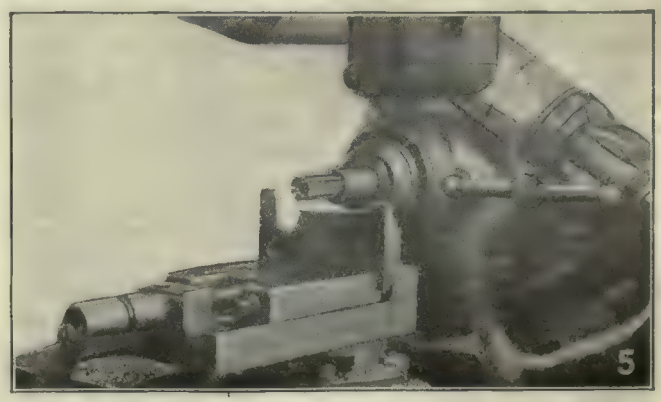
FIG. 3. HIGH-SPEED-STEEL TOOL AND BLOCK

space at *A* for the flowing in of the welding steel under the action of the acetylene torch or the electric arc. The high-speed tool itself is made a little over ¾ in. thick in the rough so that it will face down to ¾ in. in grinding. It is afterward used down to a thickness of ⅝ in. so that the life of the tool is over an extended period. The holder or base block is cut out to the form of the high-speed section and milled away at the front to give ample clearance behind the cutting edge. These tools are made in lots of a half dozen or more and the work is facilitated by the use of special cutters in the milling machine.









FIGS. 1, 2, 4, 5. THE TOOLS AND HOW THEY ARE MADE

Fig. 1—Tire tool before and after welding. Fig. 2—Group of right- and left-hand tools ready for finishing. Fig. 4—Cutters for milling the tool edge. Fig. 5—Milling the tool block.

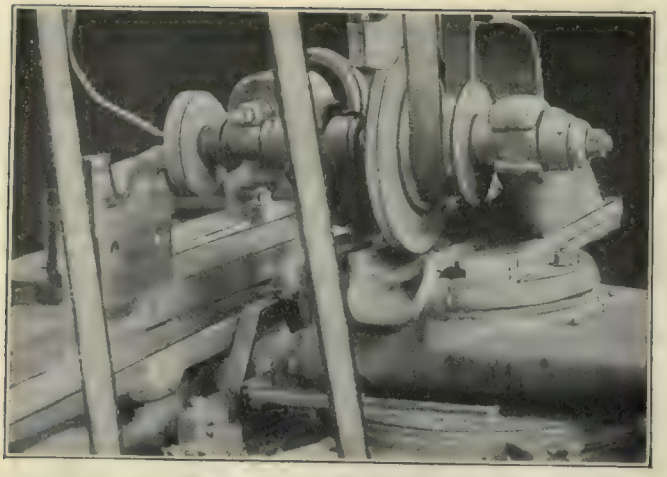


FIG. 6. GRINDING THE FACE OF THE TOOL

Fig. 4 shows the pair of milling cutters for forming the high-speed cutting edges. The deep cut in the tool for finish-forming the flange on the tire is milled out by the large cutter; the cutter at its side on the arbor is a spiral mill ground to proper shape to form the portion for machining tread of the tire.

In Fig. 5 the milling machine is shown set up for milling the edge of the tool block to form the clearance under the lower edge of the high-speed-steel section and to provide the seat for the high-speed section itself. The section through the tool and block in Fig. 3 shows the shape of the work at this point.

The method of grinding the top face of the tool in preparing it for service and for resharpening it as it becomes worn in operation is illustrated by Fig. 6. An angle plate is secured to the reciprocating table of the grinding machine and the toolholder is fastened to the upright of the angle plate by two bolts tapped in from the front. The work is then passed to and fro across the face of the cup wheel.

The cutting edge of the tool is finished in the milling process to a front clearance or rake of 7½ deg. The top face is ground out with a convex wheel to give a clean lip and provide a free cutting action along the broad face.

Why Work?

By Entropy

In these piping times of peace when everyone is thinking of everything except his duty, and when foremen dare not fire a workman for fear of starting a strike that will cost a great sum of money, the question is in many men's minds, "Why work?" Many are answering the question by not working any more than they can help, with the result that time hangs heavy on their hands, the eight-hour day seems longer than the ten-hour day ever did and the ascending spiral of cost of living mounts faster and faster.

But what are the incentives to work hard? Each man as a unit produces so little than it seems hardly worth while to make the effort. Individual effort brings neither additional money nor thanks, but only the disfavor of other workmen.

The only man who works in the real sense of the word today is the far sighted chap who can imagine the time when he wants a job and when a lot of other people want the same job. He is the man who understands that at present we are only kept in a stable position by spinning around like a top, and that when we begin to whirl only ever so little more slowly we are bound to tumble. It may be that we will tumble slowly, but it never has happened that way before, and it is very doubtful if it can happen otherwise than it has happened before. When the crash comes, and shops have to let men go, they always retain what they call their "organization" if it is a possible thing. By this they mean that essential minimum of men who are profitable and whose morale, instilled into the green men whom they will pick up when the tide turns, will build a harmonious force. This does not necessarily mean that they keep their most capable men, but the most dependable ones. It means the men who will work without watching, and who work intelligently always. It means the men who believe in the firm, even to the point where they will risk losing their reputations to back it outwardly, and will risk their jobs in criticising it mercilessly inside the shop, for the sake of bettering it. These men are perfectly well known to the management at all times. There is no need for a long notice of impending shortage of business to name the men who will be kept employed so long as the ship stays afloat. They are the men who work for the company's interest all the time.

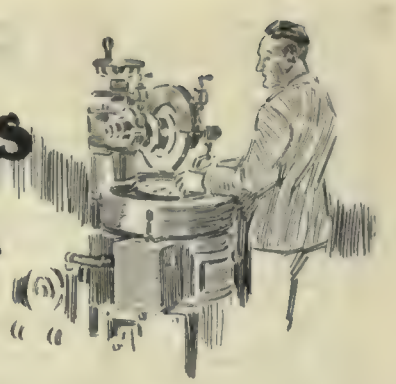
Just how good an investment is it for a man to do twice the work now that is necessary to hold the job? No one knows precisely but we know that for a long time back we have run on cycles of about ten or twelve years of which less than half have been spent in real prosperity and nearly all the rest of the time spent in climbing painfully out of the slough into which we have been precipitated almost over night. The fair weather man has had good wages less than half of the time since the Civil War, and he has had starvation wages the rest of it. He has had practically half wages for the past fifty years. The man who has stuck to the ship and done his work through thick and thin has had just as good wages during good times, and in proportion to the cost of living he has had more than good wages the rest of the time. He is at least twice as well off.

Exception to this rule is the fault of the organization, and we have to admit that there are many faulty organizations. Petty internal jealousies, lack of breadth of vision, and fear are the principal factors which hinder the complete reward of the faithful worker. Internal jealousies on the part of a foreman who does not want it known that a certain man is truly capable for fear that he will be promoted out from under him and he will have to break in another man to fill the place; on the part of fellow workmen who are resentful of the apparent favors which are shown men who are in favor and who deserve all that they get and usually much more. Lack of breadth of vision is a factor which is always to be reckoned with and absolute fear on the part of the employer is another thing which may warp his judgment, but on the whole, our employers are pretty level headed, especially regarding their own business. Of the two, more failures occur from too great optimism, too early a hope for a recovery of business than from too much pessimism. The jealousies of foremen and other workmen, are merely hazards of the process of getting ahead and must be reckoned with just as a farmer reckons with hail storms.

All-in-all it is really worth while to work, even though the returns for the moment may not seem to be increased by so doing.



Applying Magnetic Chucks to Best Advantage



by I. A. Hunt
Of the Heald Machine Co.

NEARLY every mechanic will tell you that he knows what a magnet is, but experience with magnetic chucks indicates that only a very few know its physical properties, with the exception of its ability to attract iron.

This is quite natural, for but few mechanics have the good fortune to be well posted in electricity. For this reason they are inclined to apply the magnetic chuck to only the simple jobs. This not only applies to war-made mechanics but to some of the old-time foremen, superintendents, and even proprietors of proved ability. Therefore a simple explanation of the physical properties of a magnetic chuck may help in getting the best results and in extending uses to work which may be thought impractical to hold in this quick and efficient manner.

The magnetic chuck has grown to be an indispensable tool in practically every machine shop, great and small, and while such chucks are very simple in construction and easily understood as to principle, there still seems to surround them an element of mystery that acts to prevent many machinists and toolmakers from using them to best advantage. The appended article from the pen of a man intimately associated with the manufacture of magnetic chucks should serve to sweep away some of the mental cobwebs and make clear to everybody the possibilities and limitations of this tool.

The magnetic chuck utilizes the same power that turns an electric motor. A magnetic chuck is simply a single electromagnet, like Fig. 1, or a group of them, arranged so that their ends or poles will make contact with the work and so hold it firmly in position by its pulling power. In order to really understand how to secure the best results from this peculiar holding power a bit of the theory of magnetism will be helpful, but this will be better appreciated if reference is made to the misuses of the magnetic chuck.

Some operators do not realize that the more closely the work makes contact with the chuck the more firmly it is held. Another weak point is the fact that they do not know that every magnet has two poles, a positive and a negative, and that the pulling power travels from one pole to the other. Consequently, it is necessary that the work make contact with both poles to secure the greatest holding power.

The same principle is lost sight of when an operator tries to place parallels under the work, thinking that the magnetism will enter it and hold it. The trouble is that the magnetism finds an easy path through the parallels to travel from pole to pole and does not enter the work. Special parallels may be used that are designed to conduct the magnetism to the work and that will not cause it to find a shorter path through themselves as will be explained later.

Theory explains magnetism by assuming every particle or molecule of iron as being a magnet itself. Normally, these particles or molecules are located helter skelter with no particular relative position, as shown in Fig. 2. An electric current flowing continuously in the same direction has magnetic power which will turn these molecules all to the same relative position as in Fig. 3, and their influence, combined with that of the electric current, results in the magnetic holding power of the electromagnet. This holding power is referred to as "magnetic lines of force," and should be thought of as such in considering how to place work on a magnetic chuck, for it is by an understanding of their action that the best results are obtained. Magnetic lines of force travel easiest through soft steel and are resisted to certain degrees by cast iron, hard steel, and various compositions of iron. Air has a resistance 100,000,000 times as great as that of iron which readily explains why work must make pretty close contact with a magnetic chuck in order to be held firmly. Non-magnetic material, such as brass, lead, wood, etc., does not conduct magnetic lines of force. This explains the use of the non-magnetic metal surrounding the inserted polepieces that are readily distinguished in any magnetic chuck. If these poles were not insulated in this manner, the lines of force would escape from pole to pole and, thus finding a short path, would not enter the work.

Various Types of Chucks

There are, of course, several types of magnetic chucks and the foregoing principles apply to all of them. There are valuable points to be considered in selecting a chuck and these will be noted at the end of this article. All magnetic chucks, however, have either two magnetic poles, a positive and a negative, or a series of alternate positive and negative poles. This is necessary as the magnetic lines of force travel from the positive to the negative pole. This circuit is obstructed by the resistance of the air unless an iron path is made for them to travel in, as is the case when the work is placed on the chuck. Consequently, it is quite necessary that the work reach from pole to pole in order to be held

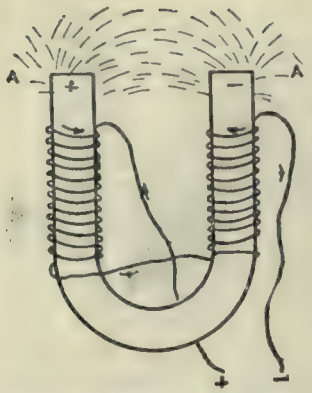


FIG. 1. A SIMPLE ELECTRO-MAGNET

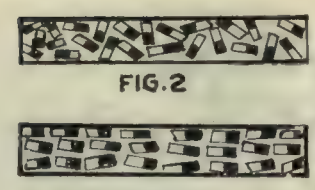


FIG. 2

FIG. 3

FIGS. 2 AND 3. ILLUSTRATION OF THE MOLECULAR THEORY OF MAGNETISM

firmly. If it is not large enough to do this the circuit may be completed by placing the pieces so that they touch each other, thus bridging the space between the poles.

Fig. 4 shows a common form of magnetic chuck with the top plate and a part of the body in section to show the way in which the magnetic lines of force travel. Here you will notice they pass up through the polepieces and through the work, also less readily through the air. From the foregoing it will be appreciated that a rough casting which allows plenty of air space between its surface and the poles of the chuck will not be held as firmly as would be the case if the surface was first snagged off to reduce the high spots, thus bringing the iron closer to the poles.

As only so many magnetic lines of force can enter a given area of iron, it follows that a piece of work covering three or four square inches of chuck surface will be held down stronger than a piece covering only one square inch. This not only applies to the width and breadth but to the thickness as well, because very thin stock does not allow enough lines of force to pass through to get a grip. This drawback can be remedied by laying a thicker piece of stock over one end of the work to be ground—increasing the path for the lines of force with corresponding increase in holding power.

Holding Irregular Shapes

Fig. 5 shows the way in which work presenting an irregular surface may be held on a magnetic chuck. An extra top plate, a duplicate of the standard top plate on the chuck, may be machined to fit the shape of the work and then screwed to the top of the chuck as shown. Of course, the chuck itself may be machined, but this spoils the chuck for other work and is apt to open up the joints in the top plate.

In Fig. 6 is shown a method tried by many mechanics

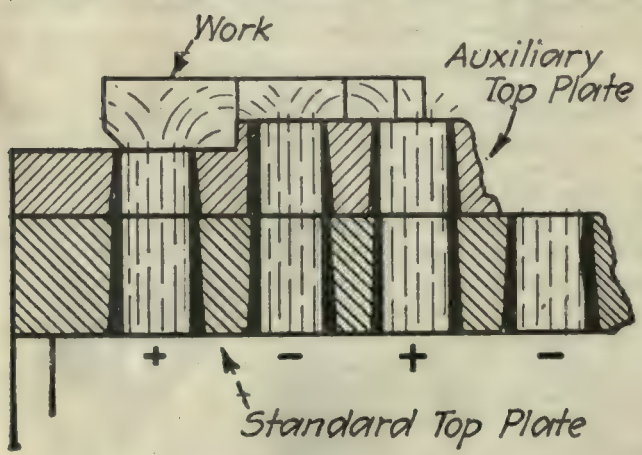


FIG. 5. AN AUXILIARY TOP PLATE

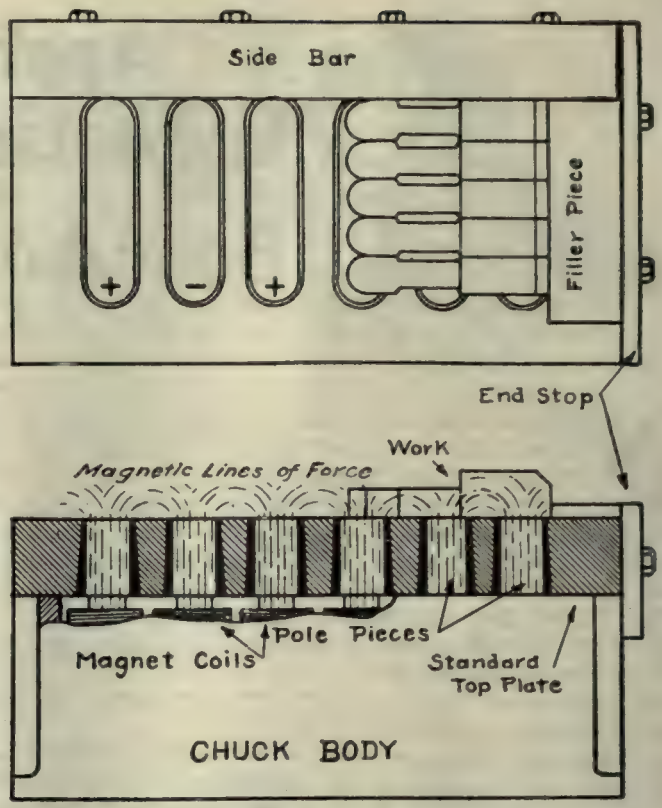


FIG. 4. SHOWING DIRECTION OF TRAVEL OF LINES OF FORCE

that is unsuccessful because the magnetic lines of force enter the solid iron plate and do not enter the work. This is practically the same thing as trying to use ordinary parallels on a chuck. It is absolutely necessary that the poles of the chuck be insulated from each other right up to the surface of the work, otherwise the lines of force will take the shorter path.

All magnetic chucks can be divided practically into two classes. The oldest type embodies the principle of a single magnet; the later types use a series of electro-magnets placed side by side, or, in the case of a rotary chuck, they are placed radially.

The Single-Coil Chuck

Fig. 8 shows, roughly, the principle of the original types. Notice that a single coil is used. One pole of the magnet leads directly to the top of the chuck; the other pole or end of the magnet coil is led around through the body of the chuck to the top.

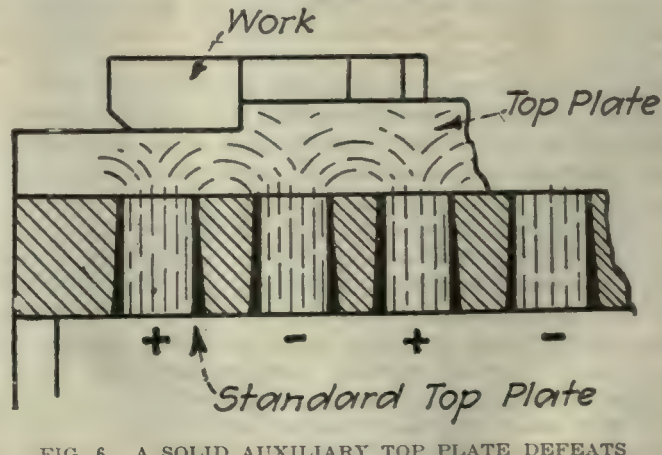


FIG. 6. A SOLID AUXILIARY TOP PLATE DEFEATS ITS PURPOSE

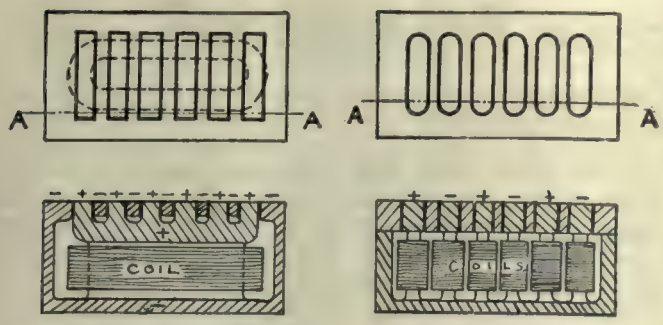


FIG. 7

FIG. 7. THE ORIGINAL FORM OF CHUCK WITH SINGLE COIL

FIG. 8

FIG. 8. THE MULTIPLE COIL CHUCK

This type of chuck is simpler to make but embodies two drawbacks. One is the fact that the roundabout path just referred to required for the magnetic lines of force to reach the top plate, dissipates them, resulting in a weakened chuck. Moreover, once the chuck is magnetized it is less easily demagnetized. The other objection is that the lines of force, in traveling this roundabout circuit, leak off into the table of the machine, and in time magnetize the table and the cutters or tools.

Multiple Magnets

The later types of chuck are as shown in Fig. 9. The number of poles is determined by the size of the chuck. Here you will notice the poles alternate positive and negative and lead directly to the top of the chuck. The magnetic coils are arranged so as to alternate, causing the bottom and body of the chuck to be neutral as is the case at the round end of the ordinary electromagnet shown in Fig. 1. The chuck is more readily demagnetized because the body and the top plate frame are neutral, the poles and cores only being magnetized.



FIG. 9. APPLICATION OF RETAINING RINGS

Any chuck should, of course, be water-tight and rigidly built Some are stronger than others and it is a good idea to buy a rectangular chuck with end and side stops, for though these may not be required for grinding purposes they are very necessary when milling or planing, and as you never know when the chuck will be transferred from a grinding to a milling machine it is well to be prepared In the case of rotary chucks, retaining rings can be used, as in Fig 10, to take care of excessive thrusts of the grinding wheel or tool.

Magnetic chucks have been successfully used to a limited extent on lathes where the work is of such a nature that driving pins or lugs could be arranged to drive the work, the chuck serving to hold it in place. A chuck arranged for use on the lathe is shown in Fig. 11.

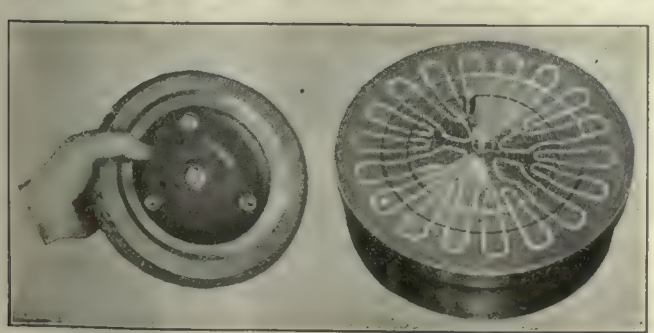


FIG. 10. ROTARY CHUCK WITH CENTER AND DRIVING PINS

Demagnetizers

A word about demagnetizers may be of value to many who are not sure, when buying a chuck for the first time, whether or not a demagnetizer is required. All chucks are furnished with demagnetizing switches which demagnetize the chucks and allow the work to be removed from it. If the work is of soft steel or cast iron and is to be used in a place where a slight amount of residual magnetism will not interfere, then no demagnetizer is required. But hardened steel and very hard cast iron retains magnetism, and in such work as dies, cutters, pawls, etc., where the magnetism would be a source of trouble, it can be removed by means of a demagnetizer.

The Oldest Form of Demagnetizer

The oldest form of demagnetizer is really a single magnet through which alternating current instead of direct current flows. The rapid reversals of polarity shake the molecules out of position and cause the work to be demagnetized when slid (not placed) across the extremities of the magnet. The later type is a hollow coil of wire through which alternating current flows, the work simply being inserted in the coil for an instant. This type is especially adapted to irregular shaped work and is very efficient.

Whenever trying out new work on a magnetic chuck be sure to recall every principle of the magnetic lines of force and how they act and you will be able to handle much more work in this efficient manner than the man who merely lays the work on the chuck in any old way and then condemns the chuck if it doesn't hold. A magnetic chuck will not hold everything, but like any machine, the more you know about it the more service you can get out of it.

Iron Castings In Iron Molds

By Elliot A. Kebler
President, Fawcus Machine Co.

Replying to the inquiry of A. W. Forbes on page 1311, vol. 52 of *American Machinist*, it is true that castings can be made in iron molds without chilling, and in fact there is a patent on such a process, which consists of removing the iron mold and also the iron core very quickly from the casting. If this is done within, say, three or four seconds, the iron is not chilled and in fact is malleableized and is, therefore, stronger than if cast in a sand mold.

A drawback about the process is that the iron molds bust be very thick, weighing two hundred pounds or more for each pound of the resultant casting.

The reason in my opinion why a permanent iron mold cannot be used is that each time the mold or the core is used it becomes slightly larger so that each casting made will be larger than the previous one.

How Can We Increase Production?*

By SIDNEY J. WILLIAMS
Secretary and Chief Engineer, National Safety Council

PRODUCTION depends primarily on two factors—machines and men. Production also requires materials, but these in turn are produced by other machines and men—using "machines" broadly to include all equipment. Production also requires capital to provide the machines and the men, and management to direct them. But machines and men are the immediate producers. They and they only can increase or decrease production. The things that cause them to do the one or the other are the things that we must study.

The basis of modern production, with respect to both machines and men, is regularity—standardization. The Swiss watchmaker a hundred years ago built his watch from the ground up, fitting each part to the parts already completed, as a carpenter builds a house. He never made two watches exactly alike. I believe the Swiss watchmaker still follows somewhat the same method. But we in America make our dollar watches (which now sell for two dollars) and our two dollar alarm clocks (which now sell for four) with dies and jigs and fixtures; we stamp out the parts on power presses or machine them in automatic screw machines, so that part No. 106 always fits part No. 105 exactly, although the men who make the two parts may never have seen each other and may not speak the same language. Whether in the eyes of an artist all the alarm clocks in America are worth a single beautiful Swiss watch, is a question that I will leave to philosophers. We as a nation are committed to the principle of mass production; and while we may deplore the vanishing of the old crafstman, few will suggest a return to the former order.

The Motion Study Expert

But we do not stop with standardizing machine operations. We standardize also the operations of men. The motion study expert tells us that practically every man wastes a large percentage of his time and effort in even the simplest operation—that a dozen skilled mechanics will do the same thing in a dozen different ways, all of them wrong. So the motion study expert determines the one best way to do a job, and in one case after another we find that by following his method we not only increase production but we decrease fatigue. While so-called "efficiency engineering," like other pioneer movements, has suffered from the pretensions of quacks, there can be no serious question that modern industry demands the elimination of lost motion and the standardization, so far as is practicable, of every job in the plant.

If this is true, as it is true, I do not believe that any one will question the next proposition that I want to make—that anything which interferes with this absolute regularity of operation is inefficient and uneconomical, and that it is one of the chief functions of the engineer and the executive to hunt out these disturbing influences and eliminate them.

The things which thus interfere with regular production are many and varied. Some of them are external to the plant itself—such as a war, or a nation-wide strike, or a railroad tie-up. The prevention of these is largely a function of government, and the American people will not long tolerate conditions that permit such national inefficiencies.

Then there are catastrophies within the plant: a strike; a disabling fire; a break-down in the power plant. Every one knows that it is the function of management to prevent such occurences and that a management which does not in general prevent them cannot be permanently successful.

Then there is a third group of apparently minor disturbances: A laborer pushing a truck strikes an uneven place in the floor and a casting falls off the top of the load. The casting is heavy and he goes for help to put it on again. Meanwhile the lathe operator is waiting for the casting. The blockade of the passageway stops another truck coming up with material for another operator, who must also wait. The total loss of time may not be more than four minutes for each of five men—twenty minutes in all, or, say, twenty-five cents worth of time.

What does the foreman do when he finds that the lathe operator is waiting for material? If he is a foreman of the old school, he goes back and bawls out the "blankety blank wop" for running his truck into a hole in the floor. The man, thus admonished, is henceforth more careful—that is, he is slower in his movements. He takes pains to avoid holes in the floor, the posts in dark passageways, the other various sundry obstructions which sprinkle his pathway. A little later the foreman is surprised and grieved to find that he must put on another man to help the truckers because they cannot keep up. He discourses feelingly and eloquently with the assistant superintendent on the total depravity of laborers in general and of his laborers in particular. Am I exaggerating? Not very much. How many of *us* carefully walk around a hole in the floor, or a slippery place, ten times a day, because it would take a little mental and physical energy to fix it up?

Of course, the foreman who is really onto his job has the floor fixed at once. If he is unusually intelligent, he also looks around for other things which interfere with efficient trucking. He may find that the lighting in the passageway is poor, and recommend to the superintendent that it be improved. He may find that the truck itself can be slightly changed to as to make it less likely that anything will fall off. The up-to-date foreman realizes that when his laborers each lose twenty-five cents worth of time a day it is up to him, not to bawl them out for it, but to find out what is wrong and correct it. And it is up to the superintendent and higher executive officers to supply what the foreman lacks in this regard. Once labor was the cheapest part of the cost—but the dollar-a-day man is gone.

The Value of Little Things

In machine operations it is even more obvious that regularity is the essence of modern production. I dare say that every punch press foreman or superintendent in the United States has as his idea of heaven a place

*Address before Engineering Section, National Safety Council, Chicago, June 24, 1920.

where—if puch presses are tolerated at all—not one of them ever misses a single stroke. Unfortunately this kind of heaven is seldom met with on earth.

I know of large and successful companies where punch press production is from 25 to 50 per cent less than perfect—that is, where only half or three-quarters of the strokes are productive, simply because proper means are not provided for placing the material in the press and taking it out again. The important point is that the greater part of this loss is positively preventable through the use of simple and inexpensive automatic or semi-automatic devices for placing and removing the material. The fact is that, with comparatively few exceptions, even in the most efficient plants, we have not had time to study these little things—the castings falling off the truck, the material sticking to the punch press—causing in each individual case a loss of time reckoned only in seconds or minutes, but causing in the aggregate a loss running undoubtedly into many millions of hours and many millions of dollars.

Leaks Must be Stopped

In the past, so vast were our resources that we could overlook these small losses, just as the city of Chicago pumps millions of gallons of water that are wasted through leaky pipes. But now the time has come, with our diminishing man power, diminishing natural resources, and prospective sharp competition from abroad, when we must meter and stop these leaks if we are to maintain our volume of production and our economic place in the front rank of the nations. I have tried thus far to make the point that modern production is built absolutely on standardized regularity of operation and that anything that interferes with regularity interferes with production. It is putting the same thought into other words to say that it is our constant effort to find the one best way of doing things and then always to do them in that way; and that anything which happens unexpectedly, whether it is a coal strike or a casting falling off the truck, is bound to interfere with our regular program and therefore to cut down our production. Therefore, it is interesting to observe that the Standard Dictionary under the word "accident" gives as its first definition this: "Anything happening unexpectedly." In a second definition the dictionary recognizes, of course, the common usage of the word "accident" as meaning an occurrence in which some one is hurt. But in the broader meaning it is plain that, from the standpoint of industry, a coal strike is unexpected and is therefore an accident; a breakdown of the power plant is unexpected and is therefore an accident; the sticking of material in a punch press is unexpected—not contemplated or desired by the designer of the machine—and is therefore an accident, whether any one happens to be injured or not. In short, "accident" in the broad meaning given it by the dictionary is exactly synonymous with all the disturbing things which interfere with production—it is the exact opposite of production efficiency. It stands precisely for all those things which we as engineers and executives must fight unceasingly.

Safety and Production

Now I come at last to the point where safety enters into the proposition. Some of the "accidents" which I have mentioned—some of the things which happen unexpectedly—result in personal injury. From the standpoint of the man interested only in production, the accidents which happen to injure some one are no more and no less important than those which do not. It is true that from other standpoints the accidents causing personal injury are much more important. To the legal department, they mean the payment of compensation. To the employment department, they mean the necessity of providing another man. To any man with a spark of human feeling in his heart they mean pain and suffering to a fellow human being, perhaps poverty and distress to his dependents. But leaving these considerations out of account, considering ourselves as absolutely non-human engineers or executives, with an abundant supply of skilled labor and no compensation laws to worry about, even then we must recognize that at the very least the accident which injures some one is no less important than the accident which does not injure any one, and all these accidents—all these things happening unexpectedly—interfere with the regularity of our operation, and cut down our production. No engineer or executive living can afford to say, "I am not interested in accident prevention," unless he is willing to say, "I am not interested in efficiency," because accidents and efficiency are absolutely incompatible; they cannot exist in the same plant. Every accident is an indication that there is something wrong with men, methods, equipment, or material.

Executives Must Be Interested in All Accidents

And if the engineer or executive must then be interested in all accidents, whether they cause injury or not, those which do cause injury have for him a peculiar importance, because they stand out conspicuously and serve as danger signals to warn him of the inefficiency that is undermining his output. This is not theory but fact. The improvements in punch press operation, which I have already mentioned, were suggested and carried out—by whom? By the production department or by some imported efficiency engineer? No—by the safety man! He found that men were losing fingers in these punch presses because they had to reach in to the press to place or remove material. He changed the method of operation by introducing automatic or semi-automatic feeds and kickouts. He did this primarily to prevent the loss of fingers. Having done it, he found that he had increased production from 25 to 100 per cent. The foremen were astonished. They need not have been astonished. Reflection would have shown them that the movement of the operator in reaching into the press, while it occasionally caused the loss of a finger, always caused the loss of time; and that an arrangement which would save the occasional finger would also save a fraction of a second every time the machine was operated. To quote another instance of a more general nature, the manager of one of the largest paper mills included in the membership of the National Safety Council once said to me, "Before we had a safety committee, every little while we would have to shut down our machine because of a belt breaking or something of that sort. Now our safety inspection catches these things before they happen and we have no more shut-downs.

Our safety work has more than paid for itself through the increase in production, aside from cutting down our compensation costs."

You may say, "These plants were not run efficiently. If they had been, it wouldn't have taken a safety man to show them how to feed punch presses or keep belts in

repair." I freely grant this. Yet the fact remains that both of the plants which I have mentioned were and are in the very front rank of their industries, they were well managed, they were making money. The management simply, like every other management that I know of, was so busy with development and with the outstanding problems which it had to face that it could not watch every single detail.

A Striking Instance of Safety Efficiency

In another instance, even more noteworthy than those I have mentioned, the chief engineer of a large company conceived an entirely new method of accomplishing an important process in the industry—a method wholly mechanical, to replace one which required constant attention by skilled men. It happened that these men were exposed to injurious dust. When the new plan was presented, it was opposed by some of the experienced factory executives who declared on general principles their firm conviction that it would not work. The president of the company said: "Even if the new method does not increase production as we hope it will, it will at least remove this danger to the health of our men. Therefore we will try it out." It was tried out. It worked. It cut down the number of attendants required from 23 to 3 and removed all hazards to those that remained. It increased production so tremendously that it will undoubtedly revolutionize the entire industry. This two-fold result was not a coincidence. It was a natural result of the fact that the old process was wasteful in both materials and time. The injurious dust that should have gone through the manufacturing process was blown out into the faces of the men. The new method saved both the dust and the men.

The man who did this remarkable piece of work was not a "safety engineer." He was an engineer who believed in safety. As a man, he believed in safety as a human necessity. As an engineer, he believed in safety as a thing inseparably bound up with engineering efficiency.

The Human Value of Safety

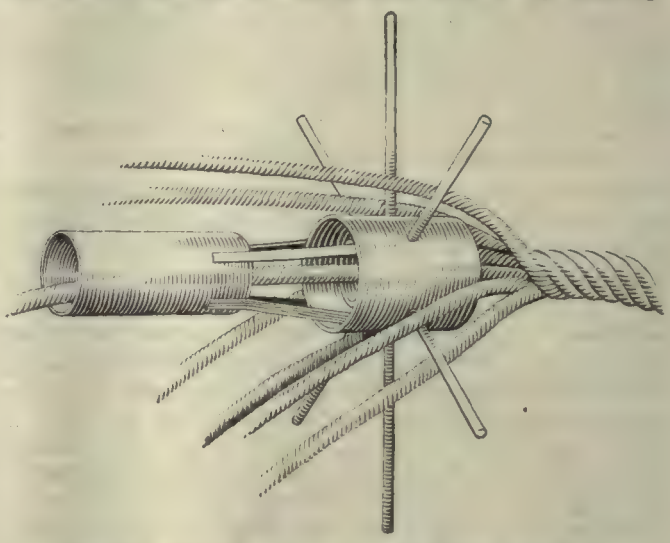
On the human value of safety, I leave each of you to judge for yourself. I know how I feel and I think I know how you feel, but that is not my topic tonight. On safety as an engineering job—I know that the engineer whom I have mentioned, and the safety man in the punch press shop, and the paper mill manager, are right—I know that safety and engineering efficiency are inseparable. You cannot have one without the other. If you safety men think you have to put on a guard that interferes with production, you may be sure that your remedy is only a temporary one and that it must give way eventually to an improved machine or method which will be safe without being inefficient. And the engineer or executive who thinks that accident prevention is not in his department—that he will leave that to the safety man or the insurance company or the state inspector—is missing something—something big. He will find out some day that every accident in his plant or on the machine which he designed is a danger signal for him—a symptom of time and dollars wasted as well as lives and limbs. The rough-shod methods of American industry a generation ago, which left a trail of human wreckage, were not only inhuman—they were inefficient. They, and the men who stood for them, have gone on the industrial scrap heap, and none of them will ever return.

Salvaging the Inner Strand of a Worn Cable

Special Correspondence

At the plant of the Spanish-American Iron Co., in Cuba, a 3-in. steel cable had been condemned and discarded because the outer strands were worn and frayed. The 1¾-in. inner strand was in good condition and, as the cable was a mile and a quarter long, it seemed advisable to salvage it. The problem was to cut away the six worn strands and leave the inner strand intact. This was accomplished with the device illustrated herewith in conjunction with an oxy-acetylene torch.

Six pieces of pipe were ox-welded into the rim of a small pulley. A short piece of sheet-iron pipe was fastened to the pulley and in line with it, by welding



DEVICE FOR SALVAGING THE INNER STRAND

on four iron straps. The outer strands of the cable were unwound for a few feet so that the inner strand could be passed through both the bore of the pulley and the pipe. With the outer strands placed between the six spokes in the pulley, it was only necessary to revolve the device against the lay of the cable and advance it as the strands were unwound, the inner strand being allowed to lie in a continuous length along the course of the work. When the strands unwound reached an unwieldy length (about 6 ft.) they were cut off by a portable ox-weld outfit.

The cable, of course, remained stationary, the inner strand being coiled up and the scrap collected after the work was completed.

The device and the method used are due to an American mechanic, John Crawford, who was in charge of the work.

Sweeping Back the Tide

By Otto Vogetzer

The second paragraph of the article, "Sweeping Back the Tide," on page 33 of the *American Machinist*, is very interesting, to say the least.

There is an opportunity for Mr. Forbes to earn the everlasting gratitude of the community at large by letting us in on the secret of how and where unskilled labor may be hired at wages from $15 per week DOWN. Is this a misprint or was it written in 1910?



Connecting Rods for the Fordson Tractor

By FRED H. COLVIN
Editor, *American Machinist*

Here is a distinctly novel method of holding and locating connecting rods during the various machining operations. It is an application of the three-point suspension method to manufacturing, and is well worth considering as a positive method of locating work in various operations.

THE transformation sheet, Fig. 1, shows the principal machining operations, the numbers corresponding to the figure numbers of the illustrations in this article. These rods, which are for the Fordson tractor 4 x 5-in. cylinder, clamp the piston pin to the rod, and use a babbitt bearing cast into the rod. The piston pin is $1\frac{3}{8}$ in. in diameter, the crankpin 2 in. and the center distance $9\frac{1}{2}$ in., the length of the main bearing being approximately $2\frac{1}{4}$ in. These sturdy proportions indicate the kind of work a tractor motor is called upon to perform.

The rods are first heat-treated and tumbled and the ends ground and faced. Then comes the straightening on the bench shown in Fig. 2. The bench itself is of cast iron and carries the straightening block shown, the block having hardened-steel faces *A* and *B*. The

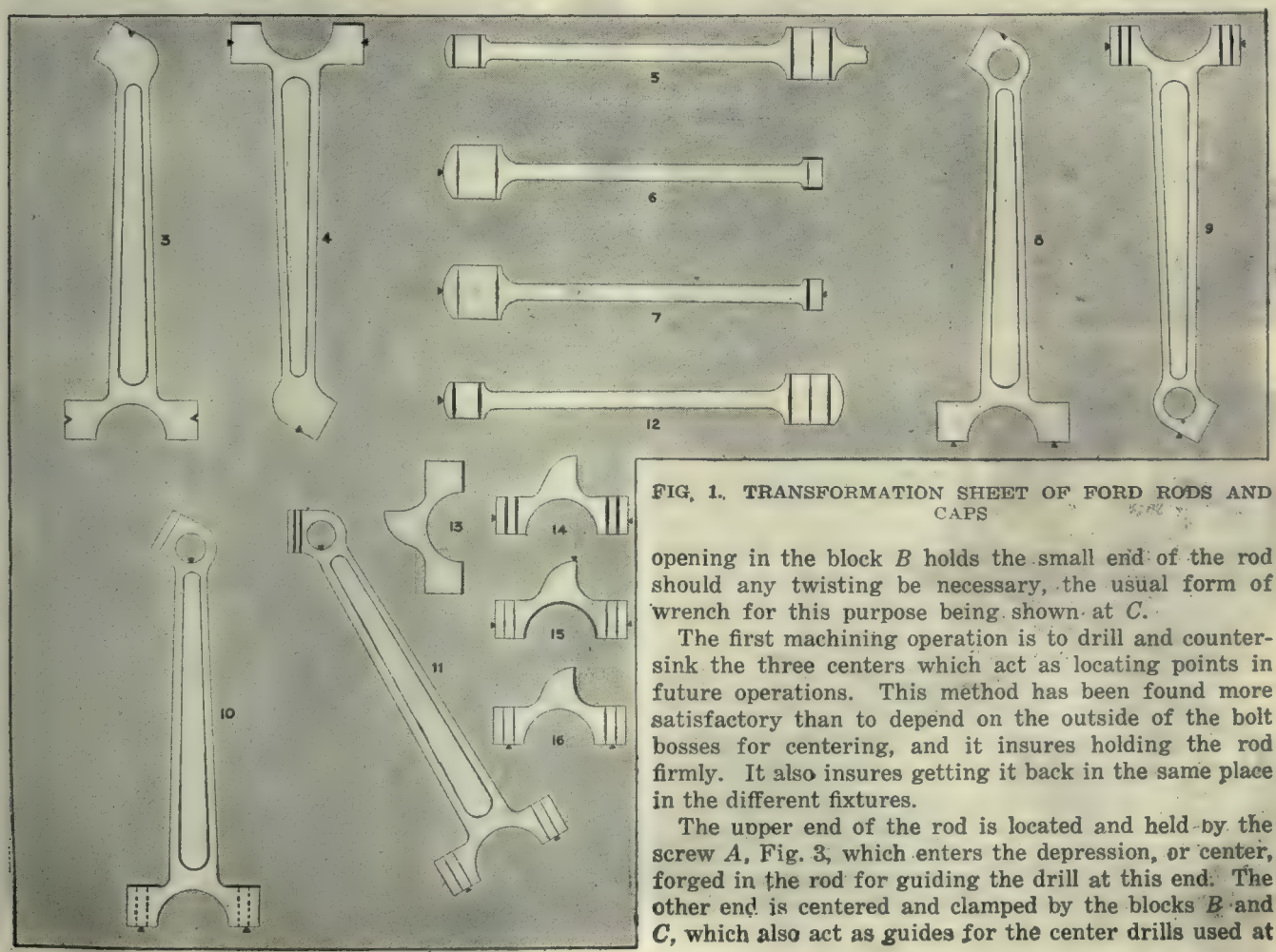


FIG. 1. TRANSFORMATION SHEET OF FORD RODS AND CAPS

opening in the block *B* holds the small end of the rod should any twisting be necessary, the usual form of wrench for this purpose being shown at *C*.

The first machining operation is to drill and countersink the three centers which act as locating points in future operations. This method has been found more satisfactory than to depend on the outside of the bolt bosses for centering, and it insures holding the rod firmly. It also insures getting it back in the same place in the different fixtures.

The upper end of the rod is located and held by the screw *A*, Fig. 3, which enters the depression, or center, forged in the rod for guiding the drill at this end. The other end is centered and clamped by the blocks *B* and *C*, which also act as guides for the center drills used at

AUTOMOTIVE CONSTRUCTION

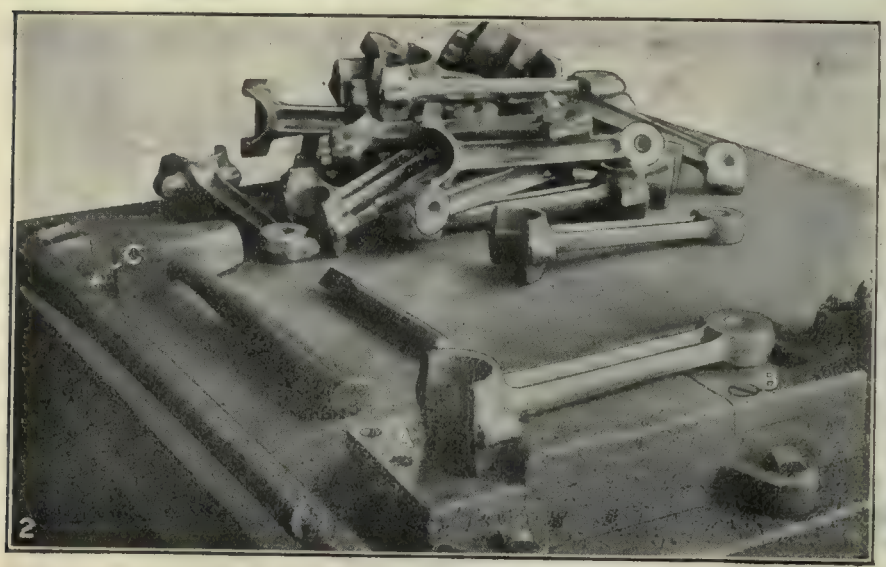


FIG. 2. THE STRAIGHTENING BENCH

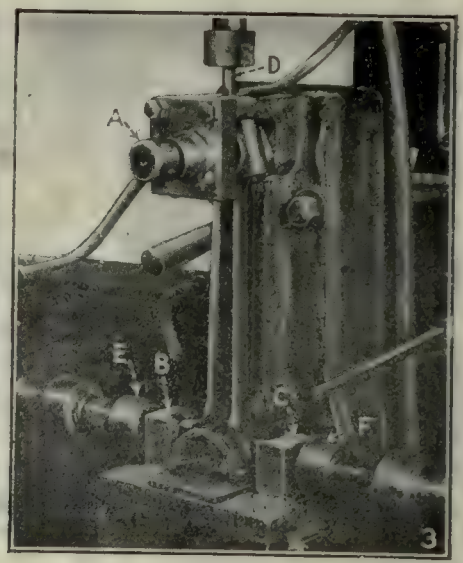


FIG. 3. DRILLING LOCATING CENTERS

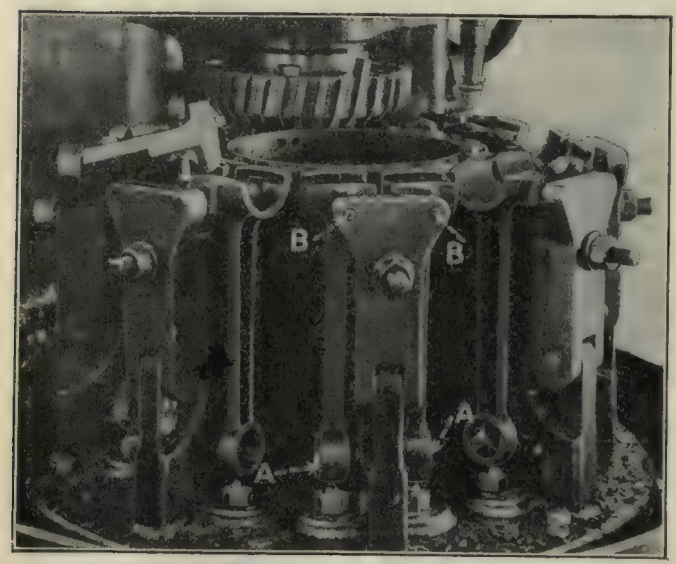


FIG. 4. MILLING THE ROD-JOINT FACE

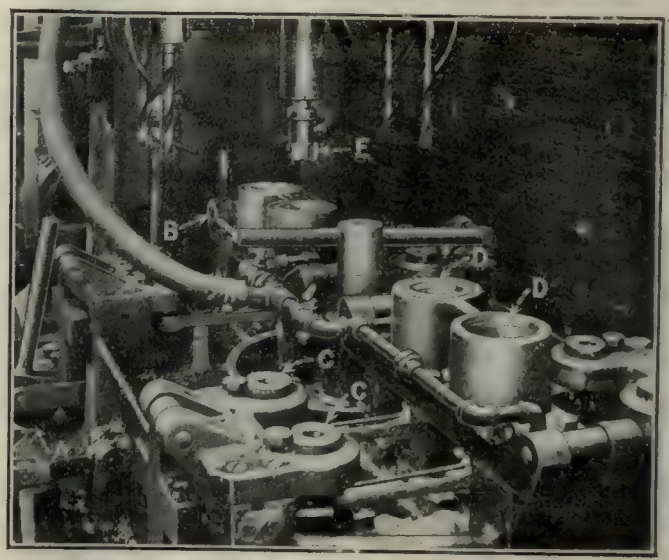


FIG. 5. DRILLING BOTH ENDS OF THE ROD

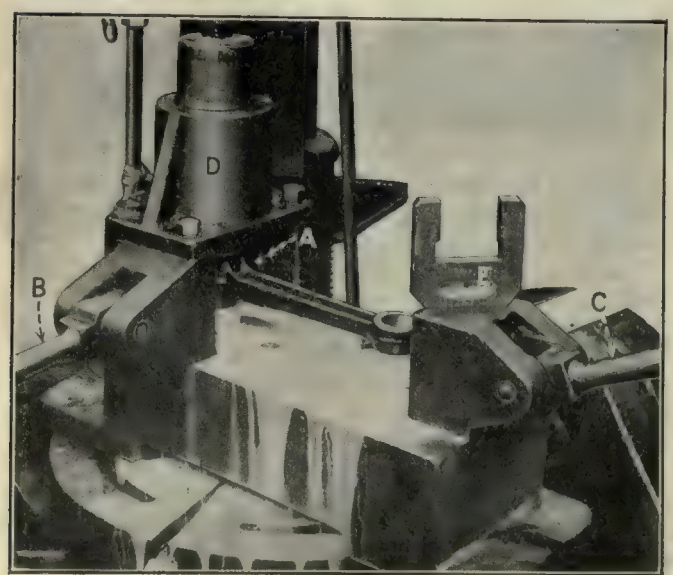


FIG. 6. FACING THE SIDES OF THE ROD

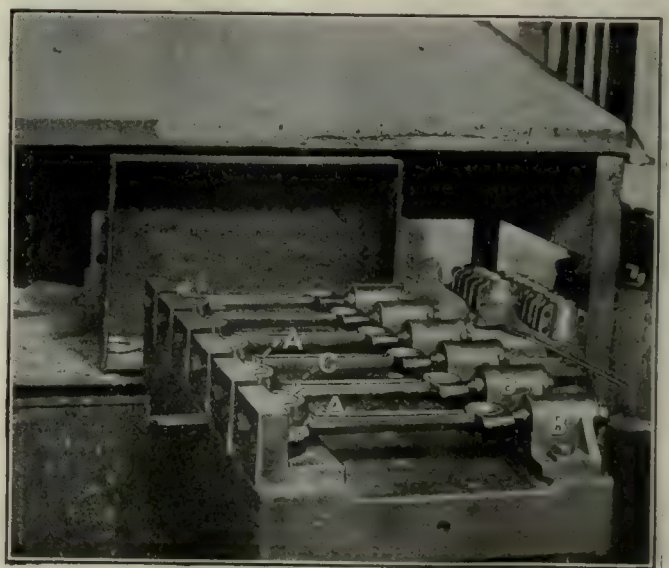


FIG. 7. BABBITTING THE ROD

AUTOMOTIVE CONSTRUCTION



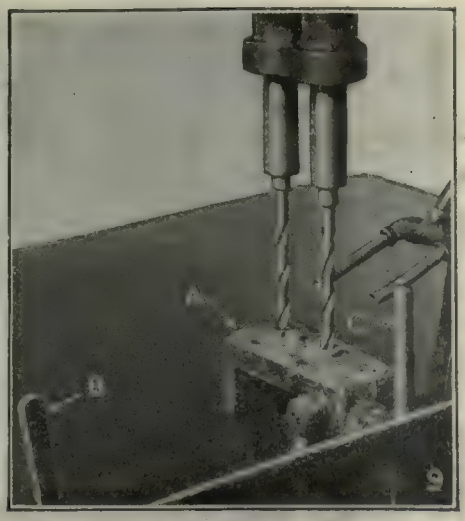


FIG. 8. RE-CENTERING THE SMALL END. FIG. 9. DRILLING THE BOLT HOLES

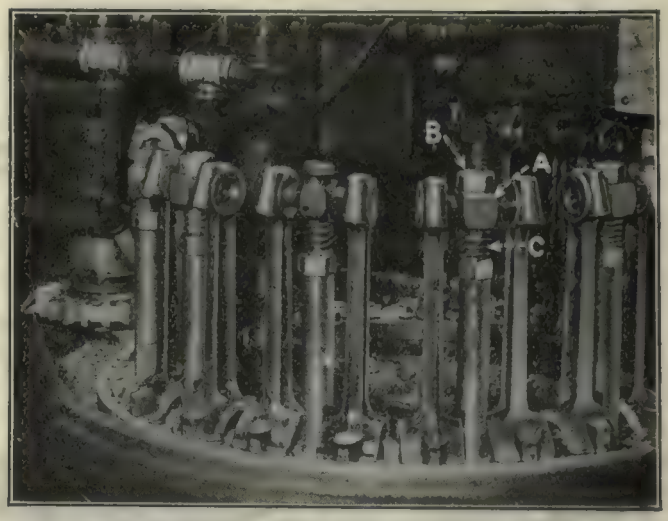


FIG. 10. MILLING THE UPPER ENDS OF THE BOLT BOSSES

this end. The three combined center drills and countersinks at *D*, *E* and *F* then drill the three locating points, which are to be used in future operations. The centers in the bolt bosses are drilled nearly at the top so as to avoid all tendency of closing in the ends under the pressure of the clamping centers.

The first use of these centers is in milling the joint face in the continuous milling fixture shown in Fig. 4. Each station holds two rods, the small ends being located at *AA*, while the upper ends are held in position by the centers *BB*. The holding clamps are easily operated, as can be seen, and the rods are loaded and unloaded while the table keeps continuously in operation.

Unusual Rod-Boring Method

The boring of the rods is somewhat unusual, the large ends of two rods being butted together as shown in No. 5 of transformation sheet, Fig. 1, and as can be inferred from the construction of the fixtures in Fig. 5. The rods are again located by the three centers, these being controlled by cams, two of which are shown at *A* and *B*. Two of the drill bushings for the small ends are shown at *CC*, while two of the large bushings are at *DD*. The latter guide the boring tool *E*, which bores the ends of the two rods which have been so located by their holding points as to make this possible. This is an indexing fixture so that one end can be loaded while the tools are at work on the other.

Next comes the facing of the large ends in the fixture shown in Fig. 6. The center *A* is stationary, but the other two centers are forced into position by the handles *B* and *C*. The facing cutter has a substantial guide at *D*, and the gage *E* shows when the bearing has been faced to the proper length.

After reaming the small ends the rods are then washed in hot soda and are ready for babbitting. They are first properly tinned and then placed in the fixture shown in Fig. 7, the rods being held squarely against the plates *AA* by means of the centers *BB*. Each plate carries a half-round form or mandrel as at *C*, and the babbitt is poured in place by means of the ladle shown. The caps

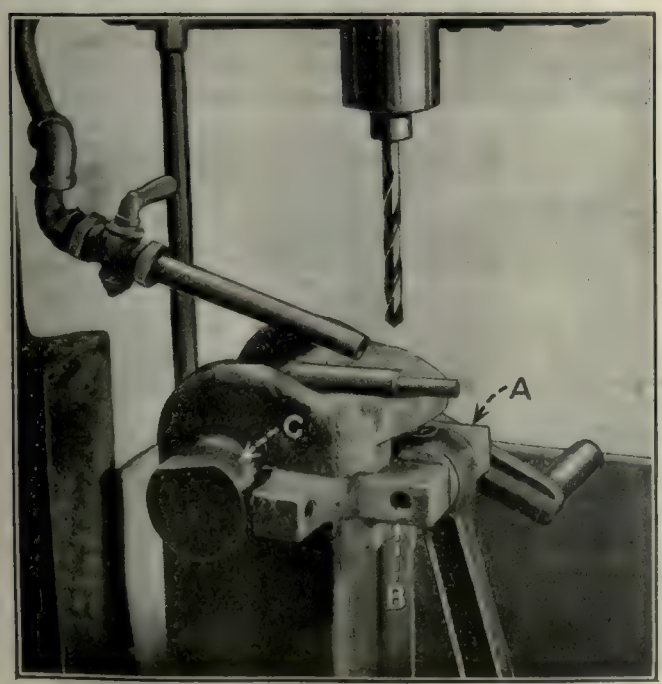


FIG. 11. DRILLING CLAMPING-SCREW HOLE

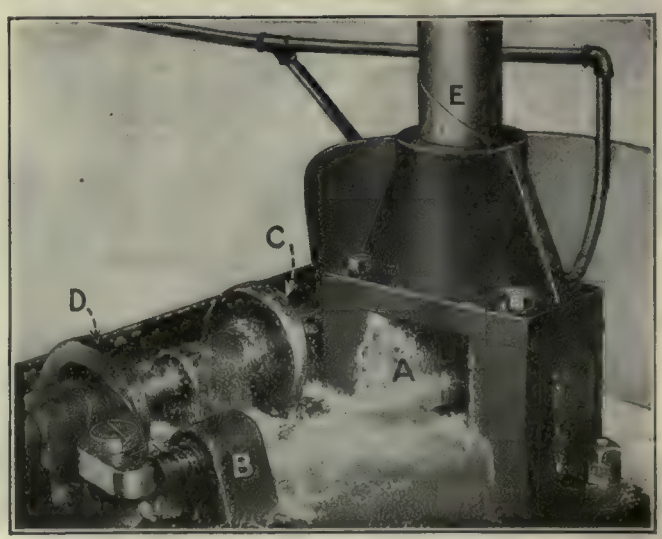


FIG. 12. REAMING ROD AND CAP

AUTOMOTIVE CONSTRUCTION

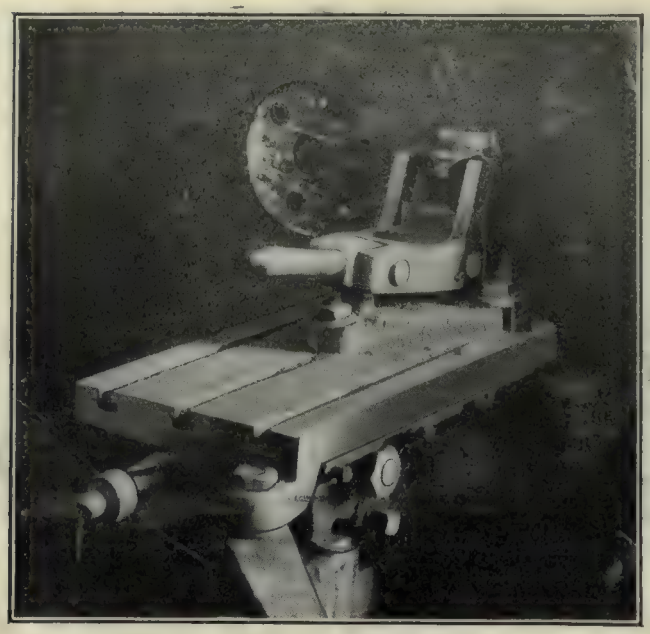


FIG. 13. DISK GRINDING THE CAP

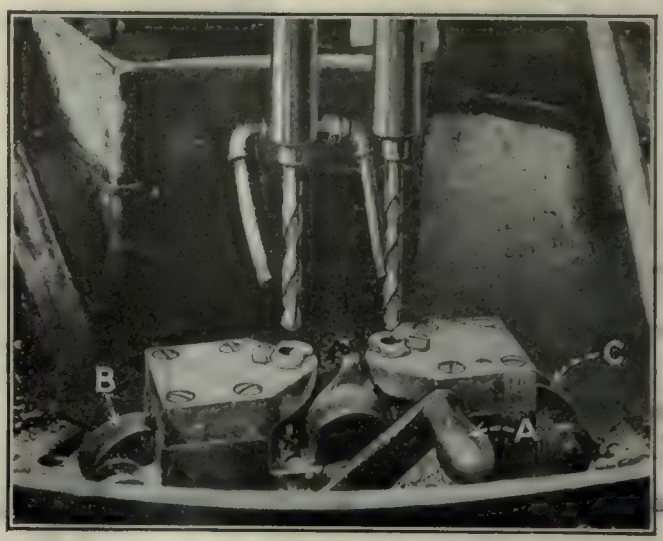


FIG. 14. DRILLING THE BOLT HOLE

are babbitted in the same manner. As can be seen, this fixture is located adjoining the babbitting furnace. The fact that this outfit handles 1,300 rods in 8 hr. indicates the ease with which it can be operated. The surplus babbitt is dressed off with a rotary file, after which the upper center is refinished, as shown in Fig. 8.

Drilling and Facing Bolt Bosses

Bolt holes are next drilled with the two-spindle drilling head shown in Fig. 9. The rod is held in the fixture *A*, the handle *B* controlling the lower center and the handle *C* the clamping center on the side. It will be noted that the whole fixture is surrounded by a high metal tank, which allows flooded lubrication without danger of splashing over. One drilling machine handles 334 rods in an 8-hr. day.

The upper ends of the bolt bosses, known as the bolt clearance in this shop, are milled in the double-spindle continuous milling machine shown in Fig. 10, which can handle 2,200 rods in 8 hr. This operation is practically identical with that of the Ford Motor Co. The three locating points are not used in this operation. Instead, the bolt holes are located over suitable dowels, while the piston-pin ends are carried on the double crosshead *A*, the rods being forced down onto the dowels by the nut *B*. The spring *C* beneath the crosshead raises the rods away from the dowels as soon as the nut *B* is released.

The fixture for drilling the clamping-screw hole is also similar to the Ford Motor shop method, the rod being clamped by the arms *A* and *B*, Fig. 11, one of which is operated by the cam *C*. The lower end of the rod fits over dowels which give it the proper angle for the screw hole.

After these holes are counterbored and tapped, the cap, which has been previously machined, is bolted into place and the fixture shown in Fig. 12 used for reaming the babbitt lining of the crankshaft bearing. The movable side-locating center is at *A*, the end center being at *B*. Both of these centers are operated by small bell cranks, these in turn being controlled by the cams *C* and *D*, which are mounted on the same shaft and

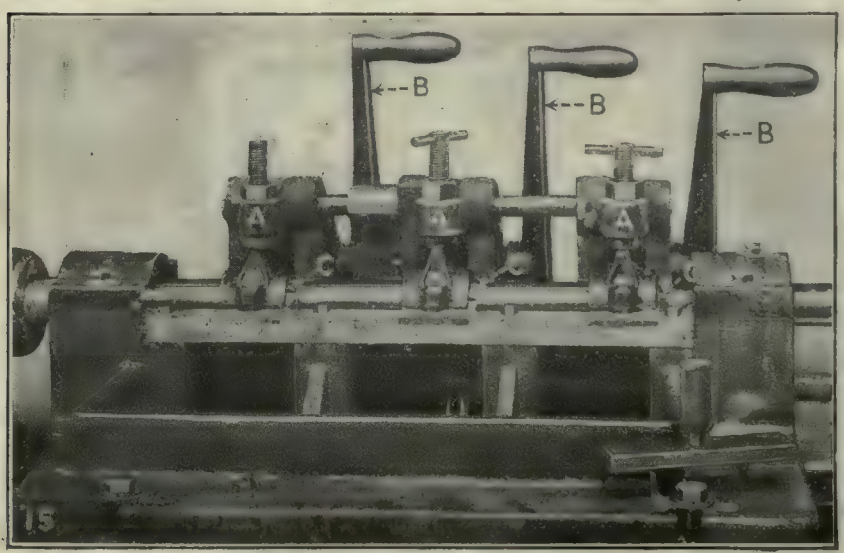


FIG. 15. BORING THE CAPS

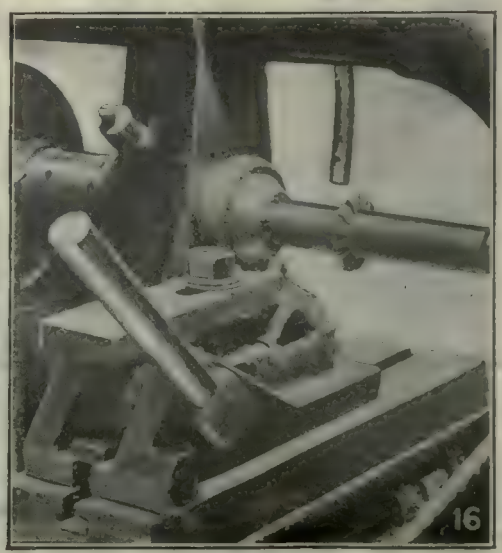


FIG. 16. MILLING THE OIL GROOVE

AUTOMOTIVE CONSTRUCTION

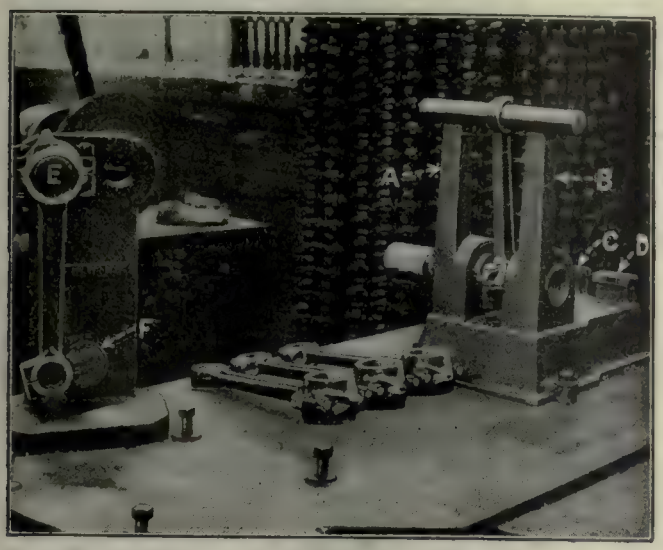


FIG. 17. THE INSPECTION BENCH

moved by a crank handle not shown. The reamer has the substantial guide *E*. After this, the ends of the babbitt bearing in both rod and cap are faced, the slot milled in the small end, and the rod finally straightened before going into the assembling department.

The Connecting-Rod Cap

In the meantime, the connecting-rod cap has been finished on other machines, some of which are shown in the previous illustrations. The caps are heat-treated in the same manner as the connecting rods, and, after being tumbled, the joint face is finished on the disk grinding machine shown in Fig. 13. The fixture for holding the cap and forcing it against the wheel is very simple and needs no detailed explanation.

The bolt holes are next drilled in the fixture shown in Fig. 14, the cap being located from the bolt bosses and the V-shaped clamps being forced into position by the handle *A* which operates the cams *B* and *C*.

The caps are then bored in the fixture shown in Fig. 15. This fixture is mounted on the stripped carriage of an engine lathe and holds three caps at one setting. The caps are located by dowel pins in the bolt holes, and held in position by the adjustable clamps *A*, which are operated by the handles *B*. The cutters *C* are mounted on the bar shown and the lathe carriage is fed along on the bar, boring the three caps at once.

The sides are then faced, the caps washed, tinned and babbitted the same as the rods themselves. The babbitt is then trimmed by the rotary-file method, and the ends of the bolt holes spot-faced. After this the oil-splash groove is milled in the scoop which projects from the cap, this being done on the small milling machine shown in Fig. 16. This leaves only the oil hole to be drilled and the oil groove to be cut, after which the assembled rod and cap are ready for the inspection department.

A corner of the inspection department is shown in Fig. 17. This shows one of the standard forms of connecting-rod testing fixtures with the arms *A* and *B* and the plates *C* and *D* to show the squareness of the two holes in the different positions, the usual test bars being used in both ends of the rod.

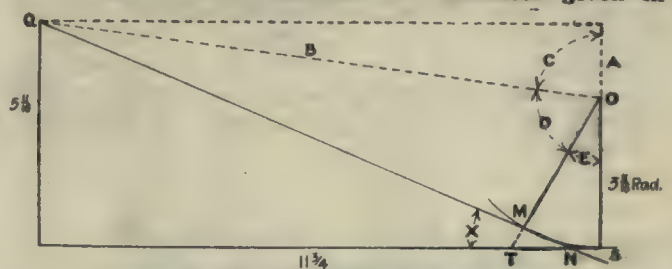
The other fixture tests the faces of the rod itself without the bars being in place. The large end of the rod fits over the pin *E* while the small end is swung past the surface *F* to test the two surfaces of the rod being parallel with each other. Some idea of the rods handled in this department can be had from the stack behind the bench. The rods are now ready to go to the assembling department.

Another Solution to "A Little Question of Trigonometry"

By E. T. Goodchild

A simple solution to Mr. McCurdy's problem of finding the angle *X*, page 713, Vol. 51, of the *American Machinist*, is obtained by first joining up the center *O* to point *Q* and then completing the dotted-line triangle by drawing the other two sides parallel to the $11\frac{3}{4}$ and $5\frac{11}{16}$ lines. Then continue the line *OM* to cut the base line at *T*.

The problem is to determine the angle *X* when only the radius about *O* and the two distances given in



A PROBLEM IN TRIGONOMETRY—TO FIND *X*

figures are known. The solution is now easily found by examining the triangles.

$$A = 5\tfrac{11}{16} - 3\tfrac{11}{16} = 2$$

$$B = \sqrt{2^2 - 11\tfrac{3}{4}^2} = 11.919$$

$$\text{Tan } C = \frac{11\frac{3}{4}}{2} = \tan 80°20.4'$$

$$\text{Secant } D = \frac{11.919}{3\frac{11}{16}} = 11.919 \times \frac{16}{59}$$

$$= \text{Secant } 71°58.6'$$

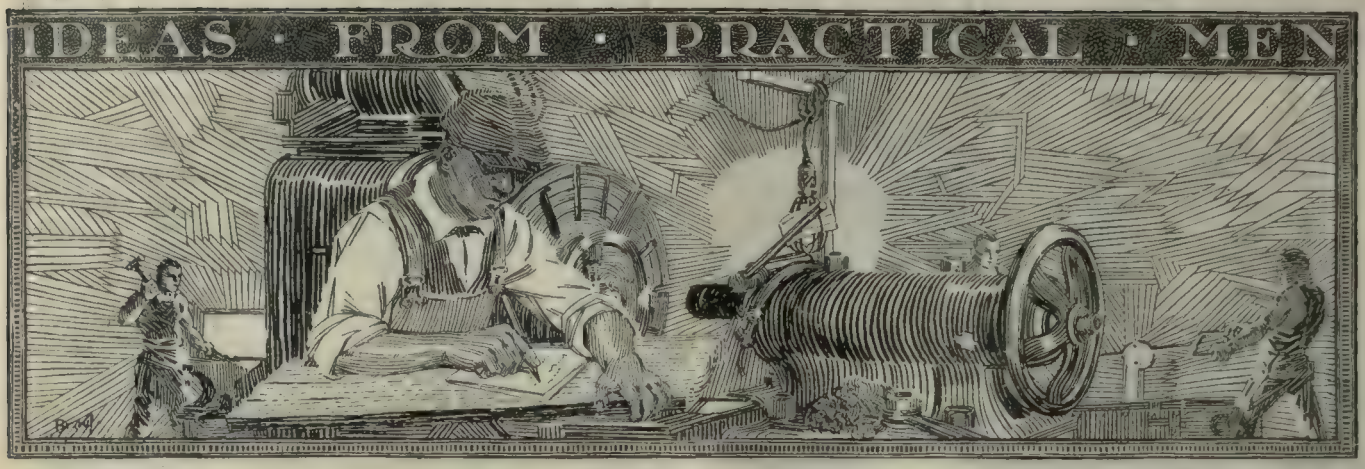
$$E = 180° = (C + D) = 180° - (80°20.4' + 71°58.6') = 27°41'$$

But, in the two right-angle triangles *OTS* and *MTN* the angle *MTN* is common to both, therefore, the third angles are equal, or

$$X = E = 27°41'$$

A doubt often arises in the draftsman's mind when tackling an awkward problem as to whether the data is complete enough for a solution. In such cases the following rule will be found very useful: If sufficient particulars are given to draw the diagram geometrically with straightedge, protractors and compasses, then the problem is solvable.

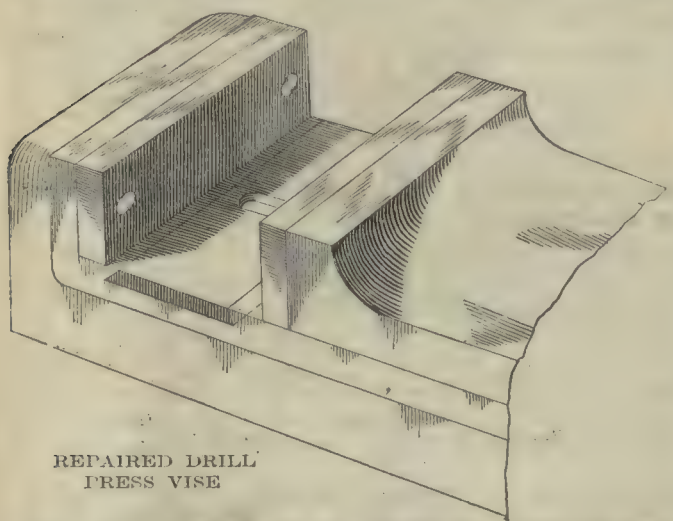
Incidentally the key to most problems involving circles or arcs is to connect the centers with one or more known points as is done, for example, in calculating dimensions when measuring dovetails with plug gages.



Repairs to Machine Vise

C. H. FRANK
Nagoya, Japan

In many workshops, vises used on the drilling machines sometimes become damaged near the solid jaw end because of the thoughtless or unskilled operators who do not use packing pieces under the work, but drill right through into the base of the vise. Instead of "scrapping" a vise damaged in this way or re-machining the base along the top—incidentally weakening it—and re-fitting the sliding jaw, I have found the method of



REPAIRED DRILL PRESS VISE

repair, shown in the sketch, to be efficient and economical.

If the dovetail piece is made a push fit, it will not be necessary to use screws or rivets to hold it in place. Should the inserted piece become damaged it is an easy matter to push it out and insert another. A spare piece can be kept in stock if desired.

It is best to finish-machine the top of the dovetail piece level with the existing base after pushing it into place.

A Boring Bar of Merit

BY JOHN HOUSSMAN

The boring bar illustrated in Fig. 1 was used by the writer for some time in the Oil Well Supply Co., of Pittsburgh. Who is the originator of it I do not know, but I do know that it has one or two advantages over all the different styles of bar that I have used. First, there is no setscrew to mushroom; second, no wrench, either standard or special, is required; and third, small bottom clearance is required when boring blind holes.

The rod that holds the tool might well be made of drill rod, but the truth is that we made it out of an old $\frac{5}{16}$-in. round file by grinding off the tang. Like the nutless bolt used in shipbuilding, only a hammer is

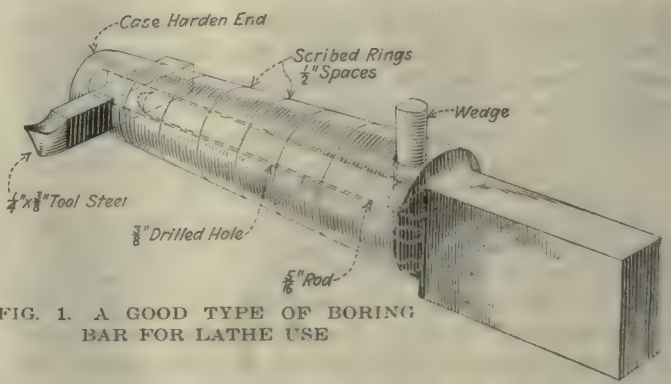


FIG. 1. A GOOD TYPE OF BORING BAR FOR LATHE USE

needed to operate it, although in the hands of a lathe operator a toolpost wrench does just as well. This device makes the most efficient toolholder I have seen.

If I were a tap manufacturer not a tap would come out of my factory with the sharp-cornered square shank, as at *A* in Fig. 2, but every one of them would have a

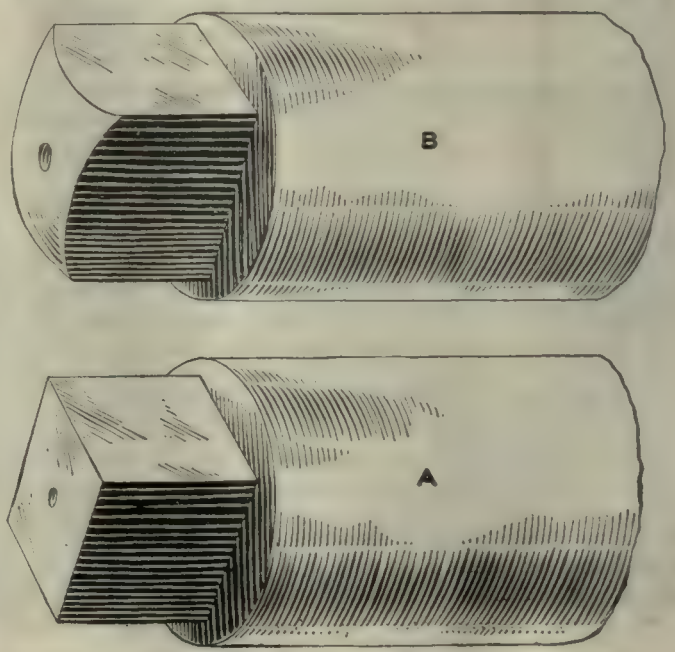


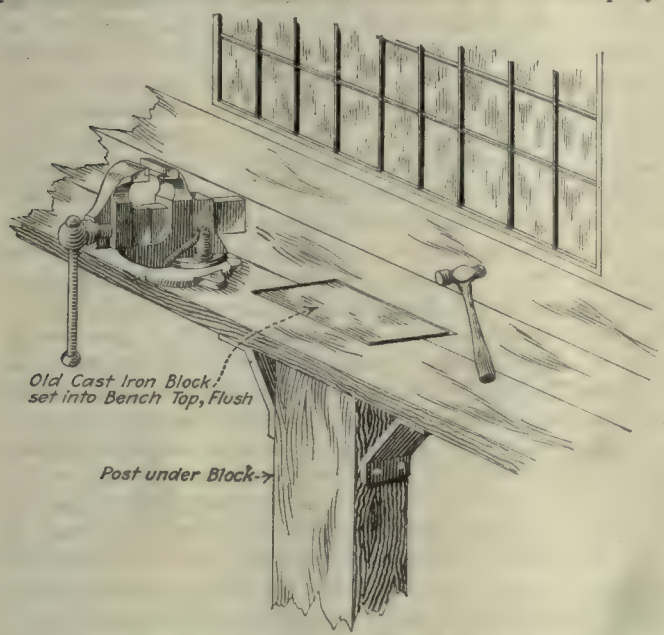
FIG. 2. DIFFERENT KINDS OF SHANKS ON TAPS

beautiful and generous chamfer on the top, as shown at *B*. Many a time I have fumed while trying to find the hole in the tap wrench, which has to be held just so, because the square on the tap will not enter until the two parts are in perfect alignment. The chamfered end would, however, enter slightly the hole in the tap wrench in any position, and a twist of the wrench would bring it into the proper position, so that it would slide down in place on the shank.

An Independently Supported Bench Block

BY CHAS. H. WILLEY

The annoyance of jars and vibration caused to toolmakers by each other when hammering work on the portable bench block has been overcome in our shop by



HOW THE BENCH BLOCK WAS SUPPORTED

setting the bench blocks into the bench flush with the top and supported by posts underneath, as shown in the sketch.

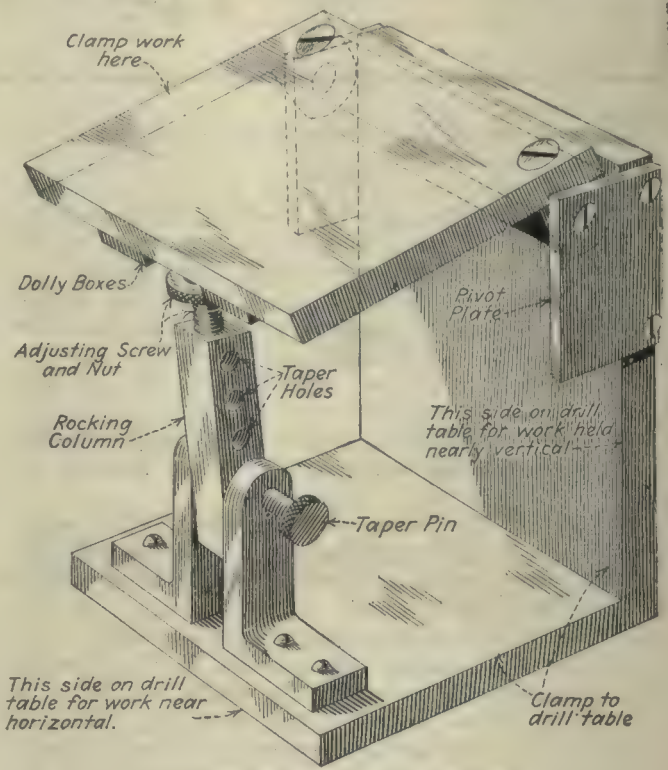
The block is set near the vise and being so handy prevents the common abuse of pounding work on the back of the vise. Being flush with the bench top it is not in the way when not in use.

Built-Up Adjustable Angle Plate for Light Drilling

BY H. H. PARKER

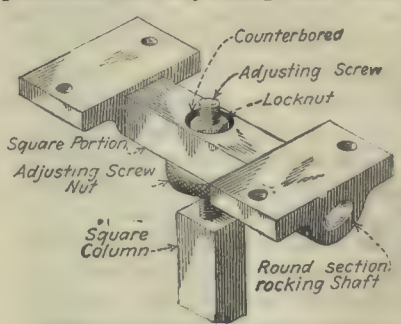
The sketch illustrates an adjustable drilling plate built up from a conventional cast-iron angle plate. Such a contrivance is useful around a drill press for drilling small holes at an angle, as it may be clamped to the drill table by either of its two sides, and quite a variety of angles obtained. As shown, the construction is formed of angle brackets, plates and square stock screwed together, though castings could be used to advantage if the cost of making the patterns would not be objectionable.

The tilting table is pivoted near the top of the angle plate and is held in any desired position by means of a square rocking column having a series of tapered holes drilled through it, while the fine adjustment is furnished through a nut working on the threaded end of the column. The nut is fixed in a rocking shaft held in two frames screwed to the bot-



AN ADJUSTABLE ANGLE PLATE

tom of the tilting table; the shaft is turned from a piece of square stock with the center portion left square and is drilled and counterbored for the nut. A short portion of the hub of the nut is squared and a washer with a square hole in it is driven over this and a locknut screwed down on top of it. This arrangement prevents the adjusting nut from working loose in its bearing. The nut should make an accurate fit on the threaded end of the column, without backlash. A substantial taper pin holds the column in place; this will probably have to be driven in by a light hammer. If the adjusting nut should prove difficult to turn by hand, a hexagon nut and wrench could be used or a series of holes drilled around its circumference and a pin inserted, making it into a capstan nut.



DETAILS OF ADJUSTING NUT

A New Designation for Bar Stock

The other morning the agent at the railroad station called up on the telephone. "Say! you fellers gotta lotta 1⅝-in. cold rolled down here. You gotta gettem right out; we want th' car."

"All right," we replied. "Tell Johnny, the truckman, to bring 'em right up."

An hour later we turned around to find John at our elbow. "Say boss," he said, "where'd yu want them solid pipes put?"

EDITORIALS

James Watt Not Inventor of Metric System

IN THE report from the Cleveland Chamber of Commerce, published on page 283, the "invention" of the metric system is credited to James Watt. This is a common error and probably owes its origin to the careless and ignorant statements emanating from the World Trade "Club." In their literature they say:

"James Watt is the man who thought out and suggested the metric system."

The evident intention of this is to create the false impression that the metric system is an English invention.

The fact is, the idea underlying the metric system, devised during the French revolution, was to establish a system whose basic units should be different FROM ANY EVER USED!

S. S. Dale says in his authoritative booklet:

"One of the essential features of Watt's common sense proposal was to retain the units that were in most extensive use. Watt proposed to decimalize the units and to establish a correlation between length, volume and weight of water. In this he was also retaining features that had become firmly rooted in the English system. Decimals had long been an essential feature of weights and measures for calculations. Correlation of cubic content and weight of water had been incorporated in weights and measures from the earliest times. The Babylonian talent of 80 pounds was the weight of a Babylonian cubic foot of water. The Roman cubic foot of water weighed 80 Roman pounds of 12 ounces each. The trade relations between Rome and Britain, beginning with Cæsar's invasion of Britain, necessarily brought Roman weights and measures into Britain. In 1685 "some Gentlemen of Oxford determined the weight of a cubic foot of spring water, or 1,728 solid inches, to be 1,000 ounces averdepois." That "averdepois" ounce (437½ grains) was almost exactly equal to the Roman ounce (437 grains).

"Correlation of cubic content and weight of water, handed down from the earliest times, was thus an established feature of English weights and measures on Nov. 14, 1783, when Watt wrote to Mr. Kirwan, proposing various plans for unifying the weights and measures of Europe. The following extracts from that letter and a later one to Mr. Magellan reveal the ideas Watt had in mind:

"My proposal is briefly this: let the philosophical pound consist of 10 ounces or 10,000 grains; the ounce consist of 10 drachms or 1,000 grains; the drachm consist of 100 grains. I would propose that the Amsterdam or Paris pound be assumed as the standard, being now the most universal in Europe; I have some hopes that the foot may be a measure of water and a pound derived from that. The common English foot may be adopted according to your proposal, which has the advantage that a cubic foot is exactly 1,000 ounces. I give the preference to those plans which retain the foot and ounce."

"The English speaking world has adopted the essential features of Watt's plan. The cubic foot of 1,000 ounces has been retained, and all the English units are decimalized for convenience in calculations." E. V.

Education for Employers

A REAL college course for the factory manager is an interesting development of modern education. To be sure it only lasts two weeks, but how many of the students could afford to spend much more time than that away from their jobs?

The course is one of the spec. summer courses at Pennsylvania State College and has been given for four years. It is under the direction of the Department of Industrial Engineering which conducts the work of the regularly enrolled college students in this branch of engineering during the academic year, and fills a long-felt want. Beginning with a classroom discussion of shop handling, the course takes the men through planning rooms and shops for demonstration of the theory The students take up stores, cost, inspection, tool handling, order scheduling and control projects. Next they take time studies on a variety of machines and operators and set rates. All the various phases of management are thus analyzed and treated concretely by the plant owners, superintendents, accountants, purchasing agents, employment directors, production experts and consultants who, with foreman and clerical heads, make up the student body of this intensified summer college.

At one of the group sessions of the Chamber of Commerce of the United States at its spring meeting in Atlantic City, Dr. Eaton, of *Leslie's Weekly*, advocated education of employers and leadership for employees as the solution of industrial difficulties. All employers will probably agree with him that the present labor leadership leaves something to be desired, but how many of them realize their own deficiencies in the matter of liberal thinking? As the old nigger said "It makes considerable difference whose ox is gored."

We have heard it said that eighty per cent of American employers are badly in need of education along the lines of up-to-date factory management. While this is probably something of an exaggeration, it shows the need for just such courses.

Those men who would not get enough from two weeks' hard work under competent instructors in management principles and details, to repay the investment of time involved, are few and far between.

We are in hearty accord with plans for education of this sort, and we hope the number of available courses will multiply. K. H. C.

Retarding Airplane Development

THE recent decision of Judge Chatfield forbidding the sale of foreign-built airplanes in this country may be more far-reaching than appears on the surface. If, as it seems, this only prohibited the dumping of obsolete foreign-built plants on the American market, there would be little room for criticism. But it apparently goes much farther and may distinctly retard the development of commercial aviation in this country, the home of the airplane.

It does not seem to be generally known that Commander Bellinger, of the N-C 3 and a well known flier in every way, and Captain Hartz, the army flier who successfully piloted a large, double-motored plane clear around the rim of the United States, have been balked in their efforts to start commercial airplane lines by this decision.

They first tried to secure suitable ships from the different builders, but without success. For one reason or another, the builders declined to supply them with the airplanes needed. Desiring to begin operations as early as possible, they went to England to get ships for their work, but are now balked by the decision referred to. It is further claimed that the ships bought were built under license of some of the patents which are now being used to prevent the machines from being brought into this country.

It will be remembered that the airplane was first successful in the United States. But it must also be remembered that its development was much more rapid in other countries, owing to the dampening effect of the dog-in-the-manger policy of the owners of the Wright patents. It was only by defiance and subterfuge of various kinds that Curtiss and others were able to bring American planes to any sort of commercial development.

When the war came all the large airplane builders pooled their patents, but substantial royalties were not forgotten, as the records will show. And now these patents are apparently being used to retard the development of commercial airplane service, when the holders of the patents are unable or unwilling to supply the planes to be used.

The monopoly patent has been the target for much criticism from various sources, and cases of this kind make excellent ammunition for the opponents of the system. They call attention to the fact that the constitution grants a patent primarily "to secure to the community the benefits of the advances in science and arts," and that if patents are not used in this way the constitution is violated.

The dog-in-the-manger policy is never popular. There was general rejoicing when Henry Ford smashed the Selden patent and made it possible to develop the automobile without the sanction of the A. L. A. M. Those who really believe in the future of the airplane and are trying to develop it in various ways cannot but regret that so much effort should be spent in preventing, rather than in aiding, its development. All must realize that the more planes which come into actual use, the sooner will the industry be on a commercial basis. And if a monopoly of patents make it possible for other countries to outstrip us, we shall be the losers. F. H. C.

U. S. Manufactures to Be Exhibited in Argentina

MOST manufacturers are already so well acquainted with the coming Exposition of United States Manufactures at Buenos Aires, Argentine Republic, March and April, 1921, that the plan needs no further explanation. The exhibit is being conducted by the American National Expositions, Inc., Bush Terminal Sales Bldg., New York City, with the idea of furthering commerce and friendship between our country and South America.

This exposition is a step in the right direction for American commerce, as it appears that our manufacturers are at last trying for foreign trade in a systematic organized manner. Most foreign countries seem to handle such expositions and trade extension as government functions, since those countries are alive to the necessity of maintaining the proper commercial relations away from home. The Department of Commerce of the United States, while it does not conduct exhibitions of this nature, is enthusiastically rendering moral support to the undertaking.

The British Board of Trade is at present planning an exposition for South America similar to the one it held in Athens shortly after the war ended. Concerted action of manufacturers is secured by government control. It is said that although the competition offered by the British is keen, their methods are fair and aboveboard.

Dr. Julius Klein, Commercial Attache to Argentina from the Department of Commerce, has stated that Germany has for some time been shipping to South America an average of two shiploads of general merchandise a month in Scandanavian bottoms. Spain and Japan, too, are active in the South American market.

In other words, foreign nations are willing to deprive themselves of goods, which they need infinitely more than we need ours, so that they can keep themselves entrenched in the market. The reason for this action is that they are far-sighted enough to see that they will have great need for that market in a short time.

It is gratifying to see that reliable American firms are supporting the American exposition so well, this being particularly true in the machine-tool industry. It will probably be necessary to supply additional space for all those who wish to exhibit. The fact must be emphasized that only those exhibitors who expect to continue trade with Latin America on a sound basis are wanted. It would really harm our relations there if publicity were given to those manufacturers who desired South America merely as a dumping spot for scrap and surplus stock. If American manufacturers will play square they ought to be able to obtain and retain control of the South American market. Never will a better opportunity be presented than now. C. J. P.

Getting Down to Work

THE announcement by officials of the Pennsylvania Railroad System that 12,000 employees were to be laid off will bring sharply to the labor slacker's mind the fact that conditions are rapidly shaping themselves so that it will soon be impossible for him to obtain high wages for half-hearted and slovenly under-production. As long as men felt that they could easily find work elsewhere, at as good or better pay than they were receiving, there was little that could be done to induce them to give their employer value received.

Several large manufacturing firms have, within the past few months, laid off a considerable percentage of their undesirable workmen, with the result that their output per man has increased surprisingly. In several cases the total output is equal to that when they had 15 to 20 per cent more men!

Restriction of output or "lying down on the job" is poor policy, and the sooner the American workman realizes this fact the better. American employers do not fear to pay well, provided they receive full value n return. The old Golden Rule is a pretty good guide after all.

E. V.

WHAT to READ —for the man in a hurry



Suggested by the Managing Editor

What to read was not a difficult matter to decide two hundred years ago when books were few and magazines unheard of. It is far different now when so much reading matter is offered to pass the time pleasantly or profitably as the reader chooses. We are doing our utmost to make the "American Machinist" not only profitable but indispensable as a clearing house of ideas and news of the machinery world. This page is the editors' advertisement of their section of the paper. It gives the high spots

WE have used so much of Entropy's stuff lately (two of his observations are in this issue, Pages 248 and 266) that we think it high time to introduce him to the few readers of the *American Machinist* who are not already acquainted with him. While we ordinarily do not believe in letting a man talk very much about himself in the *American Machinist* we have found it difficult to improve on Entropy's brief autobiography so here it is. By the way, his real name is E. H. Fish.

"After graduating from Worcester Polytechnic Institute I put in eleven years in the machine-tool business beginning with the tin dinner pail and winding up as a designer. Some of the time I was superintendent of a small shop that made lathes and special machinery. . . . After that I took a fling at teaching and was at Worcester Tech. for six years; left there to start and run the Worcester trade school where I held down a more or less political job for five years.

"After these eleven years in the educational field I reformed and joined the staff of the *American Machinist* as New England editor for a short period. However, some of the local Worcester people discovering that an editor had very little to do, (This is an entirely erroneous impression of an editor.—Ed.) suggested my going to the Norton Co. where I was supposedly educational director but turned out to be employment manager, which, in that company means doing anything that nobody else wants to do. During this period I became interested in various societies and finally became acting president of the Boston Employment Managers' Association and vice president of the National Association.



E. H. FISH—"Entropy"

"Soon after we got into the war, so many of the young men whom I had enticed into the Norton Co. began to enlist, that I became ashamed to be seen around the office and took various jobs as an alleged expert with the shipping board and other organizations in the employment line, and finally dropped into the Federal Board for Vocational Education where I still am."

Mr. Fish has just announced his association with the Cooley & Marvin Co., of Boston, as Consulting Engineer.

Entropy has said so much that we won't have to add a great deal to fill this week's page. However, we want to mention the Stamets milling machine which has been given leading space, and the Metalwood press which is described on page 256. Both of these machines were designed for work on automotive crankshafts and are worth investigating.

The two-envelope pay system of the Oneida community which has met the advanced cost of living in a satisfactory manner is discussed on Page 249.

Toolmakers will find two articles of special interest in Part X of Macready's gage series on page 253, and "Accurate Lapping" by Vorhees on page 263.

A practical article on magnetic chucks by I. A. Hunt of the Heald Machine Co. begins on page 267.

On page 273 is another of Fred Colvin's automotive shop articles, this one taking up the machining of Fordson tractor connecting rods. The operation sheet is included as in the other articles in this series.

Report of the Cleveland Chamber of Commerce on the Metric System

FRANCE adopted the Metric System in 1793. In 1812, under Napoleon, the law was repealed and the French people promptly reverted to the old system called "Systéme Usuelle." In 1837, the metric system was again made compulsory in France. Despite the operation of this compulsory law for more than eighty years, it is stated that the old units are freely used in many industries in France; for example, the aune and denier are still used for measuring silk.

Many South American countries have adopted the metric system by compulsory and permissory laws. However, a survey conducted by the American Institute of Weights and Measures conclusively proves that the use of this system is not universal in these countries.

Argentina adopted the system in 1863. Yet an examination of the results of a questionnaire shows the use of many units unknown in the metric system. For example, land is sold by the square vara. In marine measurements the kilometer, meter, pie, ton, mile, knot and cubic foot appear to be used about equally.

Brazil adopted the metric system in 1862. The same condition is found there, with such terms as gallao, arroba, alqueire, etc., appearing frequently.

The adoption of the metric system in Chile in 1858 has apparently not altered the use of the old system in that country. The units libra, quintal, pie, vara and inch are found to be used in many industries.

The same condition prevails in Colombia, which adopted the system in 1853. In fact, this is the condition prevailing in practically all of the South American countries.

With slight differences, the units other than the metric units in use in Latin American countries are remarkably similar to the English system.

The condition prevailing in South America is interesting in that, at the time of the adoption of the metric system by the several countries, little or no physical disadvantage, in the form of deep-rooted manufacturing practice, existed. Apparently the reluctance of the peoples of these countries to change is attributable to the greater convenience of their old system.

There is attached to this report a map reproduced from a report issued by The American Institute of Weights and Measures, which will show perhaps better than any other way the comparatively limited extent of the exclusive use of the metric system in the world.

It is stated on good authority that 50 per cent of all machine tools manufactured in the world are made in the United States. It is further stated that 82 per cent of the total business of this character originates in the United States and in Great Britain, both of which countries use the English system. These machine tools are the basis from which all manufactured products spring, and it is not only possible to do, but manufacturing in the metric system is being done constantly with machines and machine tools in which the great majority of the parts are built to the English inch measurements. These machines, in most cases, are standardized and in the case of frames, bases and parts of a similar nature, it makes no difference whether the machine is to be used for manufacturing products to English inch measurements or metric measurements. In the majority of cases the



MAP SHOWING THE COMMANDING POSITION OF THE ENGLISH SYSTEM

only changes which are necessary are in such moving parts as lead screws and some change gears and parts of a similar nature. Where a company is doing a considerable export business, these metric parts have also become standardized, so that they present no more difficulty in their manufacture than do the corresponding parts, which are built to English measurements.

Proponents of the metric system urge as their main argument the advantage that would result in export trade from its adoption. To this argument your committee takes exception.

Many things manufactured in the United States are sold in tremendous quantities in foreign countries without a particle of hindrance by virtue of the system of measurement by which they were made. Foreign automobiles sell in the United States without a thought being given as to whether or not they are made to the metric or to the English system, and it is a well known fact that the American automobile made to the English measurement system has invaded every known country in the world.

Examples of the ready sale abroad of articles made by the English system could be multiplied without end.

The American Institute of Weights and Measures recently conducted what might well be called a census of metric use in the United States. The response to their questionnaire is particularly illuminating when applied to a consideration of the foreign trade of many American manufacturers. For example, out of the replies received from automobile manufacturers, it was found that none were equipping their cars for foreign trade exclusively with tires and rims in metric sizes. In fact, the companies which perhaps do the largest automobile export business, such as Dodge Brothers, Ford, Maxwell, etc., ship their cars equipped exclusively with tires in American sizes.

The Paige-Detroit Motor Co. states that occasionally a request for metric spark plugs is received. They further state that such requests are few and far between, because of the predominance of American spark plugs, and that in eighteen months they have not shipped a single car so equipped.

Dodge Brothers, who ship more than a million dollars' worth of automobiles a year to foreign countries, equip all of their cars with standard English thread spark plugs. Instances of this kind could be multiplied practically without end.

The Cleveland Twist Drill Co., which has been in export trade for a great many years, reports that in its particular line 90 per cent of the shipments to France, Sweden, Italy and Spain are made in metric measurements; to other so-called metric countries, roughly, 50 per cent. But the great bulk of its exports go to countries using the English system—Canada, Australia, South Africa and Great Britain. The Cleveland Twist Drill Company is absolutely opposed to making the metric system of weights and measures compulsory.

The metric system was made legal in the United States in 1866, and is open for the use of anyone desiring to adopt it. Contracts drawn in this system are legal and binding.

It is now proposed to introduce into Congress a bill which, if passed, will make the use of the metric system compulsory in the United States. In the opinion of your committee, the enactment of such a law would cause inestimable loss to the manufacturing interests of the country, and would create confusion and chaos from which the country would probably not recover for years.

An idea of the chaos that would be created in everyday affairs may be gained from glancing over the following list of changes that would have to be made.

In domestic life:

Grocers' scales all require new poise weights, all notched balance beams scrapped and new ones provided, with new sliding weights.

Peck and bushel measures discarded.

Liter, larger than a quart, new containers required.

Hectoliter, equal to 2.8 bushels, not a practical unit.

Prices on all commodities to be readjusted to new units.

In culinary matters:

All recipes to be readjusted to kilogrammes and liters; cook books to be rewritten; general confusion in kitchen operations.

New milk bottles.

In other household affairs:

Gas meters to be replaced by new system of units of volume, or readings of meters taken in one system and converted into the other, to avoid scrapping meters in use.

Water meters in same category as gas meters.

Tape measures and yard sticks to be discarded.

In shopping:

Counter measuring machines to be reconstructed, yards to meters.

Dry goods to be folded at cotton and woolen mills in meter folds instead of yard folds, requiring change of machinery.

Photographic plates in common sizes to be known by awkward combinations of figures. An 8 by 10 plate becomes 203 by 254 millimeters.

Quires and reams to be displaced by decimal multiples, requiring changes at manufacturing plants.

All containers and cartons to be modified in sizes and shapes to be adapted to new unit sizes.

Shirts, collars and cuffs to be known by strange names of sizes. A 16-in. collar becomes a 406-mm. collar. A 187-mm. hat is worn instead of 7⅜ in.

In building materials and construction:

Abandon board measure and substitute square decimeters, centares, or ares.

Doors familiar to all builders as 2 ft. 6 in. x 6 ft. 8 in. become 762 x 2,032 mm.

An ordinary brick is 51 x 101 x 203 mm. Sizes of sash also are converted into strange units. Weights of tin, copper, zinc, lead sheets and plates placed before builders in unknown units, in awkward combinations.

Molds and pallets in brickyards to be changed to new units or inconvenient numbers used to represent sizes.

Earth excavation on basis of cubic meters, representing about 1.3 cu.yd. Designation of shovels and dippers in excavating machinery to be in fractions of cubic meters instead of definite yards.

All architects' drawings to be in new units, involving a most perplexing conversion of current building material units or made up on a system that will involve changes in all woodworking machinery to meet metric units.

In railroad affairs:

Change in position and renumbering of, say 100,000 mile posts, an incidental and minor affair relative to other changes.

Standard gage of track becomes known as 1,435 mm.

Changes in time-table mileages.

Books of rules rewritten and speeds given in new units instead of miles per hour. Slow boards all repainted with new speeds thereon.

Speed recorders scrapped or remodeled.

Employees instructed in new methods of estimating speeds.

Dimensions of all wheels, axles, standard parts of car construction changed into new units.

Railroad track and warehouse scales to be reconstructed into metric units. Capacity of cars to be in new units.

In public land surveys:

Lands in many states surveyed and staked out in townships, sections, quarter sections and eighth sections, in none of which divisions is there an easy conversion into metric units.

In reconveyance of lands, present deeds giving metes and bounds in English units would require expensive and elaborate efforts to put dimensions and areas in metric units, which if correctly made would still be unintelligible to most people.

As great as the confusion in the few respects above mentioned and as expensive as the process would be in all the usual affairs of life, these few enumerated examples pale into insignificance beside the cost involved in making the conversion in the manufacturing industries. The cost of the war is but a fraction of that which would confront the general industries of this country. Virtual scrapping of all small tools and fixtures would be faced by manufacturers were such an act of Congress passed.

A colossal fortune in changes of lead screws and screw cutting gears in lathes alone is involved.

In all machinery the changes become of such a staggering nature their mere contemplation is most depressing. Days would be required simply to state the number of changes involved in the industries.

The ravages of war have fixed definite limits of territory. The ravages of the metric system changes would be universal in domestic affairs.

Compulsory legislation in this matter would plunge the nation into economic disorder, wiping out values in billions of dollars.

A dual system is confusing beyond description. Two systems do not admit of being in common use. A gradual change, piecemeal, is impracticable. A sudden sweeping change would throw the entire country into disorder.

In the chemical laboratory the metric system is used. It is there because it has advantages in chemical work. It was adopted because of its advantages there.

The metric system would be adopted by the industries if it possessed advantages for them.

The rewriting of all text books, engineers' tables, the changes in architects' drawings, in mechanical drawings, the education of the personnel of machine shops and other industries in the use of a new system of units are matters of greater magnitude than any yet undertaken by this country.

Interchangeable manufacture is strictly an American invention. Indeed, it is referred to in Europe as the "American method." Standardization is for the purpose of interchangeability. American industries have spent time and money standardizing for the purpose of economical manufacture on an interchangeable basis and today outstrip in this respect European methods so far that there is no comparison.

Your committee is not able to believe that the adoption of the metric system will promote this sort of standardization and interchangeability. It is our opinion that it will not only retard this work, but that it will destroy all that has already been done, and that much time and money would have to be expended in making the change.

The metric system does not provide for the purpose of the manufacturer convenient units of measure. American manufacturers are accustomed to making micrometer measurements. *In gear cutting, for example, there is not a single pitch in the metric system that will fit the United States system now so universally used* An example of this is the 12-pitch gear which is used by thousands in this country. The closest pitch to this in the metric system is module 2. These gears will not run together because the thickness of the metric tooth measured along the pitch circle is .124 in., while that of the 12-pitch tooth is .131 in. thick. In order to run these gears together it would be necessary either to change the 2 module to 1.889 module, or to change our standard to 2 module. It would mean that millions of gears on hand would no longer be interchangeable, that millions of dollars would have to be expended for changing over and rebuilding gear cutters, and that the necessary gages for checking the product would become obsolete, except for the purpose of repairing old gearing.

A common automobile cylinder dimension is that of the 3¾-in. bore. It is a standard size and is turned out by one concern alone in quantities of 12,000 per day. This standard is so well established that pistons and rings can be secured to fit it in every city in the United States. The metric translation of this size is 95.25 mm. Would our manufacturers be willing to adopt, or would other countries be willing to adopt, this size of 95.25 mm., or would it not be found necessary to adopt a 95-mm. bore? If 95 mm. should become the standard, it is not difficult to estimate the effect on the manufacturer who would be forced to scrap his tools, fixtures, jigs, etc.

The United States makes more than one-half of the screw products of the world. Our system is the most interchangeable of any of the systems which are in use at the present time. The bolts and nuts made by one manufacturer are readily interchangeable with the corresponding sizes made by another manufacturer. It has even been found that our standard 1 in.-8 thread per inch bolts and nuts can be used with 1 in.-8 thread bolts and nuts of the English Whitworth system.

In the metric system there is not a single diameter of bolt or pitch which will fit those now being extensively made in the United States. The pitches in the English system are expressed in terms of a certain number of threads per inch of length; while in the metric system they are measured from a given point on one thread to a corresponding point on the next thread, and under this system all fine threads become an awkward fraction of a millimeter.

It was estimated at the time of the signing of the armistice that the gages, checks, etc., made for war munitions alone cost the government $30,000,000. At least half of these will be of no use to the War Department or to anyone else if a compulsory metric law is passed. This gives an inkling of the tremendous cost of making the change proposed.

The English system, for the purpose of manufacturing, is as susceptible to decimal division as is the metric system. Beginning with the inch it is customary to halve for each sub-division up to a convenient fraction, 1/32 or 1/64, beyond which micrometers and other instruments are adjusted to hundredths, thousandths and ten-thousandths, all of which units are practicable and usable.

In the metric system the first decimal subdivision of the meter is the decimeter, a unit 3.937 in. long, of no utility and rarely used. The next unit is the centimeter, a unit too large for good work and too small for use in distance measurements. The next is the millimeter, .03937 in., the most widely used unit because of the adaptability of its size value. This unit is about as fine as can be used on a steel scale. For tools and fine, accurate mechanisms a millimeter is too large, and so the next subdivision is the 1/100 mm., which is .0039 in. The great bulk of good work in machine tool, automobile, tool working and other in-

dustries requires units between 1/10 and 1/100 mm. The one is too coarse and the other too fine. The result is the halving and quartering of millimeters to get usable units approximating 1/100, 1/1000 or 2/1000 of an inch. Thus, it will be seen that the advantage claimed for the metric system of providing a decimal system fails by virtue of this forced use of fractions.

A great majority of manufacturers are on record as opposing the adoption of the metric system under one of the three heads:

(1) It offers no advantage over the present system of inch measurements.

(2) It is a very expensive procedure to introduce.

(3) It will produce great complications during the period of transition.

Your committee, after consideration of its investigation and of the facts that have come to its attention, earnestly urges the Chamber of Commerce to go on record as being absolutely opposed to the compulsory adoption of the metric system of weights and measures in this country, and strongly recommends that the Chamber of Commerce direct communications to the members of the Committee on Coinage, Weights and Measures of the Congress of the United States, and to all of the representatives of Ohio in the Congress of the United States, opposing a legislation which will in our opinion be so disastrous to all of us.

Respectfully submitted,

J. C. BRAINARD
N. H. BOYNTON
EDWARD L. CHEYNEY
H. F. DEVERELL
THOMAS FERRY
A. W. HENN
ROBERT LINDSAY
G. E. MERRYWEATHER
FRANK A. PECK
J. H. SCOBEL
GEORGE T. TRUNDLE, JR.

The Committee on Industrial Development.

March 29, 1920.

ESTIMATED COST OF INSTALLING THE METRIC SYSTEM IN THE OFFICE, SELLING AND ADMINISTRATIVE DEPARTMENTS OF A LARGE CLEVELAND MANUFACTURING ESTABLISHMENT.

EXPENDITURES INCURRED ANNUALLY	EXPENDITURES INCURRED BUT ONCE
(1) *Publicity and Sales.*	
Extra salesmen necessary to cover present sales districts, due to delays in ascertaining customers' needs ..$10,000.00	Re-editing catalog, preparing new plates and re-publishing .....$15,000.00 Additional advertising campaign to instruct jobbers, dealers and customers in ordering particular products under the new system .....$25,000.00 Re-marking, re-labeling and general re-handling of goods now in stock $25,000.00
(2) *Billing, Accounting and Shipping Departments.*	
In distributing 1,500,000 tools monthly some fifty thousand items are billed to some ten thousand customers. The introduction of a new system of measurements will result in a huge increase in special orders; much confusion and numerical errors by customers in attempting to order under the new system; a heavy correspondence to correct these customers' errors; and also a heavy expense for shipping and rehandling of goods sent in error. The cost of this increased work over present costs is estimated to amount to 10 per cent in shipping, 30 per cent in billing, checking and cost accounting, and 40 per cent in stenographic expense, total $23,000.00	
(3) *Purchasing Department.*	
	Revising all data used in purchasing supplies ....$2,000.00 Loss on raw steel in stock due to increased wastage in turning down to metric sizes .....$25,000.00 [See under Mfg. Dept. for details.]
(4) *Financial Burden.*	
To render adequate service to customers, it will be necessary to greatly increase finished stock in standard millimeter sizes while still continuing to carry a large stock in English sizes re-marked in millimeter dimensions. This increased inventory will tie up at least $500,000 in additional capital. Interest, taxes and insurance on this investment at 8 per cent will amount to .....$40,000.00 Interest, depreciation, taxes, insurance and maintenance at 10 per cent on $50,000,000 of building and equipment needed to house this increased stock $5,000.00	Cost of 10,000 sq.ft. of additional shipping room and office space required to house the increased clerical force and increased finished stock, at $4.00 per sq.ft...$40,000.00 Increased office and store-room equipment required.$10,000.00
(5) *Administration Expense.*	
Increased charge for executives and executive assistants exclusively engaged in supervising the change from the old system to the new $15,000.00	
Total expenditures incurred annually.....	$93,000.00
Total expenditures incurred but once.....	142,000.00

MANUFACTURING DEPARTMENT

ALL EXPENDITURES AS SHOWN INCURRED BUT ONCE

(1) *Engineering Department*

The drawings of buildings, sewer and underground pipes, power equipment and the drawings of special machinery, jigs, fixtures, gages, and the whole line of product manufactured will have to be translated over to metric denominations. All dimensions except those which are multiples of 5 in. will be in fractions of a millimeter. These millimeter fractions must be retained because it will be impracticable to change the physical dimensions of most of the machine, jig and fixture parts.

A great many of the working lists will have to be made over because there is not space enough on them for these millimeter fractions. Where the work is to close tolerances, as in drill and reamer manufacturing, the translation from English to metric will have to be carried to 1/100 mm. in order that the combined tolerances in any straight line will not accumulate an error beyond the present over all tolerances. It will take two competent engineers and two assistants four hundred days at ten hours per day to make this change $16,000.00

(2) *Purchasing Department.*

All records will have to be translated into metric units to enable them to make proper comparisons for new purchases. Raw material on hand will have to be re-arranged to suit the new units. The stock of steel, 1,289 tons valued at $645,000.00, will have to be arranged to conform to the metric units, and in many cases the amount turned off of this steel to make the metric units will have to be increased to avoid scrapping it. This extra material wasted costs from 15 cents to $1.25 per pound. There will be 205 sizes, each, of three kinds of steel (615 sizes in all for regular product only) affected by this change. There will be 151 sizes each of two kinds of steel, the size of which is now finished, and any of this material left in stock at the time of change will be of no use for metric sizes.

(3) *Factory Office.*

Change in sizes of routing books	$500.00	
A large majority of duplicates of special orders which are kept for a permanent record are English sizes, and the adoption of the metric system will make them almost worthless or require translation at a cost of	2,000.00	
Change in all shop orders for tools in the factory, which have not reached the point of stamping	200.00	
Additional rubber stamps for stamping orders	70.00	
Change in sizes of the following forms of stationery: steel sheets, control cards, sales, production and new lots report, and lot number cards	50.00	
Change in guides and inserts for the following files: Stock in process file, special order file, lot number file, statistical department's file	80.00	
Two comptometers and one Burrough's adding machine in the statistical department discarded because these machines have eight rows of countng keys. With the metric system it will be necessary to carry out the sizes to three decimal points and in checking the punching and tabulating by adding the sizes on these machines, it will be necessary to have machines with ten or twelve rows of counting keys. The cost of the new machines would be.....	1,365.00	
It will also be necessary to add two or three counters to the size field on the tabulating machine for the same reason as above stated. This will mean the designing of a new machine. [Cost unknown.]		
Total cost of equipment		$4,265.00

(4) *Production Department.*

Cost of measuring instruments calibrated in inches which cannot be changed over.....	$19,000.00	
Cost of re-marking measuring instruments which can be changed.....	4,000.00	

Re-marking existing standards and gages which would have to be retained as special metric sizes	3,000.000	
Additional metric standards and gages	3,200.00	
Re-labeling pigeon holes, racks, etc., in factory	1,500.00	
Additional pigeon holes, racks, etc., to carry new stock	5,000.00	
Re-printing production forms, records and statistics (This includes cards and forms for tabulating machines, punching machines and collecting machines.)	20,000.00	
Guides used on machinery which would be obsolete due to changing size	15,800.00	
Immediate replacement	15,800.00	
Stamps, etc., obsolete	8,000.00	
Additional labor to get present production due to confusion, $3,200.00 per month for first year	38,400.00	
Cost of training employees to use metric measuring instruments	20,000.00	
Spoiled work under most favorable conditions, $5,000.00 per month for first six months, half of this for next six months	45,000.00	
Re-modeling jigs and fixtures on machines to suit metric sizes	20,000.00	
Nothing allowed for bolts, screws, nuts, gears, cutters, etc., whose dimensions would be translated into fractional metric sizes and their physical sizes maintained, rather than have two standards with the resulting confusion	.....	
Total expenditure for Production Department		$218,700.00
Grand total expenditure for entire plant		$473,965.00

The Employment Department and the Plant Publication

By John T. Bartlett

The employment department sees the new employee first, and after that, normally, it sees very little of him. The average workman hasn't any great love for employment departments, necessary as they are to him when he finds himself looking for a new job. He associates them, oftentimes, with tough luck and discouraging experiences, and thinks of the employment manager and his assistant as possibly human but engaged in essentially a crape-hanging occupation.

True, recent years have changed things (in some cases most radically) but the new employee still regards the employment department as a necessary evil, and a place he wants to get through with as quickly as he can.

Despite the unmistakable atmosphere which envelops it, and its own peculiar position within the organization, the employment department can make effective, constructive use of the employees' magazine. Its position, for one thing, makes it the natural department to perform the first ceremonies of introduction. It stands between the organization and the strange new man. On behalf of the organization it learns things about that man. It is only fitting in return that the employment department should tell the new man something about the organization.

Employment managers are beginning to use the ideal instrument in this connection, the employees' magazine. They have stacks of recent issues handy. It is a simple thing to say, "Here! Take these and look them over. It will help you to get acquainted with us." If a delayed decision is involved, and the applicant goes away to call again in a day or two, he has these bright, companionable employees' magazines to read. They help to keep him sold on the applied-for job.

Moreover, he gets familiar with names. He catches some of the spirit of the organization. When he goes to work, the newness wears off the faster. He coalesces. He is the more quickly a "broken in" employee.

In many organizations where there is still personal contact, it is the traditional habit for the "old man," when hiring a new man, to give the latter a little intimate talk on the old man's ideas about things, what he asks of employees and what he gives in return. It is a fine old tradition, and many a man who has climbed within a company dates his new feeling about things, a feeling which determined his ultimate success, back to that first intimate little sermon by the "old man."

That first talk started the new employee right. Coming from another job, and an organization with different ideals, he likely had preconceived views which would have fatally remained in his own path. But the "old man's talk showed him "where he was at." It indicated a clear track ahead, so long as certain simple fundamentals were respected. He didn't have to acquire a friendly feeling for the new company. He felt it to start with. He believed in his new employer.

A List of New Employees

Some employees' magazines—and the number will probably grow—print lists of new employees by departments. *Delco Doings*, of the Dayton Engineering Laboratories Co., does this. So does *The Heater*, of the Westinghouse Electric Products Co.

The published name is in the nature of a formal introduction. It will please the new employee and it will keep the old ones informed of the additions. In these days when hiring with a particular concern hasn't as much dignity as it had when jobs were less easy to get, and when some workers are inclined to change jobs for little reason, the published list has special psychological value. It carries a suggestion of permanence. It suggests that entering the employ of the company is a serious thing, and one not to be considered lightly. This is a little point, but many such points all combined make a big one.

The employment department should use the employees' magazine for instructional purposes, just as other departments should. This little notice, signed by the employment manager, is taken from a publication beside me:

"Change of Address.

"The above heading is one of the most important items on a man's history card. Yet it is an item very often neglected by the rank and file.

"Occasions have arisen when a man has been rendered unconscious. The first aid department secured his last known address from the employment department. After probably a run ten miles out into the South End in the car, it is found he has moved and lives within a block of the plant.

"Two men lost jobs recently through not reporting their changes of address. They had been laid off, but a day or two later their foremen wanted them back again. They had both moved from the addresses given when they were employed and no trace of them could be found.

"If you have changed your address since you last passed through the employment office, ask your timekeeper for a change of address slip. Fill it in, and return it to him. By doing this you will help us and at the same time help yourself. Remember it is very necessary that we have every man's proper address and his telephone number, if he has one."

In such small uses as this, the employees' magazine is an important adjunct to the business. In its larger uses, some of which the employment department especially participates in, it is of still greater significance.

SHOP EQUIPMENT NEWS

-Edited By-
E. L. DUNN and S. A. HAND

SHOP EQUIPMENT • NEWS •
A weekly review of modern designs and equipment

Descriptions of shop equipment in this section constitute editorial service for which there is no charge. To be eligible for presentation, the article must not have been on the market more than six months and must not have been advertised in this or any previous issue. Owing to the news character of these descriptions it will be impossible to submit them to the manufacturer for approval.

• CONDENSED • CLIPPING INDEX
A continuous record of modern designs and equipment

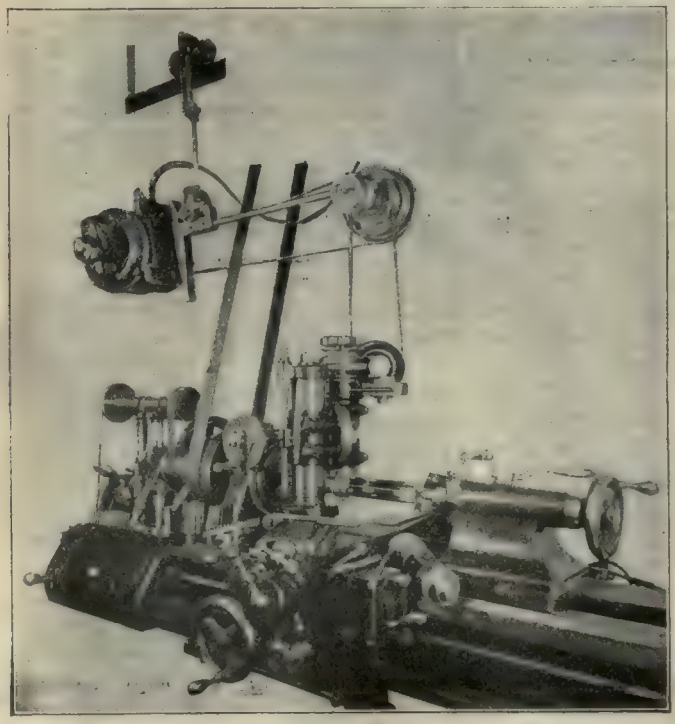
Moor Milling and Grinding Attachment

The milling and grinding attachment illustrated herewith has been recently placed upon the market by the Eccles & Smith Co., San Francisco, Cal.

The attachment consists of a vertical column carrying a saddle having either a milling or a grinding quill mounted thereon; a motor-driven countershaft suspended from a trolley rail; a driving wheel and indexing arrangement and an auxiliary countershaft.

The device is attached to the tool rest of the lathe by a central bolt through the column. The saddle can be raised or lowered on the column by a micrometer screw and can also be rotated around the column to any desired position. The quill mounting is attached to the saddle by a swivel base graduated in degrees. The milling spindle can be driven by worm gearing, as shown, for heavy cuts or slow speeds, or the worm gearing can be disengaged and the spindle run direct at high speed from a pulley. The dividing worm-wheel is attached to the lathe spindle by a faceplate, an indexing arrangement of the usual type being provided.

Longitudinal feed is belt driven from the small step of the cone pulley through an auxiliary countershaft to a grooved pulley on the change-gear shaft.



MOOR MILLING AND GRINDING ATTACHMENT

The milling spindle and quill can be easily removed and the grinding quill and spindle substituted.

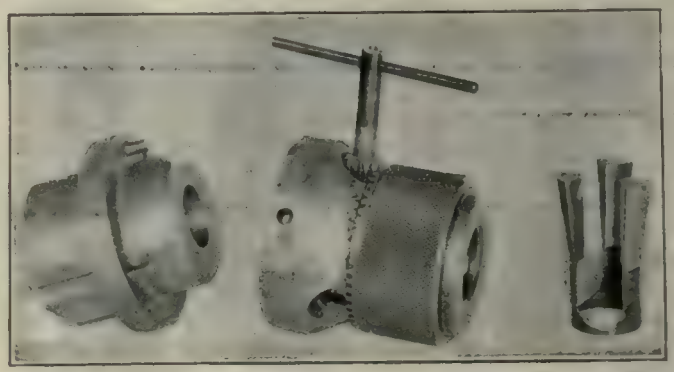
The countershaft is direct motor-driven and is suspended from an overhead rail through a universal joint, the motor overbalancing the drive pulley, so far as to keep the proper tension on the vertical belt. As the whole overhead arrangement is free to travel in a direction parallel with the lathe shears and can swivel in any direction, the milling or grinding attachment can be moved to any position on the lathe shears without cramping the belt.

Ney Draw-In Collet Chuck

The J. M. Ney Co., Hartford, Conn., has placed on the market the draw-in collet chuck illustrated herewith.

The chuck requires no tube or draw-in rod through the machine spindle as it is mounted on the spindle nose by means of a threaded adapter which is furnished with the chuck.

Rotation of the sleeve produces longitudinal travel of a shouldered nose-piece which bears on the end of the collet and forces it into a cone-shaped opening in the chuck body. Tightening pressure is obtained by the pinion key. The longitudinal thrust between the body and sleeve is taken by twenty-six hardened balls.



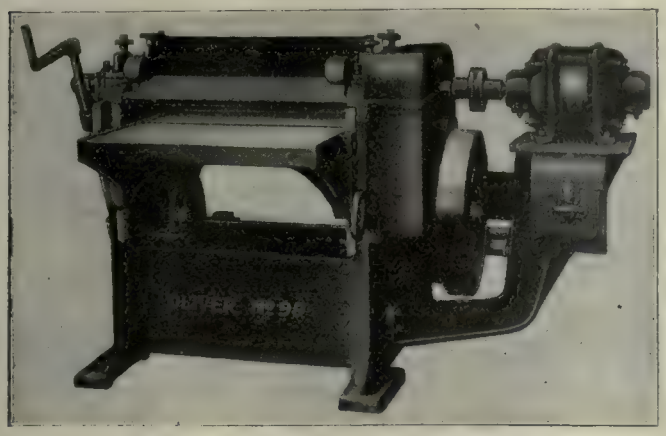
NEY DRAW-IN COLLET CHUCK

All parts of the chuck are made of machine steel, pack hardened, and ground on the working surfaces.

Each chuck is furnished with six hardened and ground tool-steel collets ranging in capacity from $\frac{3}{8}$ to 1 in., advancing by $\frac{1}{8}$ in. As each collet may be used on work $\frac{1}{64}$ in. over- or under-size, considerable flexibility is provided. Collets can also be furnished advancing by $\frac{1}{16}$ in.

Oliver Motor-Driven Surfacer

The Oliver Machinery Co., Grand Rapids, Mich., has arranged its No. 99 surfacer (which was formerly a belt driven machine) for motor drive, as shown in the illustration herewith.

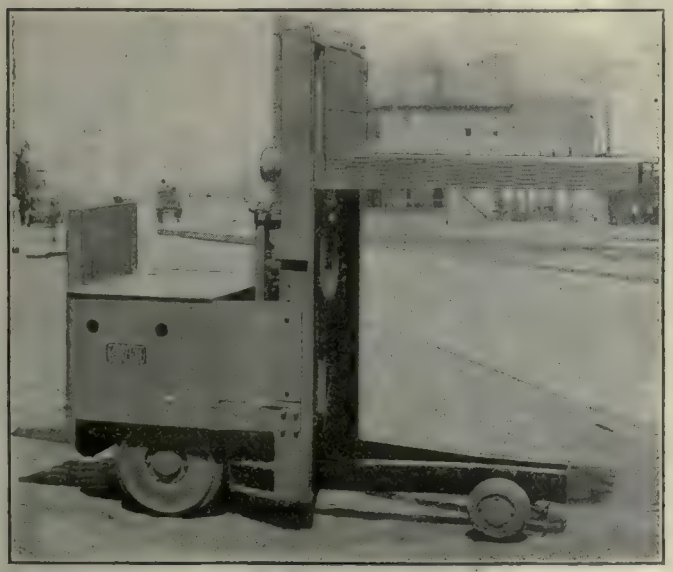


OLIVER MOTOR-DRIVE SURFACER

The drive to the cutter cylinder is direct from a standard motor running at 3,600 r.p.m.

Karry-Lode Tiering Truck

The Karry-Lode Industrial Truck Co., Inc., Long Island City, N. Y., has added to its line a lifting and tiering truck which is intended for use over smooth, level floors. The truck has a lifting capacity of 4,000 lb. at the rate of 3 ft. per min. and will deliver its load 65 in. above the floor. The platform is 26 x 54 in. in size and when in its lowest position is 11 in. above the floor. The hoisting is accomplished by a motor connected to a winding drum through a train of gears and a multiple disk clutch. The motor is allowed to accelerate to full speed before the clutch is applied to pick up the load, thus materially reducing the consumption of starting current. The platform is lowered by gravity, the speed being governed by an internal ratchet working in conjunction with the brake. The platform is controlled by means of a single lever that is located conveniently for the operator when in position on the step. A substantial drum-type controller is provided and the battery box is spring suspended and cushioned on all sides.

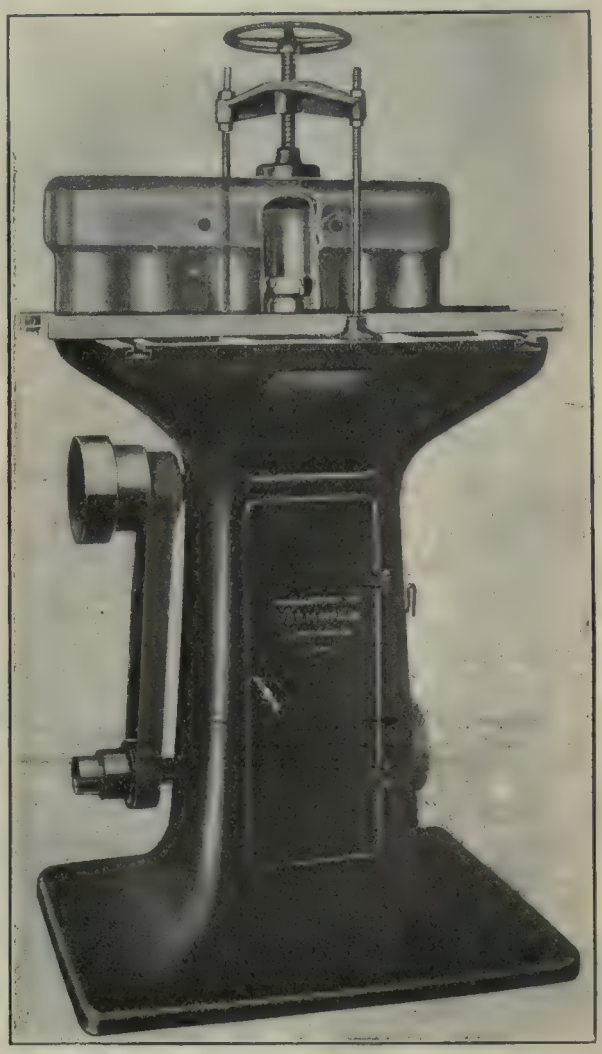


KARRY-LODE TIERING TRUCK

Storm Vertical Boring Mill

The Storm Manufacturing Co., 6th Ave. and 4th St., Minneapolis, Minn., has placed on the market the boring mill illustrated herewith.

As may be seen from the illustration, the boring bar works from beneath the table. The machine is intended for a variety of boring and provision has been made to protect the bar and bearings from chips.



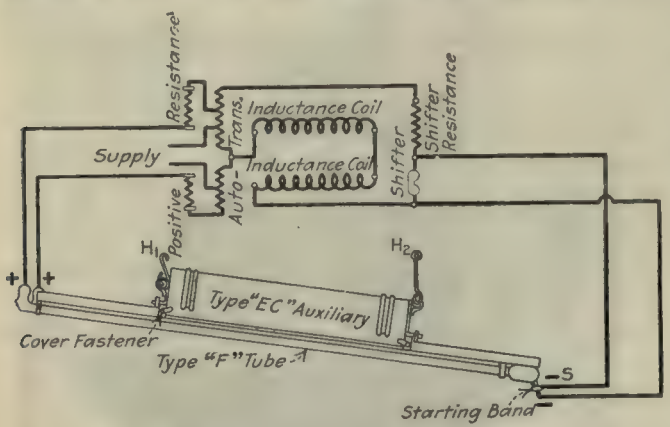
STORM VERTICAL BORING MILL

Specifications: Capacity; holes from 2⅜ to 7⅝ in. diameter and 20 in. depth with regular equipment; extra equipment can be furnished for holes up to 12 in. diameter. Floor space, 30 x 36 in. Height, 44 in. Work table, 24 x 30 in. Boring bars, 2 15/16 in. diameter, 38½ in. long. Approximate shipping weight 1,000 lb.

Four cutting heads are furnished as part of the regular equipment, each head having six high-speed helical cutters which can be universally adjusted for size. Positive feed is obtained through gears and a central feed screw. An automatic stop is provided so that when a hole has been bored to a predetermined depth, the boring bar will return to the starting position and cease revolving. Variable speed is obtained through a countershaft and three-step cone pulleys.

Cooper-Hewitt 85 Per Cent Power-Factor Lamp

The Cooper-Hewitt Electric Co., Hoboken, N. J., has developed a new type of auxiliary for use with its alternating current lighting units, which has raised the power factor of the lamps from 52 to 85 per cent. This has been accomplished by replacing the choke coils of the former auxiliary by a positive low resistance unit, as shown by the diagram. Further advantages of the auxiliary are a saving of 14 lb. in weight over the old type, and an increase in the allowable voltage variation, since



SIMPLIFIED WIRING OF AUXILIARY

the lamp has a regulation of 25 per cent, while that of the old type was only 12 per cent.

The wattage of the lamp is 450, which has increased the candlepower about 12 per cent. Since the tube will operate at 3.8 amperes d.c., normal, a further slight reduction has been made possible, as the auto-transformer need not be as heavy as formerly.

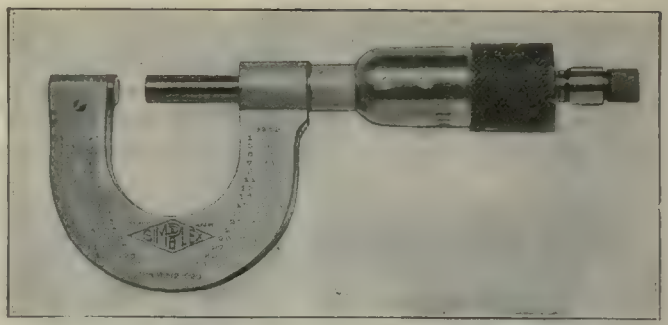
The lamp is adapted to alternating current circuits only, and can be used only on its specified frequency and within its own voltage range.

Simplex Self-Reading Micrometer

The Consolidated Tool Works, Inc., 261 Broadway, New York City, is putting out a micrometer designed to minimize errors in reading, whether the tool is used by expert mechanics or comparatively inexperienced workmen. The tool, instead of depending upon the matching of lines on thimble and barrel and counting up the lines exposed to get the measurement, carries on a part of the thimble a two wheel dial which in connection with the figures of the barrel shows the reading directly in numerals.

The part of the thimble nearest the frame does not revolve, but slides along the barrel to which it is splined. Two small dials within this part are actuated by the revolving thimble in such a way as to show through the windows the numerals that correspond to the position of the measuring spindle. Thus when a measurement is taken tenths are read from the last figure exposed on the barrel, hundredths from the wheel at the left and thousandths from the wheel at the right of the dial.

Any measurement in even thousandths within the capacity of the tool is thus shown without reference to the lines, while half and quarter thousandths may be estimated from the position of the zero line on the thimble.



SIMPLEX SELF-READING MICROMETER

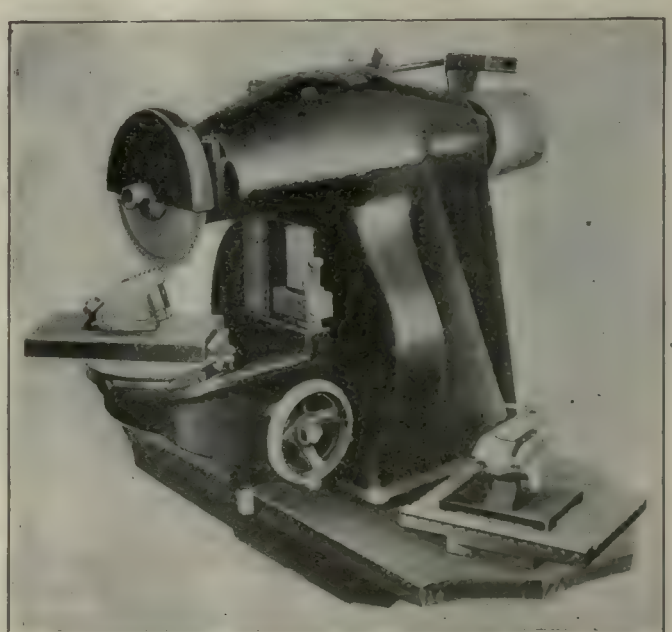
The tool is made in all regular sizes from one to six inches and in metric sizes from 25 to 150 mm. reading in hundredths of a millimeter.

It is furnished with or without ratchet stop or locknut, or with both, as desired. It is claimed to be accurate to one-ten-thousandth of an inch. The one- and two-inch sizes have full-finished frames with the table of decimal equivalents stamped upon them. Larger sizes have semi-finished frames.

Rickert-Shafer Chaser-Grinding Machine

Rickert-Shafer Co., Erie, Pa., has added to its line the chaser-grinding machine shown in the accompanying illustration. The machine is designed especially for grinding chasers of self-opening die heads. Either column- or bench-type machines can be furnished, and they can be equipped for either motor or line-shaft drive. Both the faces and the throats of chasers can be ground. For grinding faces, the fixture shown on the bench is used, adjustments being provided for varying the rake. The fixture shown on the machine is used when grinding throats, it being possible to grind chasers used for threading stock from ¼-in. to 6-in. diameter, the radius of the throat being varied by changing the angle between the axis of the wheel spindle and the fixture slide.

S. K. F. ball bearings are used throughout. The wheel is rubber corundum of 6-in. diameter.



RICKERT-SHAFER CHASER-GRINDING MACHINE, BENCH TYPE

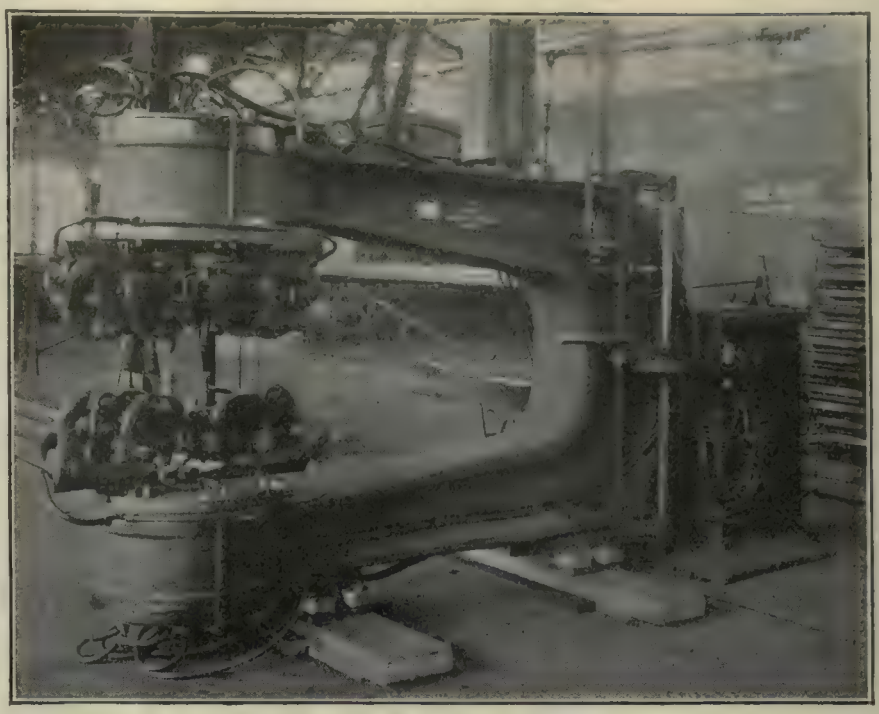
Federal Rotatable Head Two-Spot Welding Machine

A rotatable head two-spot, air operated welding machine, has been developed by the Federal Machine and Welde Co., Warren, Ohio.

It has a 60-in. throat depth and is guaranteed to weld from two thicknesses of 24-gage up to two thicknesses of 8-gage steel stock. Twelve welds per minute may be made in the latter size.

The machine is built with a 4 kva. welding transformer in the upper and lower rotating heads. Primaries are in parallel while the secondaries are in series, so that two spot welds must be made at the same time.

The welding electrodes or points are 1½ in. in diameter, are carried in water cooled holders, and are so arranged that welds from 3 to 8 in. apart may be made. The ends of each set of welding points can be separated a maximum of 5 in. The heads can be rotated through an angle of 90 deg. to permit welding at different angles on the stock being handled.



FEDERAL WELDING MACHINE

Four air cylinders are used, each operating an independent point. The air control is hand operated and so arranged that an initial air line supply pressure of 80 lb. will give from 300 to 700 lb. pressure between the points during the heating period. A second step on the air control makes it possible to apply 1,200 lb. pressure between the points for the final squeeze. The air is exhausted into the reverse side of the cylinders to withdraw the points. The regulating transformer supplies power to the welding transformer in eight voltage steps.

Redesigned Lavoie Air Chuck

The original Lavoie air chuck manufactured by the Frontier Chuck and Tool Co., 30 Letchworth St., Buffalo, N. Y., and described in the *American Machinist*, Vol. 51, page 484, was designed principally for shell work. The chuck has since been redesigned, making it adaptable for general commercial purposes. The same principle of operation is employed as formerly, but the overhang has been reduced, reversible jaws have been provided and other refinements added. The chuck is of simple construction, requiring but one packing and single piping. The grip is released by exhausting the air, a coil spring returning the piston to its original position. The chuck is made in two types as illustrated, one having two jaws, the other three jaws. The two-jaw type is made in three sizes, 6, 9 and 12 in., and is intended for brass work and odd shapes that require a simple method of chucking. The three-jaw type is made in four sizes, 10, 12, 15 and 18 in., and is used on general production work. The equipment includes one set of manufacturing jaws, one set of jaw pads, rough adapter casting, air box, and a quick-acting air valve.

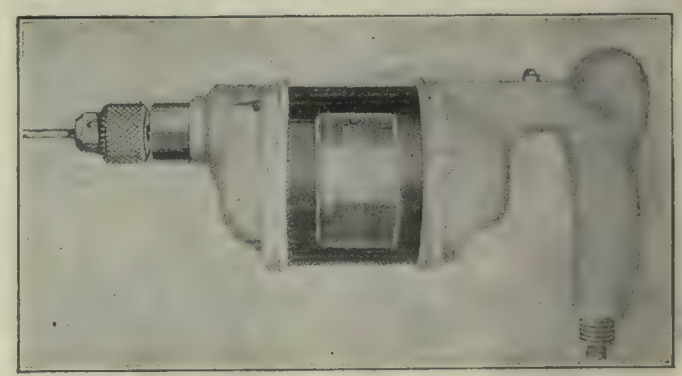


REDESIGNED LAVOIE AIR CHUCK

Electro Portable Drilling Machine

The portable electric drilling machine shown in the illustration is manufactured by the Electro-Magnetic Tool Co., 2902-8 Carroll Ave., Chicago, Ill.

The handle of the drill is of the pistol-grip type. The motor is series-wound, fan-cooled, and operates on voltages either 10 per cent above or below the normal. Adjustable ball bearings are used on the armature and a ball thrust bearing on the spindle. The reduction gears are of heat-treated alloy steel and easily removable. They run in grease in a cast-aluminum case, which is so constructed as to exclude grease from the motor chamber. A 3-jaw chuck is used. The machines are built in a range of sizes, having a capacity up to ¼-in. drills. The full load speeds vary from 750 to 8,000 r.p.m. and the weights from 4 to 8 pounds.



ELECTRO PORTABLE DRILLING MACHINE



Wickes and Niles Companies Form Machine-Tool Combine

Among the recent interesting developments in the machine-tool trade, has been the purchase of the controlling interest in the Wickes Machinery Co., of Jersey City, N. J., by F. H. Niles & Co., Inc., of New York.

H. W. McAteer, president of the American Steel Export Co., is chairman of the board of both companies, each of which will be continued under its own name. F. H. Niles, president of F. H. Niles & Co., becomes vice-president of the Wickes Machinery Co., while F. A. FitzGerald continues president of the Wickes Machinery Co. and becomes vice president of F. H. Niles & Co.

This action on the part of the Niles company becomes necessary in order to meet the demands of its rapidly growing business and to provide a more complete service.

The Wickes Machinery Co. succeeded some time ago to the business of Wickes Bros., who were engaged in the machinery and power equipment for over 40 years.

The New York office of Wickes & Co. will be in the office of F. H. Niles & Co. in the Woolworth Building. This latter company in addition to its used machinery business, also represents in the New York territory the following firms:

Cisco Machine Tool Co., lathes; Hoefer Manufacturing Co., upright drills; John Steptoe Co., shapers and millers; West Tire Setter Co., helve hammers; Kisey Wolf Machine Co., electric portable tools; Mueller Machine Tool Co., radial drills; Hawley Down Draft Furnace Co., oil burning and electric brass melting furnaces; Berkshire Manufacturing Co., molding machines.

Trade Board to Fight Suit of Steel Companies

The Federal Trade Commission has filed its formal answer to the suit of twenty-two steel companies contesting its authority to require monthly reports relating to cost of production. The document was filed in the District of Columbia Supreme Court. A temporary restraining order was issued recently against the commisison. Pending a final determination of the same the commission is gathering monthly reports only from such steel and coal companies as choose to furnish them voluntarily. The document holds that Congress has the power to regulate such business when it affects interstate trade.

Georgetown Students Welcomed at Venezuela

The impressive reception accorded to the 25 students of the Georgetown University Foreign Service School, who recently arrived at Caracas, Venezuela, to study the economic conditions of our South American neighbors, has impressed American manufacturers with the importance of sending many more such groups to the various Republics of the South and to the Far East, says the the National Foreign Trade Council.

America can never hope to establish herself permanently in foreign markets until the American youth has been instilled with the desire to adventure into far-off countries with the idea of residing therein. It is strange but true that although a race composed of emigrants from all corners of the earth, citizens of the United States are very reluctant to migrate to other countries.

The American manufacturer can send out thousands of catalogs, commercial travellers, and other agents; but never will the result equal those obtained by the use of a sample of his product on the spot by one who knows how to use it. The American office equipment used in our Consulates abroad, and the household articles used by the missionaries, have been the means of promoting more sales than any number of "snappy" letters written from the home office to a native agent.

Colleges and the Metric System

By Thomas E. Butterfield
Associate Professor, Mechanical Engineering, Lehigh University

My college enthusiasm for the metric system did not survive my employment as an engineer in Germany, the chief metric country; I found that the metric system was not in universal use there after a generation of compulsory legislation, and also found the use of the metric system of no advantage in engineering computation.

Further careful study for years has convinced me that the fancied logical advantages of the metric system are *illusory*, and that the agitation in favor of its adoption is *harmful* to American industry and to engineering education.

J. M. Larkin Heads Industrial Relations Body

J. M. Larkin, assistant to President E. G. Grace, of the Bethlehem Steel Co., Bethlehem, Pa., will direct the destinies of the Industrial Relations Association of America for the coming year. He was the unanimous choice of the members of the Board of Directors at their annual reorganization meeting held in Atlantic City. Mr. Larkin is ably qualified for the place, being one of the few industrial relations men of the country who have been given recognition as such by a seat on the Board of Directors of his company. His handling of the Representation Plan in effect at the plants of both the Bethlehem Steel Co. and the Bethlehem Shipbuilding Corporation has won the highest esteem, of both the company and himself in the estimation of the workers.

Mark M. Jones, Director of Personnel of the Thomas A. Edison industries, whose resignation as Executive Secretary was received and accepted to be effective September 15 at the latest, was elected vice president. A change in the constitution of the organization is being planned to allow the election of six other vice presidents, each one of whom will be assigned to a specific territory.

F. C. Parker, executive officer of the Central Y. M. C. A., Chicago, and Secretary of Chicago Council, Industrial Relations Association of America, was re-elected secretary for the second time.

W. H. Winans, of the Union Carbide and Carbon Co., New York City, was elected treasurer. For the present the administrative offices will remain at Orange, with E. A. Shay, the assistant secretary of the association, in charge. A meeting of the Board of Directors will be held in Buffalo on July 30 to formulate a program for the coming year and to elect a successor to Mr. Jones.

The administrative offices are now engaged in preparing for publication the proceedings of the Chicago convention in May, at which between 2,000 and 3,000 Industrial Relations workers and executives of all classes were in attendance.

British-French Combine Acquires Austrian Works

Guest, Keen & Nettlefold, of Birmingham, England, in conjunction with Jagy & Freres, of Paris, have acquired control of the two largest screw works in Austria, those of Brevillier & Co. and A. Urban & Sons. The purchase price is said to be about £150,000 ($729,975).

LD'S INDUSTRIAL FORGE
News Editor

Wright Corp. Explains Court Decree

Recently published newspaper articles concerning the suit of the Wright Aeronautical Corporation, owner of the basic Wright airplane patents, against the Interallied Aircraft Corporation have resulted in misunderstanding as to the right of the Interallied Aircraft to sell its Avro and Sopwith airplanes. The final decree of the court in that suit did prohibit the further sale or use of these airplanes, but the Interallied Aircraft Corporation has made an agreement with the Wright Aeronautical Corporation so that all the planes which the Interallied Aircraft now has and is selling are licensed under the Wright patent, and the Interallied Aircraft has the absolute right to sell them.

No purchaser or user of the airplanes sold by the Interallied Aircraft has any reason to apprehend any legal difficulties with respect to the Wright patent. Purchasers or users of unlicensed foreign airplanes do run the danger of becoming involved in expensive patent litigation, but the planes of the Interallied Aircraft are guaranteed licensed under the basic Wright patent.

Germany Buying Steel Plate and Foundry Iron

An interesting feature of the latest foreign trade situation is the report from abroad that German manufacturers have just booked orders from Japanese interests for several million tons of steel plate. On the other hand Germany is buying considerable quantities of foundry iron in this country, three large inquiries being reported from Hamburg and Frankfort within the week and shipments have been made to these cities recently via Rotterdam. Other European countries are buying heavily in the United States, but manufacturers and exporters are not at all anxious for this business under present transportation conditions.

Electrolytic Zinc Smelter To Be Opened in Norway

Announcement is made in the *Norwegian Commercial and Shipping Gazette* (Norges Handels og Sjofartstidende) of the early opening of the electrolytic zinc smelter at Glamfjord. It has been under construction for some time. It will be the first of its kind in Norway, and it is supposed its opening will greatly stimulate the development of new mines and increased production of the old workings.

W. B. Stout to Build Metal 'Planes for Navy

William B. Stout, technical adviser to the aircraft board during the war and former chief engineer of the aircraft division of the Packard Motor Car Company, has been awarded a contract by the United States Navy Department for six all-metal airplanes of a type never before attempted in this country.

The action of the government is said to have been hastened by the successful performances in America of the German Junkers model, similar to the one designed by Stout and which made a non-stop flight from Omaha to Philadelphia.

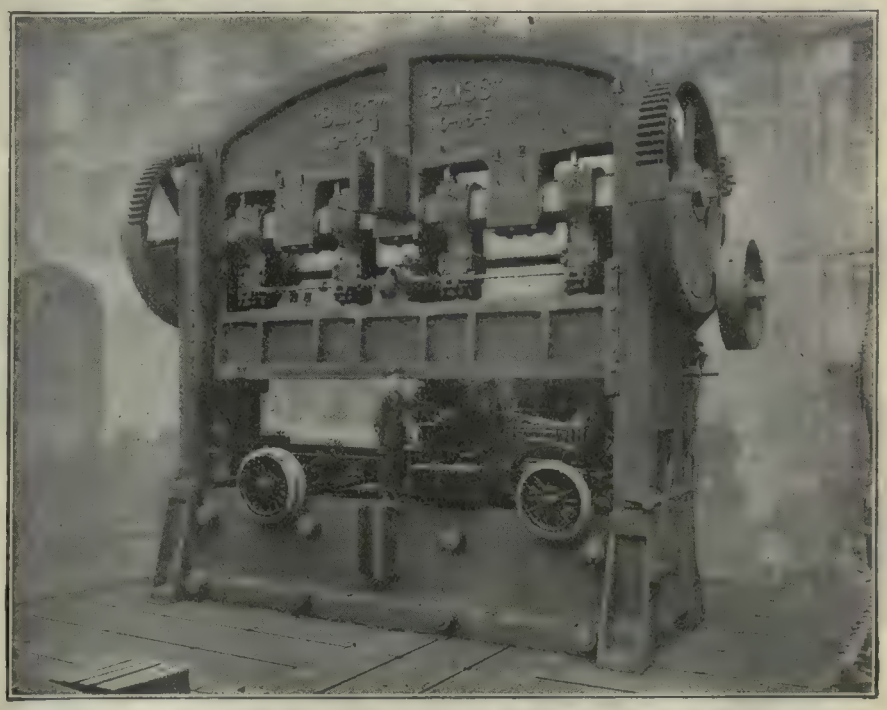
The capacity of the 'planes ordered from the Stout Engineering Laboratories has not been announced. The German airplane carries six passengers. Like the German 'plane the Stout type will dispense with the external bracing.

Stockholders of Bliss & Co. to Consider Recapitalization

Directors of E. W. Bliss & Co. have called a special meeting of stockholders for Aug. 11 to express approval or disapproval of a plan providing for the recapitalization of the company's finances. The purpose of the scheme is to enable the company to carry out a contract for the purchase of substantially all the plant and machinery of the Cleveland Machine and Manufacturing Co., of Cleveland, and also the plant of the Buckeye Engine Co., of Salem, Ohio.

Stockholders will be asked to approve the issuance of 300,000 shares of common stock, without par value and without voting rights. Also to authorize the issuance of 30,000 shares of first preferred stock, par $50, such stock to have the same rating as the present $1,500,000 cumulative preferred stock.

E. W. Bliss Co. Completes New Monster Press



The huge press shown in the illustration is a recent addition to the line of the E. W. Bliss Co., of Brooklyn, N. Y. It is a No. 15-F model, four-crank press, twin driven and triple geared, the gears being of steel. The primary use to which this press will be put by its purchaser is the blanking and perforating of side rails for the largest sizes of automobile truck frames. It can, of course, be used for other purposes and even for forming operations.

The Pierce-Arrow truck chassis shown in the photograph was placed in the press merely for the purpose of giving some comparison of sizes.

The important dimensions of the press are: Area of bed, 252 x 48 in.; area of slide face, 242 x 40 in.; number of strokes per minute, 5; total height, 25 ft. 9 in.

Personals

C. B. DURHAM, works manager of the Buick Motor Co., is to be assistant to the general manager in Chicago. Mr. Durham has been with the Buick organization since 1909 as assistant superintendent and was made works manager a year ago.

J. D. MOONEY has been appointed assistant to O. F. Conklin, general manager of the Remy Electric plant at Anderson, Ind. Mr. Mooney recently returned from England after assisting in organizing the Remy-Delco, Ltd.

W. H. MILLER, sales manager for the Pratt & Whitney Co., Hartford, Conn., completed thirty years of service with this company on Tuesday, July 29.

HARRY H. MARSALES has been appointed general traffic manager of the various plants of the Wickwire-Spencer Steel Corporation. Mr. Marsales' headquarters will be at the Buffalo plant.

H. L. SCHMEIDER, superintendent of the Advance Tool Co., Cincinnati, Ohio, has resigned. Hereafter, he will represent the Langhaar Ball Bearing Co., in Milwaukee and vicinity.

W. W. CLARK, export manager of the Hart-Parr Co., Charles City, Iowa, left this week for a three months' trip to the Far East in the interests of the Hart-Parr tractor. Mr. Clark will visit the Island of Formosa, Japan, Hong Kong, the Malay Islands and return by way of the Hawaiian Islands. He will also spend some time in the Philippine Islands.

L. H. BLOOD has recently resigned as chief engineer of the Oesterlein Machine Co., Cincinnati, Ohio, and has opened an office in the Union Central Building, Cincinnati, Ohio. Mr. Blood will specialize on the design of standard and special machine tools.

ALBERT D. WILEY, JR., in the credit department of the Norton Co., of Worcester, Mass., has been promoted to the Detroit store of the company, in charge of the credit department. Mr. Wiley will commence on his new duties Aug. 1.

ALBERT WALTON, of Philadelphia, has been made general works manager of Bateman & Co., Inc., of Delaware. Mr. Walton will be located at the general headquarters in New York City.

WILLIAM H. VOCKELL has resigned as tool engineer of the Cincinnati Milling Machine Co. and has organized the Cincinnati Engineering Tool Co., Cincinnati, of which he will be president.

H. C. UIHLEIN has resigned from the tool engineering department of the Cincinnati Milling Machine Co. to become secretary and treasurer of the Cincinnati Engineering Tool Co., Cincinnati, Ohio.

Trade Catalogs

Steel Products. Moltrup Steel Products Co., Beaver Falls, Pa. Catalog No. 1, pp. 95, 5¼ x 7¾ in. This is the first general catalog that the Moltrup Steel Products Co. has published and in it is presented descriptions and illustrations of its various products such as cold drawn steel in rounds, squares, etc.; shafting, screw stock, and special polished rod; turned and polished shafting; machine keys, woodruff keys and machine rack; flattened steel plates for various uses. It also contains tables of weights of circular plates; weights of aluminum sheets, decimal equivalents, metric conversion and others.

Precision Test Indicator. Deming Indicator Co., Dayton, Ohio. A single page circular illustrating and describing the Deming precision test indicator. Price list of parts is also given.

Air Compressors. Pennsylvania Pump and Compressor Co., Easton, Pa. Bulletin No. 100, pp. 12, 6 x 9 in. This bulletin describes a type of ring-plate valve, and an oil float gage for determining at all times, the level of oil in the crank basin.

Battery Charger. Hobart Bros. Co., Troy, Ohio. The Hobart Bros. Co. has issued two circulars describing a ten-battery charging outfit for use in garages.

Radiograph. Davis-Bournonville Co., Jersey City, N. J. Bulletin, 8½ x 11 in. This bulletin briefly describes the Davis-Bournonvill Radiograph No. 1 A and gives illustrations of the radiograph cutting steel plate and billets in fabricating plants, steel mills, boiler shops, bridge works, locomotive and car shops, with the oxy-acetylene and oxy-hydrogen torch.

Forthcoming Meetings

The International Railway Master Blacksmiths' Association will hold its next annual convention at Tutwiler Hotel, Birmingham, Ala., on Aug. 17, 18 and 19. The secretary of the association is A. L. Woodworth, Lima, Ohio.

The National Gas Engine Association, Monadnock Bldg., Chicago, Ill., will hold its thirteenth annual convention at the Congress Hotel, Chicago, on Sept. 1, 2 and 3.

The American Steel Treaters' Society and the Steel Treating Research Society will hold their second annual convention and exhibition at the Commercial Museum, Philadelphia, Pa., on Sept. 14 to 18, inclusive. J. A. Pollack, of the Pollak Steel Co., Cincinnati, Ohio, is secretary of the former society.

The American Foundrymen's Association will hold its annual convention and exhibit at Columbus, Ohio, on Oct. 4 to 9. C. E. Hoyt, 1401 Harris Trust Building, Chicago, Ill., is secretary.

An exposition of U. S. manufacturers at Buenos Aires, Argentine Republic, S. A., has been arranged for the month beginning Nov. 15. Information can be obtained from the American National Exhibition, Inc., Bush Terminal Sales Building, 132 West 42nd St., New York.

HARRIS E. WHITING has been made factory manager of Edward R. Ladew Co., Inc., Glen Cove, L. I., a subsidiary of Graton & Knight Manufacturing Co., of Worcester, Mass., at which plant he was formerly located. Mr. Whiting is now at the Ladew plant.

W. D. CREIDER, formerly Cleveland representative of the Modern Tool Co., has resigned his position and will represent the combined interests of the Reed-Prentice Co., the Becker Milling Machine Co., and the Whitcomb-Blaisdell Machine Tool Co. at the new Chicago office which they are opening.

Business Items

The Bethlehem Steel Corporation directors at their meeting recently declared the regular quarterly dividend of 1¾ per cent on both classes of common stock. President Grace reported the steel plants of the corporation operating at about 80 per cent capacity, with new business being booked at a rate equal to production. The shipbuilding plants have sufficient work on hand to assure full operations for balance of year, but there is no large volume of new business offering. The rate of operations is entirely controlled by the car supply, both for incoming and raw materials and for shipment of finished products. The corporation is providing itself with sufficient coal car equipment to protect the operation of its coal and steel properties.

Back from a trip abroad Peter S. Steenstrup, general manager of the General Motors Export Co., saw things that made him pleased with his journey. Europe, he says, is fast improving as a market for cars, but he found little to make him believe that foreign plants will soon be in a position to fill all the demands of the European trade.

It is announced that James L. Gough, president of the Federal Machinery Sales Co. of Chicago, with branches in Detroit and Milwaukee, has resigned as president and, having sold his interest in the concern, has withdrawn from any participation in its affairs. The business of the Federal Machinery Sales Co. will continue to be conducted along its established lines, no further change either in policy or personnel being contemplated.

The Sanford Riley Stoker Co., Ltd., of Worcester, Mass., has removed its offices to its new factory at 9 Neponset St. The new quarters give much additional space.

To take over the properties in Georgia and Alabama of the Bass Foundry and Machine Co., of Fort Wayne, Ind., the Rock Run Co., of Rock Run, Ala., has been chartered and incorporated under the laws of Alabama with a capital stock of $500,000. It will also operate the Rock Run furnace. Officers of the new corporation are: J. H. Bass, president; C. T. Strawbridge, vice president; G. M. Lesliem, treasurer, and L. H. Link, secretary, all of Fort Wayne, and J. M. Garvin, of Rock Run, vice president and general manager.

The associated interests of the Reed-Prentice Co., Becker Milling Machine Co. and Whitcomb-Blaisdell Machine Tool Co. are opening a new Chicago office and showrooms at 26 and 28 North Clinton St., Chicago. This new store is in the district known as Machinery Row, and is central with all the other machine-tool interests.

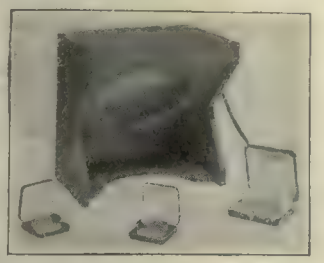
Condensed-Clipping Index of Equipment

Patented Aug. 20, 1918

Optical Equipment, Van Keuren

Van Keuren Co., 1706 Commonwealth Ave., Boston, Mass.

"American Machinist," July 22, 1920



The equipment comprises two working optical flats, one master flat and one source of monochromatic light. Comparisons can be made in units of one-half wave length of light, which for daylight is approximately 0.00001 in. As it is easy to estimate with the eye one-tenth of the width of an interference band, the difference of 0.000001 in. may be seen. Any one of the three optical flats may be used for flatness tests, though only two are required for comparison of length. However, all the flats have one accurate surface and can be used to test each other by the method ordinarily used in originating surface plates. It is claimed that the accuracy of the working flats is within 0.000005 in. and that of the master flat is within 0.0000025 in.

Reaming Sets, Cylinder

Wetmore Reamer Co., Milwaukee, Wis.

"American Machinist," July 22, 1920



The reamers are made in sets of three, consisting of a roughing reamer, semi-finishing, and finishing reamer. They are furnished with arbors to fit all makes of machines. The roughing reamer blades are set at a right-hand cutting angle and are held in place by a head lock-nut and jam-nut of heat treated alloy-steel. The semifinishing reamer has blades with a left-hand cutting angle. The finishing reamer is of the floating design, with blades set at a left-hand cutting angle, and unequally spaced. The floating device is an improved Oldham float having rollers, and is thoroughly protected from dust and grit. All cutting blades are made of high-speed steel.

Clutch, "Twyncone" Friction

Link-Belt Co., Chicago, Ill.

"American Machinist," July 22, 1920



This clutch embodies the following features: One point adjustment; perfect balance and complete inclosure of all moving parts. Very high speed may be attained without causing "throw in" or "throw out" and the clutch can be engaged or disengaged when running at any speed. The friction cones are lined with thermoid.

Press, Verson, No. 0 Inclinable Power Bench

La Salle Machine Works, 3013 South La Salle Street, Chicago, Ill.

"American Machinist," July 22, 1920

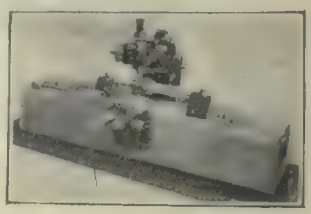


This machine is adapted for use on small parts where speed and accuracy are required. It is provided with a hardened tool steel clutch with the addition of an automatic safety device which disengages at each revolution of the press, even without the release of the treadle. The machine is of the open-back type and can be furnished with a table and legs if desired. Specifications: Stroke, 1 in. Adjustment of slide, 1 in. Bed to slide, with stroke down and adjustment up, 5 in. Area top of bolster, 6 x 8 in. Thickness of bolster, $\frac{3}{4}$ in. Width of opening through back, 4 in. Height, bench to center of shaft, 21 in. Flywheel, 12 in. diameter, by $2\frac{1}{2}$ in. face; speed, 225 r.p.m. Hole in bed, 3 x $3\frac{1}{2}$ in.

Measuring Machine, Microscopic

Alfred Herbert, Ltd., 54 Dey St., New York City.

"American Machinist," July 22, 1920



The machine has a table capable of 12-in. longitudinal movement by accurate amounts by insertion and removal of hardened steel measuring rods between flat contact pieces. The table carries a pair of centers, one of which can be adjusted crosswise to enable accurate alignment of work. A microscope fitted with two crosshairs, one rotating with the outside tube and the other rotating with the eyepiece, is mounted on a compound slide controlled by micrometer screws. The outer tube of the microscope has a dial reading to half degrees and the eyepiece has a vernier reading to one minute of arc. A light projector is fixed to the machine and will project parallel rays of light through a lens upon a mirror and past the work.

Gage, Knaeul Adjustable Taper

Knaeul Tool Works, 1544 Twenty-four and One-half Street, Rock Island, Ill.

"American Machinist," July 22, 1920

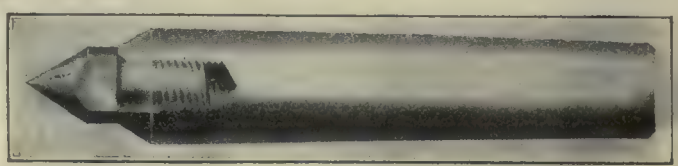


This device can be quickly adjusted and locked in position on any taper for duplicating work. In use, the piece to be duplicated is laid in the lower V and the top piece brought down until light is excluded. The gage is then locked in position. The gage is made in only one size and will cover the ordinary range of tapers up to No. 11 Brown and Sharpe or No 4 Morse.

Center, Ettco Insert

The Eastern Tube and Tool Co., 594 Johnson Ave., Brooklyn, N. Y.

"American Machinist," July 22, 1920



The threaded points are made of high-speed steel ground to size and are interchangeable. The shanks are made of carbon steel, hardened and ground, and are furnished in all standard sizes and tapers.

Drilling Machine, Natco No. 85 Inverted

National Automatic Tool Co., Richmond, Ind.

"American Machinist," July 22, 1920



The machine is used to advantage for deep hole drilling in cast iron as there is no accumulation of chips in the holes to interfere with the drill so that it is not necessary to back out the drills at frequent intervals to remove the chips. The machine, as shown, is arranged to drill five $\frac{9}{16}$-in. holes at one time to a depth of $4\frac{3}{4}$ in. The work is held in a special fixture supported from the table which feeds downward. When placed in position the work is securely locked by means of two handwheels. The drill spindles are adjustable for position and the bearings are amply protected against dust and chips.

Clip, paste on 3 x 5-in. cards and file as desired



THE WEEKLY PRICE GUIDE

IRON AND STEEL

PIG IRON—Quotations compiled by The Matthew Addy Co.:

	Current	One Year Ago
CINCINNATI		
No. 2 Southern	$45.60	$29.80
Northern Basic	42.80	27.55
Southern Ohio No. 2	46.80	28.55
NEW YORK—TIDEWATER DELIVERY		
2X Virginia (Silicon 2.25 to 2.75)	49.65	31.90
Southern No. 2 (Silicon 2.25 to 2.75)	49.70	33.95
BIRMINGHAM		
No. 2 Foundry	42.00@44.00	25.75
PHILADELPHIA		
Eastern Pa., No. 2x, 2.25–2.75 sil.	46@48.25*	30.65
Virginia No. 2	45.00*	30.85
Basic	44.50†	29.90
Grey Forge	43.50*	29.90
CHICAGO		
No. 2 Foundry local	44.25	27.25
No. 2 Foundry, Southern	47.00	31.75
PITTSBURGH, INCLUDING FREIGHT CHARGE FROM VALLEY		
No. 2 Foundry	45.65	28.15
Basic	44.40	27.15
Bessemer	44.90	29.35
MONTREAL		
Silicon 2.25 to 2.75%	43.25	.....

* F.o.b. furnace. † Delivered.

STEEL SHAPES—The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses at the cities named:

	New York			Cleveland		Chicago	
	Current	One Month Ago	One Year Ago	Current	One Year Ago	Current	One Year Ago
Structural shapes	$4.47	$3.97	$3.47	$5.00	$3.37	$3.97	$3.47
Soft steel bars	4.62	4.12	3.37	4.50	3.27	3.87	3.37
Soft steel bar shapes	4.62	4.12	3.37	.....	3.27	3.87	3.37
Soft steel bands	6.32	5.32	4.07	6.25	.....	.....	.....
Plates, ¼ to 1 in. thick	4.67	4.17	3.67	4.50	3.57	4.17	3.67

BAR IRON—Prices per 100 lb. at the places named are as follows:

	Current	One Year Ago
Mill, Pittsburgh	$4.25	$2.62
Warehouse, New York	4.57	3.37
Warehouse, Cleveland	3.52	3.22
Warehouse, Chicago	3.75	3.37

SHEETS—Quotations are in cents per pound in various cities from warehouse; also the base quotations from mill:

Blue Annealed	Large Mill Lots Pittsburgh	New York Current	New York One Year Ago	Cleveland	Chicago
No. 10	3.55–7.00	7.12@8.00	4.57	8.10	7.02
No. 12	3.60–7.65	7.17@8.05	4.57	8.15	7.07
No. 14	3.65–7.10	7.22@8.10	4.67	8.20	7.12
No. 16	3.75–6.20	7.32@8.20	4.77	8.30	7.22
Black					
Nos. 18 and 20	4.20–6.20	7.80@9.50	5.30	8.70	7.80
Nos. 22 and 24	4.25–6.25	7.85@9.55	5.35	8.75	7.85
No. 26	4.30–6.30	7.90@9.60	5.40	8.80	7.90
No. 28	4.35–6.35	8.00@9.70	5.50	8.90	8.00
Galvanized					
No. 10	4.70 8.00	8.55@11.00	6.20	9.00	8.15
No. 12	4.80 8.10	8.65@11.00	6.25	9.10	8.20
No. 14	4.80–8.10	8.65@11.10	6.30	9.10	8.35
Nos. 18 and 20	5.10–8 40	8 90@11.40	6.60	9.40	8.65
Nos. 22 and 24	5.25 8 55	9 05@11.55	6.75	9.55	9.05
No. 26	5.40–8 70	9 20@11.70	6.90	9.70	9.20
No. 28	5.70–9.00	9.50@12.00	7.20	10.00	9 50

Acute scarcity in sheets, particularly black, galvanized and No. 16 blue enameled.

Automobile sheets are unavailable except in fugitive instances, when prices are 9.45c per lb. for No. 16; 9.50 for Nos. 18 and 20, and 9.55c for Nos. 22 and 24.

COLD FINISHED STEEL—Warehouse prices are as follows:

	New York	Chicago	Cleveland
Round shafting or screw stock, per 100 lb. base	$6.25	$5.80	$6.00
Flats, square and hexagons, per 100 lb. base	6.75	6.30	6.50

DRILL ROD—Discounts from list price are as follows at the places named:

	Per Cent.
New York	50
Cleveland	50
Chicago	50

SWEDISH (NORWAY) IRON—The average price per 100 lb., in ton lots is:

	Current	One Year Ago
New York	$20.00	$21.00–26.00
Cleveland	20.00	20.00
Chicago	21.00	16.50

In coils an advance of 50c. usually is charged.
Domestic iron (Swedish analysis) is selling at 12c. per lb.

WELDING MATERIAL (SWEDISH)—These prices are the best we have been able to obtain for Swedish welding materials, of which it is reported that very little are on the market.

Welding Wire		Cast-Iron Welding Rods	
3/32, 1/8, 5/32, 3/16, 7/32, 1/4, 9/32, 5/16 No. 8, 3/8 and No. 10	21.00 to 30.00	1/4 by 12 in. long	14.00
		5/16 by 19 in. long	12.00
		3/8 by 19 in. long	10.00
No. 12		1/2 by 21 in. long	10.00
7/16, No. 14 and 1/2			
No. 18		**Special Welding Wire, Coated**	
No. 20		1/8	33.00
		5/32	30.00

Domestic—Welding wire in 100-lb. lots sells as follows, f. o. b. New York: 3/32, 8½c. per lb.; 1/8, 8c.; 5/32 to 1/2, 7½c.

MISCELLANEOUS STEEL—The following quotations in cents per pound are from warehouse at the places named:

	New York Current	Cleveland Current	Chicago Current
Openhearth spring steel (heavy)	7.00	8.00	9 00
Spring steel (light)	10.00	11.00	12.25
Coppered bessemer rods	9.00	8.00	6.75
Hoop steel	6.57	6.50	5.32
Cold-rolled strip steel	12.50	8.25	10.75
Floor plates	6.80	6.00	6.77

PIPE—The following discounts are to jobbers for carload lots on the Pittsburgh basing card, discounts on steel pipe, applying as from January 14, 1920, and on iron pipe from January 7, 1920.

Inches	Steel Black	Steel Galvanized	Inches	Iron Black	Iron Galvanized
BUTT WELD					
¼ to 3	54–57½%	41½–44%	¾ to 1¼	24½–34½%	8 –18½%
LAP WELD					
2	47 –50½%	34½–38%	1¼	.....	.....
2½ to 6	50 –53½%	37½–41%	1½	.....	.....
7 to 12	47 –50½%	33½–37%	2	20½–28½%	6½–14½%
13 to 14	37½–41 %	.....	2½ to 6	22½–30½%	9½–17½%
15	35 –38½%	.....	7 to 12	19½–27½%	6½–14½%
BUTT WELD, EXTRA STRONG PLAIN ENDS					
¾ to 1¼	52 –55½%	39½–43%	¾ to 1¼	24½–34½%	9½–19½%
2 to 3	53 –56½%	40½–44%			
LAP WELD, EXTRA STRONG PLAIN ENDS					
2	45 –48½%	33½–37%	1¼	.....	.....
2½ to 4	48 –51½%	36½–40%	1½	.....	.....
4½ to 6	47 –50½%	35½–39%	2	21½–29½%	8½–16½%
7 to 8	43 –46½%	29½–33%	2½ to 4	23½–31½%	11½–19½%
9 to 12	38 –41½%	24½–28%	4½ to 6	22½–30½%	10½–18½%
			7 to 8	14½–22½%	2½–10½%
			9 to 12	9½–17½%	5½–+2½%

	New York Black	New York Galv.	Cleveland Black	Cleveland Galv.	Chicago Black	Chicago Galv.
¾ to 3 in. steel butt welded	40%	24%	40%	31%	54%40%	40½@30 %
2½ to 6 in. steel lap welded	35%	20%	42%	27%	50@40%	37½@27½%

Malleable fittings. Classes B and C, banded, from New York stock sell at plus 32%. Cast iron, standard sizes, net.

METALS

MISCELLANEOUS METALS—Present and past New York quotations in cents per pound, in carload lots:

	Current	Month Ago	Year Ago
Copper, electrolytic	19.00	19.25	21.75
Tin in 5-ton lots	49.50	61.50	70.00
Lead	9.25	9.00	5.50
Zinc	8.25	8.70	8.00
ST. LOUIS			
Lead	8.90	8.87½	5.25
Zinc	7.90@8.40	8.37½	7.65

At the places named, the following prices in cents per pound prevail, for 1 ton or more:

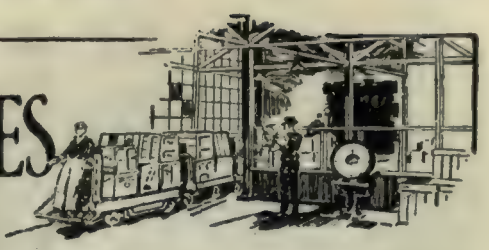
	New York Current	New York Month Ago	New York Year Ago	Cleveland Current	Cleveland Year Ago	Chicago April 8 Current	Chicago April 8 Year Ago
Copper sheets, base	33.50	33.50	29.50	32.00	33.50	36.00	36.50
Copper wire (carload lots)	31.25	31.25	26 50	29.50	29.50	27.00	25.00
Brass sheets	28.50	28.50	23 00	29.00	29.00	27.00	28.00
Brass pipe	33.00	33.00	34.00	34.00	36.00	35.00	37.00
Solder (half and half) (case lots)	38.00	33.00	45.00	40.50	41.00	38.00	41.00

Copper sheets quoted above hot rolled 16 oz., cold rolled 14 oz. and heavier, add 2c.; polished takes 5c. per sq.ft. extra for 20-in. widths and under; over 20 in., 7½c.

BRASS RODS—The following quotations are for large lots, mill. 100 lb. and over, warehouse; net extra:

	Current	One Year Ago
Mill	25.00	19.00
New York	27.00	21.50
Cleveland	27.00	30.00
Chicago	26.00	30.00

SHOP MATERIALS AND SUPPLIES



ZINC SHEETS—The following prices in cents per pound prevail:
Carload lots f.o.b. mill..... 12.50

	In Casks		Broken Lots	
	Current	One Year Ago	Current	One Year Ago
Cleveland	15.00	12.95	15.50	13.30
New York	14.00	12.00	14.50	13.00
Chicago	15.00	16.50	15.00	16.00

ANTIMONY—Chinese and Japanese brands in cents per pound, in ton lots for spot delivery, duty paid:

	Current	One Year Ago
New York	7.50	8.37½
Chicago	7.75	10.00

OLD METALS—The following are the dealers' purchasing prices in cents per pound:

	New York			
	Current	One Year Ago	Cleveland	Chicago
Copper, heavy, and crucible	16.25	16.75	15.50	15.50
Copper, heavy, and wire	15.25–15.75	15.75	15.00	15.00
Copper, light, and bottoms	13.00	13.50	13.00	14.00
Lead, heavy	7.00	4.62½	7.00	7.00
Lead, tea	5.00	3.75	5.00	6.00
Brass, heavy	10.25	10.00	11.00	15.50
Brass, light	7.75– 8.00	8.00	8.00	9.50
No. 1 yellow brass turnings	9.00– 9.50	9.00	8.50	9.50
Zinc	5.25	4.25	4 50	9.50

ALUMINUM—The following prices are from warehouse at places named:

	New York	Cleveland	Chicago
No. 1 aluminum, 98 to 99% pure, in ingots for remelting (1-15 ton lots), per lb	33.00	34.00c.@35.00c.	33.50

COPPER BARS—From warehouse sell as follows in cents per pound, for ton lots and over:

	Current	One Year Ago
New York (round)	38.00	25.00
Chicago	29.00	28.00
Cleveland	32.00	33.00

BABBITT METAL—Warehouse price per pound:

	New York		Cleveland		Chicago	
	Current	One Year Ago	Current	One Year Ago	Current	One Year Ago
Best grade	90.00	90.00	61.00	80.00	60.00	75.00
Commercial	50.00	50.50	21.00	18.50	15.00	15.00

SHOP SUPPLIES

NUTS—From warehouse at the places named, on fair-sized orders, the following amount is deducted from list:

	New York		Cleveland		Chicago	
	Current	One Year Ago	Current	One Year Ago	Current	One Year Ago
Hot pressed square	+ $6.00	$3.25	$ .50	$2.25	$.50	1.05
Hot pressed hexagon	+ 6.00	2.70	.50	2.25	.50	.85
Cold punched hexagon	+ 6.00	3.25	.50	2.25	.50	1.00
Cold punched square	+ 6.00	2.70	.50	2 25	.50	1.00

Semi-finished nuts, ⅝ and smaller, sell at the following discounts from list price:

	Current	One Year Ago
New York	30%	50–10%
Chicago	50%	50%
Cleveland	50%	60-10-10%

MACHINE BOLTS—Warehouse discounts in the following cities:

	New York	Cleveland	Chicago
½ by 4 in. and smaller	+ 20%	20%	20%
Larger and longer up to 1½ in. by 30 in.	+ 20%	20%	10%

WASHERS—From warehouses at the places named the following amount is deducted from list price:
For wrought-iron washers:
New York..... list Cleveland..... $2.50 Chicago..... $3.00
For cast-iron washers, ⅜ and larger, the base price per 100 lb. is as follows:
New York..... $7.00 Cleveland..... $4.50 Chicago..... $4.75

CARRIAGE BOLTS—From warehouses at the places named the following discounts from list are in effect:

	New York	Cleveland	Chicago
½ by 6 in. and smaller	+ 20%	35%	10%
Larger and longer up to 1 in. by 30 in.	+ 20%	20%	5%

COPPER RIVETS AND BURS sell at the following rate from warehouse:

	Rivets		Burs	
	Current	One Year Ago	Current	One Year Ago
Cleveland	20%	20%	10%	10%
Chicago	net	20%	net	20%
New York	25%	40%	net	20%

RIVETS—The following quotations are allowed for fair-sized orders from warehouse:

	New York	Cleveland	Chicago
Steel ½ and smaller	List Net	40%	30%
Tinned	List Net	40%	30%

Boiler, ½, ¾, 1 in. diameter by 2 to 5 in. sell as follows per 100 lb.:
New York..... $6.00 Chicago..... $5.62 Pittsburgh..... $4.50
Structural, same sizes:
New York..... $7.10 Chicago..... $5.72 Pittsburgh..... 4.60

MISCELLANEOUS

SEAMLESS DRAWN TUBING—The base price in cents per pound from warehouse in 100-lb. lots is as follows:

	New York	Cleveland	Chicago
Copper	34.00	34.00	35.00
Brass	33.00	34.00	34.00

The prices, of course, vary with the quantity purchased. For lots of less than 100 lb., but not less than 75 lb., the advance is 1 c.; for lots of less than 75 lb., but not less than 50 lb., 2½c. over base (100-lb. lots); less than 50 lb., but not less than 25 lb., 5c. should be added to base price; quantities from 10-25 lb., extra is 10c.; less than 10 lb., add .15–20c.

Double above extras will be charged for angles, channels and sheet metal mouldings if ordered in above quantities. Above extras also apply to brass rod other than standard stock sizes—stock sizes being considered as ⅛-2 in. inclusive in rounds, and ¼-1½ in., inclusive, in square and hexagon—all varying by thirty seconds up to 1 in. by sixteenths over 1 in. On shipments aggregating less than 100 lb., there is usually a boxing charge of $1.50.

LONG TERNE PLATE—In Chicago No. 28 primes from stock sell, nominally, for $12.50 per 100 lbs.
In Cleveland—$10 per 100 lbs.

COTTON WASTE—The following prices are in cents per pound:

	New York		Cleveland	Chicago
	Current	One Year Ago		
White	15.00@17.00	13.00	16.00	11.00 to 14.00
Colored mixed	9.00@14.00	9.00–12.00	12.00	9.50 to 12.00

WIPING CLOTHS—Jobbers' price per 1000 is as follows:

	13½x13½	13½x20½
Cleveland	55.00	65.00
Chicago	41.00	43.50

SAL SODA sells as follows per 100 lb.:

	Current	One Month Ago	One Year Ago
New York	$3.00	$3.00	$1.75
Philadelphia	2.75	2.75	1.75
Cleveland	3.00	2.50	2.75
Chicago	2.25	2.50	2.00

ROLL SULPHUR in 360-lb. bbl. sells as follows per 100 lb.:

	Current	One Month Ago	One Year Ago
New York	$3.90	$3.90	$3.65
Philadelphia	3.65	3.65	3.62
Chicago	5.00	5.00	4.12½

COKE—The following are prices per net ton at ovens, Connellsville:

	July 8	July 1	June 24
Prompt furnace	$17.50@$18.50	$17.50@$18.50	$15.00@$16.00
Prompt foundry	18.00@ 19.00	18.00@ 19.00	16.00@ 17.00

FIRE CLAY—The following prices prevail:

		Current
Ottawa, bulk in carloads	Per Ton	$8.00
Cleveland	100-lb. bag	1.00

LINSEED OIL—These prices are per gallon:

	New York		Chicago	
	Current	One Year Ago	Current	One Year Ago
Raw in barrels (5 bbl. lots)	$1.53	$2.15	$1.95	$2.53
5-gal. cans (without cans)	1.56*	2.28	2.15	2.73

*To this *oil* price must be added the cost of the cans (returnable), which is $2.25 for a case of six.

WHITE AND RED LEAD—Base price per pound:

	Red				White	
	Current		One Year Ago		Current	One Year Ago
	Dry	In Oil	Dry	In Oil	Dry and In Oil	Dry and In Oil
100 lb. keg	15.50	17.00	13.00	14.50	15.50	13.00
25 and 50-lb. kegs	15.75	17.25	13.25	14.75	15.75	13.25
12½-lb. keg	16.00	17.50	13.50	15.00	16.00	13.50
5-lb. cans	18 50	20.00	15.00	16.50	18.50	15.00
1-lb. cans	20.50	22.00	16 00	17.50	20.50	16.00

500 lb. lots less 10% discount. 2000 lb. lots less 10–2½% discount.

NEW and ENLARGED



Edited by
L-V-FLETCHER

Machine Tools

The following concerns are in the market for machine tools:

Mass., Cambridge — The Acme Garage, Prospect and Hampshire Sts.—one arbor press, one drill and one emery wheel.

Mass., New Bedford—Manomet Mills, A. Valentine, Master Mechanic.
Two 14 in. lathes with 7 ft. bed.
One 24 in. lathe with 12 ft. bed.
One miller.
One power hacksaw.
One vertical drill.
One floor drill.
One bolt machine.
One drill grinder.
Two speed lathes.
One patternmaker's lathe.
One electric grinder.
One band saw.
One table saw.
One planer and jointer.
Blacksmith shop and welding equipment.

Mass., Springfield—Freedman & Glazier, 68 Ferry St.—repair shop equipment.

Mass., Worcester—J. E. Snyder & Sons, Dewey and Parker Sts.—heavy duty boring mills similar to No. 2 Coburn.

N. J., Newark—Donner & Co., Polk St.—one automatic grinding machine with 32 in. bed.

N. J., Paterson—The Wright Aeronautical Corp.—machine tool equipment.

N. Y., New York (Borough of Brooklyn)—The I. H. Dexter Co., 27 Walker St.—machine tools for Goshen factory.

N. Y., New York (Borough of Manhattan)—The Milholland Co., 111 Bway.—one No. 35 Toledo press.

N. Y., New York (Borough of Manhattan)—The Trojan Tool Corp., 511 West 42d St.—several automatic screw machines.

Pa., Connellsville — The Yough Electric Repair Co.—equipment for manufacture of coils and dies or pulling copper.

Pa., Philadelphia—The Blumenthal Bros., Margaret and James Sts.—machine shop equipment.

Pa., Philadelphia — The Pennsylvania Screw and Machine Wks., 712 Cherry St.—Brown & Sharpe screw machines.

Pa., Philadelphia—G. E. Recklitz, 1238 North 3d St.—one 12 in. x 6 ft. tool room lathe.

D. C., Washington—A. L. Flint, Purch. Agt. for the Panama Canal—one planer, one press, one shear and one hoist.

Ky., Louisville — The Haller Troutman Bros. Motors Co., 2613 Cave Run Rd.—machine shop equipment.

N. C., Wilmington—The G. A. Fuller Co., Carolina Shipyard—two motor driven pipe machines, capacity ⅜ to 2 in.

Va., Ashland—The Ashland Garage—garage equipment.

Ill., Chicago — The Atchison, Topeka & Santa Fe. Ry., Ry. Exch. Bldg., M. J. Collins, Purch. Agt.—
One 2½ x 36 in. heavy duty turret lathe.
One 24 in. heavy duty sensitive drill press, alternative with tapping attachment, alternative with back gears.
One 36 in. heavy duty double head shaping machine with 14 ft. head.
Quotations desired on belt drive and also on 440 v., 3 ph., 60 cycle motor drive on each of above.

Ill., Chicago—The Barrett-Crane Co., 169 North Ann St.—one 16 in. crank shaper.

Ill., Chicago—The Chrobaltic Tool Co., Ry. Exch. Bldg. — one small shear for shearing rounds up to ¾ in. diameter.

Ill., Chicago—Kinsley Bros., Inc., 2799 South Wells St.—
One squaring shear for ⅞ in. stock, 96 in. long.
One gantry transfer crane.
One radial drill.
One die surface grinder.
One drill grinder.

Ill., Chicago—The Precision Eng. Wks., 838 North Wells St.—one 20 in. shaper.

Ill., Chicago—The Rock Island Lines, 179 West Jackson Bl., F. D. Reed, Purch. Agt.—For delivery to Trenton, Mo.—
One Oster power pipe and nipple threading machine with right-hand dies from 1 to 4 in.
One set of nipple jaws for above.
For delivery to Inver Grov, Minn.—
One 36 in. x 12 in. engine lathe with 3 step cone pulley, double back quick change gears.

Ill., Chicago — The Up-to-Date Machine Wks., 2915 South Wabash Ave.—automatic screw machine.

Ill., Chicago—R. Woods, 1438 1st Natl. Bank Bldg.—power gap shears.

Ind., Indianapolis — The Pioneer Brass Wks., 424 South Pennsylvania St.—$200,000 worth of equipment, including lathes, etc.

Mich., Detroit—The Bd. of Water Comrs., 232 Jefferson Ave.—repair shop equipment.

Mich., Detroit—The Cost Cut Counterbore Co., 74-78 Fort St., D. Greenspon, Mgr.—miscellaneous equipment for machining counterbore tools.

Mich., Detroit—The Square D Co., 1400 Rivard St.—one large size squaring shear for 36 in. stock or larger.

O., Cleveland—The Aetna Brass Mfg. Co., 1635 East 55th St.—one screw machine of 1 in. capacity, equivalent of No. 2 Warner & Swasey and one punch press similar to No. 4 Consolidated or No. 20 Cliff.

O., Cleveland—The J. R. Gloyd Co., 1816 East 33d St.—one lathe, 3 ft. between centers (used).

Wis., Beloit—The C. H. Besly Co.—two No. 2¾ old style, Pratt & Whitney hand screw machines with counter shafts; one screw machine with spring collet, capacity up to 2⅛ in rounds (used).

Wis., Milwaukee—The Amer. Valve Rotator Co., 917 Chestnut St., H. Davischefsky, Purch. Agt.—heavy punch presses.

Wis., Milwaukee—The Magnetic Mfg. Co., 764 Windlake Ave., E. Bethke, Purch. Agt.—one 30 in. radial drill.

Wis., Milwaukee—J. C. Nelson, 857 27th St.—drill presses and five 18 to 30 in. lathes.

Wis., Milwaukee—A. J. Uchitil, 656 Madison St.—one polishing lathe with 2 in. shaft.

Wis., Sheboygan—The Wald Mfg. Co.—one grinder to sharpen 72 in. squaring shear knife.

Minn., Winona—The Winona Wagon Co.—one bolt heading machine to head king bolts up to 1½ in. diameter.

Utah, Salt Lake City—The Builders Steel and Iron Co., 625 South 4th St., W.—one single end punch, capacity ⅞ in hole in ½ in. stock, belt or motor drive (new or used).

Ont., Toronto—The Coleman Lamp Co.—machine tool equipment.

Machinery

The following concerns are in the market for machinery:

Md., Baltimore—E. H. Koester, 648 West Lexington St.—$75,000 worth of bakery equipment.

N. Y., New York (Borough of Manhattan)—The Yukon Gold Co., 120 Bway.—one 8 ton hand power crane.

Pa., Beaver Falls — The Beaver Falls Planing Mills Co.—woodworking machinery, including molder, sander, router and cabinet planer (new or used).

Pa., Essington—The Westinghouse Electric Co.—foundry equipment.

Pa., Philadelphia—The Berger Mfg. Co., 16th and Washington Sts.—one power saw table.

Va., Richmond—The Solomon Bakery Co., Inc., 3819 Williamsburg Ave., J. N. Solomon, Purch. Agt.—bakery equipment.

Va., Richmond—The Standard Paper Co., Canal and Hull Sts., J. T. Ryland, Treas. and Secy.—$300,000 worth of machinery for the manufacture of paper.

Ill., Chicago — The International Harvester Co., 606 South Michigan Ave.—one vertical gang piston turning machine.

Ill., Chicago—The Standard Electric Mfg. Co., 216 North Clinton St.—machinery for manufacture of electric switches.

Ill., Chicago—The Victor Chemical Wks., Fisher Bldg.—one No. 201 Reliance swing saw with 14 in. blade.

Mich., Benton Harbor—The Benton Harbor Malleable Fdry. Co.—equipment for annealing room and foundry.

Mich., Detroit — The Hayes Mchy. Co., East Larned St., A. Sprague, Secy.—power and board drop hammers (used).

Mich., Hancock — A. J. Verville — woodworking machinery.

Mich., Traverse City—The Traverse City Cigar Box Co., Boardman Ave. and East High St.—equipment for the manufacture of cigar boxes.

O., Akron—The Akron Gear and Eng. Co., South and High Sts.—miscellaneous machinery for new plant.

O., Canton—The Timken Roller Bearing Co., Denber Ave.—miscellaneous equipment for new plant.

O., Cincinnati — The Lippincott Co., 42 Main St.—$50,000 worth of machinery for canning plant at Boonville, Ind.

O., Columbus — The Jeffrey Mfg. Co., North 4th St.—six cranes, one 50 ton, three 25 ton, and two 5 ton.

Wis., Milwaukee—The F. E. Abeles Co., 518 Prairie St.—one stenciling machine.

Wis., Milwaukee—The Evinrude Motor Co., 279 Walker St., C. J. Meyer, Purch. Agt.—one monorail crane.

Wis., Milwaukee—The H. W. Johns-Manville Co., 201 Clybourn St.—portable clamshell crane.

Wis., Milwaukee—M. Mueller, 109 Grand Ave.—vulcanizing outfit.

Wis., Milwaukee — The Tomah Rubber Wks., 176 16th St.—rubber working machinery for Sheboygan factory.

Ont., Alviston—McEachern & Son—equipment for planing mills.

Ont., Cobalt—The Moose Lake Lumber Co.—machinery for sawmill.

Ont., Goderich — The Natl. Shipbuilding Co., W. H. Hutchinson, Mgr.—machinery for the manufacture of flax.

Ont., Listowel—The Perfect Knit Mills—knitting machinery and special machinery for the manufacture of cloth.

Que., Thetford Mines—A. Lemieux—complete equipment for sawmill and planing mill.

Metal Working

NEW ENGLAND STATES

Conn., Bridgeport—A. Aldo, 1699 Madison Ave., is having plans prepared by F. A. Cooper, Archt., 1024 Main St., for the construction of a 1 story, 100 x 110 ft. garage on North Ave. Estimated cost, $50,000.

Conn., Bridgeport—The Amer. Tube and Stamping Co., 471 Hancock Ave., will build a 1 story, 50 x 160 ft. annealing building on Wordin Ave. Estimated cost, $30,000.

Conn., Waterbury—M. J. Daly & Sons, 543 Bank St., has awarded the contract for the construction of a 1 and 3 story addition to its plant for the manufacture of sheet metal, etc. Estimated cost, $85,000. Noted July 8.

Conn., Waterville—The Berbecker & Rowland Mfg. Co., Main St., has awarded the contract for the construction of a 3 story, 40 x 180 ft. factory on Main St., for the manufacture of metal goods. Estimated cost, $100,000.

Mass., Cambridge—G. Lawrence, Inc., 24 Cambria St., is having plans prepared by W. T. Littlefield archt., 9 Hamilton Pl., Boston, for the construction of a 1 story addition to its plant for the manufacture of automobile springs.

Mass., Holyoke—The Elm Garage Co., 243 Elm St., plans to build a 2 story garage on Elm and Cabot Sts. Estimated cost, $65,000.

Mass., Holyoke—The Magna Automobile Co., 354 South Broad St., has awarded the contract for the construction of a 2 story, 90 x 100 ft. garage on Northampton St. Estimated cost, $75,000. Noted Jan. 15.

Mass., Lawrence — W. H. Currier, 155 Salem St., is preparing plans for the construction of a 1 story garage on Salem St. Estimated cost, $10,000.

Mass., Lawrence—C. W. Dillon, 17 Oxford St., is preparing plans for the construction of a 1 story addition to his garage. Estimated cost, $10,000.

Mass., Springfield—Freedman & Glazier, 68 Ferry St., will build a 1 story garage and repair shop on North St. Estimated cost, $20,000.

Mass., Watertown—The Walker & Pratt Mfg. Co., 31 Union St., Boston, has awarded the contract for the construction of a 1 story, 200 x 230 ft. addition to its plant, for the manufacture of stoves. Estimated cost, $200,000. Noted July 22.

MIDDLE ATLANTIC STATES

Md., Baltimore—The Miller Safe Co., Fremont Ave. and Briscoe St., has awarded the contract for the construction of a 1 and 2 story, 123 x 400 ft. factory on Wilkins Ave. and Katherine St. Estimated cost, $1,000,000. Noted July 15.

N. J., East Orange — The Rich Garage Co., 393 North Arlington St., has awarded the contract for the construction of a 1 story, 50 x 100 ft. garage at 362 William St. Estimated cost, $15,000.

N. J., Trenton—The Castanea Dairy Co., North Broad St., is having plans prepared by W. A. Klemann, archt., 1st Natl. Bank, for the construction of a 2 story, 50 x 50 ft. garage on Feeder St. Estimated cost, $18,000.

N. J., Trenton — The Neidt Ertel Motor Co., 354 South Broad St., has awarded the contract for the construction of a 1 story, 60 x 181 ft. garage and machine shop on South Broad St. Estimated cost, $50,000. Noted March 4.

N. Y., Buffalo—The L & R Steel Co., 368 Main St., has had plans prepared for altering the first floor of its factory. Estimated cost, $5,000.

N. Y., Buffalo — The O'Neill Iron Wks., 268 Perry St., has awarded the contract for the construction of a 2 story, 23 x 28 ft. addition to its plant. Estimated cost, $15,000.

N. Y., Buffalo—The Parenti Motors Corp., 1760 Main St., has awarded the contract for the construction of a 1 story, 100 x 350 ft. factory at 616-32 Northumberland St., for the manufacture of automobiles. Estimated cost, $100,000. Noted July 22.

Pa., Connellsville — The Yough Electric Repair Co. is building a 132 x 198 ft. shop. Estimated cost, $20,000.

Pa., Essington—The Westinghouse Electric Co. has awarded the contract for the construction of a 1 story, 120 x 200 ft. foundry at its plant.

Pa., Philadelphia—The Brown Instrument Co., Windrim and Wayne Sts., manufacturer of pyrometers and steam gages, has awarded the contract for altering its factory. Estimated cost, $20,000.

Pa., Philadelphia—The Blumenthal Bros., Margaret and James Sts., will soon award the contract for the construction of a 1 story, 60 x 100 ft. garage and machine shop. Estimated cost, $20,000.

Pa., Wilkes-Barre — The Durkin Bros., Parrish St., will soon award the contract for the construction of a 1 story, 44 x 100 ft. garage on East South St. Estimated cost, $30,000. F. B. R. Sahur, Washington St., Archt.

SOUTHERN STATES

Ala., Birmingham—The Amer. Bolt Wks., 39th St. and 10th Ave., N., has awarded the contract for the construction of an addition to its forge shop. Estimated cost, $25,000.

MIDDLE WEST

Ill., Chicago—The Standard Electric Mfg. Co., 216 North Clinton St., plans to build a 2 or 5 story, 125 x 150 ft. factory on Wrightwood Ave., for the manufacture of electric switches. Estimated cost, $250,000.

Ind., East Chicago—The Carroll Castings Co., which has recently been incorporated with $250,000 capital stock, has purchased a site along the tracks of the Indiana Harber Belt Ry., and plans to build a plant for the manufacture of small grey iron castings.

Ind., Indianapolis — The Pioneer Brass Wks., 424 South Pennsylvania St., is building a plant.

Ind., Kokomo—The Haynes Automobile Co., 1108 South Main St., has awarded the contract for the construction of a 1 and 2 story, 75 x 200 ft. plant for the manufacture of automobile bodies. Estimated cost, $250,000.

Ind., West Hammond—The LaSalle Iron Wks., 2305 South Halsted St., Chicago, Ill., has awarded the contract for the construction of a 1 story steel plant to consist of a 210 x 560 ft. main building and 6 additional buildings. Estimated cost, including equipment, $650,000. Noted July 1.

Mich., Detroit—The Bd. of Water Comrs., 232 Jefferson Ave., has awarded the contract for the construction of a 1 story, 99 x 120 ft. machine shop. Noted June 10.

Mich., Detroit—The Michigan Grey Iron Casting Co., Harbaugh Ave., has awarded the contract for the construction of a 1 story addition to its foundry on Harbaugh Ave. along the tracks of the Wabash R.R. Estimated cost, $40,000.

O., Akron—The Akron Gear and Eng. Co., South and High Sts., has purchased a site on East Market St. and Martha Ave., and plans to build a plant. J. A. Palmer, Pres.

O., Canton—The Timken Roller Bearing Co., Dueber Ave., plans to build a 1½ story addition to its plant on 18th St., S.W. Estimated cost, $75,000.

O., Cleveland—Brennan & McBride, 6715 Carnegie Ave., has awarded the contract for the construction of a 1 story, 50 x 92 ft. machine shop addition at 6924 Carnegie Ave. Estimated cost, $30,000.

O., Cleveland—The Cooperative Stove Co., 2323 East 67th St., has awarded the contract for the construction of a 1 story, 40 x 80 ft. addition to its factory. Estimated cost, $10,000.

O., Cleveland—E. Drocz, 8616 Buckeye Rd., has awarded the contract for the construction of a 1 story, 50 x 60 ft. garage. Estimated cost, $10,000.

O., Cleveland—The Ideal Motor Car Co., 4427 Pearl Rd., has awarded the contract for the construction of a 2 story, 30 x 48 ft. garage at 4459 Pearl Rd. Estimated cost, $20,000.

O., Cleveland—The Jordan Motor Car Co., 1052 East 152nd St., has awarded the contract for the construction of a 2 story factory at 1070 East 152nd St. Estimated cost, $100,000.

O., Cleveland—The J. Laronge Co., 214 Williamson Bldg., has awarded the contract for the construction of a 1 story, 50 x 120 ft. garage on East 16th St. and St. Clair Ave. Estimated cost, $75,000. Noted July 29.

O., Cleveland—The Vcela Building and Loan Co., 5703 Bway., has awarded the contract for the construction of a 1 story, 18 x 63 ft. garage. Estimated cost, $10,000.

O., Columbus — The Jeffrey Mfg. Co., North 4th St., has awarded the contract for the construction of a 60 x 215 x 277 ft. factory for the manufacture of coal mining and conveying machinery. Estimated cost, $500,000.

O., Fostoria—The Willys Light Corp., 221 Cherry St., Toledo, is building a 1 story, 120 x 241 ft. foundry for the manufacture of iron castings. Estimated cost, $125,000.

Wis., Kenosha—The Greiner Nash Co., 266 Wisconsin St., plans to build a 1 story, 80 x 162 ft. garage and repair shop on Chicago St.

Wis., Milwaukee—S. Buchbinder, 545 Van Buren St., will soon award the contract for the construction of a 1 story, 65 x 70 ft. garage on Marshall St. Estimated cost, $15,000.

Wis., Milwaukee—The Eslein Sheet Metal Wks., 1001 30th St., will build a 1 story, 30 x 120 ft. addition to its sheet metal plant. Estimated cost, $8,000.

Wis., Milwaukee—The General Welding and Mfg. Co., 347 Florida St., will soon award the contract for the construction of a 1 story, 30 x 35 ft. addition to its factory. Estimated cost, $8,000.

Wis., Milwaukee—The Ramstack & Son Mfg. Co., 1826 Brown St., is preparing plans for the construction of a 2 story, 60 x 100 ft. addition to its factory for the manufacture of spark plugs.

Wis., Oconomowoc—R. Welch is preparing plans for the construction of a 1 story, 60 x 60 ft. garage. Estimated cost, $12,000.

Wis., Waukesha—The Waukesha Casting Co., Lincoln Ave., has awarded the steel contract for the construction of a 120 x 130 ft. foundry. Estimated cost, $50,000. Noted July 15.

WEST OF THE MISSISSIPPI

Ia., Des Moines—The Mid West Steel Co. plans to build a 2 story plant. Estimated cost, $200,000. J. Van Lew, Pres.

Ia., Dubuque—The Adams Co., 295 6th St., is building a 3 story foundry.

Ia., Newton—The Newton Fdry. Co. has awarded the contract for the construction of a 2 story, 106 x 300 ft. foundry. Estimated cost, $100,000.

Mo., St. Louis—The City has awarded the contract for the construction of a garage at the city hospital. Cost, $19,973.

Mo., St. Louis—The Trione Piston Ring Co., Pierce Bldg., St. Louis, has awarded the contract for the construction of a 1 story, 56 x 93 ft. factory on Forrest Park Blvd. Estimated cost, $20,000.

Tex., San Antonio—E. Rand, 515 Belknap St., is building a 1 story, 50 x 120 ft. garage on Goledad St. Estimated cost, $37,000.

Tex., San Antonio—Taylor & Holder are building a 1 story, 40 x 100 ft. garage on Travis St. Estimated cost, $22,000.

CANADA

N. B., St. Stephen—The Mann Axe and Tool Co. plans to build a 1 story, 50 x 360 ft. plant, to replace the one which was recently destroyed by fire. C. E. Huestis, Genl. Mgr.

Ont., Brantford—The Cockshut Plow Co. will soon award the contract for the construction of a 70 x 200 ft. foundry and forging building for the manufacture of sleighs and trucks. Estimated cost, $150,000.

Ont., Petrolea — The Adams Wagon Co. will build a 1 story, 70 x 200 ft. forge shop. Estimated cost, $25,000.

Ont., Petrolea — The Orton Motor Co., Ltd., will soon award the contract for the construction of a 1 story, 60 x 150 ft. addition to its factory. Estimated cost, $40,000.

Ont., St. Catherine — The Niagara, St. Catherine and Toronto Ry., 27 Wellington St., E., Toronto, is having plans prepared by G. C. Briggs, archt., c/o owner, for the construction of a 1 story, 60 x 150 ft. car shop here. Estimated cost, $60,000.

Ont., Toronto—The Grinnell Co., Ltd., has awarded the contract for the construction of a 1 story, 100 x 150 ft. foundry. Noted May 27.

Que., Montreal—The Archambault Garage Ltd. will build an addition to its garage. Estimated cost, $10,000.

Que., Montreal—P. A. Elliott, 619 Pontiac St., will soon award the contract for the construction of a 2 story, 25 x 48 ft. garage. Estimated cost, $15,000.

Que., Pointe aux Trembles—La Manufacture de Piano et Phonographe, Limitee, will soon award the contract for the construction of a 3 story addition to its plant. Estimated cost, $20,000.

General Manufacturing

NEW ENGLAND STATES

Conn., Hartford—The Hartford Mattress Co., Kilbourn St., is having plans prepared by B. A. Sellew, Archt., 223 Aslyum St., for the construction of a 3 story, 43 x 90 ft. addition to its plant. Estimated cost, $50,000.

Conn., Windsor Locks—C. H. Dexter & Sons, Inc., has awarded the contract for the construction of alterations to its plant for the manufacture of tissue paper. Estimated cost, $20,000.

Mass., Cambridge—The Prest-O-Lite Co., Inc., 30 East 42nd St., New York City, has awarded the contract for the construction of a plant on Erie St., here, to consist of twelve 1 story manufacturing buildings. Estimated cost, $100,000. Noted July 15.

Mass., Cambridge—The Revere Sugar Refinery, 15 Broad St., Boston, has awarded the contract for the construction of a 1 story, 90 x 200 ft. cooperage shop on 9th St. here. Estimated cost, $100,000. Noted July 15.

Mass., East Everett—The Boston Varnish Co., 2d St., has awarded the contract for the construction of a 1 story, 40 x 60 ft. addition to its plant on East Summer St. Estimated cost, $30,000. Noted July 22.

R. I., East Greenwich—The Greenwich Mills, Division St., is preparing plans for the construction of a 4 story, 80 x 90 ft. addition to its textile plant. Estimated cost, $50,000.

R. I., East Providence—The Sayles Finishing Co., Phillipsdale, R. I., has awarded the contract for the construction of a 1 story, 45 x 80 ft. factory on Wilson St., here, for cloth finishing. Estimated cost, $18,000.

R. I., Pawtucket—The J. & P. Coats Co., Inc., 366 Pine St., has awarded the contract for the construction of a 4 story addition to its factory for the manufacture of thread. Estimated cost, $22,000.

R. I., Pawtucket — The Lebanon Mill Co., 10 Front St., has awarded the contract for the construction of a 1 and 2 story, 50 x 90 ft. addition to its factory on Front and Thayer Sts., for the manufacture of knit goods. Estimated cost, $25,000.

R. I., Providence — J. F. Concannon, Chalkstone Ave., has awarded the contract for the construction of a 1 story, 75 x 125 ft. laundry on Chalkstone and Fallon Aves. Estimated cost, $28,000.

MIDDLE ATLANTIC STATES

Md., Baltimore—E. H. Koester, 648 West Lexington St., has awarded the contract for the construction of a 4 story, 20 x 80 ft. addition to his bakery on Lexington and Pine Sts. Estimated cost, $150,000.

Md., Baltimore — The Natl. Bitulithic Enamel and Paint Co., Lawrence and Woodall Sts., will soon award the contract for the construction of a 3 story, 100 x 150 ft. addition to its plant. Estimated cost, $100,000. J. R. Broderick, mgr.

Md., Violetville (Baltimore P. O.)—The Presto-Lite Co., Inc., 30 East 42nd St., New York City, has awarded the contract for the construction of a 1 and 2 story acetylene plant here, to consist of 8 buildings. Estimated cost, $125,000.

N. J., Paulsboro—The I. P. Thompson & Son Co. has awarded the contract for the construction of a 1 story, 80 x 220 ft. fertilizer building at its plant.

N. J., Trenton—The Acme Rubber Mfg. Co., East State St., has awarded the contract for the construction of a 1 story, 90 x 300 ft. rubber plant. Estimated cost, $60,000.

Pa., Philadelphia—The G. H. P. Cigar Co., 21 North 2d St., has awarded the contract for the construction of a 6 story, 85 x 100 ft. factory for the manufacture of cigars.

Pa., Philadelphia—The Flint Dental Mfg. Co., Hedge and Gillinham Sts., has awarded the contract for the construction of a 2 story, 30 x 58 ft. addition to its factory for the manufacture of dental supplies.

SOUTHERN STATES

La., New Orleans — The Union Paper Products Co., 109 Tehoupitoulas St., is having preliminary plans prepared by E. Weil, Archt., Whitney Central Bank Bldg., for the construction of a 1 story factory on Colapessa St., to have 50,000 sq.ft. of floor space. Estimated cost, $125,000.

N. C., Charlotte—The Southern Asbestos Mfg. Co. is building a 90 x 304 ft. factory.

Tenn., Knoxville—The Holsten Mfg. Co. has awarded the contract for the construction of an addition to its plant for the manufacture of hosiery. Estimated cost, $250,000.

Va., Richmond—The Standard Paper Co., Hull and Canal Sts., has had prelminary plans prepared by J. H. Wallace & Co., Engrs., 5 Beekman St., New York City, for the construction of a 2, 3 and 4 story, 150 x 230 ft. factory. Estimated cost, $200,000.

MIDDLE WEST

Ill., Chicago—The Enterprise Paint Mfg. Co., 854 West Van Buren St., has awarded the contract for the construction of a 5 story, 44 x 60 ft. addition to its factory on Van Buren and Peoria Sts. Estimated cost, $50,000.

Ind., Gary—The Universal Brick and Tile Co. is building a 1 story, 100 x 200 ft. plant. Estimated cost, $200,000.

Mich., Detroit—The Detroit Packing Co., 40 Bushey St., plans to convert a brewery into a packing plant. Packers Architectural & Eng. Co., 431 South Dearborn St., Chicago, Archts and Engrs.

Mich., Traverse City—The Traverse City Cigar Box Co., Boardman Ave. and East High St., is preparing plans for the construction of a 2 story, 50 x 75 ft. factory. Estimated cost, $20,000.

O., Cleveland—The Baum Ice Cream Co., 1720 Crawford Rd., plans to build a 2 story, 53 x 80 ft. addition to its factory on East 14th St. and Central Viaduct. Estimated cost, $40,000. L. Baum, Pres.

Wis., Milwaukee — The Pitcarn Varnish Co., 213 Lake St., has awarded the contract for the construction of a 2 story, 70 x 106 ft. factory and 60 x 112 ft. warehouse. Estimated cost, $180,000.

Wis., Stephens Point—The Pfiffner Lumber Co. is having plans prepared for the construction of a 2 story, 60 x 100 ft. planing mill, storage and office building. F. Spalenka, Archt.

WEST OF THE MISSISSIPPI

Ia., Des Moines—The Hawkeye Tire Co., 215 East 3rd St., has awarded the contract for the construction of a 4 story, 180 x 280 ft. factory on East 18th and Court Aves. Estimated cost, $500,000.

Minn., Minneapolis—Downs & Eads, 803 Phoenix Bldg., plans to build a 3 to 5 story factory on Malcom Ave. and University Ave. S., for the manufacture of patent medicines. Cost between $125,000 and $150,000.

Minn., St. Paul—The House of the Good Shepherd, Blair and Virginia Sts., has awarded the contract for the construction of a 3 story, 42 x 122 ft. laundry and domestic science building on Blair and Victoria Sts. Estimated cost, $100,000.

Mo., Chillicothe—The Chillicothe Furniture Co. plans to build a 100 x 239 ft. factory. Estimated cost, $80,000. T. A. Ritter, mgr.

Neb., Omaha — The Corn Products Co. plans to build a large plant here.

WESTERN STATES

Ore., Klamath Falls—The Klamath Pine Mfg. Co. is building a sawmill, to have 50,000 sq.ft. floor space. Estimated cost, $100,000. E. W. Doe, gen. mgr.

CANADA

Ont., Alviston—McEachern & Son are preparing plans for the construction of planing mills to replace those which were destroyed by fire.

Ont., Exeter—The Exeter Creamery Co. plans to build an addition to its plant.

Ont., Listowel—The Perfect Knit Mills will build a 3 story, 80 x 280 ft. extension to its plant. Estimated cost, $85,000.

SEE SEARCHLIGHT SECTION

Pages 378-411

August 12, 1920 American Machinist Vol. 53, No. 7

Machining the Gear-Shaper Saddle

By DOUGLAS T. HAMILTON
The Fellows Gear Shaper Co., Springfield, Vt.

Accurate machine work can only be produced by accurate tools. Just as a chain can be no stronger than its weakest link, so a piece of work can be no more accurate than is the machine that produces it. Interchangeability of parts in machine tools requires work of the highest accuracy.

WITH the exception of the index wheel and worms, the gear-shaper saddle, shown completely machined in Fig. 1, requires the most accurate machining of any other member of the gear shaper. The saddle not only carries the cutter, cutter slide, and cutter spindle, which holds and controls the action of the cutter, but also contains the upper index wheel and worm. The cutter spindle must be held in perfect alignment with the work spindle; it must run absolutely true, and its relation to the other members must be accurately maintained as the saddle is adjusted along the bed for cutting gears of different diameters. In view of these many exacting requirements, the gear-shaper saddle represents an excellent example of inter-

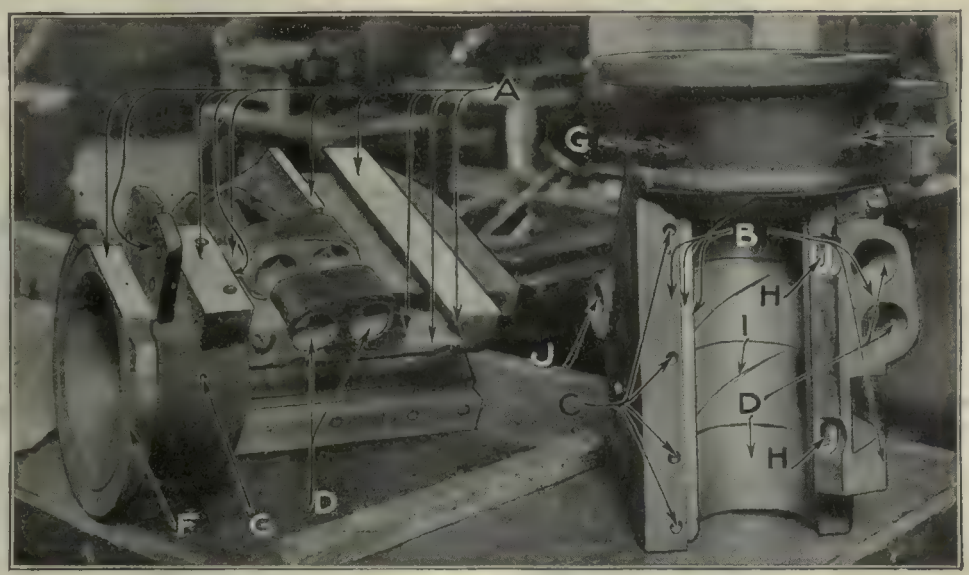


FIG. 1. COMPLETELY MACHINED SADDLE

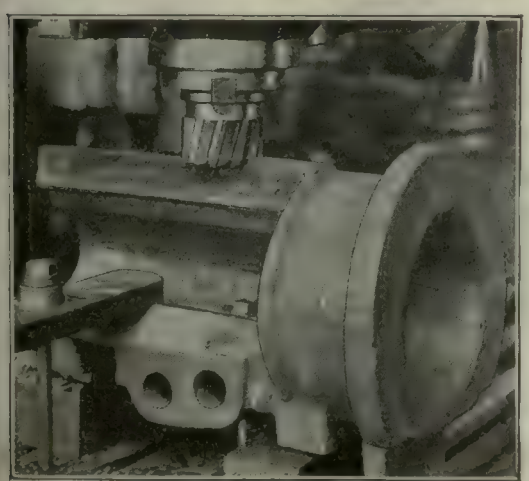


FIG. 2. MILLING FRONT FACE AND SPOT POINT USED FOR LOCATING SADDLE FOR PLANING



FIG. 3. GENERAL VIEW SHOWING SIX SADDLES HELD IN SPECIAL FIXTURES FOR COMPLETE PLANING

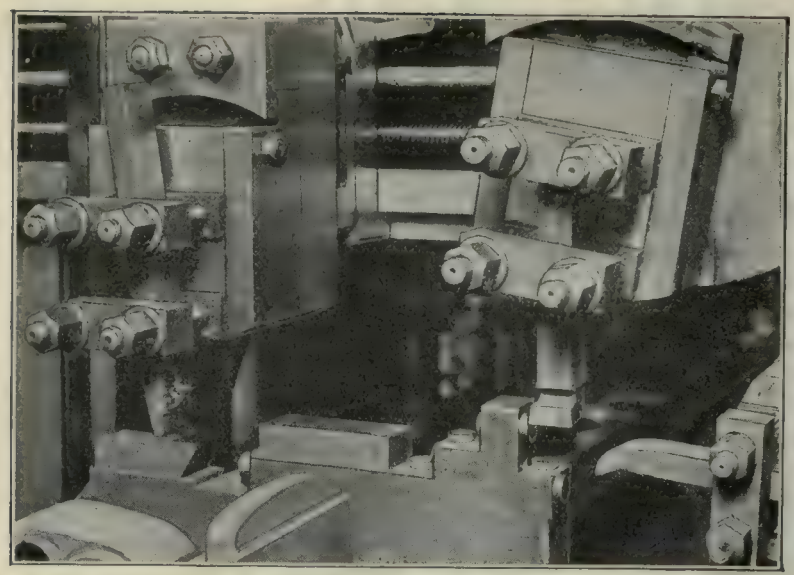


FIG. 4. TOOL SETTING BLOCKS USED FOR SETTING, ROUGHING AND FINISHING TOOLS ON PLANER

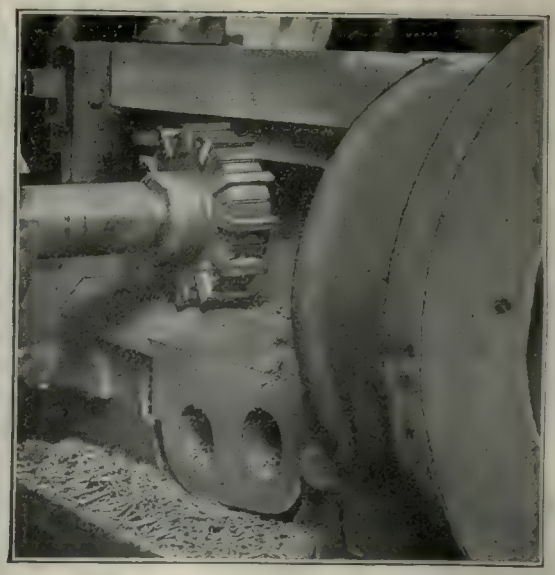


FIG. 5. MILLING GEAR-SHAPER SADDLE

changeable manufacture as applied to the production of a highly accurate machine tool.

The preliminary operations on the saddle are not unusual, and consist in snagging and smoothing down the casting with a portable grinding wheel. It is then brought to a milling machine (see Fig. 2), where two spots are milled, one being the front surface which is finished at this time. These two spots are used for locating the saddle in the first important operation, which consists in planing the entire saddle on those surfaces, marked *A* in Fig. 1.

The planing of the gear-shaper saddle is done very expeditiously. Six castings, as shown in Fig. 3, are held at one time on special jigs, clamped to the platen of the planer. Roughing and finishing cuts are taken from all surfaces marked *A*, Fig. 1, and for setting the tools, tool-setting blocks are used, as illustrated in Fig. 4. By means of these hardened and ground blocks, and a feeler, the operator can set the tools very accurately.

The planing operations on this saddle are as follows: Set the three tools, shown in Fig. 4, for the rough planing operation. Set tools for finish planing straight surfaces. The platen is then cleaned, the clamps on the fixtures released and the fixtures adjusted for planing the taper for the gib. In Fig. 3 it will be noticed that the fixtures are made with a flange which extends below the top surface of the platen. The flange on the left-hand side is parallel with the travel of the platen;

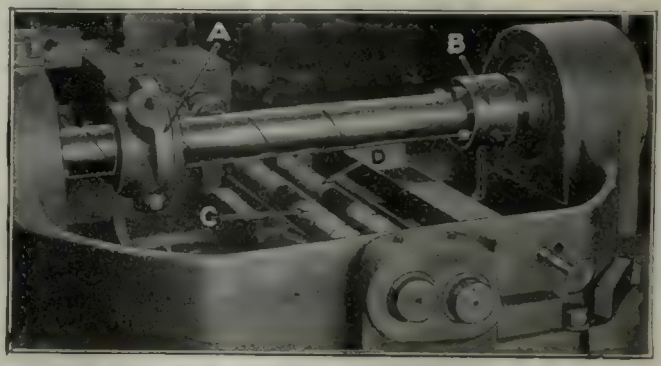


FIG. 8. FIXTURES AND BORING BARS USED ON MACHINE ILLUSTRATED IN FIG. 7

whereas the one on the right side is at an angle. For the taper planing for the gib, this angular flange is brought in contact with the side of the planer platen.

After the fixtures are clamped, the taper way is then rough- and finish-planed, the tools being set with



FIG. 6. TOOL SETTING BLOCKS USED ON MILLING MACHINE ILLUSTRATED IN FIG. 5

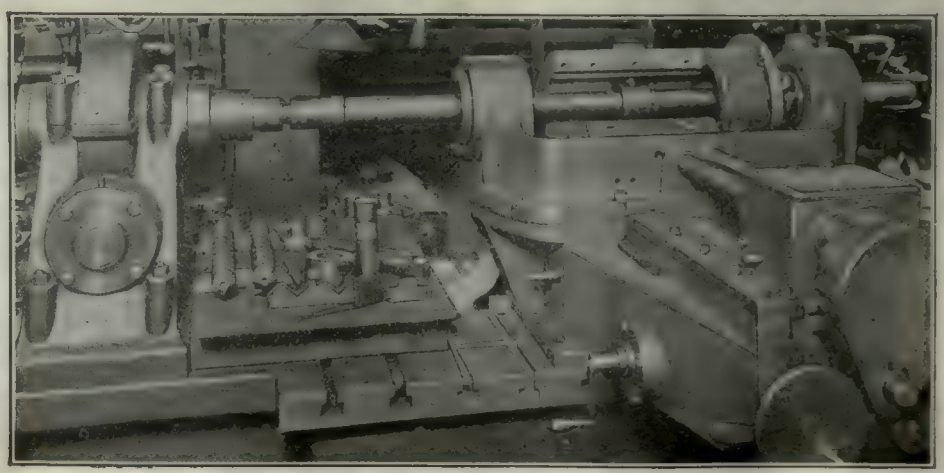


FIG. 7. GENERAL VIEW OF TWO-HEAD SPECIAL BORING MACHINE USED FOR COMPLETING ALL IMPORTANT BORING OPERATIONS ON SADDLE

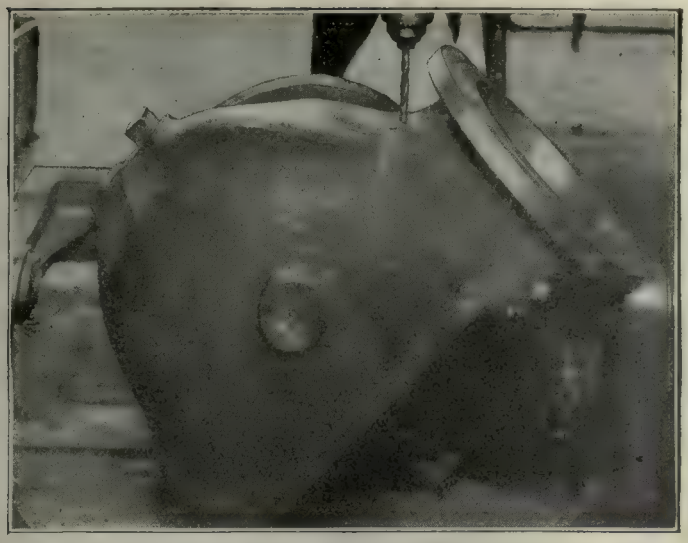


FIG. 9. TRUNNION JIG USED IN HOLDING SADDLE WHILE DRILLING THE OIL AND NAME-PLATE HOLES

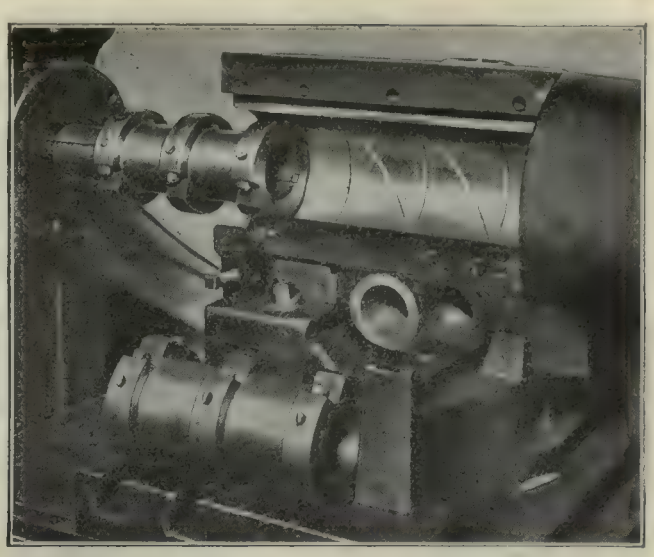


FIG. 10. CLOSE VIEW SHOWING SPECIAL THREE-TOOL HEAD USED IN CUTTING SPIRAL OIL GROOVES IN SADDLE

setting blocks. The ways are now tested for accuracy with a gage before removing from the fixture. The total planing time is 54 minutes for each saddle.

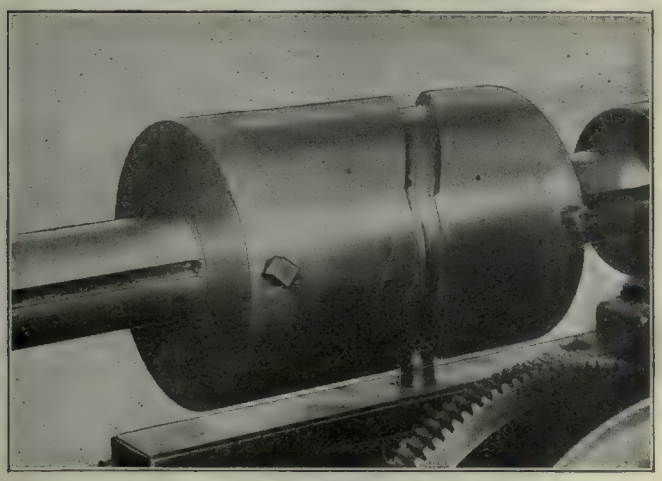


FIG. 11. SHOWING CAM THAT OPERATES THREE-TOOL HEAD FOR CUTTING OIL GROOVES

Following the planing operation, the saddle is taken to the horizontal milling machine, shown in Fig. 5, where those surfaces, marked *B* in Fig. 1, are completed. The work from now on is located from the ways or guide in the saddle from which point it is finally located on the bed. Every jig from this point on until the saddle is complete is really a duplicate of a section of the bed, and the saddle is clamped up against the same surfaces that it will rest upon when it is assembled in the complete machine.

Fig. 6 shows a close view of the special fixture used in holding the saddle while the surfaces *B*, Fig. 1, are machined. The operations are: Place saddle in fixture and clamp. Mill for taper gib, see point on setting gage, Fig. 6, rough and finishing cuts, setting milling cutter to tool-setting blocks. Mill out seat for back-gib; mill top of taper; mill face of rock-shaft boss and face for lead-screw bushing; mill face; unclamp and remove from fixture. Following this operation, the holes for clamping the front gib, which are marked *C*

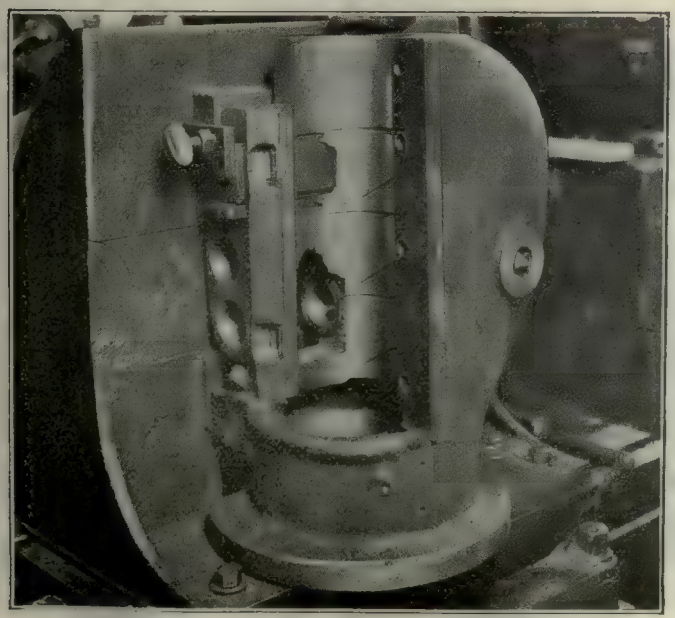


FIG. 12. FIXTURE USED FOR DRILLING, BORING AND REAMING SADDLE PINION-SHAFT HOLE



FIG. 13. SCRAPING BEARING FOR CUTTER SLIDE IN SADDLE

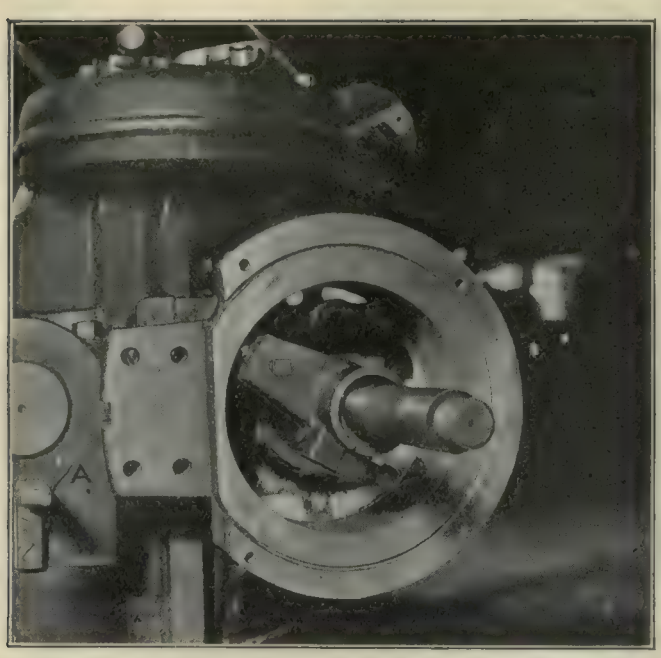


FIG. 14. SPECIAL FIXTURE FOR RE-BORING AND RE-FACING INDEX-WHEEL HOUSING BEARING AND SEAT

in Fig. 1, are drilled in a radial drilling machine.

The boring operations on the saddle are handled on a special two-head horizontal boring machine having arrangements for driving three boring spindles. The general arrangement of this machine is illustrated in Fig. 7, where the saddle is shown being machined in place. Fig. 8 shows the fixture with the saddle removed and illustrates how the various boring-bars are held and supported; also, the method of locating and clamping work. It will be noticed here that the locating points in the fixture resemble in form, a section of the gear-shaper bed.

The operations performed at this setting are: Place saddle in fixture and clamp; rough-bore for upper index-wheel housing, using head *A*, Fig. 8; rough-bore for cutter slide, using toolhead *B*; chamfer end of cutter-slide bore using a tool that is inserted in head *B*. The roughing heads *A* and *B* are now removed, and finishing heads substituted.

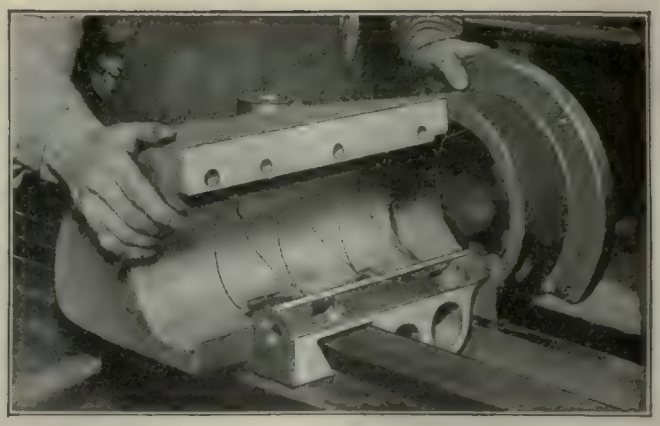


FIG. 17. SCRAPING SADDLE TO MASTER BED

The second boring cut is now taken for the upper index-wheel housing; bore for rock-shaft and lead screw, using bars *C* and *D*, and at the same setting take second cut on cutter-slide bore. Remove heads, and finish-bore for upper index-wheel housing, and at the same setting face seat for rock-shaft gear. Finish cutter-slide bore and face other seat for rock-shaft gear bring boss to length. Face inside of lead-screw hole to gage; unclamp, remove work and clean out fixture. Then ream lead-screw and rock-shaft holes by hand. The various surfaces in this operation are indicated by *D* in Fig. 1.

Drilling Operations

Now follows a series of relatively unimportant drilling operations which are handled on a radial drilling machine. Following this, the flange and oil groove, *F*, Fig. 1, are machined in a horizontal boring machine. Then the oil and name-plate holes, *G*, Fig. 1, are drilled in a special rotating jig shown in Fig. 9. The elongated holes, *H*, Fig. 1, for the setscrews for the gib are now machined in a hand-milling machine.

Cutting Spiral Oil Grooves

The spiral oil grooves, *I*, Fig. 1, in the saddle, for furnishing lubricant to the cutter slide, are now cut in a special machine, which is illustrated in Figs. 10 and 11. Fig. 10 shows the special three-tool head used

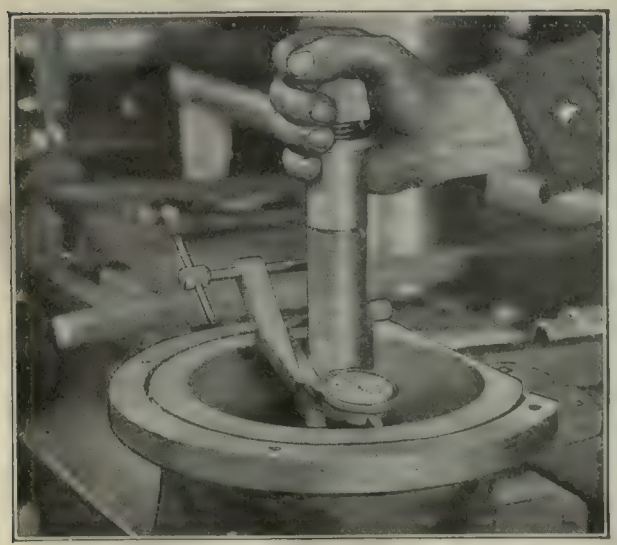


FIG. 15. TESTING TRUTH OF INDEX-WHEEL HOUSING BEARING WITH CUTTER SLIDE AND CUTTER SPINDLE

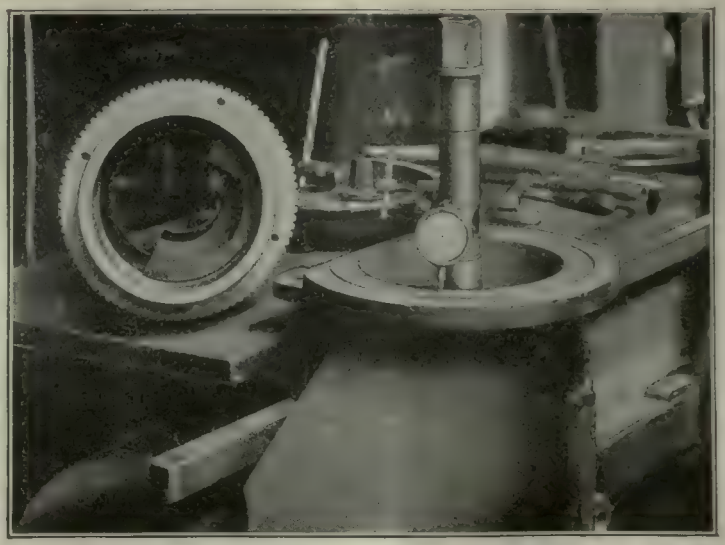


FIG. 16. TESTING TRUTH OF SEAT ON SADDLE FOR WORM-WHEEL HOUSING WITH RELATION TO CUTTER SLIDE AND CUTTER SPINDLE

in cutting the oil grooves; whereas Fig. 11 shows the barrel cam that controls the action of the oil-grooving tools. In this same setting, a clearance cut, eccentric to the cutter-slide bore is made so as to relieve a portion of the bearing of the cutter slide in the saddle.

Drill, Bore and Ream Pinion-Shaft Hole

The next operation, which consists in drilling, boring and reaming the hole for the bevel pinion shaft, *J*, Fig. 1, that is used in adjusting the saddle along the bed, is performed on a special horizontal boring machine, illustrated in Fig. 12. The saddle is located from the ways upon which it rests, when assembled on the bed. The clamping spot mentioned in connection with the first milling operation is now removed, after which the saddle passes to the assembling department.

The first operation in the assembling department is really a hand-fitting one, and consists in scraping the

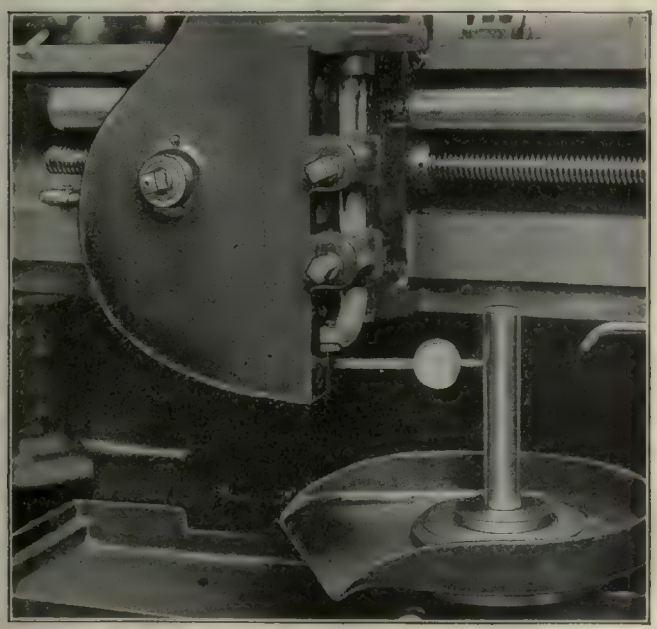


FIG. 18. TESTING ALIGNMENT OF WORK AND CUTTER SPINDLES

cutter-slide bearing. Owing to the fact that the cutter slide is reciprocated twice for every cut taken, it is highly essential that it shall have a perfect bearing in the saddle in order that it may have a long life and run with extreme accuracy. For this reason, great care is taken in scraping the saddle seat for the cutter slide.

For the scraping operation, the saddle is held in a cradle, so that it can be swung to various positions, as indicated in Fig. 13. The cutter slide is ground all over and is machined to very close limits, but, as has been previously explained, the fit of the slide in the saddle is a vital point, so that each saddle is scraped to a cutter slide which will finally be assembled in it.

An operation which illustrates very clearly the pains taken to secure accuracy is illustrated in Fig. 14. This shows the boring of the seat for the upper index-wheel housing. The saddle is held on a special fixture resembling in form a section of the bed, the cutter slide and cutter spindle which will be assembled with it are put in place; on the cutter spindle are clamped special boring heads used in boring and facing the seats for the index-wheel housing.

The boring-head is driven from a driving arrangement connected to the cutter spindle through a universal joint. Two boring cuts are taken. Then the head is changed and two cuts are taken from the top flange or seat. The facing head, not illustrated, carries a screw and star feed, which is operated by the projection *A* on the fixture, as the head rotates.

As an indication of the accuracy obtained, it might be stated that the bore seldom, if ever, runs out more than 0.0015 in. before the finish-boring operation, so that this final boring operation secures concentricity to as close limits as is possible by the best-known machining methods.

Testing for Accuracy

The operations from now on consist in scraping, fitting and testing. Fig. 15 illustrates how the bore for the index-wheel housing is tested for concentricity. In this same setting the guide is held on the cutter-spindle and is tested and scraped to a bearing in the index-wheel housing, the latter being fitted in the saddle.

Fig. 16 shows how the top surface is tested with a dial indicator for truth relative to the cutter-spindle and index-wheel housing. It is also scraped at this setting to a bearing.

The final scraping operation is illustrated in Fig. 17, and consists in scraping the ways in the saddle to a bed whose plane surfaces have been accurately scraped. This insures interchangeability of saddles and beds.

The final testing operation is made when the machine is completely assembled, and is done as illustrated in Fig. 18. A dial indicator is clamped to the cutter spindle; an accurately ground arbor placed in the work spindle and the parallelism of these two members tested. A maximum tolerance of 0.001 in. in 5 in. is permitted.

In addition to the refinements in machining, the completed machine is tested under actual power for five hours' steady running. Every machine also must produce an accurate gear before it is permitted to leave the plant.

What Is a Machine Tool?

By E. Lytton-Brooks

In reply to the query of F. J. Deacon on page 548, vol. 52 of *American Machinist*, with regard to "What Is a Machine Tool?" I hardly think a true definition of this class of tool can be found in any dictionary. The definitions given are generally very vague or elusive, sometimes accompanied by little sketches or blocks of the machine itself usually copied from a type many years obsolete. The dictionary, no matter how modern, seldom keeps up to the times in mechanical matters and a good reference book on up-to-date tools is more likely to give a fairly accurate description.

I have always been given to understand that a machine tool was one which incorporated at least one purely mechanical movement and performed an operation with a tool by this mechanical movement. Say a lathe with an automatic traverse: the fact that the machine is capable of operating or removing material unaided, or taking care of itself until that operation is concluded, constitutes a machine tool. I should think that any machine that moves the tool or the work in any plane and at the same time causes the work to be operated upon definitely under its own mechanical movement and temporary control could be classed as a machine tool no matter what material is operated on.

An Experimental Investigation of Steel Belting—I

By F. G. HAMPTON, C. F. LEH, and W. E. HELMICK
Stanford University, Cal.

(*From Mechanical Engineering, July, 1920*)

At the annual meeting of the American Society of Mechanical Engineers, held Dec. 2 to 5, 1919, in New York, Student and Junior prizes were awarded to the authors of the following paper. It treats of an investigation undertaken by them at Leland Stanford University as a partial requirement for the degree of engineer. Part I was written by Messrs. Hampton and Leh in 1918, and Part II by W. E. Helmick the year following. The first section deals with a description of the apparatus employed, the character of the belting, and a discussion of the results obtained in investigating the coefficients of friction and velocity of slip.

ATTENTION has been called from time to time to the successful use of thin ribbons of steel for belting, and the purpose of the experimental work herein described was to determine, as far as time would permit, the characteristics of operation and the general laws controlling the performance of this means of power transmission. The literature on the subject of steel belts is very limited, and so far as is known there has been little or no experimental work done.

The controlling features of the design of an apparatus for testing steel belting may be enumerated as follows:

1. The machine must be so constructed that very high speeds may be obtained, and also means provided to vary the speed over as large a range as possible.
2. Since very high efficiencies are expected, it is necessary to provide means for measuring accurately the losses of power which occur in the belt.
3. The apparatus must be so constructed that the tensions in the tight and loose sides may be accurately determined.
4. On account of relatively small slip it is necessary to provide specially constructed apparatus to accurately determine this variable.
5. For the sake of convenience it is necessary to have the machine built so that belts can be changed easily and different lengths used.

Description of Apparatus

Two special high-speed pulleys were constructed upon which the belt to be tested was run. Since the speed at which cast iron can be safely run is far below that which was desired, it was necessary to select a stronger material and so construct the pulleys that they could be faced with some material other than steel. The pulleys used were built in the department shops by the authors and consisted of two boiler-plate disks, a cast-iron hub, and a wooden rim. The pulleys were made relatively large in order that high peripheral speeds could be obtained with relatively low shaft speeds. The facing consisted of sheet cork, which was chosen as the best material on account of the friction properties and its durability. One of these pulleys, which was to be the driven pulley of the machine, was keyed directly to the shaft of a 100-hp. Sprague dynamometer (see Fig. 1), which was used in testing only as a means of absorbing the power delivered to the driven pulley, and, although record was kept of the readings of the dynamometer, they were only used as a check and did not enter into the calculations of the test.

The other pulley, the driver, was mounted on a short countershaft held in two bronze bearings which were cast and finished specially for the purpose, the bearings being held in a pair of standard shaft hangers which were bolted to the frame. This shaft carried the driver pulley on one end, and on the other end the pulley with which the shaft was driven by a motor through a leather belt.

In order to measure the tensions in both sides of the steel belt, two special idlers were hung behind the driver in such a way that each one completely reversed the direction of the belt on both the tight and the loose sides between the driver and the driven pulleys.

In the original design of the machine the straight sections of the belt were all to be kept parallel by using a small driver, a large driven pulley and idlers of such size that the sum of the diameters of the driver and two idlers would be equal to the diameter of the driven pulley. This arrangement was discarded because of the work which would have been necessary on the available apparatus and the belts were run with their straight sections at an angle. The manner in which this angularity was corrected for will be discussed later.

The idler pulleys were hung on swinging frames so that they were free to swing in the plane of middle of the driver and driven pulleys' faces, but were constrained from moving in any other direction. They were carried on short shafts with high-grade ball bearings in order that friction would be reduced to a minimum. The design of these pulleys was also controlled by the high speed at which they were expected to run, and it was necessary to use a stronger material than cast iron.

Castings were made which formed the hub and a thin, solid web, and rims were made by cut-

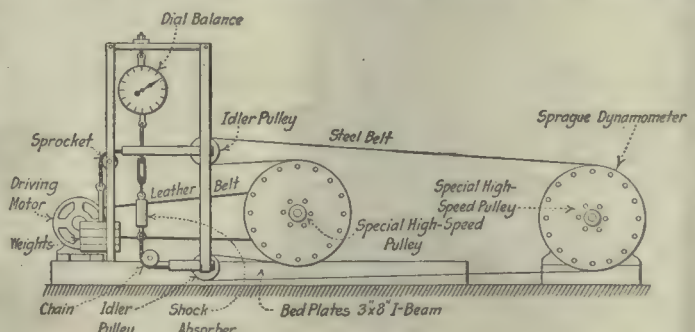


FIG. 1. DIAGRAMMATIC SKETCH OF STEEL-BELT TESTING MACHINE

ting sections from a piece of heavy lap-welded 10-in. pipe. The castings and steel rings were finished all over, the proper allowance being made for a shrink fit, and the rims heated and shrunk on to the webs, after which they were again machined all over and accurately balanced.

Since it was not considered desirable that the steel belt come in contact with the steel surface of the idlers, even though slippage at this point would be very improbable, the pulley faces were covered with the same variety of sheet cork that was put on the large pulleys.

Throughout the test no trouble was encountered with the cork faces of either the idler pulleys or the large pulleys, and, although speeds as high as 12,000 ft. per minute were attained, there seemed to be no tendency for the cork to fly off.

In order that the pull exerted by the belt on the idlers could be accurately measured, yokes were put on the idler shafts around the idlers, and to these were attached link chains which passed horizontally over ball-bearing sprockets so that, when the swinging frames were in their normal position, the chains were tangent to the arc of their swing and in the same plane. The chain from the idler, over which the tight side of the belt passed, hung vertically downward after passing over its sprocket, and on it was suspended a stem with a plate on its lower end and upon which weights could be placed. The chain from the other idler extended vertically upward after passing over its sprocket, and was attached to the lower part of a dial balance which measured the pull on the loose-side idler.

After starting the test it was found necessary to introduce some kind of a shock absorber to reduce the vibration of the needle on the dial balance, and for this purpose a spring balance of 200 lb. capacity was used. It was also necessary to adjust the length of this chain on account of the variations arising from difference in tension, and to do this a turnbuckle was put in between the dial and spring balances.

The swinging frames, guides, sprockets, and the dial balance were all carried on a rigid superstructure composed of iron bars and angles, and this was firmly bolted to the same I-beams which carried the shaft hangers holding the countershaft, and also the driving motor, so that there could be no relative movement between the various parts of the assembly.

The bedplates which supported this unit consisted of two 8-in. I-beams 16 ft. long, which were set at right angles to the shaft of the Sprague dynamometer and firmly bolted to the floor and shimmed with neat cement. These bedplates formed a guide upon which the driver unit was supported so that this part of the apparatus could be easily moved along the bedplate to accommodate belts of various lengths and without having to disturb the relations between the several elements of the unit.

The motor which was used to supply the driving power was a variable-speed, three-phase induction motor with speeds of 600, 900, 1,200, and 1,800 r.p.m., and rated at 4, 6, 8, and 12 hp. for these respective speeds. The motor was mounted on an adjustable base so that the leather belt driving the countershaft could be tightened, and the controller was mounted on the sliding frame near the motor.

The motor, which is of the most desirable type for the purpose, was not nearly large enough, and as a consequence the range of experimentation was limited by the available power supply and not by the transmission properties of the steel belt as it should have been.

Since it was necessary to make as accurate a determination as possible of the slip which occurred in the belt at all times, two similar devices were made which would electrically control two speed counters, one mounted on the center of the driver shaft and the other on the driven shaft. Two Veeder revolution counters were used for this purpose, being fixed to the shafts so that their spindles rotated on the same centers as that of the shaft; the remainder of the counter floating on the spindle and remaining stationary. On the stationary part was suspended a bar which carried an electromagnet so arranged that when current passed through the coils the movement of the armature would actuate a small lever, which slid the floating part of the counter axially so as to engage the dog clutch and count the revolutions of the spindle. Springs returned the counter to the original position and disengaged the clutch when the circuit was opened.

This arrangement gave a fairly accurate measure of speed because both instruments were made alike; and since the coils were in the same circuit and the springs of the same strength, it should give very dependable results. The difficulty, however, was not in the determination of the absolute speed, but of the difference of speed, and, since the counters only registered to the nearest revolution and the clutches were only two-jaw clutches, there is a possibility and also a probability of an error of one revolution either way, or two revolutions, and when the slip is small, say only 2 r.p.m., may involve an error in slip of 100 per cent, although the error involved in determining absolute speed is only a very small fraction of one per cent. In order to make accurate measurements of slip, it is evident that a differential counter should be used of such design that it would record to at least 0.10 r.p.m.

The entire testing apparatus as herein described is in itself a transmission dynamometer which measures its own losses. Having measured the tension in both the tight and the loose sides of the steel belt, and the peripheral velocity of both driving and driven pulleys, the power delivered to the driving end of the belt may be computed from the value of the net pull, which is the difference between the two belt tensions and the peripheral speed of the pulley face. In a similar manner the power delivered to the driven pulley may be computed from the net pull and the peripheral velocity, the tension in the belt being uniform between pulleys, and the friction or slippage losses may be obtained from the net pull and the velocity of slip.

It is assumed that no work is done or power consumed in bending the belt, and this assumption is substantiated by the fact that the material is perfectly elastic within the limits worked, and whatever power is required to bend the belt is given back to the system when it returns to its normal condition.

In order to further verify this assumption, pieces of the belting were caused to vibrate at a very high rate of speed by holding them on the teeth of a rapidly turning sprocket. Had there been any appreciable internal friction losses present there would have been a noticeable rise in temperature in the part of the steel which was subjected to such rapid bending. Although the pieces became warm at one end from the friction of contact with the sprocket, and on the other end from

impact on the material with which they were held, the part which was subjected to the severest bending remained cool.

This leaves the only losses sustained in transmitting power by steel belting to be those due to slippage of the belt on the cork surface, and since this can be reduced to practically nothing by increasing the belt tension, it appears that practically 100 per cent transmission efficiency may be obtained. The experimental results consistently verify this statement.

Belt Material and Correction for Angularity

The material which was used for the steel belts in this work was what is known in the commercial world as clock-spring. It is very high carbon steel drawn and rolled, apparently ground to size, hardened, and drawn to a dark-blue color. A rough test showed a tensile strength of slightly over 300,000 lb. per square inch and an elastic limit nearly as high. The material in pieces 0.01 in. thick receives no permanent set when bent around a radius of ½ in. and snaps with a clean break when bent around a radius of $\frac{1}{16}$ in.

The chief difficulty in using such material for belting is to get a joint which will develop a sufficient proportion of the strength of the material. Considerable work was done in this connection, and, although no prediction of the durability of the joints used can be made, on account of the short duration of the test, they proved to be entirely satisfactory within the limits used, and under conditions which were probably more severe than would be found in an actual commercial installation.

Because of the arrangement of the pulleys, and the consequent reversal of the curvature which any part of the belt receives when passing over them, it was impossible to use the standard fastening, which consisted of a strap of a curvature equal to the smallest pulley and to which the two ends of the belt were made fast by means of screws or rivets. A later discussion of the subject of joints will describe the various ones used and show why the plain butted joint held with silver solder was the best one for the purpose.

In order to correct for the angularity of belt pull on the idler pulleys and its effect upon the readings of the dial balance and the dead weights, a method was used which calibrated the exact belt tension directly against the readings of both the dial balance and the dead weights.

A belt was put on which, instead of being spliced, had its two ends joined by a link composed of a turnbuckle and an accurate spring balance. Weights were put on the hanging platform, the swinging arms brought to their normal positions by adjusting the turnbuckle below the dial balance, and readings were taken of the dial balance and the spring balance while slowly rotating the driven wheel first in one direction and then in the other. This method divided the friction, and the average of the two readings gave the true readings which could be plotted against one another and a curve drawn from which the true belt tension could be read for any reading of the dial balance or the dead weights.

On account of the limited time it was only possible to cover a small portion of the work necessary for a complete test of steel belting, and accordingly the field in which speed, horsepower, and tension are the chief variables was selected for investigation.

A series of runs was made at constant speed and, keeping one value of tension constant, the load was varied from no load to an upper value limited either by the available supply of driving power or by the slippage of the steel belt.

Since the tension in the tight side, T_1, was kept constant over any run, it may readily be seen that for an increase in transmitted horsepower the factor $T_1 - T_2$ could be made larger only by decreasing T_2, and that when this quantity was reduced to a very small value the loose side of the belt would become very unstable. After covering the range of horsepower possible, the tension was changed and another run made with varying horsepower.

Having covered the desirable range of tensions, the speed was then changed and another series of runs at the new speed was made. In making a run, the apparatus was adjusted to operate under conditions of practically no load, the swinging frames on the idlers were brought into their normal position by adjusting the turnbuckles and readings were taken of r.p.m. of driver and driven pulleys, the dial balance indicating the tension in the loose side and the dead weights the tension in the tight side. In timing the r.p.m., 2-min. intervals were used in order to reduce the error due to starting and stopping the counters.

The instruments indicating the other readings were found to be exceptionally constant, and since each reading was checked by both the parties making the run, only one reading for the most part was entered on the log sheets. By taking readings of the Sprague dynamometer beam, data were made available for a calibration of this machine at low capacity values which also served as a rough check on the other readings.

All Instruments Accurately Calibrated

An accurate calibration was made of all the instruments used on the test, including the two spring balances, stop watch, and dead weights. The readings taken can be depended upon to have a high degree of accuracy, with the exception of the difference of r.p.m. in driver and driven pulleys. Since this is a very small value and the error involved is in starting and stopping the counters, the percentage of error in the indication of absolute speed is practically zero.

Since the readings of the tight-side tension were made with weights, they are as accurate as the weights. No difficulty was encountered in reading the dial balance to the nearest pound, and since the idlers were adjusted to their normal position for every change, the readings relative to the belt tensions should be accurate to within 1 per cent.

The arc of contact was measured for each belt length used. As can be seen, when the distance between centers of driver and driven pulleys is varied there will be a slight change in the arc of contact. Since this change was so small and was used only in connection with the value of slip which, as explained before, had a large percentage of error, the change in the arc of contact was not considered.

The following will show how the various values used were obtained from the results of the tests:

Revolutions per Minute. The difference in the readings of the positive speed counters at the beginning and at the end of the timed interval will give the r.p.m. of the driver and driven pulleys, while the difference between the values thus obtained will give the r.p.m. slip.

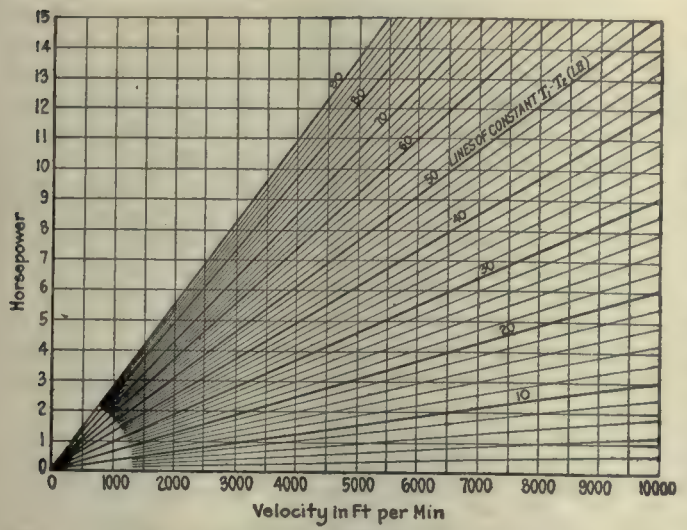


FIG. 2. DIAGRAM FOR COMPUTING HORSEPOWER FROM VELOCITY AND DIFFERENCE IN TENSION

V_s On account of a slight difference in the circumference of the driver and driven pulleys, it was necessary to make a correction. This was made by constructing a diagram from which the velocity of slip could be read directly for any r.p.m. slip and any speed.

V_d The driver velocity is obtained by multiplying the driver r.p.m. by its circumference.

T_1 The tension in the tight side of the belt is read directly from a calibration curve.

T_2 The tension in the loose side is also read directly from a calibration curve.

t_1 The unit tension in the tight side is found by dividing T_1 by the cross-sectional area of the belt, or

$$T_1/0.01 \times 0.75 = T_1/0.0075$$

Driver hp. was obtained from the relation:

$$hp. = \frac{force \times distance\ moved\ per\ min.}{33{,}000} = \frac{(T_1 - T_2)\,V_d}{33{,}000}$$

A chart was made (Fig. 2) from which the horsepower at any speed or any value of $T_1 - T_2$ may be read directly. This was done by plotting the lines hp. $= KV_d$ for values of K corresponding to the required values of $T_1 - T_2$.

Hp. Loss. This can be obtained from Fig. 2 by using V_s in place of V_d and dividing both horizontal and vertical scales by the same power of ten.

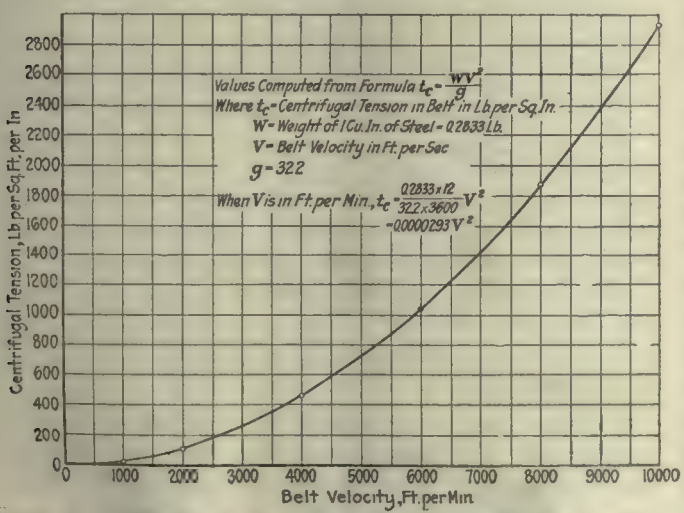


FIG. 3. CURVE OF CENTRIFUGAL TENSION FOR BELT SPEEDS UP TO 10,000 FT. PER MIN.

Efficiency is computed by taking the ratio of the power input to the belt to its power output:

$$\frac{hp.\ driver - hp.\ loss}{hp.\ driver}$$

t_c The centrifugal tension is determined from the relation:

$$t_c = \frac{WV^2}{g}$$

Fig. 3 shows a plot of this using the proper units and from which t_c for any belt speed may be read.

u The value of the coefficient of friction was calculated from the relation:

$$\log \frac{t_1 - t_c}{t_2 - t_c} = 0.4343\,u\theta$$

where u = coefficient of friction
θ = angle of contact in radians.

Discussion of Results

On account of the uncertainty of the test values of V_s it was first necessary to find, if possible, how this value varied with the others and to discover the law

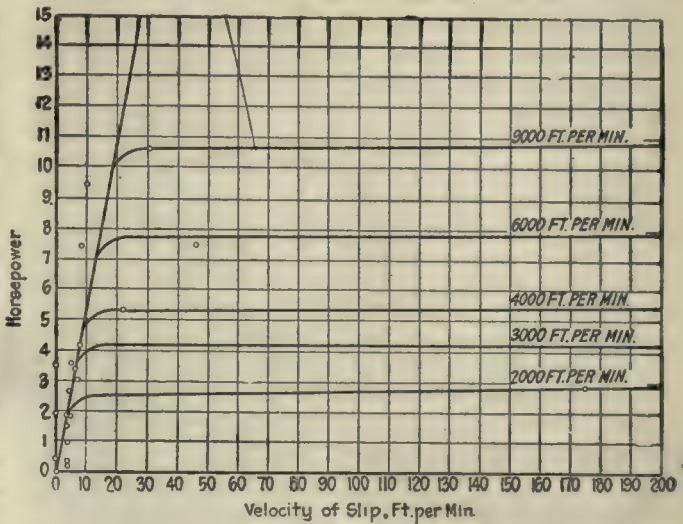


FIG. 4. CURVES SHOWING RELATION BETWEEN VELOCITY OF SLIP AND HORSEPOWER FOR $T_1 = 100$ LB.

which connected its variation with that of other quantities involved. The first step in this process was to plot the test values of V_s against the corresponding values of hp. This was done over the whole range of the test, one sheet for each constant, T_1. Table I and Fig. 4 show results and curves for $T_1 = 100$ lb

After careful consideration of the location of these points, it seemed that the curves for all speeds for any T_1 seemed to follow a straight line beginning at the origin and then to break sharply and leave this line, the point of departure depending upon the speed, and being different for different values of T_1.

It was also noticed that for high values of T_1 the straight line from the origin was much steeper than for lower values. Working on this assumption straight lines were drawn which represented the mean of all points which seemed to locate the line. Although there is a wide variation in the location of these points, it must be remembered that the percentage of possible error in the value of V_s is very large, in fact large enough to justify the moving of practically any of the points to the mean line.

Since it was evident that some simple law existed

TABLE I. DATA AND RESULTS OF TESTS ON 0.75 × 0.01-IN. STEEL BELT (T_2 = 100 LB.)

No. Run	R. p. m. Driver	R. p. m. Driven	Slip ft. per min.	V_d ft. per min.	T_2 lb.	Hp. Driver	Hp. Loss	Eff., per cent	u	V_{sc}
21	243	242	4	2,075	46.0	0.16	0.0002	99.9	0.023	0.1
	242	240	4	2,055	34.0	0.90	0.0008	99.9	0.122	0.3
	240	239	4	2,048	19.0	1.82	0.0031	99.8	0.317	1.7
	238	217	176	2,032	3.5	2.64	0.1200	81.4	.....	44.0
16	364	363	4	3,110	46.0	0.235	0.0001	99.9	0.0246	0.3
	363	361	4	3,090	33.5	1.41	0.0013	99.8	0.127	1.4
	360	359	4	3,080	20.5	2.61	0.0043	99.7	0.303	2.5
	358	357	4	3,050	12.5	3.32	0.0065	89.6	.....	3.0
	357	295	493	3,050	0.5	4.41	0.7200	83.5	.....	246.5
13	485	484	0	4,140	45.5	0.38	0.0001	99.9	0.097	0.4
	480	479	0	4,100	32.5	1.97	0.0022	99.9	0.136	2.3
	476	472	0	4,060	20.0	3.50	0.0057	99.8	0.322	3.1
	466	410	473	3,990	0.0	5.85	0.7000	88.8	.....	227.0
1	727	725	5	6,210	36.2	2.31	0.0010	99.9	0.118	2.1
	723	721	5	6,180	28.5	3.75	0.0035	99.9	0.223	3.5
	715	711	22	6,110	14.5	6.30	0.0089	99.9	0.601	5.8
	709	701	57	6,060	7.2	7.58	0.0706	99.1	.....	10.0
	702	656	358	6,060	2.5	8.37	0.4990	94.1	.....	179.0
	698	607	729	6,060	1.7	8.45	1.0300	87.9	.....	365.0
33	1,102	1,099	8	9,400	33.0	4.31	0.0033	99.9	0.231	3.7
	1,065	1,062	8	9,085	21.5	7.41	0.0105	99.8	0.690	6.5
	1,050	1,047	9	8,905	13.5	9.47	0.0170	99.8	.....	8.5
	972	939	265	8,205	2.5	11.44	0.0570	96.7	.....	128.0

between the various curves, as shown by the change in slope of the main straight line from the origin for different values of tension, values of V_s were plotted against their corresponding values of tension, at constant horsepower. This was done by taking the values of V_s from each curve at 10 hp. and plotting them against the value of tension corresponding to the curve.

The relation as shown from the plot proved to be a very close approximation to a straight line and accordingly the line was assumed and the lines previously located to represent the mean of the plotted points were so changed as to make their inclination to the hp. axis conform to the law. This correction was considered desirable and even necessary on account of the uncertainty in the values of V_s, which has been discussed.

Data were now available for the construction of a characteristic diagram in which lines of constant hp. were laid down on V_s and T_1 axes. (See Fig. 5.) It was noticed on the hp.-V_s curves that there seemed to be some symmetrical relation between the points at which the curves for different speeds broke away from the characteristic straight line. Accordingly, all of these points were transferred to the V_s and T_1 diagrams, the result being a series of surprisingly well-defined lines radiating from very near the origin and cutting the lines of constant hp.

Since the quantity $T_1 - T_2$ is more valuable for use in connection with this work than the quantity T_1, it was found desirable to provide some means of showing the relation of $T_1 - T_2$ to the other variables.

To do this the values of $T_1 - T_2$ were computed for various points on the diagram, and after marking the values in their proper places contours were run so as to show the lines of constant $T_1 - T_2$. The intersections of constant hp. lines and constant-speed lines were used for this purpose and the corresponding values of $T_1 - T_2$ were computed from the following relation:

$$T_1 - T_2 = \frac{33{,}000 \times hp.}{V_d}$$

This diagram may be used in connection with the design of a steel belt within the range of the values used, and applies only to steel belting of the same size as used in the test and run over cork-faced pulleys.

For any belt speed the maximum horsepower which can be transmitted with a given tension and the corresponding velocity of slip and $T_1 - T_2$ can be determined. For instance, if we wish to transmit 10 hp. we have a large range of values of both T_1 and belt speeds from which to make a choice, but when either of these values is fixed, the other assumes a definite value.

It must be remembered in using this diagram that owing to the method of its construction some of the quantities represent not the absolute values, but the limiting values corresponding to the others which have been fixed. Thus if we assume a belt speed of 6,000 ft. per minute with the original assumption of 10 hp. transmitted, it will be seen that T_1 will have a value of about 135 lb. This means that with the conditions which were assumed (10 hp. and 6,000 ft. per minute) any value of T_1 less than 135 lb. would be below the limiting value and that excess slip would be expected. It would be advisable, however, to use a somewhat higher tension, since in this way the velocity of slip would be materially decreased.

On the other hand, if we wished to find what speed would be necessary if we assumed T_1 to be, say, 200 lb., from the diagram it appears that a speed of about

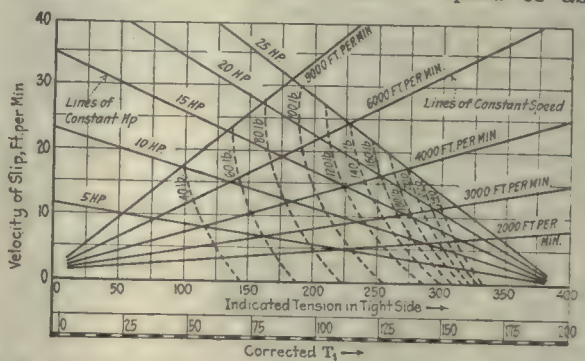


FIG. 5. CHARACTERISTIC DIAGRAM FOR STEEL BELTING

3,600 ft. per minute would be the least speed at which 10 hp. could be transmitted without excess slippage, and at this condition the slip would be about 12½ ft. per minute. Here again it would be advisable to either increase the speed or the tension, in order to work safely below the critical point, because the relations on the diagram represent conditions which correspond to the points on the straight lines of the V_s and hp. curves at which the holding power of the belt on the pulley breaks down and a very great increase in slippage begins.

By extending this diagram to cover a large range of hp., belt velocity and tension, and applying certain coefficients to compensate for changes of belt size and other variables which may occur, a complete working diagram for steel-belt design would be obtained.

The next relation which was wanted was that of the coefficient of friction to the velocity of slip. The method used in calculating these values has been previously explained, the values of V_s used being the corrected values obtained by the method before described.

Fig. 6 shows the curves obtained, and it was found that not only does the coefficient of friction vary with the velocity of slip but also with the belt speed, increasing with increased velocity of slip and with a decrease of speed.

A rather interesting feature was discovered in connection with the computation of the values of the frictional coefficient. In using the quantity

$$\log \frac{t_1 - t_c}{t_2 - t_c}$$

it was found that for some readings the values of $t_2 - t_c$ became negative, and hence the expression

$$\frac{t_1 - t_c}{t_2 - t_c}$$

also became negative

Investigation of the curves showed that such values appeared to develop at or near the points where the hp. and V_s curves broke away from their common characteristic line.

Very little can be determined for these values from the experimental data taken, and it is evident that such points are outside of the practical range for the use of steel belting. The phenomenon can, however, be explained as follows:

Whenever the value of t_c became greater than the existing value of t_2, which is the condition under which $t_2 - t_c$ is negative, it is evident that there was no force

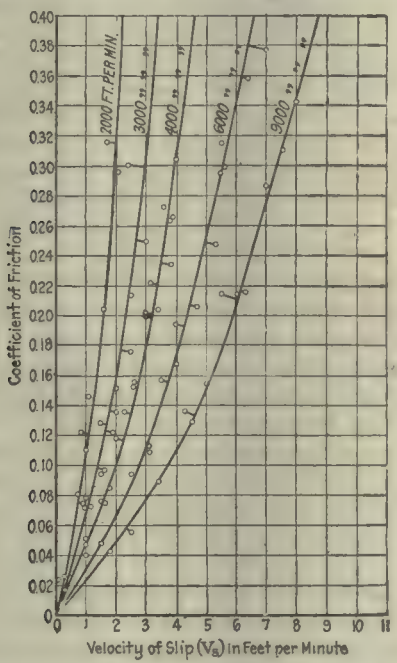


FIG. 6. CURVE SHOWING RELATION BETWEEN VELOCITY OF SLIP AND COEFFICIENT OF FRICTION

acting to keep the belt in contact with the pulley on the loose side. Accordingly, the arc of contact was diminished and conditions brought about which gave rise to the unstable and uncertain conditions which showed up in the experimental work.

In obtaining the values of the coefficient of friction an attempt was made to compute them from the relation:

Ft.-lb. lost due to friction $= u\,p\,r\,\theta\,V_s$

where u = coefficient of friction
p = pressure per unit length of belt on pulley face
r = radius of pulley
θ = angle of contact in radians
V_s = velocity of slip.

Assuming that the total power loss due to friction is also equal to the product of the velocity of slip by the difference in tension

$$(T_1 - T_2)V_s = u\,p\,r\,\theta\,V_s$$

and since

$$p = \frac{T_1 + T_2}{2r\theta}$$

$$V_s(T_1 - T_2) = u\,\frac{T_1 + T_2}{2r\theta}\,r\theta V_s$$

$$u = \frac{2(T_1 - T_2)}{(T_1 + T_2)}$$

Fig. 7 shows the curves plotted from this relation, but on account of their being independent of V_s, values of u were obtained in another manner.

Discussion of Belt Joints

One of the serious difficulties which had to be contended with was the development of some method of joining the ends of the belt in such a way as to develop a fair proportion of the tensile strength of the steel belt and at the same time not to interfere with the smooth operation of the belt and to be of such a nature that the joint will be sufficiently durable.

The following requirements are those which determined the most desirable joint to use:

a In order that there shall be the least possible amount of concentrated strain it is necessary either to have the joint extend along the belt as small an

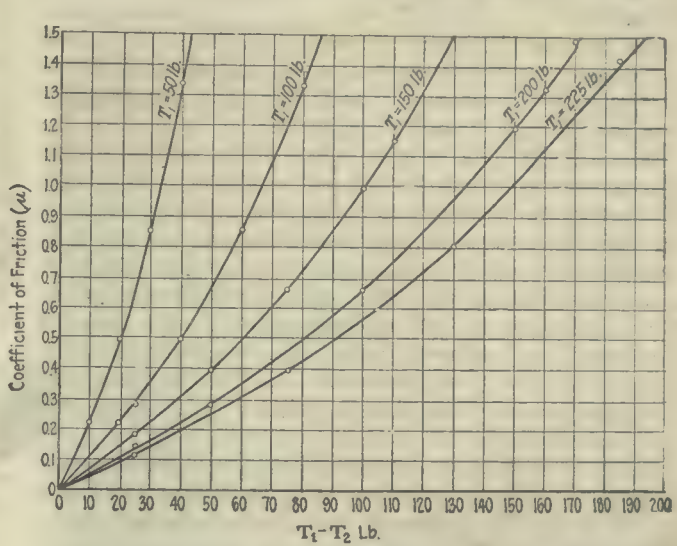


FIG. 7. CURVES SHOWING RELATION BETWEEN COEFFICIENT OF FRICTION AND DIFFERENCE OF TENSION

amount as possible, or to have it so constructed that its flexibility is approximately equal to that of the original belt. If the joint is of such construction that there is a distinct change in the flexibility in adjacent sections the stresses would be so concentrated at the junction point that destructive stresses would cause an early failure of the material.

b On account of the design of the testing machine it was necessary that the joint would be capable of withstanding reversed stresses and that nothing should interfere with using both sides of the belt in contact with the pulley wheels. This condition, while being essential for the test is not necessarily applicable to all installations, because for ordinary straight drives only one side of the belt is run in contact with the pulleys.

c The material of the belt is a very high-carbon steel carefully tempered and any joint which depends upon the use of solder must be made in such a way that the original temper is either not drawn or that it is drawn to only such a degree that the material is not damaged.

It can be readily seen that a joint could not be retempered without tempering the entire belt, because there would be a section each side of the heated part which would have received enough heat to draw its temper and still would not be hot enough to harden.

Efforts were made to develop a joint which satisfied the foregoing requirements, and after much experimentation it was found that the most successful manner of joining the belt ends, so far as the test was concerned, was to make a butted joint with the edges beveled about 60 deg. and then secured by means of silver solder. Care was taken to confine the annealing effect of the soldering flame to as small a length along the belt as possible and only enough solder was used to make the joint complete. With the ¾-in. belt it was possible to confine the annealing effect to a very small length (as little as ½ in.), and to so distribute the solder that it was not necessary to do any filing in order to make the joint ready for service.

Joints of this kind were used throughout the test with apparently no signs of weakening or failure and showing no undesirable effects on the running stability of the belt.

An attempt was made to weld the belting by means of an oxy-acetylene torch, but on account of the extreme thinness of the material and the high temperature required the effort was unsuccessful.

In an attempt to make a joint which would develop a large percentage of the original strength of the material, one of the ends to be joined was cut to a sharp V and the edges serrated, and the other end so cut as to interlock with it. It was expected that when this joint was silver-soldered the strain would be taken up by the material instead of by the solder as it would be with the simple butt-soldered joint. This method was not a success, because when heated to a sufficiently high temperature to flow the solder it buckled and twisted and could not be made flat.

Riveted joints were also tried and proved fairly satisfactory. The joints were made in the V-shape in order to distribute the rivets and both ends were cut out so that the tendency to stiffen the joint would be reduced to a minimum. They were made by the use of a punching die into which one end of the belt was clamped and fifteen No. 50 holes were punched. The other end was punched in the same die, being put through from the opposite end so that the holes in the two pieces exactly matched. The rivets used were No. 51 punchings from phosphor bronze about 0.03 in. thick. These were placed in the holes and headed down lightly on both sides, care being taken not to stretch the material by upsetting them too much. A joint of this type was run for a considerable length of time and then a very small crack was discovered in the edge. It is the opinion of the authors that with sufficient care and experimentation a very satisfactory riveted joint could be developed.

Why the Blueprint?

By H. W. Weisgerber

I was interested in an article by Frank Richards that was reprinted from the *American Machinist* in the *Compressed Air Magazine*. Upon looking at the title I thought here at least we are going to have something of real value; but not so, for the farther I read into the article, trouble was the only thing that I saw in his plan. I had visions of the photostat machine but no, he never mentioned it.

After finishing the article I came to the conclusion that the author knew nothing about the printing business and that his theory about reproduction on zinc plates was only a harmless "pipe dream."

I have been directly connected with blueprint departments for more than twenty years; and now in my present position in charge of the blueprint department of the Youngstown Sheet and Tube Co., where we run from one to four 100-yd. rolls of blueprint paper a day, I would consider an opportunity to save paper at the present prices to be most welcome. I fail, however, to see that opportunity in the use of zinc plates.

To use Mr. Richard's plan requires a printing press of some kind. The plates must either be nailed or screwed to wood blocks, put in a frame and fastened to the press. Then, if the lines and characters that form the drawing on the plate are all of a uniform height, all might be well; but would they be? If not, then they must be brought to the proper height by building up on the platen of the press with pieces of tissue paper so that the lines or characters will all print legibly. All of this requires time and patience, for if a letter or figure were missing the plate would be useless.

If only one or two copies of any particular drawing were desired, all of this preliminary work would be rather expensive. If a few hundred or a thousand copies were wanted it would be a mighty saving over the blueprint. Even if but one copy from the plate were wanted it would be necessary to put in the paper padding else the plate would make indentations in the paper that might blur certain characters in the second plate that would be placed in the press.

With some months experience in a small job printing office, coupled with fifteen years with a printing press that was used for title printing and other jobs in the blueprint department, I learned something about the accidents that will happen to type, plates and etchings. They must be handled with extreme care to prevent damage to their delicate surfaces and they must be scrubbed everytime they are used in order to keep the ink from clogging the small characters.

Mr. Richards refers to the drawings that he has incorporated in his article as being legible and easily read. But does he think that every Tom, Dick and Harry of a boy or man that he might place in a blueprint department could or would do as good work as a pressman employed on a magazine of the character of *American Machinist*? I think not. The magazine must use better ink than he would, and the type and cuts are in good condition; not having been battered about here and there in drawers and cabinets.

I will admit that smaller drawings than are now used would be more convenient to handle, but the process would lie in the direction of the use of the photostat; large drawings could be reduced to the size of sheets that these machines make, and then four or six of these sheets could be reduced again into one sheet which would bring the size of each drawing down to somewhere near the size that Mr. Richards advocates. With paper at the prevailing price, and likely to go higher, a way will soon be found to get along with far fewer prints—or else they will be made smaller by some process of photography. I have reproduced 33 x 42-in. drawings to lantern slide plates that were less than 3 x 3 in. and still had all lines and characters legible, but such fineness would scarcely do for printing-press work.

Inspection and the Modern Factory

By O. B. WHITTAKER

Inspection, as applied to modern factory practice, is the comparison of the factory's product in a semi-finished or finished state with that which the designer has portrayed by blueprint, sketch or other means.

THE subject of inspection usually interests the management in one of two ways depending upon the characteristics of the company in question. In a growing organization, if no inspection of the product has been inaugurated, the question confronting the management is when should inspection be started. If on the other hand inspection has been started, the extent to which it should be carried becomes a matter of prime importance.

In rendering decisions in either of these cases the investment must be considered a profitable one. No inspection department that is not a paying unit of the whole organization can be considered a success. The great variety of ways in which inspection brings about a saving requires the closest study of each individual case, as often the saving is made in such a way that it cannot be expressed in terms of money value. The cost of incorrect fulfillment of a contract on deliveries, or the indirect damage done by the delivery of a faulty product can never be fully determined. This point can be emphasized if the reader will imagine himself in the position of either the dealer or consumer, whichever the case may be, and choose from any of the various known materials on the market, some one manufacturer's product in which a feeling of great faith is held. An analysis of the reason for the confidence placed in the one chosen will, it is almost certain, be found to lie in the dependability of that company to supply the material as ordered and as represented in any preliminary negotiation. The large mail order houses in this country owe practically their entire success to the confidence which their customers have found they can place in them to supply the material as represented.

Practically all large companies that had their origin in the so called "One man shop" have had to face the necessity of instituting inspection at one time or another. The topic at this juncture is attacked from many angles, but despite this, there is a more or less definite means of determining the proper time to inaugurate inspection if the general characteristics of the company are known.

In the small factory or shop each workman can be depended upon to exercise more care in his work since he takes greater pride in making and fitting each individual part. He has a hand in the final assembly of the product and then, too, any mistakes made can be easily traced to the one responsible for them. Also in the small organizations, the foreman can more effectively supervise the work of the individual workman, especially in instances where the foreman is responsible for all operations necessary in making a given product from the beginning to the end.

As long as this condition remains, there is little or no use for an inspection department, but when it becomes necessary to expand the organization so that the shop becomes specialized, that is when certain parts of the factory are set aside for carrying on certain operations only, it immediately becomes necessary to introduce inspection, to prevent one specialized department from passing inferior or spoiled work to the next department; to prevent disputes between foremen over inferior or spoiled material; to create fair and clean competition between departments; to assist the management in localizing any trouble which may be found to exist in the product and if in a factory where "piece work" is done, to pass on the quality and quantity of the men's output. Inspection thus becomes the element which overcomes the detrimental factors of the specialized factory and, as specialization is the key to the successful operation of the large factory, inspection may be rightfully claimed as the keystone.

Inspection and The Product

All the details of an inspection organization should be adapted to the product to be inspected. Very frequently no precedent can be found covering the inspection of certain products or parts of products. This condition may well emphasize the need of a man rich in the possession of original ideas and filled with initiative, to fill the position of chief inspector.

Before any inspection is started, a very careful study of the product should be made with a view to determine in what quantities the product will be made; the extent of identical part production and the accuracy to be obtained.

Inspection of parts manufactured in large quantities is a comparatively easy matter as in such cases it is profitable to make gages of the "go and not go" type and other special tools. Such special tools, with very little patience exercised in training the personnel, permit the employment of comparatively unskilled labor, thus appreciably reducing the cost of inspection.

The manufacturing of parts in small quantities presents large and more difficult problems, as in many cases it not only becomes problematical whether or not special gages and fixtures are necessary, but those responsible are confronted with the difficulty of obtaining and training satisfactory help where "fixed" gages are not profitable.

On the other hand it will be found advisable in many instances to make special inspection fixtures even though the part to be inspected is not made in quantities which would ordinarily warrant "fixed" gages, especially if accuracy or a high degree of interchangeability is required.

Some companies have gone so far as to provide a separate organization, under the direction of the inspection department whose duty it is to plan and prepare the best and most economical way of inspecting parts. This organization may, in co-operation with the tool designer, design any special inspection tools found necessary. As a study is made of each part, a set of instructions for inspecting it is prepared. This serves as a guide for the inspector who will later inspect the part.

There is a broad variety of ideas as to the relation

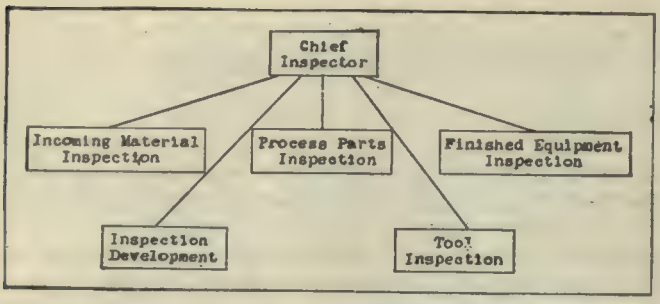


FIG. 1. ORGANIZATION CHART OF INSPECTION DEPARTMENT

of the inspection department with the other departments of an organization. Many are exponents of the idea of having it as a part of the engineering organization; others advocate that it should come under the factory's control and still others advocate that it should be an independent part of the organization with its line of responsibility meeting the others at the general manager of the entire organization.

Many good and bad points can be advanced for all of these plans, but the second, that of bringing the inspection department under the factory manager, seems to work out best. This is especially true if there is a factory manager superior to the factory superintendent, methods superintendent, production superintendent, etc., thus giving the head of the inspection department an equal footing with the heads of other departments in the factory division. In some factories the head of the inspection department is responsible to the factory superintendent. It is generally believed, however, that this is not good practice as it vests almost unlimited control of the product in the factory superintendent's hands. There are, of course, exceptions to this, but where such an arrangement is to be found working satisfactorily, a man of unusual breadth and ability will be found filling the position of factory superintendent.

In general, it is best to place the head of the inspection department on equal footing with the factory superintendent. Any differences coming up between them will have to be settled by the factory manager or management.

The superintendent of production is very apt to be one of the inspector's most disturbing factors since it is his task to meet a certain promised delivery, he is very apt to influence the inspector against his own best judgment regarding defective parts or material.

Some factory managers favor engineering control over the inspectors, as it is the belief in this case that the engineer is the most capable of finally judging the product of his own design. This relation of the inspector to the rest of the factory organization has its advantages in keeping final decisions entirely away from all branches of the factory, but tends greatly to isolate the inspection staff from the factory organization and its routine. In many factories the inspector is so nearly an integral part of the factory organization that any tendency to make him too independent causes a break in the routine which has been found to be most efficient.

Necessity For Full Co-operation

Regardless of his line of responsibility, the inspector must be willing to co-operate fully with whatever branch of the whole organization he may be called upon to serve. Any lack of co-operation and willingness to assist on the part of the inspector makes him a dangerous link in the chain of a factory's organization and in such cases he should be removed, even though it results in sacrificing inspection of a part, as in such cases he readily becomes a worse menace than the entire omission of the inspection department.

In any case the inspector must either be or become, as soon as possible, an authority on the manufacturing operations he has to inspect and then be ready to render any assistance that may be required by the man carrying out those operations. In many cases witnessed by the writer, the inspector simply attached rejection tags to the rejected articles and returned them to the production department with no reason given for their return. It was then necessary for the foreman of the production department concerned to go to the inspector and inquire the reasons the articles were rejected,—resulting in the loss of time amounting to more perhaps than the value of the parts. A better method would appear to lie in encouraging or perhaps compelling the inspector to analyze the cause of the part being spoiled and communicate the findings to the foreman at once and have the part returned as soon as possible with all details written out clearly on the rejecting tag.

A very good example of such co-operation was recently witnessed where a company was manufacturing large numbers of delicate instruments for the Government. There had been many rejections due to difficulty in getting certain of the parts to align themselves with each other properly. The almost continuous rejection of the parts by the assistant inspector gave the inspector in charge of that branch of the organization abundant time to study the problem. This man worked nights, Saturday afternoons, Sundays and holidays for several weeks and finally offered his suggestion as to how the trouble could be overcome. His suggestion was adopted and proved to be the right solution to the problem. This accomplishment was particularly meritorious since the trouble had been continuously before the engineers for solution since it first arose. It is not always that an inspector has this same opportunity, but again, how many inspectors are confronted with similar opportunities and fail to sense them at all,—in fact the inspector's intimacy with the product should put him in an excellent position to improve the quality materially.

Convincing the foremen that the inspector is willing to co-operate with them in bettering the product is of first importance in a factory where harmony is to exist between the production and inspection departments. An instance is recalled where in starting an inspection department in a factory the foremen demanded that they be informed of the policies of the new organiza-

RECEIVING RECORD — No. 35020

Received from: J.J.Chalcus, Watervliet, N.Y. — Req. No. 1234 Riley — Purchase Order No. 101010

Via: Parcel Post — Charges — Specification No. 9876 — Part No. 30796-98

Quantity	Description	Weight	Unit Pr.	Value
200	1 Minute Level Vials			
100	5 " " "			

Date: 3-16-1920 — Receiving Clerk: Merrorose. — Entered

INSPECTION RECORD

Quantity Accepted	Quantity Rejected	Inspected By	Date	Order to be Replaced
195/ 97	5-3	Gough	3-16-1920	

Remarks: 6 Rejections broken in transit.
2 Rejections Broken for Inspection purposes.
O.K. (W.G.)

Quan. Rec'd	Received By	Date	Floor	Section	Bin	Entered	Noted
195-97	CROOKE	3-16-1920	2	A	3	3-16-1920	

FIG. 2. RECORD OF MATERIAL RECEIVED

tion. They objected to certain records that were being kept which gave a summary of all material that passed through the inspector's hands during the day, the number of rejections and the department concerned. In some way the foremen obtained the idea that these records were being kept to incriminate them. As a matter of fact, the real purpose of these records was to find in what factory department the inspectors were co-operating properly with the factory, a continual high rejection usually indicating the lack of proper co-ordination between the two departments. A meeting of the factory foremen and all inspectors was called by the management and the matter thoroughly discussed and the results were almost miraculous in reducing the number of rejections and improving the product.

In factories where piece work is done, the co-operation between the factory and inspection department employees must be carefully controlled, as unfair decisions may result since the rejection of a part means a loss to the man making it. In such factories inspection is usually of a highly routine nature and but few outside of the foremen inspectors are able to co-operate with the factory efficiently. This to some extent overcomes automatically the dangers of too close association between the inspectors and the factory employees.

The routing of the product also bears closely upon this general topic. In all well organized factories the product passes through inspector's hands after each important operation and finally into stock. In case of rejection it is in most organizations returned to the production department which performed the operation for which the part was rejected. If the fault cannot be easily corrected, two courses are open, and the next move will depend entirely upon the rest of the factory organization. In instances where there is a salvage department the rejected part may be forwarded there and an effort may be made to salvage it, or the manufacturing department may scrap it and charge it off the books. It is obvious that in case the part is forwarded to the salvage department, and there found to be beyond reclaiming, that it should be charged off the books in order to keep the stock records accurate and up to date. Precaution should be taken to see that no parts enter the stock rooms except through recognized channels, in order to prevent rejected material from gaining access to a place where it will enter into the regular product as first class material.

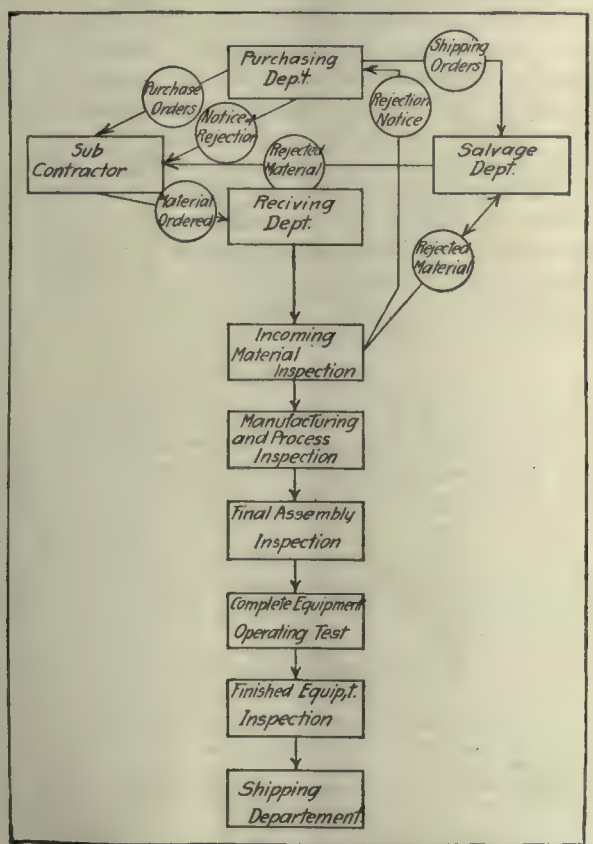


FIG. 3. CHART SHOWING METHOD OF HANDLING PURCHASED MATERIAL

SYMBOL G4 | NAME OF PART BINNACLE BASE MK IV COMPASS | PART No. 57319 | DATE 9-26-19 | SHEET No. 1

ISSUED BY WFM | MATERIAL CAST IRON | MFG. QUAN. | SUPERSEDED BY | APPROVED | No. OF SHEETS

	OPERATION	FIXTURE	LOCATION	TOOLS	DEPT. No.	MACH. OR BENCH No.	TIME HOURS SET UP	PER PC.	ALLOW
	Purchased Casting			Pattern 22954-E					
1	Inspect				1H				
2	Rough Grind O.D.	F X T-6738-FG	8K		6F				
3	Inspect				"				
4	Chuck on inside of base, Face back, Cut off front end to length, Bore front end to 9.500"		9E	Spider Center T-3558-FG	9B	E L			
5	Drill 4 holes in base	DJ *T-7261-FG	"	3/4" Drill	8G	1 DP Barnes 24"			
6	Drill 1 hole in side of Base	DJ *T-7261-FG	8K	1 23/32" Drill	8G	1 DP Barnes 24"			
7	Tap 1 hole		"	1 1/2" Pipe Tap	"	"			
8	C'bore 4 holes in Base		"	CB *SG-1169-70	"	"			
9	Drill 8 holes	DJ *T-2988-FG	"	5/16", 1/4" Drills	8G	Prentiss 20 DP			
10	Countersink 8 holes		"	C'sink	"	1 P			
11	Inspect				"				
12	Finish as specified				8F				
13	Inspect								

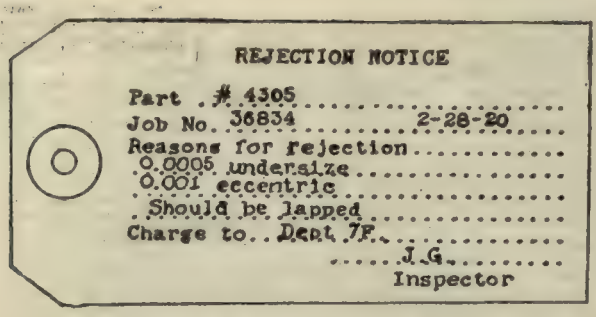
FIG. 4. OPERATION SHEET INDICATING PERIODS OF INSPECTION

Tolerances

Properly prepared blueprints are as essential to the inspector as are his tools. Few blueprints carry all the necessary information that may be of assistance to the men using them. It is not infrequent that it is impossible to carry out exactly the wishes of the designer as specified on the print and in anticipation of this, a working allowance for each dimension is usually given on all manufacturing prints. This allowance is usually known as a working tolerance. For example—a certain dimension may call for one inch. It is a well-known fact that except by accident, a piece of material cannot be cut to exactly one inch, it might be only 0.0001 over and yet that may or may not be close enough for the requirements. If the piece could be 0.0001 in. under or over size, it would be said to have a tolerance of 0.0001 in., or in other words, the piece could be used whether it was 0.9999 in. or not more than 1.0001 inch.

The use of the tolerance system has two very distinct advantages; it increases efficiency by indicating to the mechanic the relative importance of any given dimension and it removes the use of personal judgment on the part of the mechanic and inspector.

The subject of tools for the inspector is a matter of ranking importance. The tools for the inspection department should be chosen with the utmost regard for the nature of the product to be inspected.


REJECTION NOTICE

Part # 4305

Job No. 36834 2-28-20

Reasons for rejection

0.0005 undersize

0.001 eccentric

Should be lapped

Charge to Dept 7F

J.G.

Inspector

FIG. 5. REJECTION TAG

Where a product manufactured in quantities is to be inspected, it is usually best to consider special tools and gages especially made or set for the product. This is often found advisable where quantity is less evident but where close tolerances are necessary. For instances not included in the above, the ordinary mechanic's measuring tools will usually be found to be satisfactory.

Every factory should be equipped with a set of accurate gage blocks with which all of the tools or equipment used to gage the product should be frequently checked. Such blocks, when properly used, make possible the interchangeability of parts—they serve as a standard to which parts may be made in opposite parts of the country and still fit when assembled, etc. In this age of highly specialized manufacture, these are important matters. Take as an example the manufacture of the Liberty Motor; dozens of highly specialized plants in widely separated parts of the country contributed parts to that motor and they fit accurately when assembled. Of course, all the credit for this cannot be taken by the gage blocks, but we can rest assured that they made a great contribution to it.

Such a set of standards in the average machine shop will be found in the hands of the tool inspector where it is used for checking all manufacturing and inspecting tools. Some factories find it advisable to carry matters in this respect a step further by making a set of master gages from recognized standards and then using the master gages for checking the working gages and then checking back with the recognized standards at only infrequent intervals. This method further prevents wear in the standards, and is broadly practiced where possibly some of the most exacting problems of interchangeability are encountered, such as in the manufacture of ball bearings.

In factories where electrical machinery is manufactured, equal care should be taken to see that the standard instruments are kept uniformly accurate.

Organization

The plan of organization for the inspection department itself depends upon the size of the plant and the nature of its products.

Most plants of a sufficient size putting out a product of a mechanical nature have an organization laid out along the lines represented by the chart shown in Fig. 1.

The responsibilities of the department units may be outlined as follows:

The Chief Inspector is responsible to his superior for the direction, supervision, and co-ordination of all sections of the inspection department.

The *Incoming Material Inspector* is responsible for:

(a) Keeping on file copies of all purchase drawings and specifications under which materials are purchased. These to be kept in a convenient manner for ready reference when shipments on purchase orders are received.
(b) Checking all incoming material against the requirements specified on the purchase orders, and marking the date and quantity accepted and rejected on the receiving record.
(c) Forwarding all rejected incoming material with proper information to the salvage department.
(d) Rendering proper reports as requested by the chief inspector.

The Process Parts Inspection Section is responsible for:

(a) Inspection of all process parts between important operations in their manufacture.
(b) Inspection of all finished patterns before they go to the foundry.
(c) Inspection of all castings as they come from the foundry.
(d) Notifying the production department of any delays in the transfer of material to or from any of the inspection benches.
(e) Co-ordinating the work of the inspectors with the factory foremen.
(f) Rendering proper reports as requested by the chief inspector.

The Finished Equipment Inspection Section is responsible for:

(a) Inspecting all finished material and equipment and checking its mechanical and electrical features against the requirements of the order and specifications covering the material before being turned over to the shipping department.
(b) Obtaining the certificate of approval or acceptance from the customers when required.
(c) Rendering proper reports as requested by the chief inspector.

The Tool Inspection Section is responsible for:

(a) Checking all tools, gages, fixtures, etc., with requirements of specifications and drawings immediately after they are completed by the tool makers and before they are turned over to the production department.
(b) Checking any gages and fixtures that may be returned by the shop or other sections of the inspection department for rechecking.
(c) Rendering proper reports as requested by the chief inspector.

The Inspection Development Section is responsible for:

(a) Developing ways and means of checking all parts to see that they conform to the terms of the requirements.
(b) Rendering proper reports as required by the chief inspector.

Incoming Material Inspection Section

Almost every factory purchases raw material. If the factory is of any consequence at all the purchasing agent hasn't time to inspect the material he buys, nor is it usually the case that he is capable of telling whether the material he has purchased is satisfactory or not, even though he had the time. His profession is a buyer and not an engineer or inspector. It is therefore somebody's business to see that the material purchased is what was ordered.

The incoming material inspector must know the requirements of the material he is to inspect and he should know it in time to make any special arrangements or provide any special equipment necessary. He is therefore supplied with a copy of the purchase order and complete specifications covering the material to be purchased. The purchase order indicates whether inspection is to be made at the plant of the contractor or at the home plant; delivery dates, etc. Payment on purchased material is not made until the material is approved by the inspectors, a space being provided on the receiving record, Fig. 2, for the inspector's approval or disapproval. Fig. 3 illustrates in detail the method used in handling purchased material.

Process Parts Inspection Section

After the material has been approved and placed in stock, all subsequent inspection, up to the point of testing, is made by the process parts inspection section. This group of inspectors approve the material between all important operations as specified by the factory on the operation cards, Fig. 4, which indicate at what periods the part shall be inspected. All material must be approved before being sent to the stock room. This

INSPECTION INSTRUCTIONS

Name of Part	Operation	Prepared By	Approved By	Date
Guide bearing case	Grinding	J.F.C.	L.M.F.	1-8-20

Tools	Plug gage T-3889	
Location	30 crib bin No. 84	

Procedure: The tool for this part is a "go and no go" plug gage and is to be used with no variations from the tolerances allowed on it.

FIG. 6. REPORT OF INSPECTION DEVELOPMENT SECTION

section also takes care of all testing done on unit and sub-assembly parts. Upon completion of the product and after a thorough assembly inspection by the process part inspectors, the product is turned over to the test department, which is a separate part of the company's organization. It is here given a thorough test and if approved, is turned over to the finished equipment inspection section.

Finished Equipment Inspection

The finished-equipment inspectors check the material thoroughly against the customer's specifications to see that it complies with them in every respect.

Rejected Material

All rejected material is returned to the department responsible for the fault for which it was rejected. A rejection tag, Fig. 5, describing in detail the reasons for the rejection is attached to the material before its return. This tag is signed by the foreman inspector.

The department responsible for the trouble investigates the reasons for the material's rejection, with a view to reclaiming it. If it can be corrected, it is fixed up and returned to the inspectors for approval. If it cannot be reclaimed, it is forwarded to the salvage department. If it is an assembled unit, the good parts are removed and returned to stock and the bad parts scrapped.

Inspection Development Section

This section is continually in touch with new work that is being prepared to be placed in the shop. Its work bears the same relation to the inspection department as the methods department does to the factory; in other words, it makes a thorough study of the product and prepares ways and means of inspecting it. Careful reports, Fig. 6, are made as a result of the study of each part. These records then serve as a guide to the inspector, who will have to inspect the part when it gets into production.

Drilling and Tapping Ring Gears

By Frank C. Hudson

Among the specialties of the Weeks-Hoffman Co., Syracuse, N. Y., is the manufacture of the ring gears for cars of various kinds. These are machined in the regular way, but some special tooling is necessary when it comes to drilling and tapping.

A multiple-spindle drilling machine has been rigged up, as shown in Fig. 1, so as to drill all the holes in two of the gear blanks at one setting. The guide plate is fastened to the column of the drilling machine, so as to guide the drills and insure the gears being interchangeable.

The gears to be drilled are mounted in pairs on the drilling table, the table being suitably indexed in its proper position, so that the guide plates will center the drills correctly. It will be noted that the guide plate *A* has a raised place in the center of each ring of drills, which performs the double function of allowing space for the hub of the gear and also of distributing lubricant to the drills.

The size of the pipes for distributing soda or other cutting compound indicates that flooded lubrication is believed in.

Tapping the drilled holes is also done in a multiple-spindle drilling machine, which is, however, set up for

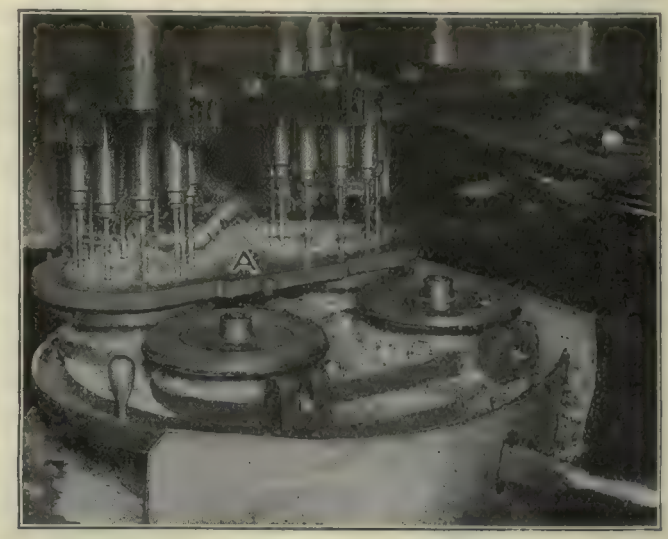


FIG. 1. DRILLING TWO GEARS AT ONCE

only one ring gear, involving the use of ten taps as shown in Fig. 2. There is nothing unusual about this set-up, except perhaps the simplicity of the holding fixture, which only has to support the gear and to resist an upward pull. The ten taps have no tendency to turn the gear as a whole.

Features of Operation

It will be noted that there is plenty of play, both vertically and in twisting around the spindle, in the driving connection at *A*. The tapering chuck carries a sleeve which is well supported by the spindle inside, but allows it sufficient motion to prevent any tendency to bind and to allow slack when the spindle reverses from one direction to the other. An ample supply of cutting lubricant is provided by the large pipe which encircles the taps, the holes in the pipe being so located as to thoroughly lubricate each individual tap as it revolves.

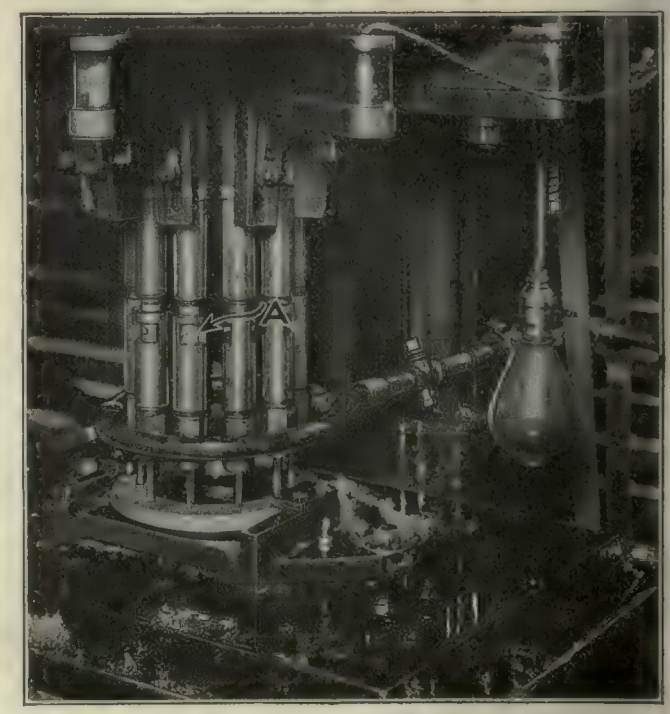


FIG. 2. TAPPING WITH TEN SPINDLES

FOR SMALL SHOPS *and* ALL SHOPS

By J. A. Lucas





The Evolution of the Workshop—XII

By H. H. MANCHESTER

The development which took place in the metal-working industries of Great Britain during the period between 1820 and 1870 was very great, and it shows to what an extent the factory system had grown. Improvements made in the method of working hot metal were as important as those arising in machine-tool work, the rapidity of the development being truly striking. The more general application of steam power and the raising of the standard of accuracy in machine work are among the important points discussed by the author.

(*Part XI appeared in our July 29 issue.*)

IN GREAT BRITAIN the decade following 1820 was very largely one of improvement on the machine tools such as the lathe and planer which had recently been invented, and it was not until two decades later that any new tools of prime importance were developed. Several of the notable improvements of the period were credited to Joseph Clement, who, it will be remembered, was one of the first to adopt the planing machine to iron. Between 1820 and 1825 Clement built planing machines for iron which were used in his shop, and the combined these in various ways with the lathe. While the work of this machine was far more accurate than could have been attained by other methods, it was not at all cheap, for Clement's price was 1½ cents a square inch, at a time when skilled labor received only about fifty cents a day.

There is a long description of Clement's planer in the "Transactions of the Society of Arts" in 1832. This account contains the following passage, "This planing machine for metals . . . performs its work in right lines, and is so constructed that during longitudinal cuts the tool is stationary and the work moves, but during lateral cuts the tool moves. The tools or cutters are similar to those used on the lathe, their forms being in like manner varied from a strong point to a chisel-shaped edge to finish the work. In the lathe a mandril supported by immovable columns presents the work to the tool in the firmest manner and with the least possible friction. . . . Mr. Clement also saves time, or uses the whole time, by making cuts both ways, there being two cutters mounted, one to cut while going, the other while returning."

In 1827 Clement invented a self-regulating lathe, so that practically the same quantity of metal could always

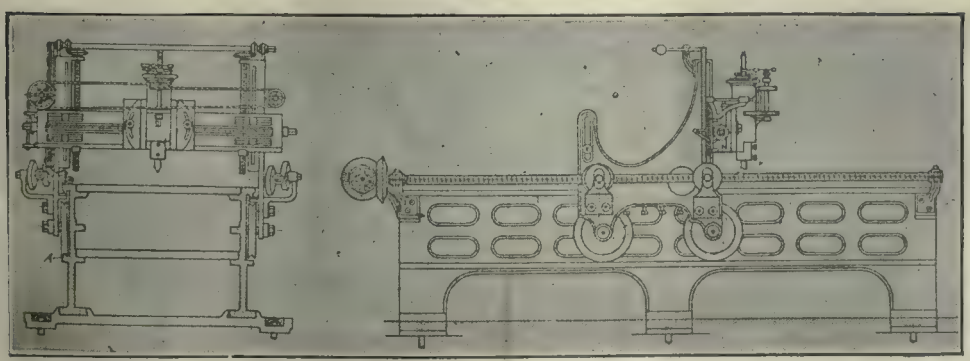


FIG. 74. WHITWORTH'S PLANE FOR IRON, ENGLAND, 1835

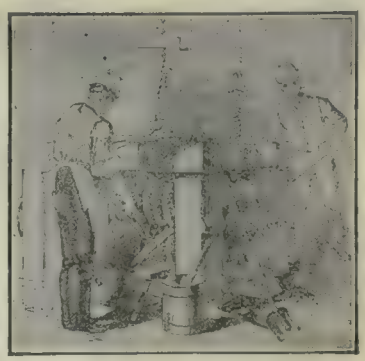


FIG. 75. ROLLING BAR IRON IN THE FIFTIES

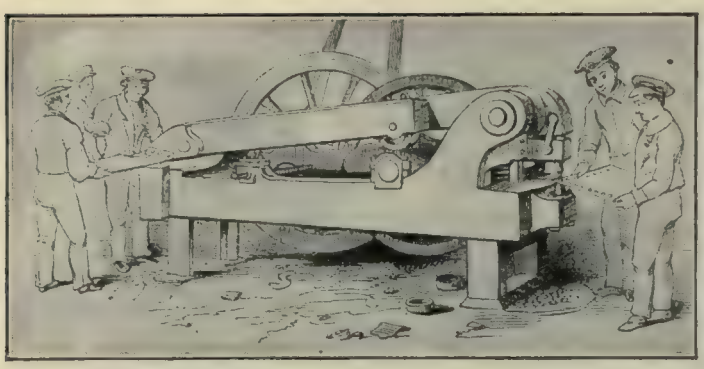


FIG. 76. CUTTING AND PUNCHING SHEET IRON, 1850

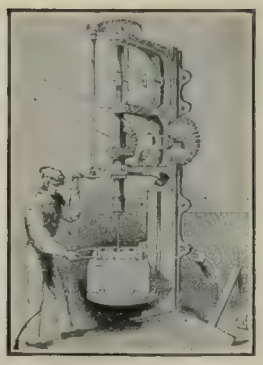


FIG. 77. A BORING MACHINE OF 1850

be cut in the same length of time. For this he was given a gold medal by the Society of Arts. The next year the same society gave him a silver medal for his self-adjusting double-driving center chuck. About this time he began to standardize the number of threads according to length and pitch in the screws he made, and constructed a machine which would produce them in accordance with this standard. In the same year he began to produce fluted taps with a revolving cutter, and also invented a headless tap.

As is regularly the case, the patents of the period evinced the demands rather than the actual accomplishments.

A so-called universal chuck was invented by Bell in 1821, and a gun-stock lathe, probably suggested by Blanchard's, in 1822. In 1825 Cornelius Whitehouse received letters patent for a method of welding pipe. That the lathe was far from being generally run by steam power is shown by a patent for the application of steam power to it given to L. R. Fitzmaurice in 1828. Tyndall received a patent for nail rolling in 1827, and there were various patents for nail cutting in 1830 and 1831. At about this time we hear also of drawn wire nails in Paris, which seems to be their first introduction.

Inventions in the Thirties

Several important inventions in machine tools date from the thirties. Steel screw manufacture was begun by James Perry in 1830. Whitworth's highly successful plane, shown in Fig. 74, was patented in 1835. New boring machines also were invented by Whitworth, and a new punching machine by Charles Phillips. Presses and stamps were improved upon by Sharp, Whitworth, and Bodmer. In 1836 James Nasmyth invented a shaping machine which was long known as "Nasmyth's steel arm." Improvements in screw- and bolt-cutting machines belong also to this period. Between 1834 and 1841 Whitworth probably did more than anyone had previously done toward standardizing the threads in screws, bolts, and nuts, establishing a constant angle for the threads of 55 deg.

Iron canal boats had been built as early as 1786, but the first iron steamer seems to have been constructed in 1821. It was intended merely for river purposes, and the first iron steam ships to cross the Atlantic were the Sirius and Great Western in 1838.

The increasing importance of iron ships, the steam engine, and the demands of the new locomotive are suggested by the invention of a riveting machine worked by steam by William Fairbain in 1839. This was applied both to boilers and ships, and may be said to have made practicable the building of armored ships which followed a decade or so later. Patents for rolling rails were taken out by Joseph Freeman in 1837, and by James Hardy and J. G. Bodmer in 1838.

Attention was at this period being called to gearing and the form of the teeth for wheels. These were still constructed almost entirely in accordance with the individual whim of each machinist without any definite scientific principles to follow. In 1837 J. I. Hawkins made some valuable suggestions on the use of the involute curve for the outlines of teeth. Four years later the subject was taken up more in detail by Professor Wills, who established at least a few mathematical laws in regard to the subject.

During the construction of a new machine shop J. G. Bodmer in 1839 and 1841 took out patents covering various machines and their arrangement in the new shop. These patents covered in all about forty improvements, and, together with the careful planning of the entire shop, made an important step in the evolution of shop practice. Bodmer, by the way, was the inventor of a vertical boring mill which he designated and intended, however, as a circular planer.

The steam hammer, which revolutionized heavy forging and made the tilt hammer scarcely more than a memory, was designed by James Nasmyth in 1838 to forge the shaft of the "Great Britain," but when the drive was changed to a screw propeller, the idea was temporarily dropped. The plans had, however, been shown to two Frenchmen, and four years later Nasmyth was amazed to see his hammer at work in the Creusot iron mills in France. On his return to England the same year he took out a patent, and constructed a hammer that weighed 1½ tons.

Nasmyth's original invention simply admitted the steam beneath the piston in such a way that it raised this and thereby the hammer. In 1843, however, an automatic movement for the hammer was designed by

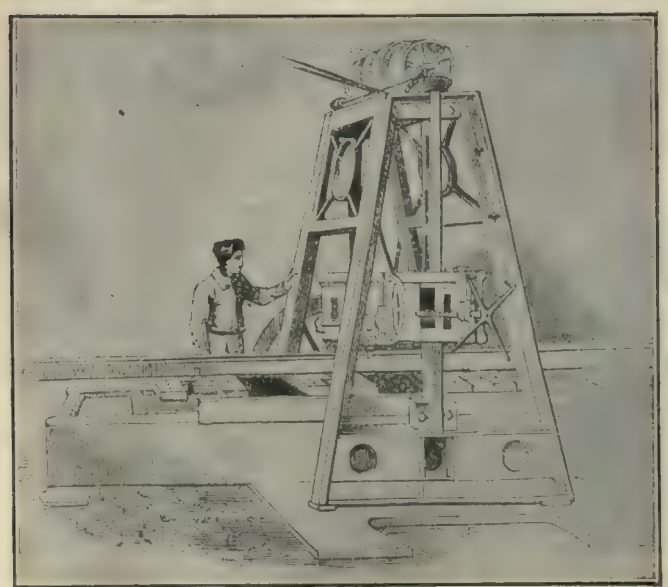


FIG. 78. A PLANING MACHINE OF 1853

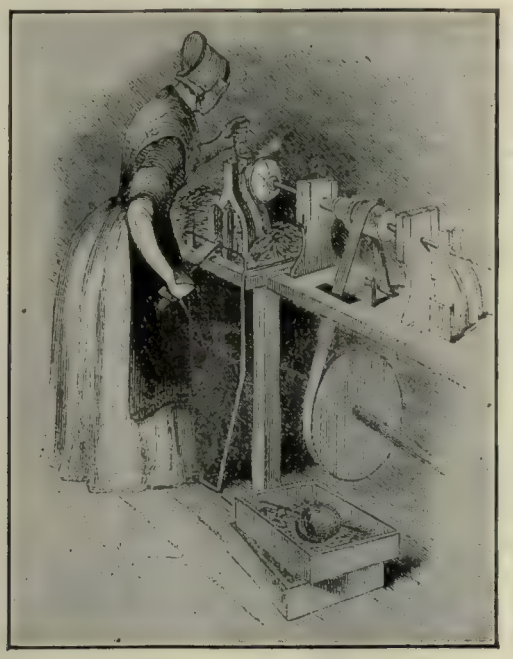


FIG. 79. A WOMAN CUTTING SCREW THREADS, ABOUT 1853

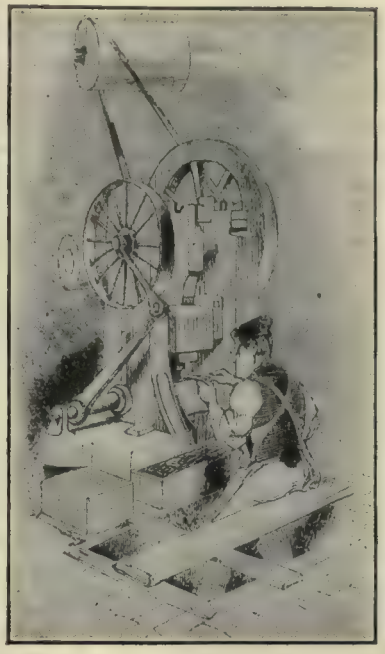


FIG. 80. MAKING THE HEADS OF SCREWS, ABOUT 1853

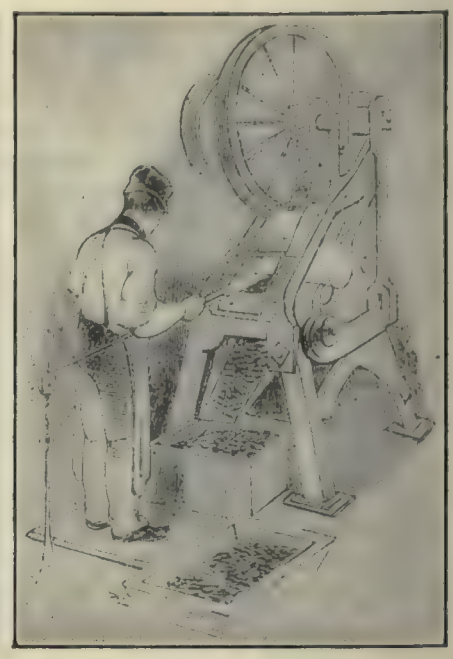


FIG. 81. MAKING CUT NAILS, MIDDLE OF THE 19TH CENTURY

Wilson, and it was not long before the hammer could be raised, forced down, and stopped at any point desired.

Crude milling machines were used by Nasmyth, Sharp, and Haley in the early thirties, but they could not have been very successful, because two decades later the milling machines imported from America were considered far more efficient than anything of the sort known in England.

In spite of the many planing machines for iron which had been already constructed, Whitworth in a paper read at the British Association at Glasgow, declared: "A true surface instead of being as it ought to be in common use, is almost unknown; few mechanics have any distinct knowledge of the method to be pursued for obtaining it, nor do any practical men sufficiently advert either to the immense importance, or to the comparative facility of the acquisition." Whitworth's method was to obtain his plane surface by scraping, rather than grinding, as he claimed the latter method could never give satisfactory results.

In the forties we read of various new machines, most of which were, however, improvements rather than basic patents. In 1840 a patent for a shaping machine was taken out by Whitworth and John Spear, and the next year another for a shaper by Henry Davies. This is about the same date as the invention of the shaper for iron in America, but it seems to have come into more general use in the latter country.

An indication of an interesting advance is the patent of H. R. Palmer in 1842 for making corrugated iron for roofs. A patent for rolling iron for suspension bridges was given to Thomas Howard in 1845, although such bridges themselves had been introduced in the previous century. Fig. 75 shows how bar iron was rolled after the introduction of this method.

In 1842 Nasmyth applied his steam hammer to an improved form of stamping machine, and another machine for stamping and shaping was patented by T. F. Griffiths in 1846. In the latter year improved machines for shearing plates were patented by Charles May and Charles Fox. A patent for pressing by steam power was given to Richard Prosser in 1850. Various other patents were taken out for shearing, shaping, and com-

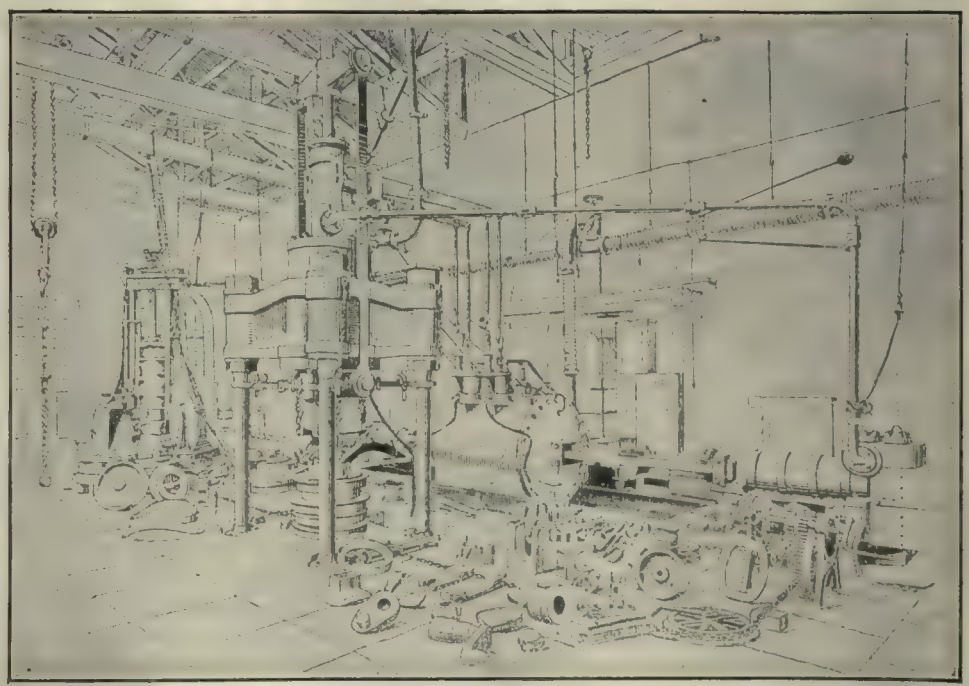


FIG. 82. HASWELL'S HYDRAULIC PRESS, ENGLAND, 1863

pressing in the next few years, Fig. 76 showing a typical machine.

An important evolution in measuring was made by Whitworth about 1856, when he combined his recently attained true planes and standard screws to produce a gage capable of measuring one-twenty-thousandth of an inch about as easily as one sixty-fourth of an inch was estimated in the previous century.

In 1859 Nasmyth introduced traversing or slot-drilling machines in which the motion was applied to either the work or the drill. In this period there were various patents for machines for slot drilling, milling, tapping, shaping, and planing, all before 1860, but they were in reality merely improvements. Figs. 77 and 78 show machine tools which were typical of the fifties. Fig. 79 shows that female labor was applied at that time to some machine work, while Figs. 80 and 81 give examples of some of the best specialized machinery of the times.

One important principle established by Whitworth was the use of hollow castings for machine tools in order to combine lightness and strength. In 1859 this principle was also applied to the construction of girders and beams. In 1855 J. Herdman received a patent for a cellular formation in such structural iron.

A great advance in ship building which served to increase incalculably the importance of iron and steel work was that of armored ships. As early as 1854 a floating battery had been protected with iron plates, but the first armored ship seems to have been the "La Gloire" of France, which appeared in 1858. The first English ship with armor was the "Warrior" built in 1859. That very year John Arrowsmith took out a patent for rolling iron plates for ships, and the next year Lancaster and others patented steel plates for ships. In 1861 another patent was granted for the use of Bessemer steel for this purpose. These ships were as yet experiments when the success of the "Virginia" or "Merrimac" over the wooden ships in Hampton Roads, and the victory of the "Monitor" revolutionized all ship building.

The first extensive examples of wire rope transmission seem to date from 1859. This was of importance in doing the heavier work required at the larger plants which were then being established.

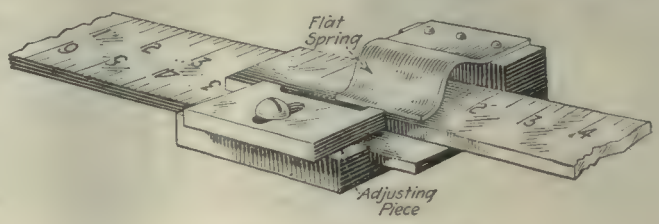
Another important improvement was the hydraulic press or hammer, shown in Fig. 82, which was built by Haswell in 1860, and which did much to increase the facility of fast forging. In 1865 Nasmyth & Co. constructed a 72-ton hammer. The next year the self-acting steam hammer was invented by Charles Emmet, and the atmospheric hammer by D. Grinshaw, as well as a forging machine for iron wheels by Holliday. In 1867 a double-acting steam hammer of somewhat new construction was put out by Thwaites and Carbutt of Bradford.

In some ways the best conception of the machine shop in England about fifty years ago is given by P. R. Cola. The development reached there is summarized by him in the following passage: "Lathes are now made in . . . Europe that would turn with ease a mass of fifty tons in weight, or as many feet in length; planing machines that will bring to truth and flatness, surfaces of 40 feet by 10 or 12 feet; boring machines that will scoop out cylinders more than 12 feet in diameter; slotting machines that will gradually chop asunder a block of steel a yard thick; shears that will bite through a bar of forged iron a foot wide; and steam hammers of twenty tons and upwards, falling twelve feet, whose blow at a distance is felt as that of an earthquake." Cola also gives an estimate of the machine tools required for a workshop fitted to do all kinds of repairing for steamships and manufacturing plants. This estimate is of interest in enumerating not only the machines but the prices prevalent at that time.

Attachment for Extending a Scale

By R. H. Kasper

A scale may easily be extended by the use of the attachment shown in the sketch, which firmly clamps two scales together and still leaves them free to slide. The scales are held together by the friction induced by



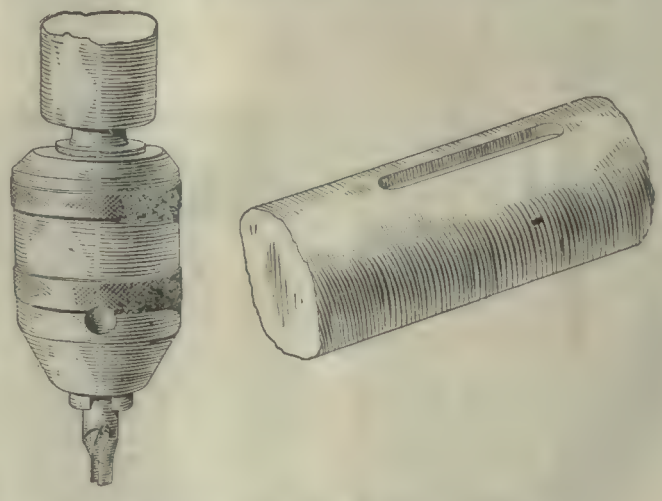
CONNECTOR FOR SCALES

the spring. Adjustment is provided for using scales of different widths. Two scales, held by this attachment, may be inserted into inconvenient places and extended. After the measurement has been taken, the length is reduced and the scales withdrawn.

Cutting Keyways with a Center Drill

By H. W. Armstrong

It is sometimes desired to mill a small keyway in a shaft and an end mill small enough to perform the operation is not on hand. In fact it is almost impossible to buy an end mill smaller than ¼" diameter. Often



CENTER DRILL GROUND FOR END MILLING

a keyway is made by drilling a hole and shaping into it or by using a Woodruff key cutter which may be obtained in small sizes. However the disadvantage to this method is that the end of the keyway takes a radius from the cutter which is not always desired.

A good method is to take a combination drill and counter-sink or center drill, grind flat on end and use as an end mill. An ordinary drill of the required diameter may also be used.

Power Consumed in Milling

By FRED A. PARSONS
Chief Engineer, Kempsmith Manufacturing Co., Milwaukee, Wis.

This investigation of the variables affecting the power consumed in milling, was undertaken for the purpose of constructing a slide rule which would indicate, for various cuts, the power required, and therefore, the machine best adapted for the job.

THE data available were a large number of tests made by the Kempsmith Manufacturing Co. on various Kempsmith millers, especially the No. 4 Maximiller and the No. 33 Production miller. Because these tests were not made for this purpose the majority are not well adapted, too many factors being varied at once and too much time having elapsed between suitable comparisons to permit exact knowledge of all conditions such as sharpness of cutter, motor efficiency, accuracy of electrical instruments, etc. For this reason they must be considered only as preliminary figures of reasonable accuracy.

It appears that the factors which affect the power consumed and their effect, if other things are equal (some of the items being different for spiral and face mills), is as follows:

Feed in Inches Per Minute. Affects power directly according to f;

$$\frac{f}{F} = \frac{p}{P}$$

Feed in Inches per Tooth of Cutter. Affects power inversely according to $f^{0.5}$ for spiral mills, or $f^{0.4}$ for face mills

$$\text{For Spiral Mills } \frac{f^{0.5}}{F^{0.5}} = \frac{P}{p}$$

$$\text{For Face Mills } \frac{f^{0.4}}{F^{0.4}} = \frac{P}{p}$$

Note—In computing power, both feed in inches per minute and feed per tooth must be considered.

Width of Cut. Affects power directly according to W.

$$\frac{w}{W} = \frac{p}{P}$$

Depth of Cut. For spiral mills affects power in two ways, the combined effect being directly according to $d^{0.78}$;

$$\frac{d^{0.78}}{D^{0.78}} = \frac{P}{p}$$

For face mills affects power directly according to d;

$$\frac{d}{D} = \frac{p}{P}$$

Material Cut. Power required is in about the following ratio:

Cast iron, 1; cast steel, 1.65; and bar steel, 1.65.

Type of Machine Used. Affects power required in about the following ratio:

Maximillers, 1; cone type, 1; No. 33 Production, 1.15.

Spindle Speed Used. Affects power required in about the following ratio (this varies somewhat on different types of machines and ranges of speed).

Lowest speed, 1; highest speed, 1.10.

Number of Teeth in Cutter. Has very pronounced effect, included in the expression of "feed in inches per tooth of cutter" (see above). If considered alone affects power inversely as $t^{0.5}$ for spiral mills and as $t^{0.4}$ for face mills.

$$\text{For spiral mills } \frac{t^{0.5}}{T^{0.5}} = \frac{P}{p}$$

$$\text{For face mills } \frac{t^{0.4}}{T^{0.4}} = \frac{P}{p}$$

An inserted blade spiral mill, having the effect of a single tooth, broken up and staggered around the body to reduce shock (first design stellite maxi-cutter spiral mill) gives 4 cu.in. cast iron per horsepower minute, compared with the usual 1½ to 2 for spiral mills with wide spaced teeth and ¾ to 1 for old style fine tooth cutters.

Front Rake on Blades. Very pronounced effect, but can be carried to only about 10 or 15 deg. in practice. Affects power as follows:

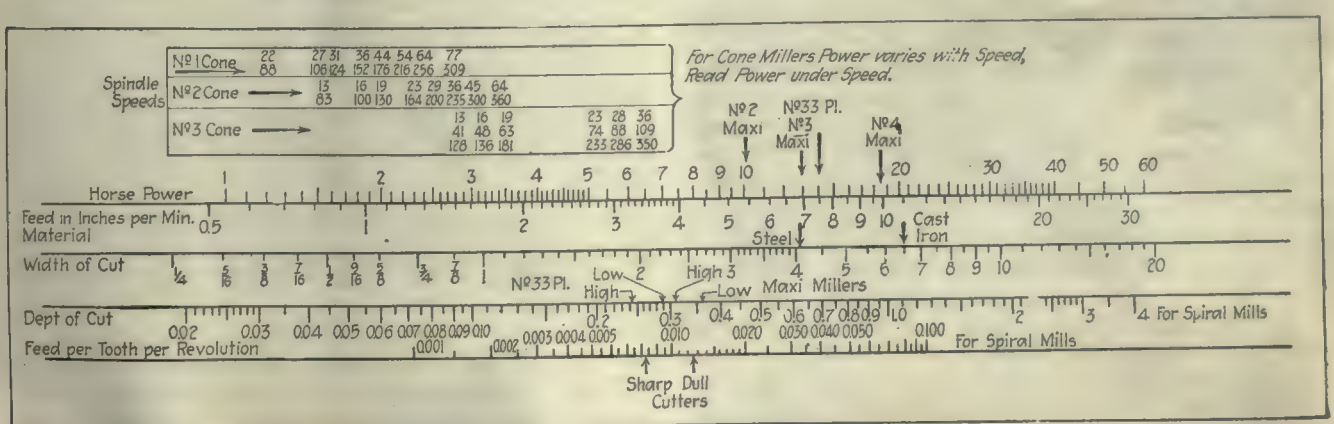
$$\left(\frac{\text{coversin 1}st\text{ rake angle}}{\text{coversin 2}d\text{ rake angle}}\right)^2 = \frac{1st\text{ power}}{2d\text{ power}}.$$

The above gives the following ratio of power required.

For 10 deg. rake, 1.00; for 15 deg. rake, 0.86.

Spiral Angle on Spiral Mills. The main effect of the spiral angle seems to be to reduce the bumping action of the cutter and reduce the strain on the machine and the tendency to chatter due to carrying load.

Judging from the fact that a load suddenly applied has twice the effect of a load applied gradually, it



POWER CONSUMED IN MILLING

appears that the peak of the load at the cutter might be twice as high, or even more, with a mill having straight teeth, and although this variation might be considerably reduced at the belt, due to the flywheel effect of gearing, etc., the best way to overcome it is to give plenty of spiral angle, or in gangs such as gear cutters where this is not possible, stagger the cutter faces so that no two are on one line. A 25-deg. spiral angle seems best, as this minimizes the "bump" and makes it unnecessary to nick the cutter to break the chip.

Cutting Speed. Peripheral speed of cutter seems to have no effect, but r.p.m. of cutter has an effect on power, as noted under *"Feed,"* in that it affects the "Feed per Tooth of Cutter." Other things being equal an increase in r.p.m. of cutter decreases the feed per tooth and increases the power in the following inverse relation:

$$\text{For spiral mills } \left(\frac{r.p.m.}{R.P.M.}\right)^{0.5} = \frac{P}{p}.$$

$$\text{For face mills } \left(\frac{r.p.m.}{R.P.M.}\right)^{0.4} = \frac{P}{p}.$$

Type of Cutter. Other things being equal there seems to be little difference in the power required at the cutter, whether for spiral mill or face mill. There is a difference however, especially noticeable on the smaller feeds and cuts in the belt horse power required for the feed mechanism when using spiral mills, due to the great table pressure set up.

When removing 12 cu. in. of cast iron per minute with a face mill at 8.7 in. feed, the power per cu. in. is almost exactly proportional to that for a spiral mill on a similar cut and feed. On a feed of only 4.4 in. the spiral mill takes more belt power than the face mill. Not enough data is available to state the ratio exactly.

Dulling of Cutter. Apparently very pronounced effect, and probably accounts for some wide variations in tests run thus far, and which are not otherwise accounted for. Not enough data to state ratio exactly, nor have we at present a standard for "dullness."

Conclusions

Conclusions reached are as follows:

(a) From the above it is possible to construct a slide rule showing with fair accuracy the power required for a cut under known conditions, and to determine therefrom which machine it should be run on, or conversely, what changes should be made in the conditions to run it on any given machine.

(b) Further tests will be run under conditions more suitable for establishing the above data exactly.

(c) Well designed cutters running at proper speeds and feeds may remove metal with four to six, or even more, times the economy of poorly designed cutters running at poor speeds and feeds, and still both may be within the limits of usual practice, and the difference in the appearance of the job would excite no comment. For instance on cast iron a cut ¼ x 6 x 4 in. feed = 6 cu. in. per min.

(1) An old style cutter with fine teeth, no front rake and somewhat larger diameter than necessary, might take 12 hp.

(2) A wide-spaced cutter, with 10-deg. rake, as small in diameter as possible, might take 6 hp. for the same spindle speed, or by reducing the r.p.m. to increase the thickness of chip, might take only 5½ hp.

(3) An inserted blade "maxi-cutter" spiral mill, same speed as (2) might take only 2.1 hp. This gives a ratio for (1) and (3) of nearly six to one, while if cutter (1) was dull this would be increased to seven or eight to one.

Not only may power be saved but the machines conserved in about the same proportion.

(d) A preliminary slide rule (see cut) embodying the above has been made up to be later revised according to results of special tests. The results are very satisfactory for spiral mills, somewhat less so for face mills, due probably to a lack of standardization of the corner radius. The table shows results by tests and slide rule over widely varying conditions.

(e) While all the above refers only to power consumed the paragraph "Effect of Dulling of Cutter" shows that it is very important that the useful life of the cutter under various conditions should also be investigated. Some data now available show that this follows laws entirely different from the above, and will require a separate slide rule, which can probably be later combined with the power slide rule to make a "Complete Miller Slide Rule" after the manner of the Barth-Taylor lathe and planer rules.

(f) It should be noted that least power may not mean best cutting conditions, as least power is required, other things being equal, for slowest r.p.m. of cutter, least teeth in cutter and greatest depth of cut (on spiral mills). This may increase the table pressure until the feed drive breaks or may cause poor finish due to large feed per tooth. Evidently the best cutting condition is a compromise on strength of feed drive, finish required, and cutting efficiency, or power.

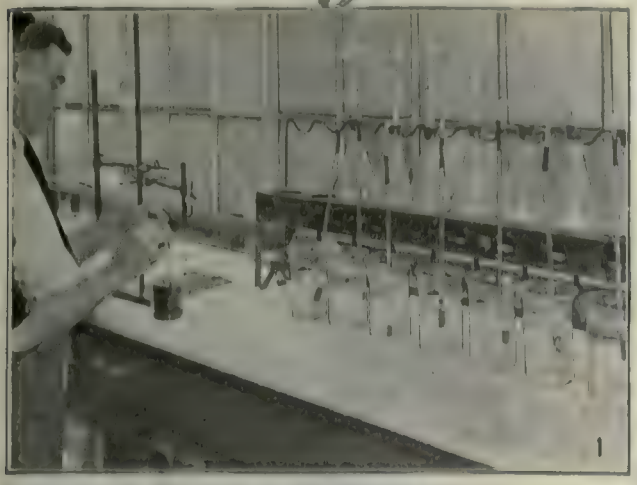
TESTS OF FIRST SLIDE RULE

Material	Machine	Total Hp. by Test	Hp. by Slide Rule
Spiral Mills			
Cast iron	No. 4 Maxi.	14.10	14.20
Cast iron	No. 4 Maxi.	10.50	10.10
Cast iron	No. 4 Maxi.	3.30	3.20
Cast iron	No. 33 Prod.	5.30	5.80
Bar steel	No. 33 Prod.	7.00	10.50
Cast iron	No. 4 Maxi.	21.60	10.50
Cast iron	No. 4 Maxi	5.60	5.40
Cast iron	No. 4 Maxi.	26.50	25.50
Cast iron	No. 4 Maxi.	6.10	6.10
Cast iron	No. 4 Maxi.	9.00	9.20
Cast iron	No. 4 Maxi.	3.75	4.10
Face Mills			
Cast iron	No. 4 Maxi.	3.08	3.35
Cast iron	No. 4 Maxi.	4.30	4.20
Cast iron	No. 33 Prod.	3.60	2.35
Cast iron	No. 33 Prod.	5.70	4.10
Cast iron	No. 4 Maxi.	8.90	7.80
Cast iron	No. 4 Maxi.	6.50	6.30
Cast iron	No. 4 Maxi.	2.50	2.90
Cast iron	No. 4 Maxi.	4.45	4.70

The above have not been especially chosen as corresponding either well or poorly, except that no test is included on which there is reason to doubt the accuracy of the actual horsepower figured from test. A wide variety of speeds, feeds and cuts are represented.

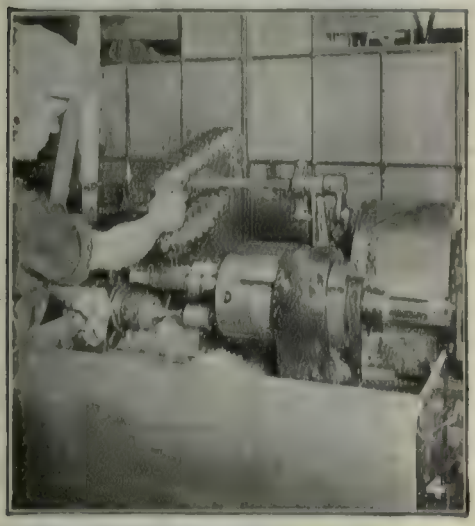
Washington's Pocket Knife a Relic.—One of the unique relics of American history still extant is the sixteen-blade pocket knife which was presented to George Washington by Captain Samuel DeWees in 1784. The knife was recently acquired by George DeWees of Chicago, a descendant of Captain DeWees. It is quite likely that the knife was of Sheffield origin, the best knives coming from there at that period.

Making the Essex Piston Pin





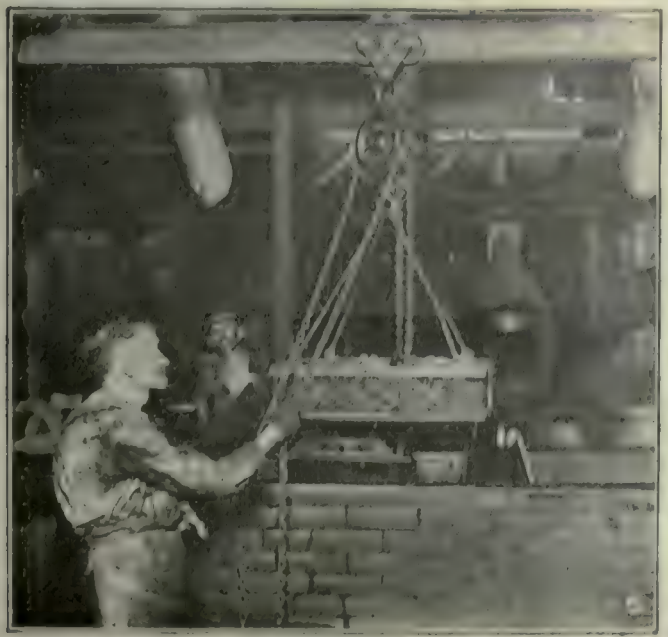




BY FRED H. COLVIN
Editor, *American Machinist*

Few users of automobiles realize the details and the care necessary in producing satisfactory parts for their cars. This article gives a picture story of the making of a piston pin for the Essex motor and cannot fail to impress everyone as to the care taken in motor construction. Very little text is required, the pictures telling their own story to a large extent.



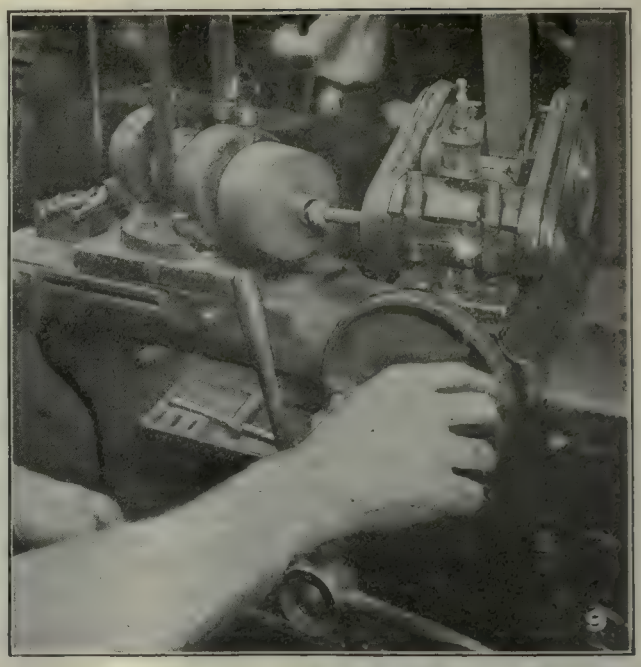




FIGS. 1 TO 7. THESE VIEWS SHOW SOME OF THE FIRST OPERATIONS

Fig. 1.—The Laboratory Analysis. Fig. 2.—The Stock Racks. Fig. 3.—First Screw Machine Operation. Fig. 4.—The Second Operation. Fig. 5.—A Quenching Process. Fig. 6.—Basket for Handling. Fig. 7.—Sandblasting Machine.



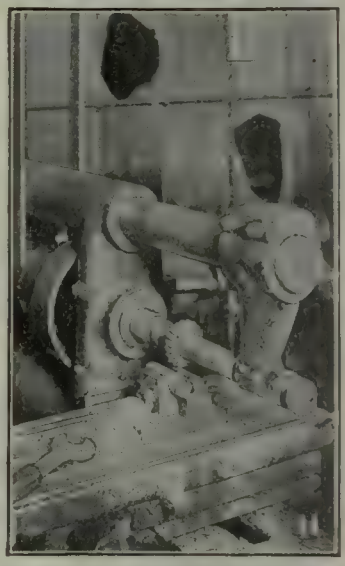




BEGINNING with the laboratory analysis of the steel to be used, Fig. 1, the accepted steel goes to the storage rack shown in Fig. 2, and is taken from here to the first screw machine operation as in Fig. 3, where a National-Acme multiple-spindle automatic is facing, drilling, turning and cutting off.

The second operation is done in a single-spindle Cleveland automatic with the magazine feed as shown in Fig. 4.

Then come the various heat-treating operations as shown in Figs. 5 to 8. These operations include heating and quenching, sandblasting and washing in a hot bath. The handling apparatus for this is rather unusual and interesting, as it consists of three arms mounted on a central post, the arms being equipped with air hoists so as to raise and lower the cradle when it is swung into position over the tank of hot liquid.







FIGS. 8 TO 13. HEAT-TREATING, GRINDING, AND TURNING OPERATIONS

Fig. 8—Handling in hot bath. Fig. 9—Grinding bevel in ends. Fig. 10—Finish-turning. Fig. 11—Grooving for clamp bolt. Fig. 12—Filling with sand. Fig. 13—Packing for carbonizing.



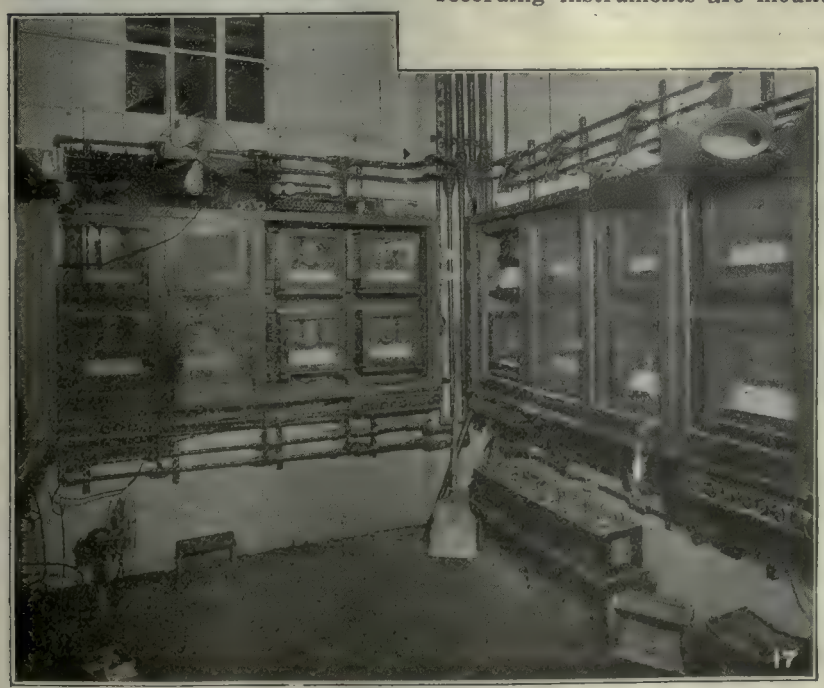




Then the machining operations begin once more, the end of the hole being beveled on a grinding machine so as to insure its running true in finish turning, as in Fig. 10.

Next comes the milling of the groove for the cross screw for the clamping bolt, after which the pins are pack-hardened. The hardening operations are shown in Figs. 12 to 17. They include filling the center of the pins with sand, Fig. 12, and packing in carbonizing material as in Fig. 13. Fig. 14 shows the method of handling the carbonizing boxes, which makes it much easier for the men and saves them from close contact with the heat of the furnaces. The heating and quenching after the pack-hardening are shown in Figs. 15 and 16, while Fig. 17 shows a corner of the pyrometer room, where numerous Leeds and Northrup recording instruments are mounted.



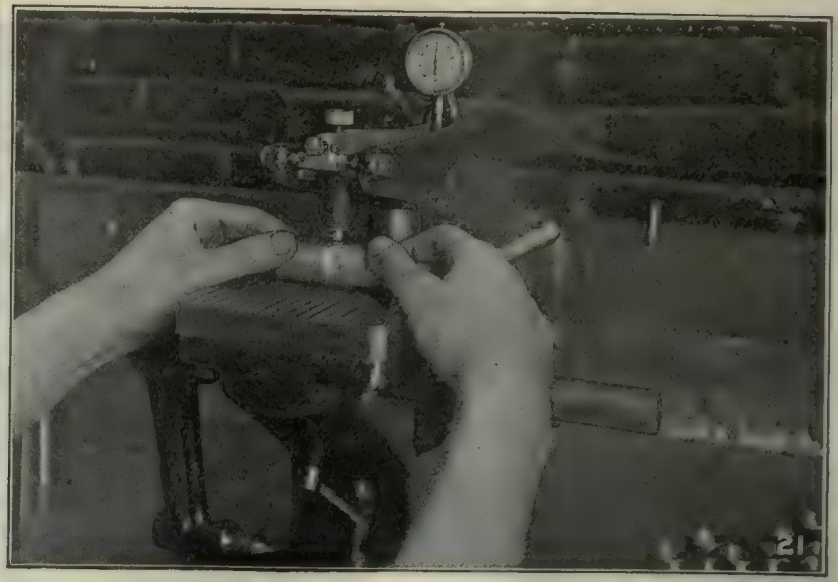


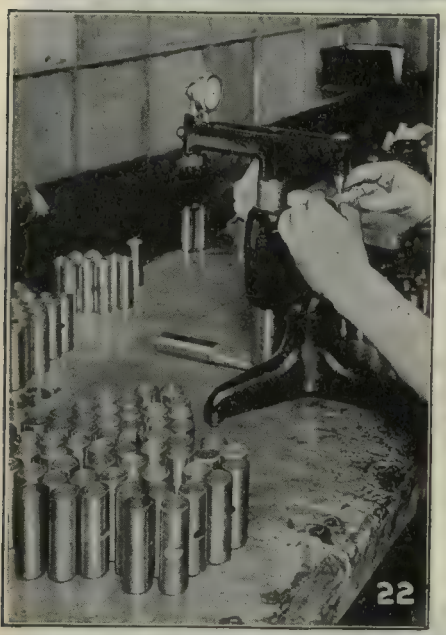


FIGS. 14 TO 19. HEAT-TREATING, TESTING AND GRINDING

Fig. 14.—The Charging Machine. Fig. 15.—The Tempering Bath. Fig. 16.—Agitated Cooling Bath. Fig. 17.—The Pyrometer Room. Fig. 18.—The Brinell Test. Fig. 19.—Grinding the Groove.

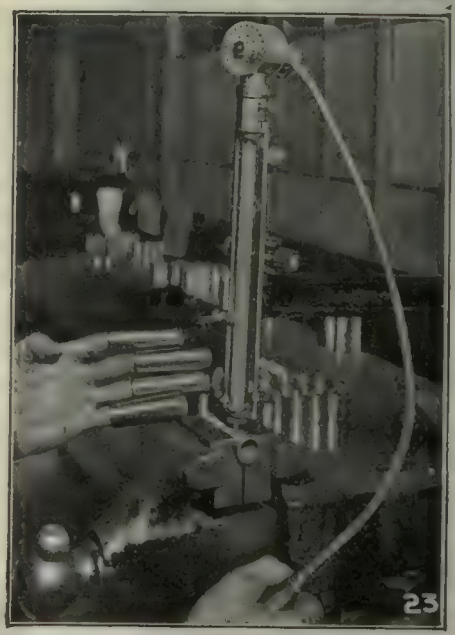


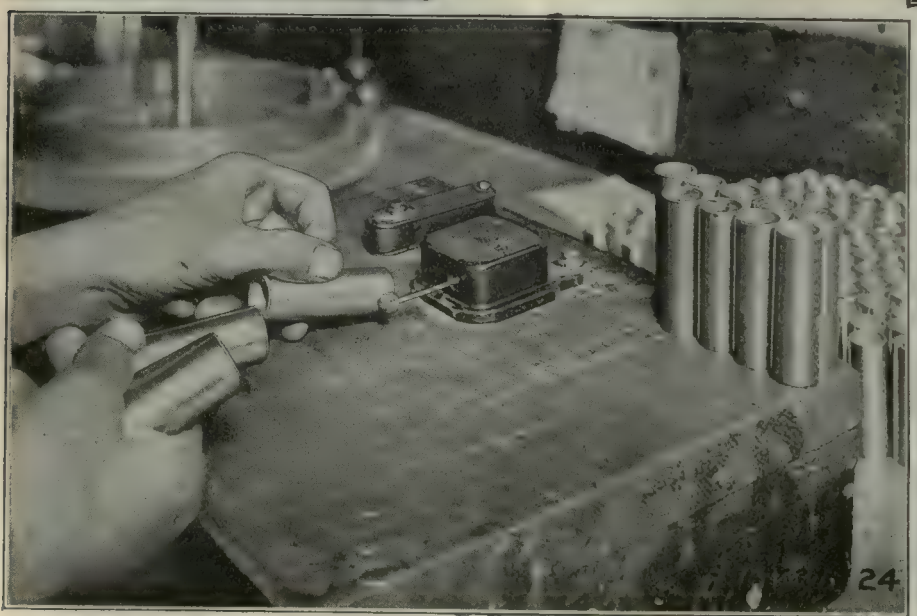


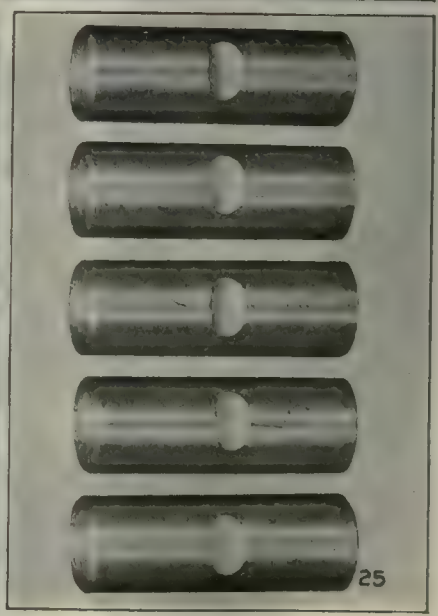


Next comes the Brinell hardness test in Fig. 18, grinding the groove in Fig. 19 and the finishing of the outside by grinding in Fig. 20. Inspections by two types of gaging instruments are shown in Figs. 21 and 22, multiplying levers being used, in both cases to secure extra fine measurements. Fig. 23 shows the scleroscope test with the pin held in special vise jaws, so as to insure uniform testing conditions.

Lastly the pin is tested for fire cracks by means of the electric vibrator shown in Fig. 24. A cracked pin gives out a very different sound from one which is perfect in every particular. Fig. 25 shows the finished pins.







FIGS. 20 TO 25. THE REMAINING OPERATIONS

Fig. 20.—Grinding the Outside. Fig. 21.—Gaging the Diameter. Fig. 22.—Another Multiplying Dial Gage. Fig. 23.—The Scleroscope Test. Fig. 24.—The Bell Test for Cracks. Fig. 25.—The Finished Pins.

Broaching Gas-Engine Tappet-Guide Holes

By J. V. HUNTER
Western Editor, *American Machinist*

A change in the finish-machining methods for tappet-guide holes in gas-engine cylinder blocks is being brought about by the introduction of a method of broaching in machines especially designed for this purpose.

SEVERAL conditions to be met with in the manufacture of cylinder blocks have combined to make the method of finishing tappet-guide holes by broaching preferable to that of reaming, and it is stated that the results obtained have been very satisfactory to the engine builder.

By the older method the operations included drilling, roughing and finish-reaming the holes, the rough reaming operations being necessitated by the close limits required as well as to save wear on the high-speed reamers used for the last cut.

For broaching, the holes are first drilled and rough-reamed and the final broaching operation finishes the holes to very close limits of accuracy. The limits of finish allowed are usually plus 0.001 in. and minus 0.000 in., or a total variation of 0.001 in.

Some engine builders claim that in finishing a hole of this character by reaming that the hole will be out of round as much as 0.001 in., even under average conditions. It is stated that by the use of round broaches where all of the cutting edges are engaged throughout the length of the cut, the concentricity of the holes will be maintained.

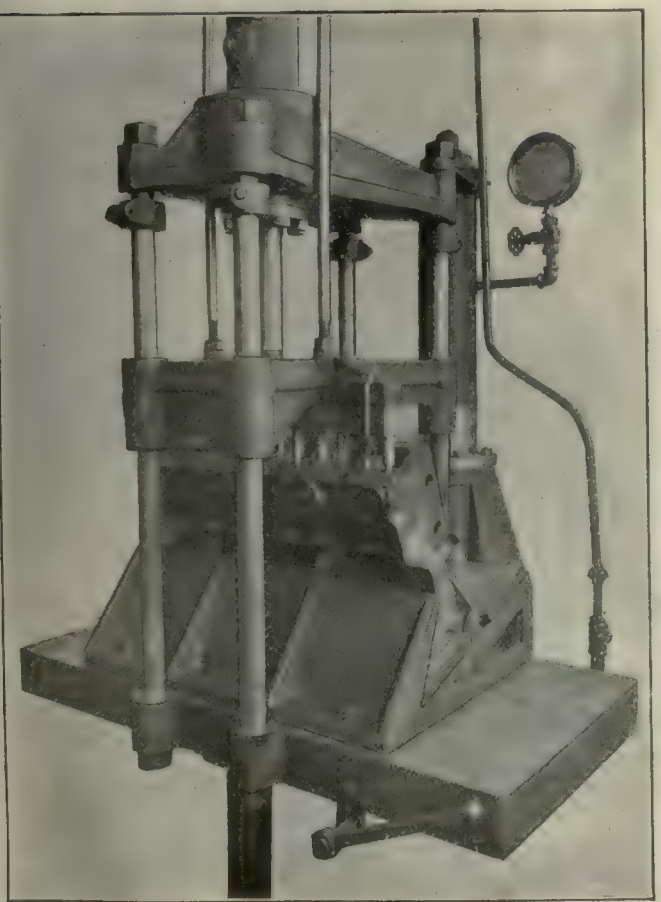


FIG. 1. CYLINDER BLOCK IN BROACHING POSITION

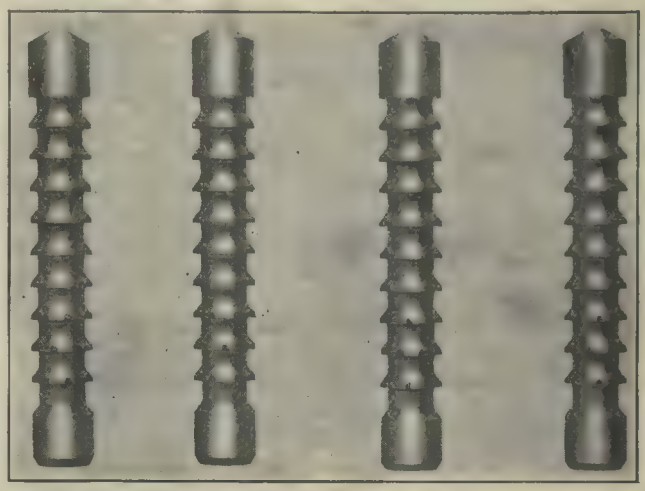


FIG. 2. TYPE OF BROACHES USED

The broaches are made to close limits and their ability to hold them with a minimum cost for tool upkeep is one of their greatest advantages. The average cost of broaches is stated to run about one-tenth the cost of reamers for the same amount of work and same grade of workmanship.

Therefore we find three claims advanced in advocacy of the broaching method, namely: First, accuracy and concentricity of the hole; second, extensive reductions in the tool upkeep cost; third, a slight saving in the time of the actual machining operation.

In the modern engine-building shop the cylinder blocks are transported on conveyor tracks to the broaching machines and then located in correct position relative to ram of the machine by suitable stops. The ram carries a broach head of a length sufficient to cover all of the tappet guide holes in the block, although it is customary to only broach the alternate holes, that is to handle six broaches at a time on a six cylinder engine block which will have twelve tappet-guide holes. However, this method is subject to some change and when broaching cylinder blocks in which the tappets are not evenly spaced, it is sometimes necessary to finish all the holes at the same time. A cylinder block in position underneath a broaching machine is shown in Fig. 1.

The broaches, Fig. 2, are used as loose tools and are dropped into each alternate tappet hole before lowering the broach-head. Upon conclusion of the ram's stroke the tools drop through into an oil pan underneath the machine, and for the remaining holes the operator uses a duplicate set of tools while his helper picks up those first used and cleans them. The cleaning is done by passing them rapidly between a pair of brushes which are attached to a block so that the brushes face one another. It is advisable to always have the broach tools well cleaned of chips.

The time for completely broaching a six-cylinder block in two strokes of the machine will be about one minute from floor to floor. This should be the average

time required, but of course, like all manufacturing operations, it varies somewhat with the ability of the individual operator.

The stroke of the ram is carefully regulated by speed valves which control the rate of flow of the liquid into the ram cylinder so as to obtain a uniform feed of the broach. However, this rate of feed is not dependent upon the operator, but is governed entirely by automatic valves. For the average grade of cylinder iron it has been found preferable to have the feed range from 12 to 16 ft. per minute, since this rate of feed has been found to give the best surface finish in the hole.

The condition of the finished surface of the metal is considered to be one of the points of advantage of broached holes, as it is claimed that the grain of the iron is closed by the formation of a hardened or burnished surface.

To accentuate this skin-coat effect it is sometimes the practice to make up the broaches with the last two or three rings left without cutting edges for burnishing, usually making them about 0.0003 in. larger in diameter than the cutting rings, so that they exert a slightly increased pressure when passing through the hole.

The best practice in desiging broaches requires that the annular cutting rings be ground with an established cutting angle of 1½ deg. and a clearance angle usually not less than 6 deg. nor more than 7½ deg. The lands do not exceed $\frac{1}{32}$ in. in width. Various grades of steel have been used for these tools, the preference depending entirely upon the individual shop. Some use high-speed steel, others high-carbon steel and still others are making them of a low-carbon steel and giving them a heavy "case" by the carbonizing process.

Drill Jig for Exhaust Manifold

By Fred H. Colvin

The illustrations show a somewhat unusual form of roll-over jig used for drilling the bolt holes in the flanges of the exhaust pipes for a Pierce-Arrow six-cylinder motor. This consists primarily of the body *A* having the disks *BB* at the ends, and carrying plates *CC* for centering the manifold at each end. The flanges of the manifold are placed face down in the fixture and the plates *DD* pushed over the flanges which are then bolted down by the bolts at *EE*. The drilling bushings are in the body of the jig, the holes in the holding plates *D* simply allowing the drills to pass through. The side outlet is drilled at *F*.

The details of this fixture can be seen in the three views in Fig. 2, the cross-sections being shown at the end.

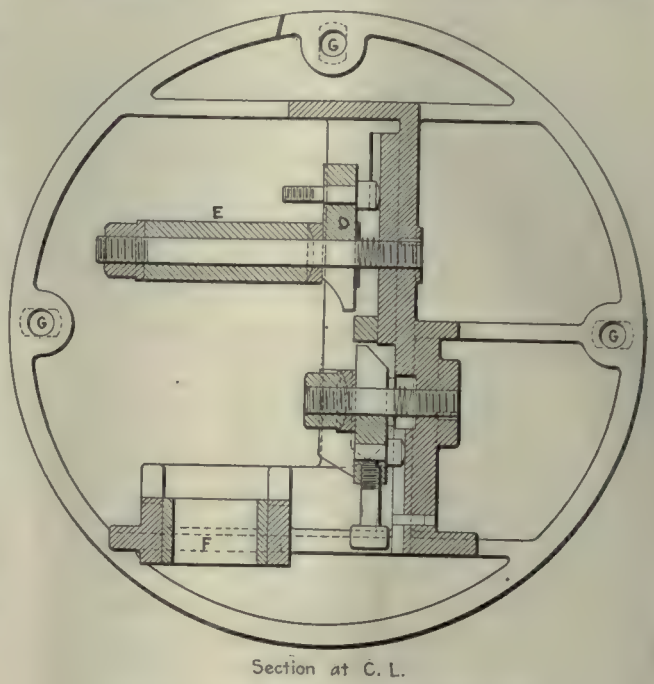


FIG. 3. CROSS-SECTION OF FIXTURE

In order to bring the work to be drilled in the proper position, the disks at the ends of the fixture rest on the rollers *RR* in Figs. 1 and 3, which are mounted on the rod shown in the base provided for the fixture. These rollers allow the work to be easily turned into the

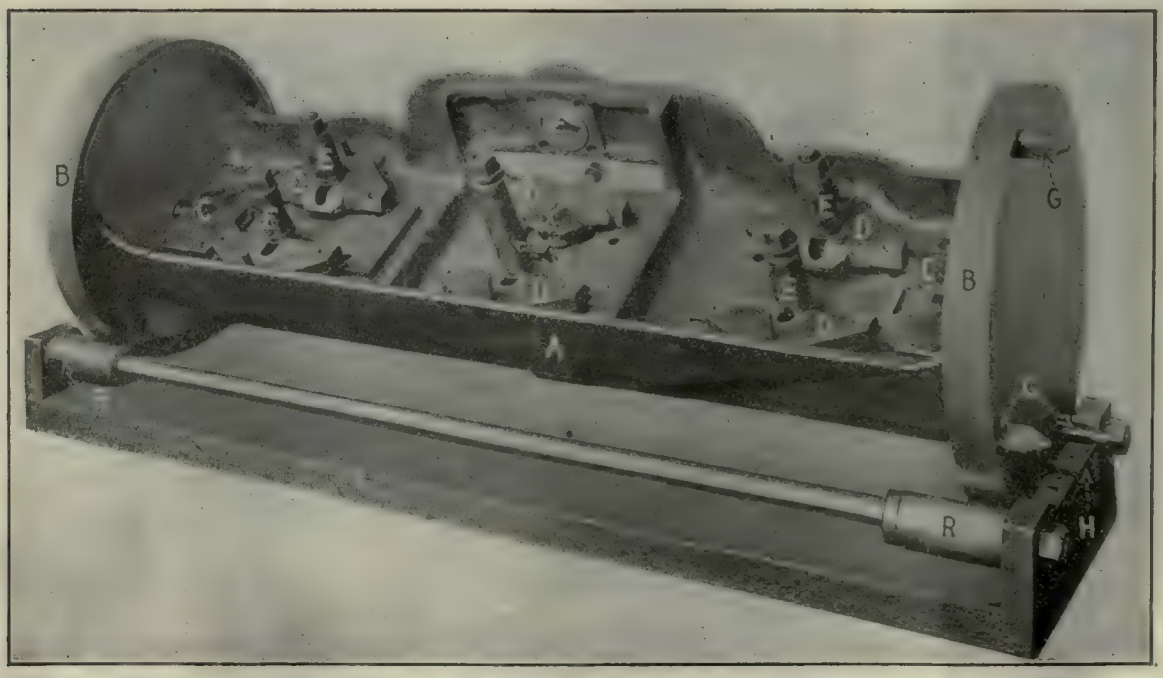


FIG. 1. A LARGE ROLL-OVER DRILLING FIXTURE

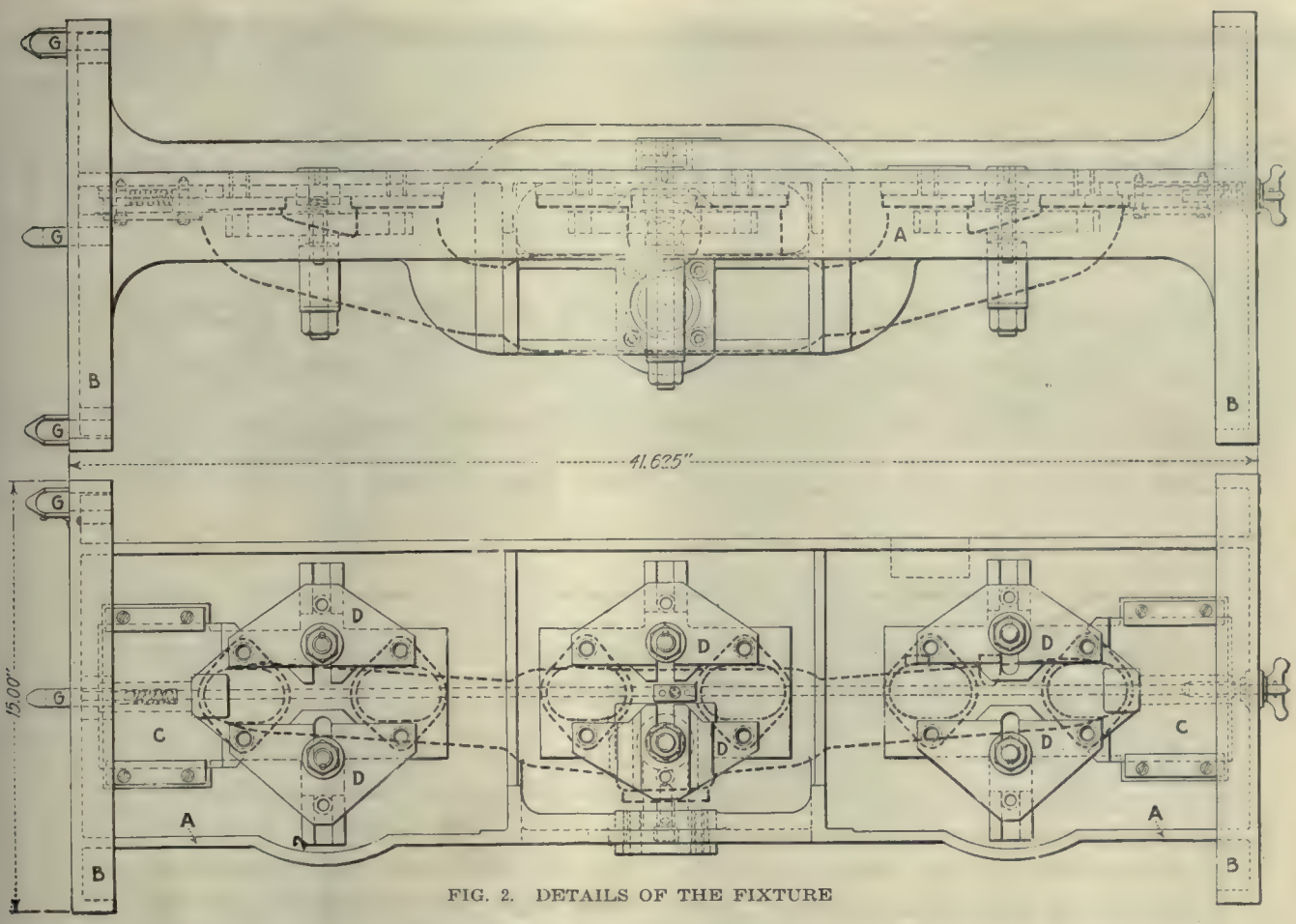


FIG. 2. DETAILS OF THE FIXTURE

desired position, while the three stops *G* afford a ready means of indexing by sliding them into the slot *H* at the end of the base. In order to make this easily handled, the rolls allow the whole fixture to be moved endwise with very little effort, thus engaging the indexing pins. The work is then turned to the desired position and the next stop slid into the opening *H*, which holds it very firmly during the drilling operation. The illustration gives the general proportions and sufficient detail to allow any desired modification to be made.

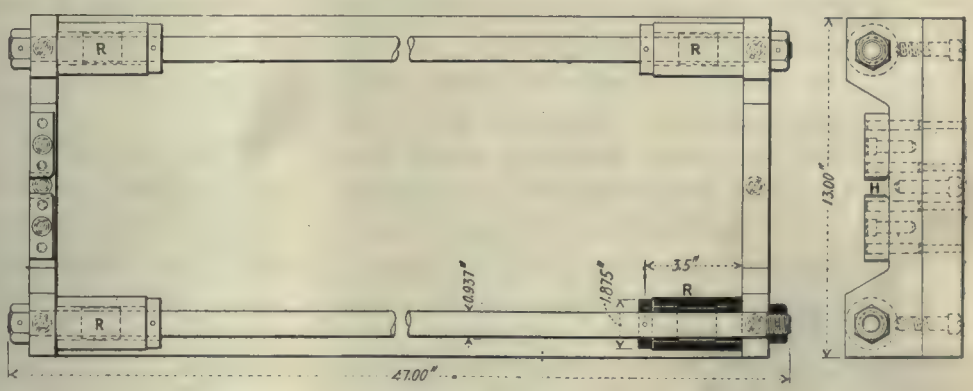


FIG. 4. THE BASE ON WHICH IT ROLLS

How to Keep Employees on the Job in Summer Time

By Charles D. Folsom, Jr.

The use of a bonus for keeping up attendance in the summer months was described on page 1365, vol. 52, of the *American Machinist*, by Frank H. Williams. Here is another method of meeting the problem, which is in use in the plant of Victor R. Browning &•Co., at College Point, N. Y.

Incidentally this was the idea of the employees themselves; they requested it by a petition, and the plan was put into effect at the beginning of June. It is planned to continue it throughout July and August. The shop had been working on the conventional forty-eight-hour week schedule, viz., 7:30 to 12:00, 12:45 to 5:00 and 7:30 to 12:00 on Saturdays. Realizing that, as Mr. Williams says, "Too frequently the Saturday half-holiday becomes an all-day holiday during the summer months . . .," the men desired to let it go at that by changing to a five-day week. The hours are now 7:00 to 12:00 and 12:30 to 5:00, making forty-seven and a half hours per week. This makes a rather long day, but nobody seems to notice the extra half-hour's work in the morning or the quarter hour less for lunch, so much as the half-day on Saturday.

There was, quite naturally, a little trouble at first with late-comers in the morning, but on the whole the new schedule operates smoothly. It appears to have solved the summer attendance problem satisfactorily to both the employees and the management, and without adding any additional burden to the company's payroll.

Card Report from Washington

This report was sent to us July 29, by Paul Wooton, our Washington correspondent. It certainly is encouraging, but our readers should not forget that the fight is not over, and that we must make such

"Space is at a premium in the office building of the House of Representatives. The already limited floor space assigned to the Committee on Coinage, Weights and Measures is being further restricted by the steady encroachment of the *American Machinist* cards asking that the Committee take no action to make the metric system compulsory. All of the cards received are being carefully preserved. Thus far they have been accorded shelving space but since they are about to monopolize all of the Committee's shelf room, other arrangements are in contemplation which will preserve the cards and have them readily available for inspection.

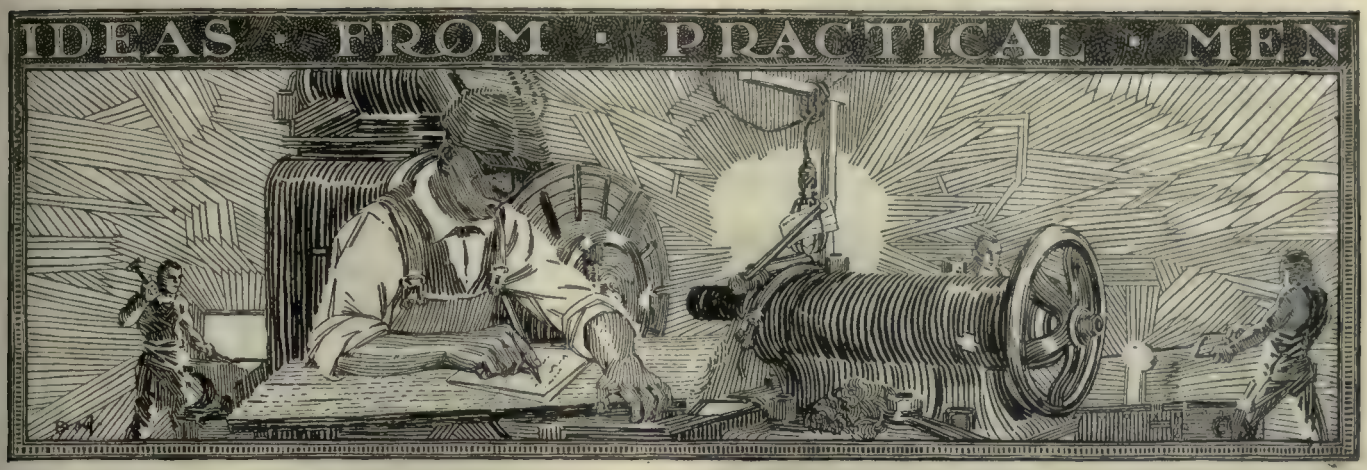
One of the significant features in connection with the receipt of the cards is their contrast with the insignificant number of communications which are reaching the office at the suggestion of those who desire to see the metric system foisted upon the country.

While the number of cards being received has decreased considerably since Congress adjourned, they are still being received at the rate of about thirty per day."

an overwhelming showing that the pro-metric advocates will be completely buried. For this reason send for more cards. They are absolutely free.

Thos. Viall

Editor



Portable Electric Reboring Machine

By C. W. Geiger

A portable electric reboring machine, designed by Arthur S. Bacon, of Oakland, California, is shown in Fig. 1. It is claimed that by means of this machine 70 per cent of open-head automobile and tractor engine cylinders can be rebored without removing them from the block, and that any size cylinder can be handled.

The machine consists of base *A*, tapered centering cone *B*, boring head *C*, boring bar *D*, driving motor *E*, and flexible cable *F*. In preparation for boring, the base is set over the cylinder with the clamping bolts loose, the tapered centering cone is inserted and the base bolts tightened. The centering cone is then removed and the boring head and boring bar, with tool previously set for the cut, are placed in position on the base and tightened by four bolts. Roughing and finishing cuts are taken by different tools, each held in its own head. The base is centered with the bore by means of the centering cone. Four sizes of cones are furnished to care for the various sizes of the bore. With the base in position the boring head when applied is automatically centered with the base through a male and female joint.

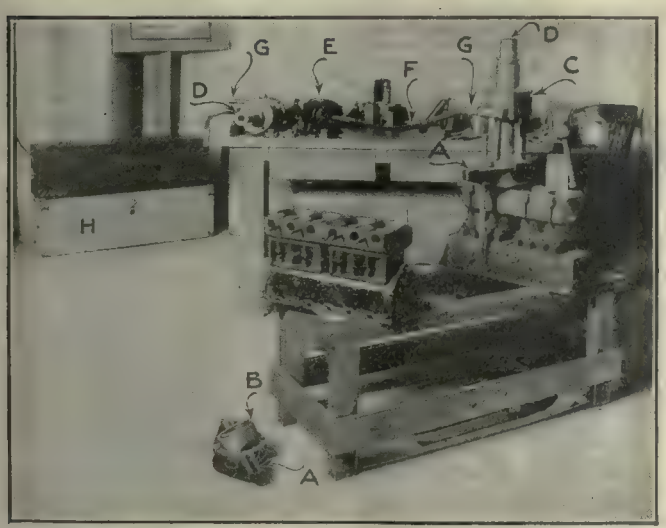


FIG. 1. PORTABLE ELECTRIC REBORING MACHINE

The driving motor receives its power from any light socket. It is one-sixth horsepower, runs at 1,710 r.p.m. and operates the boring bar at a speed of 60 r.p.m. through a 7-ply wire flexible cable which is enclosed within a leather tube. The cable is connected to a completely encased worm gear on the boring head at *G* (Fig. 1) and may be withdrawn from it instantly and as quickly replaced. The motor is set on the floor or bench, as there is no necessity to anchor it.



FIG. 2. INTERCHANGEABLE HEADS WITH ROUGHING AND FINISHING TOOLS

The cut can be started at either top or bottom, a simple feeding arrangement being provided to feed in either direction, with feeds from 0.0083 in. to 0.0666 in. per revolution. The feed knockout is automatic.

The detachable cutter-heads with roughing and finishing tools are shown in Fig. 2. They are secured to the boring bar by two screws and a dowel pin. The tools are set by using the special micrometer, shown in Fig. 3, which is a part of the equipment of the machine. There is also a special chart for use in connection with the micrometer in setting the tools.

Some of the great advantages claimed for the machine are that it is not necessary to employ a skilled mechanic to operate it, the only skill required in addition to that necessary to grind and set the tools being the ability to use and read a micrometer; that on account of its light weight of 57 lb. it can be easily handled by one man; and that the entire equipment fits into a compact box such as the maker's shipping case shown at *H*, Fig. 1.



FIG. 3. SPECIAL MICROMETER FOR SETTING TOOLS

New Use for the Photostat

By Eward W. Theilig

In order to preserve a record of a special valve a photostatic print was made as shown in Fig. 1. The photostat was made full size and was then tacked down on the drawing board and the sectional drawing, Fig. 2, made with a minimum of labor and practically no measuring of the parts. The resulting tracing is all that can be desired as a matter of record, and the time required for its production was perhaps ⅒ of that which would have been required to lay out the parts in detail.

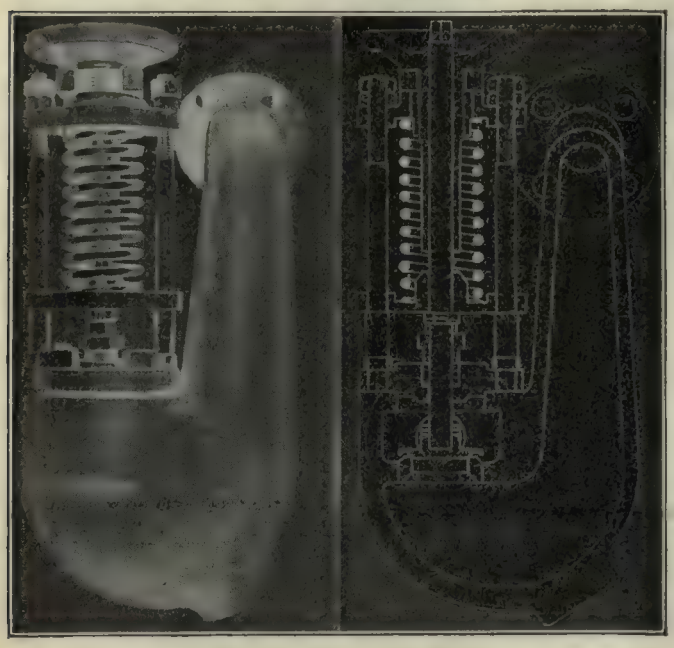
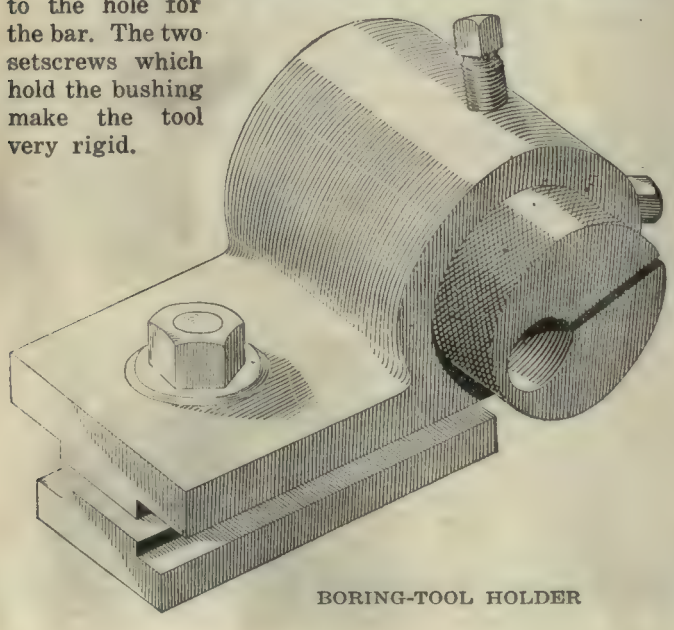


FIG. 1. PHOTOSTAT OF VALVE
FIG. 2. TRACING MADE FROM PHOTOSTATIC PRINT

Adjustable Boring-Bar Holder

By Joseph B. Murray

The illustration shows a boring-bar holder that can be adjusted for height by turning the eccentric bushing. The housing is of cast iron, the bushing is steel, split to the hole for the bar. The two setscrews which hold the bushing make the tool very rigid.



BORING-TOOL HOLDER

Grinding a Radius on a Gage

By Richard F. Moore

In making the gage shown in Fig. 1, it was necessary to figure out some way to grind the radius accurately.

As there were five gages on the order, I gave up the idea that first came to my mind of soldering them on to a plug or cylinder and made the fixture shown in Fig. 2. The V-blocks were already on hand. I finished the gage on every surface except the two ends, leaving about 0.006 in. on these. This eliminated the necessity of working to a dimension when grinding the radius. After the radius was finished the dimensions *A* and *B* Fig. 1 were ground to size. Fig. 2 shows the job set up in the grinding machine. The gage is brought central with the plug by figuring what dimension *C* Fig. 2 should be.

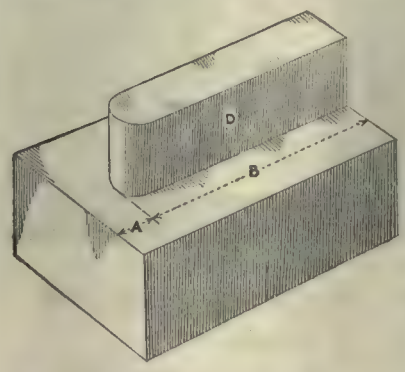


FIG. 1. THE GAGE TO BE GROUND

For example:

diameter of plug = 0.875 in.
Thickness of gage = 0.364 in.
0.511 ÷ 2
0.2555 in. size to make *C*.

The stops allow the plug to revolve just 180 deg. bringing the faces *D* parallel with the table.

After clamping a gage in position the fixture is placed on the magnetic chuck of a surface grinding machine with the long way of the block parallel with the cross feed. The fixture is then brought central with the spindle of the machine and the part to be ground put under the grinding wheel.

The wheel is then lowered until it begins to cut. Then the plug is turned backward and forward (by hand) and the feeding of the wheel continued until the wheel is the correct distance above the center line to give the required radius.

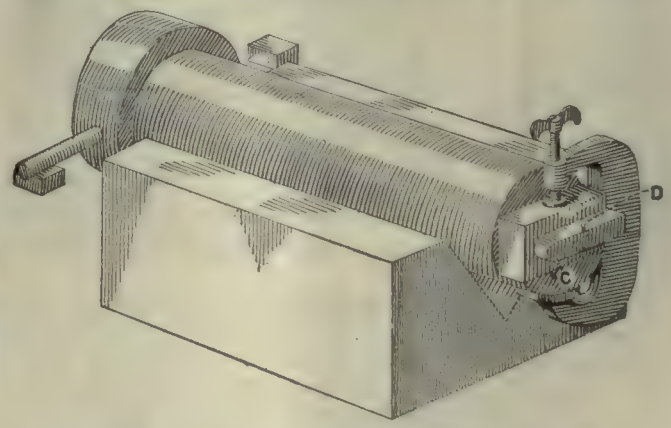


FIG. 2. METHOD OF MOUNTING THE GAGE FOR GRINDING

I used quite a hard wheel and dressed it often to keep the face square as the cross feed was not used after the fixture was located.

WHAT to READ —for the man in a hurry



Suggested by the Managing Editor

"MACHINING the Gear-Shaper Saddle" is the leading article. It is by Douglas T. Hamilton of the Fellows Gear Shaper Co. The author says that the saddle, next to the index wheel and worms, requires the most accurate machining. He then tells about the machining methods from the first operation, that of snagging and smoothing down the casting with a portable grinding machine, to the final operations of testing.

There has probably been much thought concerning the possibilities of successfully using steel belts; little, however, has been written. "An Experimental Investigation of Steel Belting" is the title of a paper by F. G. Hampton, C. F. Leh and W. E. Helmick, of Stanford University. The article goes into detail and it has been necessary to divide it into two parts, the second of which will appear in a later issue. Part I begins on page 298. Student and Junior prizes were awarded to the authors of this paper at the annual meeting of the American Society of Mechanical Engineers, held Dec. 2 to 5, 1919, in New York.

Every manufacturer, whether on a large or small scale, should know the exact quality of the goods he produces. Such a knowledge is secured from some form of inspection, though not always recognized as such. When the output is comparatively great, an independent department of inspection is necessary. "No inspection department that is not a paying unit of the whole organization can be considered a success," says O. B. Whittaker in "Inspection and the Modern Factory," page 305. He continues: "The great variety of ways in which inspection brings about a saving requires the closest study of each individual case . . . The cost of incorrect fulfillment of a contract on deliveries, or the indirect damage done by the delivery of a faulty product, can never be fully determined." As a reciprocal statement, neither can the value of prompt deliveries and faith of the customer be accurately estimated. Some very good points are brought out by the author.

H. H. Manchester's twelfth installment on the "Evolution of the Workshop" is up to the usual interest standard of this series. The current article deals with the development which took place in the metal-working industries of Great Britain during the period between 1820 and 1870. One of the author's quotations serves very well to convey the spirit of the article: "Lathes are now made in . . . . Europe that will turn with ease a mass of fifty tons in weight, or as many feet in length; planing machines that will bring to truth and flatness surfaces of 40 x 10 or 12 ft. . . . steam hammers of twenty tons and upwards, falling twelve feet, whose blow at a distance is felt as that of an earthquake." Page 311.

What to read was not a difficult matter to decide two hundred years ago when books were few and magazines unheard of. It is far different now when so much reading matter is offered to pass the time pleasantly or profitably as the reader chooses. We are doing our utmost to make the "American Machinist" not only profitable but indispensable as a clearing house of ideas and news of the machinery world. This page is the editors' advertisement of their section of the paper. It gives the high spots.

There is an interesting treatise by Fred. A. Parsons, Chief Engineer of the Kempsmith Manufacturing Co. on "Power Consumed in Milling." The experiments which furnish the basis of this report were undertaken to secure data for the construction of a slide rule by which could be determined the power required for a given job. One of the author's conclusions is that: "Well designed cutters running at proper speeds and feeds may remove metal with four or six, or even more, times the economy of poorly designed cutters running at poor speeds and feeds, and still both may be within the limits of usual practice and the difference in the appearances of the jobs would excite no comment." Page 315.

Another of Fred Colvin's automotive articles is given —page 317—dealing with "Making the Essex Piston Pin." It is a story presented by 25 half-tones and some 300 words—easily, but profitably, read.

Western Editor Hunter takes up the broaching method of finishing tappet-guide holes in gas-engine cylinder blocks. He presents the details of this method and compares them with those of the older method of reaming. He also has some things to say regarding the design of the broaches and their cost when compared to that of reamers. The article begins on page 321.

"Card Report from Washington" is the heading Editor Viall used for his editorial on page 324. He might equally well have written "News from the Front." Yes, the news is "good" but won't you take his advice and help to make it "splendid."

EDITORIALS

Encouraging Reports of Increased Production

THE publication by the Manufacturers Association of letters showing an increase in production in their factories is encouraging, whatever the cause. It is the sign of a tendency to return to normal conditions which can be interpreted in various ways. But is it not natural that it should be so?

The unreal and unnatural conditions of the war, the talk of fabulous profits and the great demand for labor, all tended to cause a decrease in effort as a natural reaction.

There is every reason to believe that production will continue to increase, particularly in places where the management is making an earnest effort to promote a better understanding with its men. For such efforts must come from the top, they can hardly start in any other way. Exaggerated ideas of profits too often exist because no effort has been made to let the men know the facts in the case.

As one manufacturer in the great Northwest remarked, "we have shown our men too little of our ledgers and too much of our limousines" so that it is but natural that ideas as to profits should be somewhat out of proportion to the facts in many cases. Nor must we overlook the fact that abnormal profits have been made in many cases, as shown by published statements of dividends, both in cash and in stock. That these all have their effect is admitted by all who study the situation carefully.

The trend of the letters quoted is to credit the increased production to specific items such as piece work, open shop, etc. Observations of specially successful shops, however, do not point to any one panacea for our industrial ills. Good and bad shops can be found using practically the same systems. One uses piece work and bonus with great success. Another has secured almost identical results with straight day work and no bonus of any kind.

We all know of shops without any apparent system which get along without difficulty, and of others with elaborate systems which fail completely because of a lack of confidence and harmony.

The average man in the shop and the average manager are both square and mean to play the game fairly, as they see it. The point of view is too often warped by lack of knowledge and understanding of the problems of the other side. The sooner we make a determined effort to get together, to see what the problems really are and to face them fairly, the sooner will we get back to normal production—and beyond. But pressure or coercion on either side will not accomplish the desired result.

It may appear to win for a time, but resentment remains and prevents any real harmony. An armed truce, with either side waiting for an opportune time to attack, is not conducive of the kind of co-operation which makes for increased production.

Now that the tide of production has started to flow in the proper direction let us encourage it by such sane and helpful methods as will increase confidence in the claim that the interests of both men and management are the same. Let us show that both sides are getting a fair share of the value of the product and so refute all claims to the contrary.

F. H. C.

Technical Press or Engineering Society?

HOW far should the engineering society go in collecting actual shop data and methods for the benefit of its members? Aside from the matter of standards, which is admittedly an engineering question, how much of such material can be handled by an engineering society to better advantage than it is now handled by the trade and technical press?

In connection with the Production Session at the spring meeting of the Society of Automotive Engineers, a circular letter was sent out to a selected list. This letter asked how the society could best aid in the solution of industrial problems.

Two of the answers are worthy of attention. One of them makes the following suggestion: "Compile data with regard to manufacturing methods used in production of automobile, truck and tractor parts. This data to include type of machines used, kind of fixtures, tool equipment, details of motion and time studies and the quantity produced in a certain time."

The other recommends "the establishment of a bureau or clearing house for troubles that pertain to the automotive industry and for outlines of machine operations, machines, tools and fixtures that have proved successful for some particular job. * * * this would eliminate one manufacturer going over the same ground with the same idea that has been proved inefficient."

A combination of these two recommendations will give a very fair statement of the policy of the *American Machinist* toward the whole machine industry and not only the automotive branch of it. If they had been written after a careful reading of this and other technical papers, we would have very little to say, but we do not believe that this is the case.

We have only to refer to the comparative automotive shop practice articles which have been running for the last few months to give one instance of the presentation of exactly the type of material suggested. Our contention is that the trade paper is the proper medium for the supplying of this sort of information. This is not to be interpreted as any sort of a reflection on any one of our great national engineering societies, for we have a lively appreciation of the value of the work they are doing.

It is simply to indicate our feeling that our staff of shop experts, trained to secure and prepare just such data, can handle the material in question at least as well and more expeditiously.

K. H. C.

Legislators vs. Manufacturers and Engineers

EVERY once in awhile some man or group of men, with more enthusiasm than practical knowledge, attempts to regulate, or change by law, certain conditions in the industrial field. They half guess at a situation, multiply this by two, and proceed to pursuade some affable, or gullible, legislator to introduce a "reform" bill of some sort.

As an example of such procedure, we again call attention to the attempts of the "World Standardization Council" alias the "World Trade Club," etc., etc., to "reform" our measuring system and force through a compulsory metric law.

No one with the slightest knowledge of our domestic and foreign trade industrial conditions would ever seriously attempt such a thing. To pass any law affecting industrial conditions, fostered only by enthusiastic theorists, would be the height of folly. We have frequently urged the need of successful engineers and business men in Congress in order to prevent foolish legislation and to introduce constructive legislation. However, any attempt to change our present system of measurement should never be started from the legislative end. If any change or standardization is necessary, the proper way to begin is to have the great engineering societies and manufacturing associations work the problems out in conjunction. When so worked out the results will FIT industrial conditions and will need no law to enforce their adoption.

A shining example of engineers and manufacturers working hand and hand to bring about desirable standardization is that of the Society of Automotive Engineers. No legislation has been, or ever will be, needed to bring about the adoption of the standards decided upon by the special committees of this society. Proposed standards are thrashed out in conferences of practical production men and a tremendous amount of constructive standardization of automotive parts and accessories has been brought about.

There is no doubt that certain standards should be incorporated in our present system of measurement in order to bring about greater uniformity in units used by the English speaking nations—and which, if adopted by them, the rest of the world would quickly follow.

However, such standardization has its logical starting point with manufacturers and engineers and NOT with legislators. E. V.

Workers to the Rescue

A SPECIAL dispatch to one of the New York daily papers a few days ago said that the 11,000 employees of the Philadelphia Rapid Transit Co. have offered their combined savings of more than $500,000 to President Thomas E. Mitten, as a loan without interest to be used to tide the company over financial difficulties. Not only this, but they offered their future savings and agreed to forego collecting the increase in wages (automatically due them at this time) until Mr. Mitten shall have found sufficient financial backing to carry on his fight against interests that are opposing his policy of not increasing the fares. While the majority of the board have upheld Mr. Mitten, unfortunately, the few who disagreed and resigned from the board were the financial backers of the company.

Why have the employees of such a great street-railway system come to its rescue? Do they not belong to a union—a very great union? Does their union teach actions such as they are credited with? Would Sam Gompers et al have advised them to take such a step? Have they done this for fear the company might be forced into bankruptcy and they would lose their jobs?

The reason for this fine and loyal action on the part of the 11,000 employees of the Philadelphia Rapid Transit Co. is a very simple one. It is because Thomas E. Mitten has at all times been absolutely *fair* with them and has always laid all his cards on the table, face upward.

Mr. Mitten came to the Philadelphia Rapid Transit Co. at a time when the efficiency of the system was at a very low ebb and was suffering the after effects of a costly and disastrous strike—at a time when many predicted that it was more in need of an undertaker than a doctor—and behold the results. Mr. Mitten by fair dealing made his men loyal to him and a leader with loyal men to back him can do almost anything.

We do not think this case should be without a parallel —or many parallels. We are believers in the American workingmen and we believe that if all of them were treated as Mr. Mitten has treated his men, all opposition to employers would cease and strikes would no longer be prevalent.

All honor to the 11,000 loyal employees of the Philadelphia Rapid Transit Co.—"They have builded better than they knew."

S. A. H.

Factory Bulletins That Count

THE Factory Bulletin in the June, 1920, issue of the *Wigwam*, the house publication of the Spreckles "Savage" Tire Co., contains the following pertinent and helpful paragraphs:

Notice of Leaving

Do not wait until the last minute to give notice of leaving. If you are thinking of leaving, talk the matter over with your foreman. Leave a good feeling behind. You may want to come back some time.

Kicks

Any employee having kicks or complaints make them within the four walls of the plant.

It often does good to kick in the plant to the proper authority. It never does any good to kick outside. Put your kicks in the form of suggestions and drop them into the suggestion box.

Don't Dodge Responsibility

Dodging responsibility is a senseless habit that started way back in the Garden of Eden when Adam blamed Eve for tempting him to eat the apple and Eve in turn blamed the serpent. If mistakes have been made, be honest and manly about it. Admit your part and the part your men have in making them. It saves long arguments and puts you in the right light.

Increased Salaries

The young man who would be successful should remember one special thing. Make yourself responsible for something—responsibility is what counts.

You will find that a business will give you back just what you put into it. The cash in advance idea does not prevail in any business any more than in life. The code letters for increased salaries are "C. O. D."

F. H. C.

What Other Editors Think

A Transportation Experiment

From *Iron Age*

THE Transportation Act of Feb. 28, 1920, was less than three months old when an experiment on a very large scale was begun under it. With the new powers granted it by the act, the Interstate Commerce Commission is endeavoring to effect the movement of the commodities that most affect the public and to reduce a traffic congestion that has been throttling manufacturing and commerce generally. This is an experiment of the most vital importance.

For years we have been wondering what we ought to do with our railroads. After much discussion the new transportation law was enacted, and the act has been very generally approved. If conditions do not prove satisfactory, the experiment of Government operation can hardly be avoided. The present transportation act, in the opinion of men who have followed the subject closely, provides the only trial that can be expected of private ownership and operation of the railroads. All developments in this trial, therefore, are to be watched with the greatest interest.

The Interstate Commerce Commission's present effort to improve traffic conditions was undertaken after leading railroad executives had asked the commission to act, but the new law gives the commission the power to act without such request. The language of the law regarding car service rules, routing, etc., is: "Whenever the commission is of opinion that shortage of equipment, congestion of traffic, or other emergency requiring immediate action exists" it may proceed at once, being answerable to no one, and money penalties are designated for failure of carriers to obey orders.

The commission has its own observers in the field, it has the advice of railroad executives, and it is in close touch with shipping interests and their traffic managers, who are able to give important information and advice. Thus the experiment is a crucial one, and if there is failure, no fresh experiment of this general character can be proposed.

The shippers of the country wish the Interstate Commerce Commission success in this operation and entertain definite expectations that sufficient improvement in traffic conditions will result to make it clear that the powers provided by the transportation act are useful. Success of the experiment as an experiment does not require that the traffic congestion be ended entirely, but that a reasonable improvement be seen.

If these efforts succeed, the success will show that strikes by railroad operatives cannot be as effective with the new transportation act in force as they would have been under former conditions. That would be a separate and distinct advantage in the matter of strikes being avoided, apart from the requirement of Section 301, that "it shall be the duty of all carriers, and their officers, employees and agents, to exert every reasonable effort and adopt every available means to avoid any interruption to the operation of any carrier growing out of any dispute between the carrier and the employees or subordinate officials thereof."

The amount of idleness of workmen at the present time is such as justify expectations that a noticeable change in the mental attitude of labor generally will be produced. For a long time, the job has sought the man, and workmen all seemed convinced that they need have no care for themselves, that wages would always be offered for any degree of performance they chose to offer. And the complaint has been heard several times lately that the iron and steel industry has not helped in its taking into employment numbers of the striking railroad workers. These last are without strike benefits and without a voice in the councils of the Railroad Labor Board. In each of several industrial centers, tens of thousands of men are idle as a result of the railroad strike, while there are various separate strikes, many of which do not promise results satisfactory to the men. In some quarters, it has been urged for months past that labor needs "the rest cure" through there being a period of industrial inactivity. Such a cure is now being taken by not a few men and were it a case of a little leaven leavening the whole loaf, the results, as to more efficient and enthusiastic labor performance in future, would not be in doubt.

The Alien Influence

From the *Cincinnati Enquirer*

SHOULD someone have the time and the Joblike patience needed to investigate the countless instances of trouble that rise between employer and employee he would find that in a surprising number of cases the dissension is due not to the general dissatisfaction of the men themselves but to the fomenting efforts of an outsider.

Left to themselves a group of men almost invariably will take sincere action to settle disputes through the only fair and sane medium, arbitration. It is the professional organizer, the paid agitator, the so-called walking delegate, who skillfully plays upon the sympathies of the men, kneads them into a milling crowd and finally prevails upon them to scoff at the quiet measures of the council table.

Most of all to be regretted is that the organizer, sent more often than not from a central office of a union for the express purpose of stirring up dissent, knows all too little about the local conditions to which the men are subjected. He knows nothing of their needs or of those of their employer. He is ignorant of the humor of the public, that mighty force, and neither has he adequate knowledge of its needs. He has founded on a commercial basis for his own personal advantage the art of trouble making.

That American citizens will submit indefinitely to having such parasitical producers of nothing but upheaval gain their livelihood at the expense of the public weal is a false assumption. They are of no use to society. They tear down. Like a destructive fire, they should be extinguished.

SHOP EQUIPMENT NEWS

-Edited by-
S. A. HAND

SHOP EQUIPMENT • NEWS •
A weekly review of modern designs and equipment

Descriptions of shop equipment in this section constitute editorial service for which there is no charge. To be eligible for presentation, the article must not have been on the market more than six months and must not have been advertised in this or any previous issue. Owing to the news character of these descriptions it will be impossible to submit them to the manufacturer for approval.

• CONDENSED • CLIPPING INDEX
A continuous record of modern designs and equipment

Falcon Pipe and Fitting Wrench

J. H. Williams & Co., Brooklyn, N. Y., has added to its line the Falcon wrench shown in the illustration. The wrench has a wide range of application and is particularly adapted for work on pipe fittings. The curved jaw is solid across the center but has open ends, the face resembling somewhat the letter H. It is claimed that this design affords several advantages, among which are that the open end will straddle the corner of an awkward fitting, while the solid center may be used as a thin flange, and that the solid, one-piece jaw cannot spread.

The curved face of the jaw allows an effective grip with three shifts of the chain links and also permits



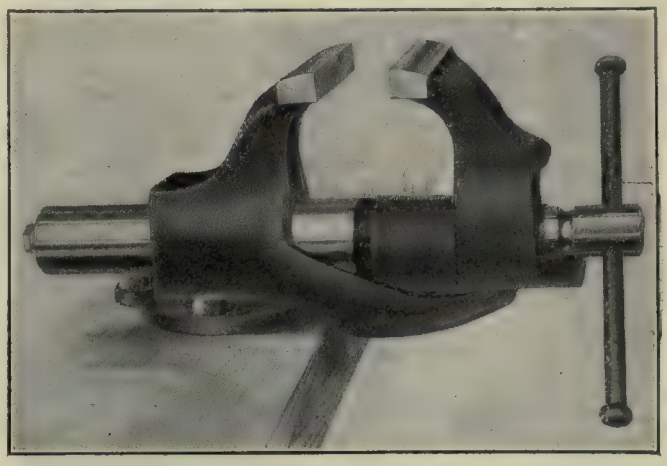
FALCON PIPE AND FITTING WRENCH

work in close quarters, such as connecting radiator pipes. The wrench is designed for one-way operation, consequently there is no chance for confusion when hurried. When the jaw becomes dull its position may be reversed by driving out the holding pin, thus doubling its life. The jaw is made from tool steel and the lever from 0.45 per cent carbon steel. The wrench is made in six sizes, covering all sizes of pipe from ½ to 12 inches.

Soderfors "All-Steel" Vise

The illustration shows a vise made by the Soderfors Bruks, Falun, Sweden, and recently introduced in the United States by V. Lowener, 114 Liberty St., New York City.

The main parts are made of Dannemora special alloy steel, which is claimed to be stronger and tougher than chisel steel. The stationary jaw is an intregal part of the body. The movable-jaw body is round and fits closely in a hole in the main body, insuring parallelism of the jaws. The screw and nut are said to be made of a special long-wearing alloy steel. The vises are made in eight sizes and can be furnished with either

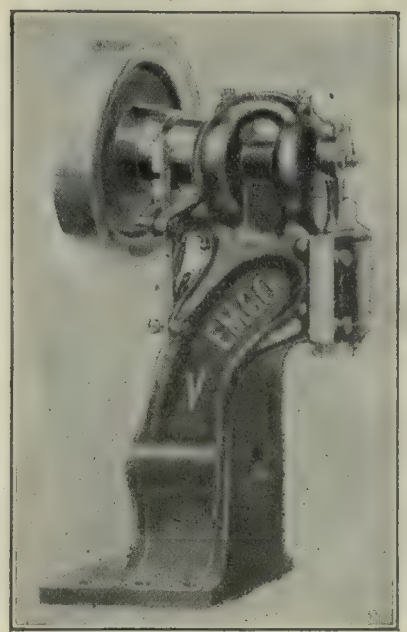


SODERFORS ALL-STEEL VISE

plain or swivel bases. The jaw widths of the various sizes range from 3¼ to 8⅞ in. and the weights with plain base from 11 to 200 lb. With swivel base from 13¼ to 250 pounds.

"Emco" Bench Horn Press

The Enterprise Machinery Co., 30 South Clinton St., Chicago, Ill., has added to its line the bench horn press, shown in the accompanying illustration and known as type "V." The press is intended for rapid production in the assembling of small parts and for operations such as seaming and riveting on hollow work.



"EMCO" TYPE "V" BENCH HORN PRESS

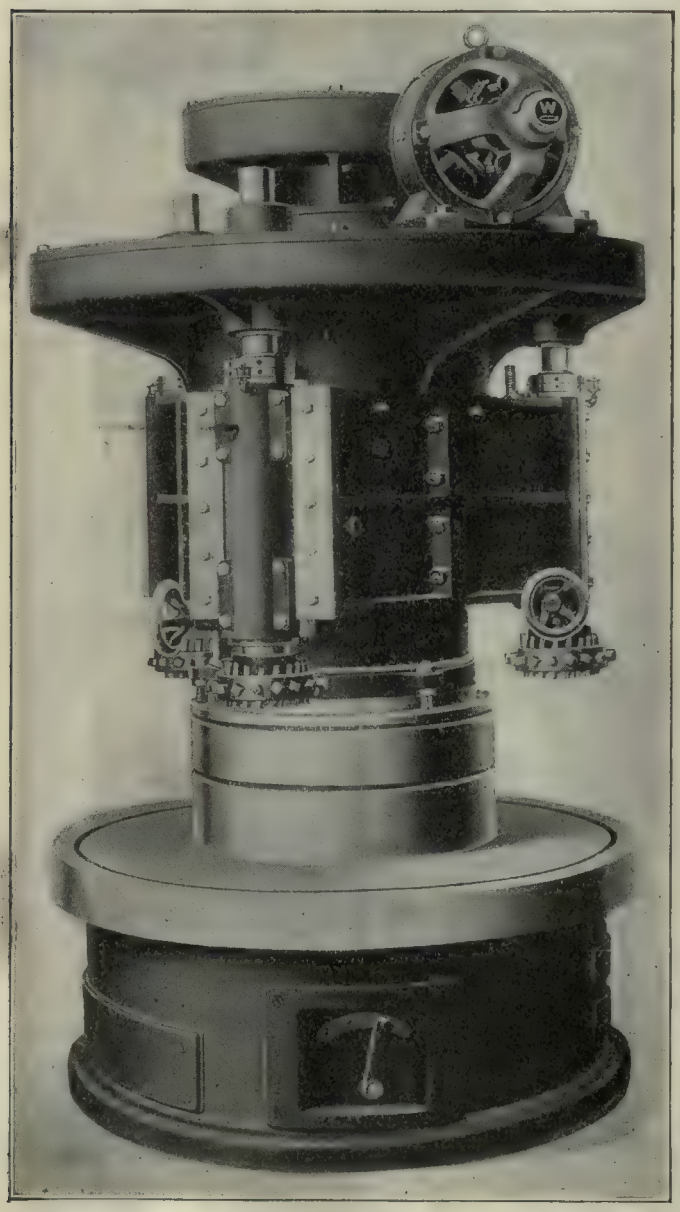
The machine has a single-stop stroke and is made with strokes of ¾, 1¼ and 1¾ in. The ram is 1⅜ in. square and has an adjustment of ½ in. The horn hole is 1⅞ in. diameter. The press is 26 in. high, runs at 300 r.p.m. and weighs 130 lb.

Betts Multiple-Spindle Continuous Vertical Milling Machine

The multiple-spindle continuous vertical milling machine here illustrated is being built by the Betts Machine Co., Rochester, New York. The machine is intended for heavy production milling on duplicate parts and is of simple and rigid construction.

It is provided with three spindles, but can be furnished with additional spindles if required. The four-spindle machine may be fitted with two roughing cutters and two finishing cutters. The spindles are steel forgings, driven through long splines and spur gears, and they may be adjusted vertically by hand. The machine may be driven either from a pulley or by an individual electric motor at the top of the machine.

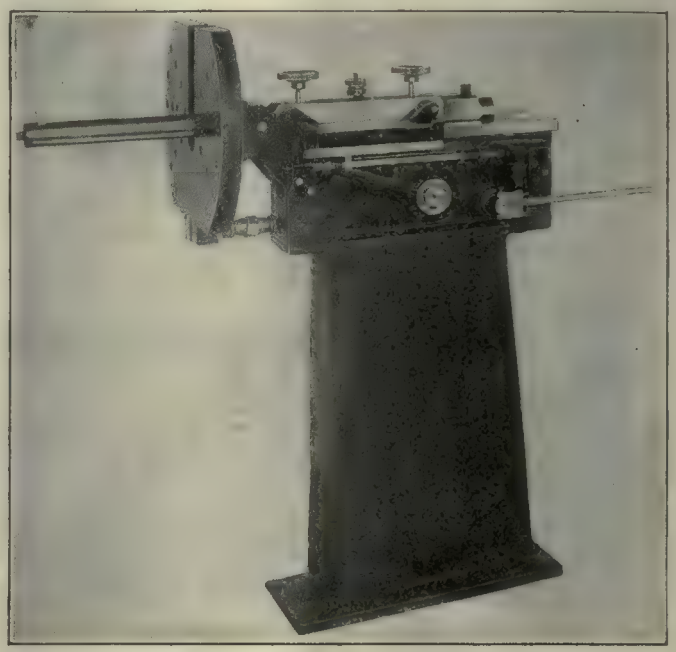
The work-holding fixtures are carried on the continuously revolving table, and the pieces are changed while the fixture is passing from one cutter to the next. The table has a flat bearing on the bed, and a split tapered bushing provides for taking up wear in the bearing on which the table revolves about the column. The table is driven through a large internal gear, all bearings being bronze-bushed and all gears running in oil. Four rates of continuous feed are obtained through sliding steel gears, none of the gears being in mesh except those that are actually transmitting power. It is claimed that one of these machines will take care of as much work as can be conveniently handled by two men, and that the machine has a production capacity three times as great as a single-spindle machine.



BETTS MULTIPLE-SPINDLE CONTINUOUS VERTICAL MILLING MACHINE

Hercules Key-Seating Machine

The accompanying illustration shows a key-seating machine made by the Hercules Manufacturing Co., Portland, Ore. The machine is simply constructed, the crosshead being driven through a rack and pinion. By means of a wood-covered friction disk operating between the two driving pulleys running in opposite directions and engaging them alternately the reversal of motion is accomplished, it being claimed that the action is very smooth. The length of stroke is adjusted by means of the set-collars at the side of the machine, and the motion of the ram can be started, stopped and reversed by means of the lever at the back.



HERCULES KEY-SEATING MACHINE

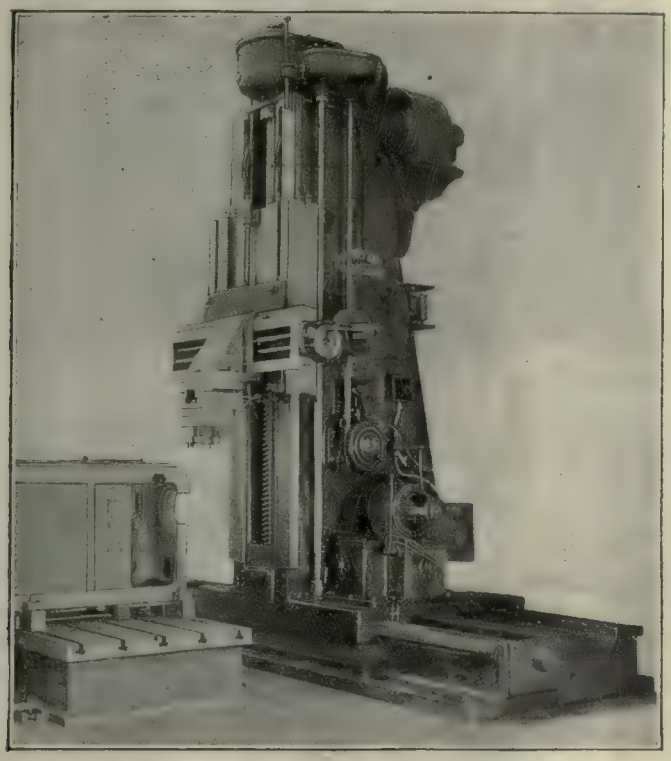
Specifications: Length of stroke, 12½ in. Diameter cutter bar, 2 in. Widest cutter that can be used, 1⅛ in. Diameter of faceplate, 20 in. Driving pulley, 12 in. in diameter; speed, 150-250 r.p.m. Strokes per min., 15. Horsepower required, 2. Net weight, 800 lb.

The work is bolted to the faceplate, which can be tilted if it is desired to cut a taper keyway. The machine cuts on the forward stroke, and the cutter is relieved on the backward stroke through the action of two wedge-shaped blocks in the base of the bar rest.

The two knobs on the top of the machine control the feed, one being operated for cutting upward and the other for cutting downward. The rear end of the cutter bar is bored to hold special cutters. Bars of special size can be furnished. The machine is light enough to be moved up to very heavy work, rather than to move the work.

Newton Portable Slotting Machine

The large portable slotting machine shown in the accompanying illustration has recently been brought out by the Newton Machine Tool Works, Inc., 23rd and Vine Sts., Philadelphia, Pa. The machine consists of an upright mounted on a sub-base and carrying a tool suitably mounted on a saddle that reciprocates vertically.



NEWTON LARGE PORTABLE SLOTTING MACHINE

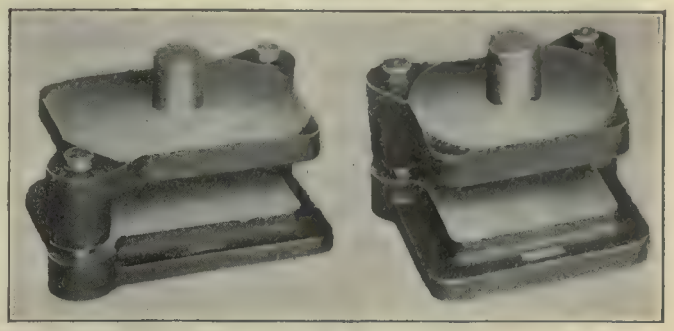
The saddle is counter-balanced and has a maximum stroke of 76 in. The tool slide has a crossfeed of 40 in. and an in-and-out feed of 6 in., both actuated by power. The tool slide has, also, a vertical adjustment on the saddle of 24 inches. The toolholder is hinged, so as to relieve the cutter on the up stroke, and the tool apron can be swiveled through a full circle for angular cutting. The crossfeed of the upright on the sub-base is 84 in., it being driven by a separate 7½-hp. motor that can be engaged by means of friction clutches controlled by a hand lever.

The traverse of the saddle is operated by a coarse-pitch, large-diameter screw running in a one-piece bronze nut.

The screw is driven by a 15-hp. reversing planer-type motor mounted at the top of the upright, the driving gears being fully inclosed. The screw is so fitted with roller thrust bearings at both top and bottom that it acts always in tension. In order to prevent jamming, a clutch is provided which disengages when the saddle reaches the top or bottom of its travel. Dogs for reversing the motion of the saddle are mounted on a rod on the side of the machine.

U. S. Sub-Press

The U. S. Tool Co., Inc., 51-53 Lawrence St., Newark, N. J., manufactures sub-presses of the type shown in the illustration. Special sub-presses are built to suit particular jobs, and stock ones are carried in a range of platen sizes from 2 x 3 in. to 6 x 8 in.



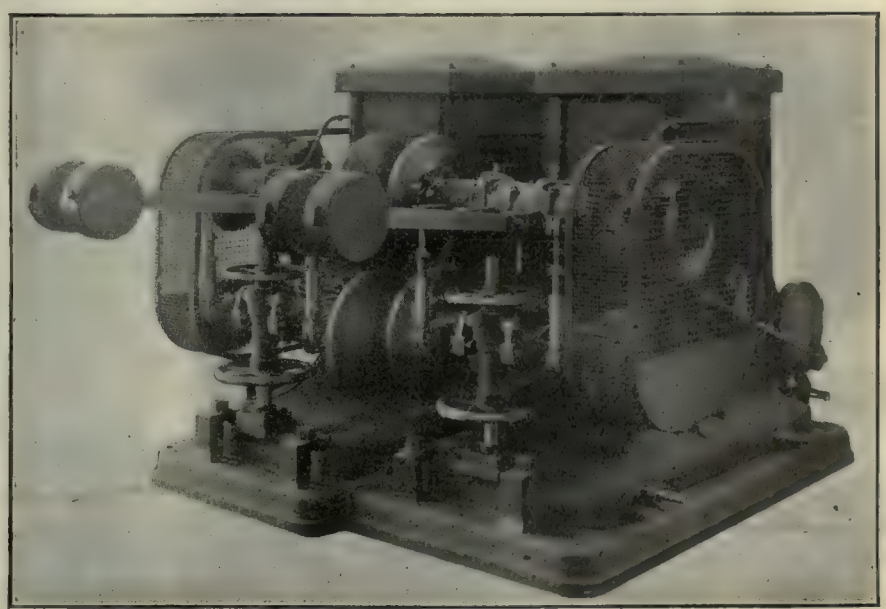
U. S. SUB-PRESSES

Federal Automatic Spot Welder for Channels

The machine shown was made by the Federal Machine and Welder Co., Warren, Ohio, for spot welding two rolled steel channels together to form an I-beam. It is capable of welding two spots at a time on two pieces of material ¼ in. thick, at the rate of 60 welds per min. The two welding transformers are for 220 volts primary, and are air cooled. Four copper disks are used for welding contacts. These are securely bolted to bronze shafts to insure good electrical connections. The secondaries of the welding transformers are connected to the brass bearings of these shafts, completing the welding circuit.

The welding current is controlled by auto transformers in the primary circuit in eight equal steps from 65 per cent to full line voltage.

The welding disks can be adjusted to handle from 4 to 16 in. channels. Simultaneous spot welds from 4 to 12 in. apart may be made. A variable speed motor is used to control the feeding of the work through the machine at from 25 to 60 ft. per min.

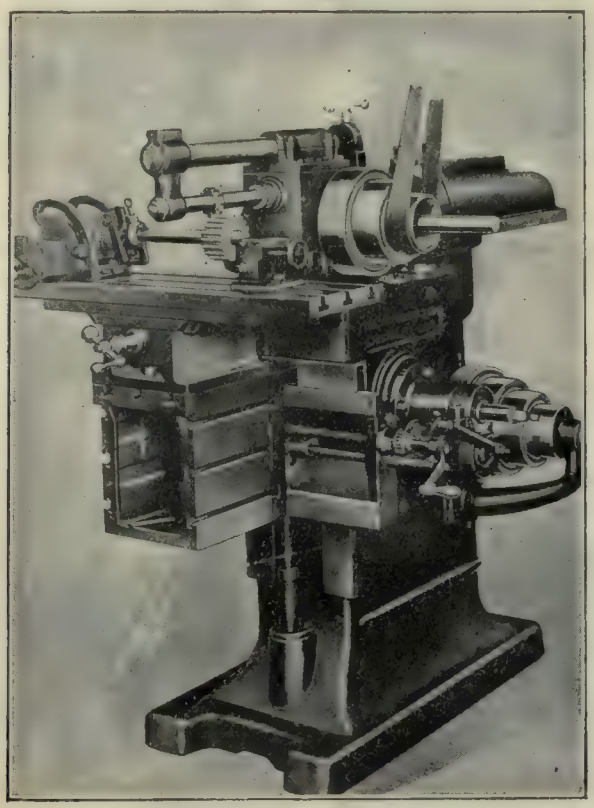


FEDERAL CHANNEL WELDING MACHINE

Tri-State Milling Attachment

The Tri-State Milling Machine Co., Memphis, Tenn., has brought out the milling attachment for shapers shown in the illustration herewith.

The spindle is worm driven and is supported by a substantial overarm. The attachment is intended to be mounted in the shaper ram-way, the ram being moved back out of the way. All parts shown on the shaper, except the dividing head and the tailstock, are



TRI-STATE MILLING ATTACHMENT MOUNTED ON SHAPER

Specifications: Cone pulley steps, 4, 6, 8 and 10 in. Bearings, taper bronze, adjustable. Drive, hardened worm and gear, running in oil. Spindle: hollow, 1⅞ in. diameter; hole, No. 4 Morse taper; nose threaded for chuck. Table, 3 ft. long; mounted on swivel base. Cross feed, 7 inches.

part of the regular equipment. Size and make of shaper on which the attachment is to be used should be given when ordering. One arbor is furnished with the attachment.

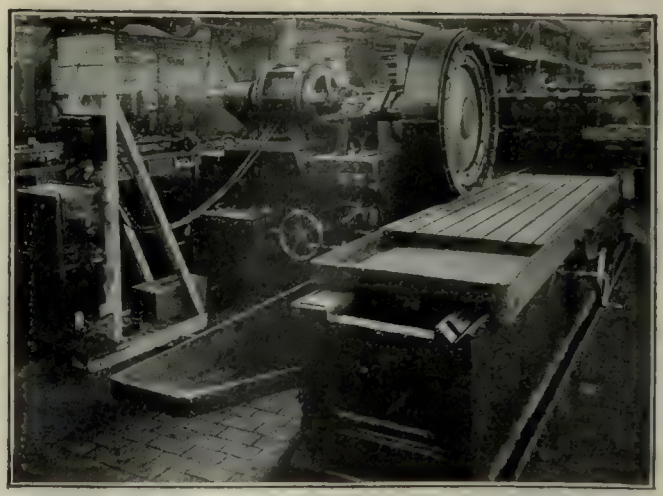
Diamond 54-In. Extra-Heavy-Duty Face-Grinding Machine

The Diamond Machine Co., 9 Codding St., Providence, R. I., has brought out the extra-heavy-duty face-grinding machine shown in the accompanying illustration.

This machine is intended for heavier and larger work than any machines heretofore built of this type and was designed for grinding the bases of multiple-spindle drilling machines.

A sectional-type grinding wheel is used consisting of a number of abrasive blocks held in a chuck.

One of the features of the machine is the provision made for handling the coolant. The tank is of large area so that the necessary volume of coolant is of moderate depth. This arrangement facilitates the settling of sediment so that clean coolant is returned to the circulating system.



DIAMOND 54-IN. EXTRA-HEAVY-DUTY FACE-GRINDING MACHINE

Specifications: Spindle, 9 in. diameter. Grinding wheel, 54 in. diameter. Platen: width, 36 in.; longitudinal travel, 134 in. Speeds of table, 12, 17, 22, 28 ft. per min. Speed of grinding wheel, 324 r.p.m. Feeds, 0.002 to 0.020 in. per stroke of table. Motor, 100 hp. Approximate weight boxed for shipment, including motor, 35,000 lb.

Two sets of centralized controls are provided so that the machine can be operated from either position.

The drive is by a motor mounted on the grinding-wheel head, from which power is delivered to the spindle through a Morse silent chain.

International Toolrack

The International Purchasing Bureau, 203 East 15th St., New York City, has placed on the market a handy toolrack of the type shown. The trays are made of cast iron and are arranged to swivel. The small round tray at the top is intended for micrometers, etc.



INTERNATIONAL TOOLRACK

Testing Strength of Oxyacetylene Welded Pipe

At the big gas show at Buffalo, in the course of informal discussion on oxy-acetylene welding of oil pipe lines, a Kansan questioned the strength of the welded line to hold up under the service pressures in his field. What he wanted was a breaking pressure test to determine just where the welded pipe would give way under breaking strains. In his opinion the break would occur in the weld.

The discussion was staged, as it happened, in a stronghold of oxyacetylene welding. One of the factories and machine shops of the Linde Air Products Co. is located in Buffalo and in its Buffalo laboratory the Linde engineers welded together two short sections of standard 3-in. iron pipe, threaded the ends and screwed on two standard cast-iron caps. When the cold water pressure test was applied to the breaking point, the top of one of the caps blew out, leaving the pipe and weld intact. The undamaged cap and the remaining portion of the broken cap were then removed and two extra heavy iron caps were screwed on. At a pressure of 6,200 lb. per sq.in. one of these caps let go, still without injury to the weld or the pipe. Again the uninjured cap and remnant of the broken one were taken off and extra heavy steel caps screwed on. This time the caps held, but the pipe split and ripped under the added pressure upon passing the elastic limit, tearing up to, and being effectually stopped by, the weld which refused to give.

The next test was made with 4-in. pipe. Two lengths were welded together, the ends threaded and two extra heavy standard caps screwed on. In this test one of the cap heads blew out at 4,400 lb., as shown in the illustration, which gave a total end pressure on the cap of approximately 33 tons, proving that the broken cap was not in any respect defective. The weld was not impaired at all. After this test it was suggested that an entirely new weld with other pipe lengths of the same diameter be tried. Accordingly two more lengths of 4-in. pipe were welded, threaded and sealed, this time with extra heavy steel caps made to withstand a working pressure of 3,000 lb. of air. The pressure was applied and the pipe gave way in the threads at 4,200 lb. In all of the tests the welds held securely.

The gentleman from Kansas decided that if there is anything stronger than a good oxyacetylene weld it is not needed in the oil fields of the Southwest. He examined a large number of welded pipe specimens that had been subjected to hydrostatic breaking tests, finding that in no instance had the pipe given way at a weld.



CAP RUPTURED AT 4,400-LB. WELD INTACT

Oxyacetylene welding of oil pipe lines, gas and water mains and laterals is increasing daily in all parts of the country, and it is more and more being specified in preference to riveted and threaded construction.

The Evolution of the Engine Lathe

By Frederick A. Halsey

Referring to Mr. Franzen's very interesting article, "The Evolution of the Engine Lathe," published in your impression for July 22, I think he is in error in his explanation of the origin of the term "engine lathe."

Originally the word "engine" was substantially synonymous with machine. When Watt used the term "steam engine" he meant, and might have said, steam machine. The steam engine was a new thing in the World, being the first power generator apart from waterwheels and the muscles of men and animals. It soon became of commanding importance and the word "engine" thus became identified with it, signifying, as it now usually, but now always, does, a machine for generating power. Before the advent of the steam engine it could not have had this meaning as there was no machine to which to apply it.

The original lathe was a very simple thing, as Mr. Franzen has pointed out and scarcely to be called a machine. When Maudsley added the slide rest and geared headstock it became a machine. It might properly have been called a machine lathe but, as in the case of the steam engine, it was called an "engine lathe" and the term still survives. When the slide rest and back gears are omitted and it becomes less of a machine we drop the word "engine" and call the result a "speed lathe."

This, however, is not the only case in which the word "engine" is still used in the old sense, as we find it applied to machines of high importance or precision. Thus ruling machines of high precision are commonly called "dividing engines" and the machine with which the dentist bores our teeth and tortures our nerves is always called a "dental engine," meaning simply dental machine. I well remember that when Professor Sweet made his first precision grinding machine at Cornell University he called it a "grinding engine."

The most curious survival of all is found in the term cotton gin. Ely Whitney called his machine the cotton engine, meaning cotton machine, but the negroes in their picturesque way, knowing little and caring less about such things, shortened the word engine to "gin." Ultimately the whites adopted the expression and today we hear no other.

The term "engine lathe" is, I believe, now confined in usage to this country. At any rate it is not to be found in English engineering journals except in the advertisements of some American lathes, the copy for which, if not prepared in this country, at best uses the term which we employ for our own product. In England the usual term is slide lathe, sometimes screw cutting lathe.

Regarding the invention of the slide rest, it has always seemed to me that Maudslay did much more than he is usually given credit for. What he really did, in a large way, was to introduce the mechanical control of cutting tools. In this sense he had one anticipation in the boring bar of Wilkinson, but that application was so very special that Maudslay may fairly be credited with the larger conception of the idea.

Business Conditions in England

FROM OUR LONDON CORRESPONDENT

LONDON, July 12, 1920.

BRITISH returns of overseas trading for the half year ending with June last suggest a further considerable improvement as compared with the same period of last year, although the month of June did not make quite such a good showing as did May. For the six months of 1920 the imports have been valued at £1,033,334,684, being an increase of about 44 per cent as compared with the same period of 1919. Exports were valued at £637,466,884, an increase of 90 per cent, and re-exports, valued at £135,891,048, showed an increase of 145 per cent, the total exports thus indicating an increase of about 98 per cent. In the month of June imports were valued at £170,491,230, or £4,157,414 more than for May. Exports were valued at £116,352,350 or £2,967,072 less than in May, and re-exports, valued at £20,123,928, were £136,160 less than May. What is known as the adverse trade balance is now being reduced: it was £260,000,000 for the first six months of this year, this comparing with pre-war figures of about £62,000,000 for the corresponding period of 1913. It is in fact estimated that the "invisible exports" are more than sufficient to make a balance. The satisfactory condition is due to high prices; by some signs a prospective fall, possibly temporary only, in overseas orders for British goods is indicated, and there is at least a suggestion of reduction in prices obtainable.

For persons outside politics and sport, prospects at the moment in Great Britain are rather dull. Retail trades of several kinds continue to show decline in the purchasing efforts of ordinary customers, and the engineering industry as a whole has lost much of its elasticity, owing, apart from other causes, to the further demands of workpeople now under consideration by an Industrial Court. The Restitution of Pre-War Practices Act will expire in the autumn, though it is not very probable that this will lead to much change in the workshops. For the production of some parts of machine tools women were found very serviceable in war time and since then one firm in Halifax fought their battle through all the courts, only to be beaten in the end. This firm specializes in lathe production and was perhaps the first to employ women on the operation of scraping, though other firms soon followed. Machine-tool shops are being carried forward by the momentum of orders received long ago. Very few fresh orders, however, are coming forward at the moment, and a decline in certain small tools is quite as marked. The motor-car industry continues to excite much concern and here, as with engineering concerns, the prices of shares have been falling away steadily. The view is not wanting, however, that this is being engineered to some extent. Banks have been called on to help for the purchase of materials. Prices of cars are held by manufacturers to have reached their upward limit. The ordinary cycle trade has been poor, the season is over, and many machines are reported still in the hands of manufacturers, while the gilt has been taken off the motorcycle industry.

THE IRON AND STEEL TRADE

Firms with sufficient castings are still as rare as houses to let, though if they could depend on foundry promises machinists would not wish for anything better. At the last meeting of the London Iron and Steel Exchange prices remained unaltered, and according to the official report, business continued restricted. The Birmingham report is that new business is being held up, and in Manchester the turn of the tide of prices is predicted. Sheffield denies any slump but admits falling away in special steels owing to the engineering decline. Iron and steel, whatever its quality or stage of manufacture, are still consumed as soon as available. For various well-known and often-stated reasons the export trade is practically at a standstill, and in the circumstances there is not much that is heroic in the further statement that "English and Scotch producers have agreed not to accept foreign orders until the British needs are fully covered." Of construction material more is available; cancellations in the shipbuilding industry are responsible for this. At a recent interview between a deputation from the Federation of British Industries and the chancellor of the exchequer to discuss the excess profits duty and corporation tax, it was stated that orders for seventy-six big ships were canceled last month alone. It is a many-times-told story to add the excess profits duty acts very unfairly to firms with a bad pre-war basis of profits. Firms with a good basis are inclined to remind opponents of the duty that we have had a war and that wars, if paid for, are expensive affairs. At the interview mentioned it was stated that one firm had during the war distributed £120,000 to shareholders and paid by way of tax £800,000. It is useless here to discuss the tax position; the matter will be decided long before these lines can be printed.

As regards supplies, the coal situation is easier. With restriction of exports, the home demand has fallen away, whether for industrial or household coal. Miners threaten once more to strike, on the ground that the prices set by the government are not justified. The strike is intended (1) to lower the price to consumers, (2) to raise wages because of the increased price charged. Meanwhile now one day after giving the order, the Londoner can have delivery of as much coal as he can find room for, at 58s. 2d. a ton.

EMPLOYMENT SITUATION

Although it may not be pronounced, some unemployment is being noted in engineering centers. Discharges are reported, for instance, from Lincoln and from three or four Wolverhampton motor car, etc., firms, one of them having abandoned night-shift working and reducing its force by about six hundred men. Another well-known firm is understood to have reduced its office, etc., staff pretty considerably, but on the other hand to be increasing the number of workpeople. Reductions in commercial vehicle prices have been announced. In the north-west area of England too, including of course Lancashire, the general employment conditions have in part lately been reversed as regards skilled men, for, according to the latest labor exchange report, some 1,061 engineering fitters registered themselves as unemployed, the number of vacancies reported being about forty-three. Similarly, 305 metal machinists were entered as unemployed against 66 vacancies, and 722 boiler makers against 156 vacancies. The case is even worse as applied to semi-skilled and unskilled labor. Here 1,388 engineering laborers registered themselves and twelve vacancies were notified, while as to laborers in shipyards the unemployed numbered 905, with six vacancies. Then 5,844 general laborers (heavy) entered themselves against thirty-six vacancies notified, while general laborers (light) are entered at 1,899, with no vacancies. Turning to the building trades, the conditions are as before: twenty-nine joiners were registered against 781 vacancies, and five bricklayers against 1,132 vacancies. In London, to take a single case of shortage of building labor, seven bricklayers were found engaged on a contract for 400 houses.

In the end the skilled foundry workpeople, like the engineering skilled workers, have declared against any general system of payment by results. As has been reported, this was recommended for acceptance by the workmen's own committee, who pointed out that the minimum district rates proposed would mean a considerable increase in wages, while the schemes gave some measure of management to to the labor side. But in the end the proposal was not officially recommended, and a ballot of the ironfounders, core makers, and metal dressers concerned ended in 11,490 voting against, with 8,216 for acceptance.

Transport systems of more than one kind are in financial difficulties. The most important of course is the case

of the railways. Here for the year 1919-1920 the deficit was £41,349,530. Now the Ministry of Transport issued a statement to the effect that, including Ireland, the working of the British railways will on present workings show a deficiency as from April 1 last of £54,500,000 per annum. A public inquiry is to be held and a rates advisory committee will consider the increases to be made in rates, fares, charges, etc. so as to bring about a balance by the end of June, 1921. It is anticipated that fares, etc., on the average will be increased by about 25 per cent, this bringing in rather more than the sum necessary, provided of course traffic conditions remain constant. We are being reminded that some time ago the present minister of transport suggested in the House of Commons that any increase in goods traffic rates beyond 70 or 80 per cent over pre-war rates was "unthinkable." But the present rates already average about an increase of 50 per cent so that the estimated addition of 25 per cent will mean an increase greater than the limit mentioned by the minister. Of the deficit it has been estimated that more than £22,000,000 will be due to wage increases. The rest of course arises mainly from the higher coal and material costs; that is also largely wages.

The abnormal cost of all the material needed and the inability of manufacturers to give firm quotataions, whether as to price or delivery, plus the difficulty in raising capital in present railway circumstances, are adduced as reasons for the postponement of the electrification of railway lines to the southwest of London.

Then again, the estimated deficiency on the London County Council tramways is £929,512,000 if certain proposals regarding renewals being charged to capital account are accepted, or £1,038,512 if consent is not obtained. The estimated receipts for the year are put at £4,553,930. Salaries and wages which before the war amounted in the year to £1,102,220 are now £3,254,162, and arrears and repairs to rolling stock imply an annual expenditure of £400,000. Fares are again to be revised, but it has been pointed out that although in the past they have already been increased by 100 per cent, in some cases considerably more, in some less, the increase in revenue is but 33 per cent. Then again, the directors of the Underground Electric Railway Co. announce that, after paying full interest on certain 6 per cent debentures but nothing on 6 per cent income bonds, profits of the past half year amount to £42. Similarly the directors of the London General Omnibus Co. state that "the financial position of the company does not justify them in declaring an interim dividend on the shares." The chickens are coming home to roost. But both tram and omnibus workers are preparing to make another demand for higher wages and can fortify themselves by references to increasing costs of food and rents. The decline in wholesale prices has not touched the chief foodstuffs; in fact they have risen. The chief drop is in textiles. The other road transport workers, i.e., drivers of vans, etc., are demanding a fresh national minimum, and a public inquiry is probable.

General Trade News

As to the Machine Tool Exhibition to be held at Olympia, London, W., from September 4 to September 25, one firm has certainly resigned on account of general trade conditions. The space they had taken was immediately let. There have been rumours of other withdrawals, but unsupported, as far as the writer is aware. It is expected that some 200 exhibitors will take part and that 1,000 machine tools will be in motion. Nothing German is to be included. The tools will, in fact, be almost predominently British, that is mainly English, with some American.

Of importance to American and other firms exporting motor cars into Great Britain is the agitation being carried on to prevent cars with left-hand drive entering the country. Consideration of this problem has been one of the first businesses of the new Ministry of Transport. An inquiry has been held and it is confidently predicted that ultimately the entry of such cars will be suppressed. Perhaps next France, having, like the rest of the world, the opposite rule of the road, will object to the entry of right-hand cars as dangerous, and the British motorist will then find difficulty in touring the continent. There is more than a suspicion in the move of another kind of protection.

Seeing that its students are spread all over the world, some readers in America will be specially concerned to learn that Finsbury Technical College has only just escaped, if it has escaped, closure at the end of the next year. Lack of funds is one of the reasons adduced, plus inability to find accommodation for the increasing number of students. The college is of course a plaything of the City and Guilds of London, and rather than lose their independence, the committee concerned have refused offers of financial help from the governement and the Board of Education. The almost lifelong professorship may be mentioned in electrical engineering of the late S. P. Thompson, and in mechanical engineering for many years of John Perry.

New Companies Registered

Company promotion in London during the first six months of this year showed a large increase both in numbers and capital. Apparently some 878 public companies were registered, capital exceeding 290½ million pounds, and 5,537 private firms, capital exceeding 158 millions, the total being 6,415 companies registered, with a total capital of £448,738,317. During the last half of the second quarter the higher capital duty, £1 per £100, had its effect, to say nothing of high bank rates, etc. In engineering the twenty public companies had a combined authorized capital of £4,291,000, and 268 private companies had a capital of £4,388,300. As to motors, twenty-four public companies and 333 private companies were registered, the former with a capital of £8,635,700, and the private companies with a combined authorized capital of £3,953,310.

Resetting a Tool for Boring Tapers

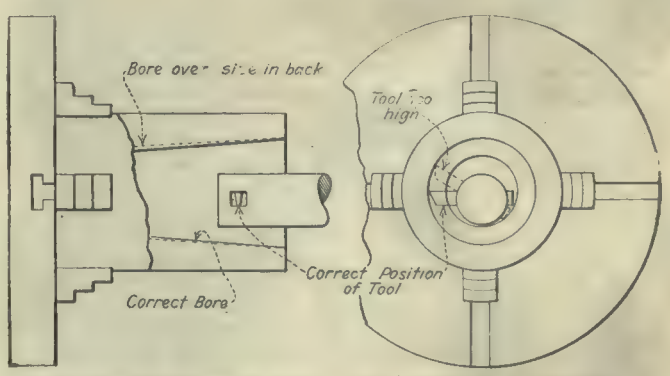
By John J. Burke

Many mechanics, and most of the apprentices, dislike boring tapers for the simple reason that they do not know how. Most of the misfits that occur are due to the improper setting of the tool.

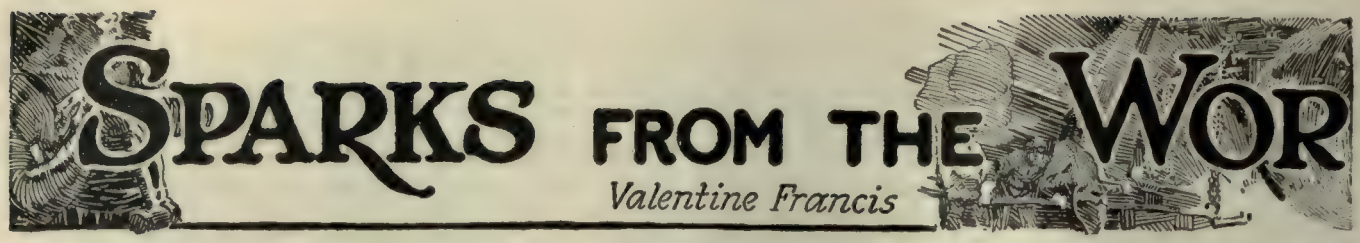
After roughing a hole to nearly the size, the tool is ground for finishing and here is where the harm is done. Instead of setting the tool back in its proper place it is set either too high or too low; the result being that the hole is usually over size in the back. Sometimes the tool is set high or low to begin with and after resetting it is brought nearer the center, making the hole small in the back.

The sketch can easily be understood. It shows the correct position of the tool and one of the many incorrect positions.

In boring a taper it is best to place a short line on the face of the work and let the line just come even with the edge of the tool before removing it for grinding. Then when replacing it be sure that it is even with the line and you will have little trouble in boring tapers.



RE-SETTING THE TOOL FOR BORING A TAPER



Black & Decker Announce No Reduction in Prices for Next Year

The Black & Decker Manufacturing Co. of Baltimore, Md., has issued the following statement to its customers, concerning the possible reduction of prices during the coming year.

"There will be no reduction in prices this year and starting January 1, 1921, we will protect you against loss through price reductions for 60 days after the purchase of goods.

"We have recently had a number of inquiries from jobbers asking if any reduction in price was contemplated in the near future. This has suggested to us, in line with our policy of co-operation with our jobbers, that we can work more closely with them in this respect.

"There is no price reduction of any kind possible on our line at present and you may accept this letter as guaranteeing you against any decline in the prices of Black & Decker portable electric drills, electric valve grinders or electric air compressors, between now and December 31, 1920.

"Furthermore, we take this opportunity of advising you that after that time you will be protected against loss through price reduction for a period of 60 days after purchase of our products. This does not mean if conditions make it possible for us to get a lower price on our products that we will give you 60 days notice and defer the reduction for that length of time. If a reduction is possible it will be made promptly so as to give the ultimate purchaser the benefit and we will absorb any loss which would otherwise be caused the jobber who bought within 60 days before the change in price."

R. T. Hazelton Now Works Manager of Cincinnati Shaper Co.

R. T. Hazleton, who was superintendent and chief engineer of the Cincinnati Milling Machine Co. for several years, is now works manager of the Cincinnati Shaper Co., Cincinnati, Ohio. Mr. Hazleton undertook his new duties July 1, coincident with the throwing into operation of the large addition to the plant of the company just completed.

Mr. Hazleton in his new position will also have charge of production for the Cincinnati Gear Cutting Machine Co., which is a subsidiary of the Cincinnati Shaper Co. Following the program of expansion of these companies, and the large additional floor space now available, it is anticipated that the output of the two companies will be doubled in the very near future.

Belgian Import Duty Increased

A bit of news that may be of interest to the trade is that the Belgian customs duties have been increased on many articles. This, following French precedent, is accomplished by the promulgation of a royal decree directing the ministry of finance to levy customs duties at so many times the established tariff, the rate of increase varying according to the class of article. On machine tools the figure is three, which means that, until modified, duties will hereafter be 60 frs. per metric ton (net weight) instead of 20 frs. per ton as heretofore. This is still not a very heavy burden, but it is interesting to note that the rate on machine tools is increased by the highest co-efficient listed, three being applied only to certain articles which are largely manufactured in Belgium. One wonders if the Belgians think that they are manufacturing machine tools also.

A Professor of Mechanical Engineering Writes on the Metric System

There is, I believe, a mistaken feeling that college officials and professors can be expected to favor the metric system and urge its adoption in this country to the exclusion of our established system of weights and measures. Such a feeling may exist among those who have not had practical manufacturing experience but on the part of professors of mechanical engineering and those who are familiar with the needs of our factories I believe there is a strong sentiment against a change. Further, I feel that it is distinctly hurtful to instill into the minds of college students ideas favoring a change in our basic standards which later experience in practical work makes it necessary to revise.

Colleges and universities should make every effort to co-operate with manufacturers instead of promulgating radical ideas which will "throw a monkey-wrench into the wheels of industry."

L. P. BRECKENRIDGE,
Professor Mechnical Engineering, Yale University.

Navy Lists Excess Bolts, Nuts, Rivets and Washers

The Navy Sales Board in Washington announces that a consolidation of lists of steel and iron bolts, nuts, rivets and washers into a new catalog is being made. These articles are now being held in large quantities at the various Navy Yards and are to be sold by sealed bids. This catalog will include all classes of bolts, with and without nuts, hexagonal and square head, black and galvanized. It will include all styles such as standard, carriage, stove, eye, forcing, stud, etc. Separate nuts will be round and hexagonal, blank and galvanized, and standard and case hardened. Rivets are ship, boiler and structure. Washers will be both iron and steel.

It is suggested that all prospective purchasers of these articles send their names in at the earliest possible moment to the Board of Survey, Appraisal and Sale, Navy Yard, Washington, D. C. This will insure their receiving a catalog as soon as it is ready for distribution.

A new steel catalog is also under consideration which will contain approximately 20,000 tons of plates, sheets, structural shapes, bars and billets.

Levey and Associates Organize Film Co.

Harry Levey, for three years manager of the industrial and educational department of the Universal Film Co., has resigned that position to head a producing company of his own, which will exclusively make this type of picture. Connected with the organization are Don Carlos Ellis, formerly head of the film service of the Department of Agriculture, and Mrs. Henry Moskowitz, secretary of the New York State Reconstruction Commission and the Governor's Labor Board.

Mr. Levey has already started motion picture production on a fairly large scale. He has been retained by the Association of Chemical Industries to make a series of pictures showing the history of dyes, explosives, medicines, automobiles, aeroplanes, paint, leather, electrical supplies and food preservations.

The Jersey City Chamber of Commerce recently asked its members to indicate their views regarding the "open shop." The result was 827 to 0 in favor of the "open" and against the "closed" shop. Of the 116 manufacturing plants at present operating in Jersey City, 96 are open and 20 are closed.

LD'S INDUSTRIAL FORGE
News Editor

German Machine Industry Faces Dangerous Crisis

According to the press, a report from the Union of German Machine Plants shows that during the year ended June 1, 1920, this industry suffered enormously from labor troubles and shortage of materials. A marked shortage of skilled labor was also felt. The attitude and conduct of the older workmen was satisfactory, but much trouble was experienced with the younger workmen, who were opposed to doing piecework and objected to overtime. The union estimated that in the year just closed that labor was only 50 to 60 per cent efficient. In spite of signed agreements the workmen made demands from month to month for increased wages. Auxiliary materials like leather and oil were difficult to obtain, and oil which formerly cost only 40 marks per 100 kilos is now sold at 1,700 marks per 100 kilos. The uniting of different plants and the standardizing of types of machines showed encouraging progress. The rise in the value of the mark has caused a falling off in orders and has increased the stagnation of business. To keep plants running even at part time many of them took to doing repair work.

Practically all orders from Poland and Austria have ceased because of unfavorable exchange. The high cost of production has also necessitated large capital increases. The prospect of normal business for the coming year is most doubtful because of the uncertainty as to future supplies of raw material, coal, electric current, and transportation. If conditions do not soon improve, it is anticipated that many factories will have to close down. Competition in foreign countries is difficult to meet, and on the whole the future of this industry is not at all encouraging.

Large Force Needed to Make Our Cutlery

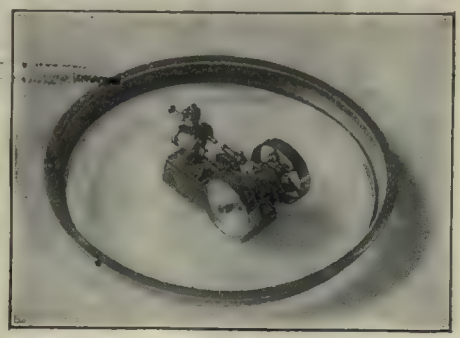
The cutlery industry continues very strong, according to the Cutlery Bureau of Information, New York, and is adding new men every month to its force of helpers.

Statistics for the State of New York, which are representative of the situation all over the United States, prove that the ratio of employment in the industry shows a new gain and that now 174 men are employed for every 100 which found employment during June, 1914. The total wage payments of the industry have more than trebled as compared with the time before the war.

A Small Model Steam Engine

The small model steam engine shown herewith is not new, having been exhibited at the world's fair nearly 30 years ago; but when our correspondent ran across it a few weeks ago he decided that it was worth photographing and presenting as a novelty to our many readers, to whom the world's fair is very ancient history indeed.

The thing upon which the model is resting in the engraving is not a pie-plate; it is the crystal and bezel ring of an ordinary-sized watch. The engine is made of gold, silver, brass and steel, and weighs 20 grains. The bed is ½ in. long; the bore of the cylinder



MODEL RESTING ON WATCH CRYSTAL

is 0.083 in., the stroke 3/32 in. It has a perfect working flywheel governor, a cylinder lubricator and a throttle valve. There are stuffing boxes around valve- and piston-rod that can be packed and the main bearings are adjustable for wear.

The model was built by Charles H. Allen of Pittsburgh when he was but 19 years old. The construction occupied his spare time for 15 weeks.

G. M. Graham Elected Vice-President of Pierce-Arrow Co.

The Pierce-Arrow Motor Car Company announces the election of George M. Graham as vice president, succeeding W. J. Foss, who resigned on July 1.

Mr. Graham went to the Pierce-Arrow Motor Car Co. from the Willys-Overland Co., and during his four years at Buffalo has successively held the place of assistant commercial manager, general sales manager and now vice-president.

During the war Mr. Graham was chairman of the National Motor Truck Committee at Washington, representing the entire motor-truck industry in all of its activities that centered there. He has been spokesman for the motor-vehicle industry in many important presentations.

Work of Engineering Council's Committee Classification and Compensation Endorsed

Lars R. Jorgensen, electrical and hydraulic engineer of San Francisco, Cal., who has been appointed on a committee of the American Society of Civil Engineers to consider the recent request for endorsement of its work by the Committee on Classification and Compensation of Engineers of Engineering Council, writes as follows:

"About six months ago I was a member of a committee appointed by the Civil Service Commission of California to work out classification and compensation for engineers in Civil Service in the State of California. In this particular case it was the electrical engineers only.

"After much investigation, inquiry and work, we found that we could not propose anything better than the classifications recommended by the Engineering Council. We had advance copies of same at the time.

"In my opinion there is no doubt that this classification, dated Dec. 15, 1919, is the best obtainable and can be used everywhere in the United States to great advantage. It is most complete, very well worked out as to details, and such a uniform classification ought to be adopted all over the country. I know it represents a great deal of work to compile such a document, and we should be grateful to the men who did all this work. My vote will be for the adoption of this classification.

"When it comes to compensation of engineers in the various grades it is more difficult to lay down a standard rule to be followed in all parts of the country, but the proposed rates of compensation seem to be elastic enough to allow for necessary local variations, and to constitute a good guide, which is really all that can be expected.

"I believe it will be of great advantage to the engineering profession if Engineering Council's Classification and Compensation of Engineers are generally adopted."

French Machine-Tool Purchases

The French mission acting on the machine-tool contract with the United States returned to France from America a short time ago, having selected and shipped some 1,100 machines in all. Since the kind of machines the mission particularly wanted could not be found in the War Department's stocks its members consider the contract terminated. The machines they would have purchased were: bor-

ing mills, horizontal boring machines, gear-cutters, car-wheel lathes, heavy planers, forging machinery, bolt and nut machinery, large punches and shears, etc. They still have on hand in their warehouses in France more of the standard sizes of the usual machine-shop tools than they require.

The approval of the contract by the French Chamber of Deputies did not carry with it the authority to purchase the machines elsewhere, consequently the Ministry has no funds or credit for the purpose. As a matter of fact, a responsible French official stated that the policy of the present government is to restrict, as far as possible, purchases for governmental account; and that therefore they did not anticipate going into the market and buying machine tools for stock. The government officials feel that it is up to the manufacturer to purchase direct such special machinery as he may require.

There is no confirmation from the War Department of the United States regarding the number of machines the mission finally bought, nor regarding the termination of the contract, but the French view given above is, no doubt, correct.

Davenport Dons Denim—Does Daily Drudge

Picture the once immaculate figure of a real, honest-to-God state senator, clad in the uniform of a twentieth-century machinist (even the white collar and shell-rim glasses)—and you have an idea of Frederick M. Davenport, senator from the Thirty-sixth (Oneida) district, of the State of New York, spending his vacation in the plant of the Franklin Automobile Co. at Syracuse, N. Y.

At the invitation of Mr. Franklin the erstwhile legislator took up this new phase of life in order to get some first-hand "dope" on present industrial relations as affecting factory employees.

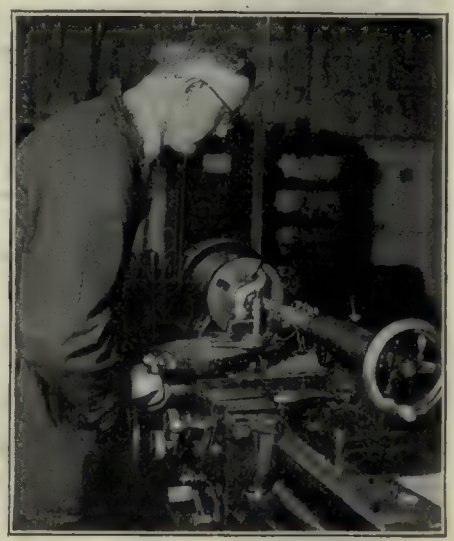
Senator Davenport doesn't punch a time clock but he's as punctual as any man in the plant, commuting every day from home and "getting the inside," the real point of view of the mechanic and laborer by working alongside him in daily association.

The senator has learned a lot about industrial operation since he came here a month ago and expects to learn a lot more before he quits to take up his regular job of teaching law. He is particularly impressed with the training in infinite detail the man who produces in an automobile plant is obliged to undergo.

"I have driven an automobile for 10 years with scarcely a thought of the processes through which it went and the mental and physical keenness required in its construction. I scarcely ever even looked under the hood," said the senator. "But my work here has taught me the vast importance of the various operations. I received a letter from Mr. Franklin indicating, in substance, that he had been keeping his eye on my interest at Albany in the direction of measures to establish better industrial relations between employer and employee and suggesting that it might be mutually helpful if I had an opportunity to spend some time inside a great industrial unit like the Franklin plant.

"Upon conferring with Mr. Franklin I found that we agreed that the matter of sounder industrial relations between employer and employee is of vital importance to the future of the country, and that whatever is done ought to be done with care and kept close to the actual facts and needs of industry."

Senator Davenport says he has had great freedom of movement and of information, having studied the poli-



SENATOR DAVENPORT

cies of the management on the one hand and working at the lathe among the men on the other hand. This week he is going into the toolroom and will probably put in some time among the final test men, the fellows who really have the last word before a car is sent out of the factory.

New Pierce-Arrow Dual-Valve Trucks Mark Big Advance

Announcement of an expanded line of motor trucks, powered by dual-valve engines, is made by the Pierce-Arrow Motor Co., of Buffalo, N. Y. The new line includes five-ton, three and one-half-ton and two-ton trucks and a tractor unit, each equipped with double ignition and electric lights.

The dual-valve power plants which distinguish the advanced design are declared to effect as great a forward stride in motor truck performance as did the introduction of the worm gear, pioneered by Pierce-Arrow in 1910.

"The dual-valve engines equip the trucks with a pulling power superior to any demand," said Robert O. Patten, truck sales manager of the company. "Moreover, this power is obtained with an increase in economy; gasoline yields more miles per gallon."

The dual-valved engine, constructed on the principle of the dual-valve engine developed by Pierce-Arrow engineers so successfully in passenger-car use, has been in process of design and test for more than two years. Extended usage under actual working conditions has eliminated all guess work as to what its performance is.

Adherence to the basic Pierce-Arrow engineering principles, the company states, insures that the present line retains the distinctive characteristics of reliability and durability. But with the refinement of design, the new trucks not only set new performance standards, but establish a record low level of repair and maintenance costs. This is achieved through an accessibility which permits of quick, economical repairs, insuring a minimum of time lost in the service shop and a minimum of repair costs, according to the company's statement.

Modernized manufacturing methods combined with an expansion of factory facilities necessitated by efficient war production methods has enabled the Pierce-Arrow company to enhance the quality upon which Pierce-Arrow reputation has been built. More accurate machining, an even greater uniformity of product and improved methods of testing have achieved the result.

Details as to the specifications of the new models and facts as to their actual performance may be obtained from the company or any of its distributors in all of the principal cities of the country.

The technical department of the University of California, Extension Division, announces a new course by correspondence in Determinative Mineralogy and Blowpipe Analysis, by Arthur S. Eakle, Professor of Mineralogy in the University of California. It is equivalent to the course given in the regular session of the University. Two units of University credit will be given, if desired, on the passage of an examination. For further information write to the University of California, Berkeley, Cal.

Business Items

The Phoenix Manufacturing Co., Eau Claire, Wis., has announced the removal of its office from Cleveland, Ohio, to Chicago, Ill. W. L. Harrison, who has been manager of the Cleveland office for a number of years, will manage the Chicago office.

The Hart-Parr Co., Charles City, Iowa, on account of the rapid expansion of its overseas trade, has appointed E. R. Verhaeghe, of Anvers, France, to act permanently in supervisory capacity over the European territory. He has been in charge of the tractor department of the Hart-Parr distributors in Anvers, France, ever since the Hart-Parr tractors have been sold there. He

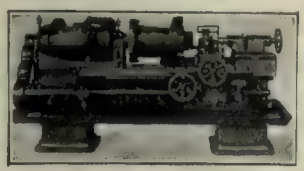
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Condensed-Clipping Index of Equipment

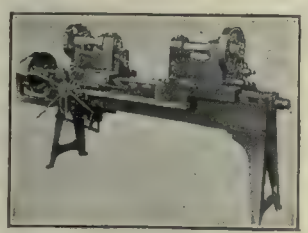
Patented Aug. 20, 1918

Lathe, Crankshaft, Line-Bearing and Flange Turning
Wickes Brothers, Saginaw, Mich.
"American Machinist," July 15, 1920



The lathe is used for turning the line-bearings and flanges of crankshafts and is made in one size only with a 20-in. swing. The headstock is back geared to suit the job and the drive is either by belt from countershaft or direct motor as required. The spindle has a collar on the work end, forged integrally, and all bearings are ground to size. A Hilliard multiple-disk clutch transmits the power. The gear box has eight feeds. A cast-steel pot chuck is furnished, designed especially for the crankshaft it is to support.

Drilling Machine, No. 8 Duplex
Moline Machinery Co., Moline, Ill.
"American Machinist," July 22, 1920



The machine has special spindle heads designed to meet the requirements and is similar in its general character and construction to the No. 7 duplex machine, with the exception that it is not equipped with power feed. The feed is actuated by the pilot wheel at the left through a pinion and two opposed racks, thus feeding the two spindle heads equally. An adjustable stop is located on the left-hand head, which permits regulation of travel in order to provide for drilling the holes to the proper depth and to prevent the two drills from coming in contact. The gears can be changed to drive one spindle faster than the other, if so desired. Specifications: Length of bed, 7 ft. 8 in. Width of bed, 12 in. Distance between spindles, minimum, 10 in.; maximum, 40 in. Hole in spindles, No. 4 or 5 Morse taper. Distance from spindle to bed, 8 in. Capacity, up to 1⅜-in. drill.

Drilling Machine, No. 10 Duplex
Moline Machinery Co., Moline, Ill.
"American Machinist," July 22, 1920



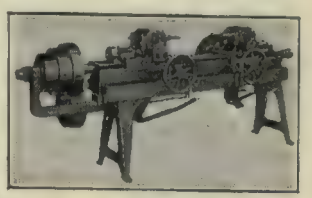
The machine is similar to the No. 9 machine, except for the feed of the heads. The heads are geared to travel in the same direction, which arrangement is employed when one head is used for drilling and the opposed head for reaming. Since special heads can be built to drill any number of holes at the same time, this feature is a desirable one, because it permits of drilling and reaming at a single setting of the work in the jig. Specifications: Dimensions of table, 7 x 12 in. Height of the table from floor, 32 in. Distance between spindle ends; minimum, 6 in.; maximum, 18 in. Travel of head, 6 in. Hole in spindles, No. 2 or 3 Morse taper. Capacity, four ½-in. drills in cast iron. Floor space, 24 x 40 in. Net weight, 1,200 lb.

Milling Machine, No. 3 Duplex Slot
Garvin Machine Co., Spring and Varick Sts., New York.
"American Machinist," July 29, 1920



The machine is capable of slotting the largest locomotive crossheads, and it is adapted to other work such as cutting keyways and slotting fork ends. The machine mills both sides of a slot simultaneously, the work reciprocating and the cutters feeding inward intermittently. When milling slots entirely through a piece, one cutter automatically retreates before the two cutters meet, and the other one continues to advance and complete the slot. Specifications: Size of cutters used, ⅞ to 2½ in. Table, size, 21 x 87 in.; maximum travel, 10 in. Swing; over table, 30 in.; over bed, 12 in. Spindles; taper hole, No. 11 B. & S.; maximum distance between, 41 in. Spindle sleeves; diameter, 6 in.; length of bearing, 24 in. Feed; total per spindle 6 in.; per table stroke, 0.01 to 0.025 in. Motors; speed, 650 to 1,950 r.p.m.; horsepower, 5. Length of bed, 128 in. Floor space, 100 x 190 in.

Drilling Machine, No. 7 Duplex
Moline Machinery Co., Moline, Ill.
"American Machinist," July 22, 1920



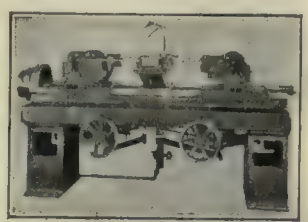
The machine is used for opposed drilling and reaming and has a power feed. The design permits the drilling and reaming spindles to be run at different speeds. The drive is from the three-step cone-pulley at the left through a central driving shaft, and from this through suitable gearing in the carriages or sliding heads. The gears can be changed so as to run the spindles on one carriage faster than those on the other, if desired, and the spindles are adjustable for position. Specifications: Length of bed, 7 ft. Width of bed, 10 in. Distance between spindle ends; minimum, 4 in.; maximum, 30 in. Hole in spindles, No. 4 Morse taper. Distance from spindle to bed, 8 in. Capacity; up to 1¼-in. drill. Each carriage has three feeds.

Drilling Machine, No. 9 Duplex
Moline Machinery Co., Moline, Ill.
"American Machinist," July 22, 1920



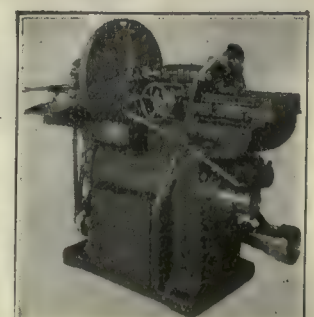
The two opposed spindles in front perform the drilling operation, and the two rear spindles the reaming. The machine is driven by two belts from the countershaft, one to each spindle head. It employs hand feed by rack and pinion, but power feed can be furnished if desired. The hand-feed machine is equipped with a ratchet lever and the power-feed machine with a handwheel. Specifications: Dimensions of table, 7 x 9 in. Height of table from floor, 32 in. Distance between spindle ends; minimum, 6 in.; maximum, 16 in. Travel of each head, 5 in. Hole in spindles, No. 3 Morse taper. Capacity, four ½-in. drills in cast iron. Floor space, 24 x 40 in. Net weight, 1,000 lb.

Drilling Machine, No. 12 Duplex
Moline Machinery Co., Moline, Ill.
"American Machinist," July 22, 1920



The machine is provided with power feed, which can be automatically disengaged at any desired point. The drive is effected from a shaft extending along the back of the bed. This shaft is splined throughout its length and is driven by a three-step cone pulley. Specifications: Distance between spindle ends; minimum, 8 in.; maximum, 44 in. Capacity, eight 1¼ in. drills in cast iron. Height of bed from floor, 40 in. Maximum center distance between end spindles on same carriage, 24 in. Floor space, 4 x 8 ft. Net weight, 5,000 lb.

Grinding Machine, No. 9 Hole
Van Norman Machine Tool Co., Springfield, Mass.
"American Machinist," July 29, 1920



The drive is self-contained and is mounted on the machine base. The machine can be furnished with motor drive, in which case the motor is placed inside the cabinet base. All driving shafts are mounted in self-aligning ball bearings. The work head is mounted on a transverse slide, providing ample room for the operator to gage the work and to handle it in or out of the machine without danger of injury to his hands. Specifications: Swing, 20 in. Will grind holes 4½ in. deep. Speeds; work spindles, six, from 72 to 431 r.p.m.; grinding spindle, three, from 3,400 to 19,000 r.p.m. Floor space, 39 x 63 in. Weight; net, 2,950 lb.; boxed, 3,100 lb.

Clip, paste on 3 x 5-in. cards and file as desired

will now co-operate with the dealers in England, Belgium, Denmark, France, Sweden, Spain, Portugal, Algeria, Tunis and Egypt. The next month will be spent by Mr. Verhaeghe at Bruges, Belgium, in the interests of the Hart-Parr.

The Wellman-Seaver-Morgan Co., Cleveland, has taken a contract for two 200-ton tilting furnaces for the Imperial Steel Works, Japan. These furnaces will be used in connection with a Talbot process. They will be fired with producer gas and their tilting mechanism and valves will be electrically operated.

The Hercules Electric Co., Indianapolis, Ind., plans the installation of such new machinery as will enable the company to manufacture magnetos, electrical machines and devices. Additions on a large scale are planned at the plant, which recently was purchased by Charles G. McCutcheon, Indianapolis, and Perry and Frank Remy, former owners of Remy Electric Co. at Anderson, Ind.

Personals

JOHN GREGG, attorney for the Hart-Parr Co., Charles City, Iowa, returned recently from a six months' trip through twenty-two countries of Europe on business connected with the Hart-Parr tractors. The Hart-Parr Co. will give a banquet in Mr. Gregg's honor.

CARL HOLL, formerly connected with the Persons Manufacturing Co., Worcester, Mass., is now with the Graton & Knight Manufacturing Co., Worcester, makers of factory leather belting.

JOHN P. GREGG, of the Hart-Parr Co., Charles City, Iowa, has been promoted to divisional sales manager for the Canadian territory and will have charge of all sales of northwestern Canada.

Obituary

AMOS WHITNEY, founder of the Pratt & Whitney Co., Hartford, Conn., and for a number of years president of the Gray Pay Station Telephone Co., died on Aug. 5 at Poland Springs, Me. He was eighty-seven years old. [Mr. Whitney's biography will be published in our next issue.]

FRANK TAYLOR, former president and one of the founders of the Taylor Instrument Companies, died recently at his home at 47 Wellington Avenue, Rochester, N. Y., in his 76th year.

CLARENCE A. SEVERIN, Cleveland manager of the Reed-Prentice, Becker Milling Machine and the Whitcomb-Blaisdell Machine Tool Co., died on Wednesday, July 21.

Trade Catalogs

Grinding Wheels. Norton Co., Worcester, Mass. A small circular illustrating and describing the balancing of grinding wheels for Norton precision grinding machines.

Precision Levels for Machinists. Queen-Gray Co., Philadelphia, Pa. Bulletin A-5, pp. 7, 8 x 11 in. An illustrated and descriptive bulletin of precision levels for machinists.

High Precision Measuring Tools. The Golden Co., 405 Lexington Ave., New York City. Catalog No. 257, pp. 3, 8¼ x 11¾ in. This catalog briefly describes and illustrates the various machines and appliances made by the Societe Genevoise d'Instruments de Physique, for whom this company is the exclusive agent.

Forthcoming Meetings

The International Railway Master Blacksmiths' Association will hold its next annual convention at Tutwiler Hotel, Birmingham, Ala., on Aug. 17, 18 and 19. The secretary of the association is A. L. Woodworth, Lima, Ohio.

The National Gas Engine Association, Monadnock Bldg., Chicago, Ill., will hold its thirteenth annual convention at the Congress Hotel, Chicago, on Sept. 1, 2 and 3.

The American Steel Treaters' Society and the Steel Treating Research Society will hold their second annual convention and exhibition at the Commercial Museum, Philadelphia, Pa., on Sept. 14 to 18, inclusive. J. A. Pollack, of the Pollak Steel Co., Cincinnati, Ohio, is secretary of the former society.

The American Foundrymen's Association will hold its annual convention and exhibit at Columbus, Ohio, on Oct. 4 to 9. C. E. Hoyt, 1401 Harris Trust Building, Chicago, Ill., is secretary.

An exposition of U. S. manufacturers at Buenos Aires, Argentine Republic, S. A., has been arranged for the month beginning Nov. 15. Information can be obtained from the American National Exhibition, Inc., Bush Terminal Sales Building, 132 West 42nd St., New York.

DOMESTIC EXPORTS FROM THE UNITED STATES BY COUNTRIES, DURING MAY, 1920
METAL-WORKING MACHINERY

Countries	Lathes 491	Other Machine Tools 492	Sharpening and Grinding Machines 493	All Other 495
Belgium	$29,148	$67,689	$14,732	$96,452
Czechoslovakia	.....	.....	1,678	.....
Denmark	5,147	7,914	9,317	.....
Finland	.....	1,998	.....	.....
France	75,499	230,167	68,917	234,423
Germany	.....	6,890	790	6,542
Greece	725	3,942	.....	1,412
Iceland and Faroe Islands	.....	.....	52	.....
Italy	24,685	107,397	8,604	168,470
Netherlands	5,702	1,875	1,230	2,243
Norway	.....	2,466	860	9,823
Poland and Danzig	.....	.....	1,500	.....
Portugal	3,403	3,190	37	.....
Roumania	4,733	2,348	825	8,015
Spain	59,940	18,807	4,158	30,279
Sweden	13,941	15,028	10,682	3,647
Switzerland	198	13,456	.....	11,002
Turkey in Europe	.....	651	.....	.....
England	246,812	445,605	67,202	574,513
Scotland	.....	10,613	444	3,640
Ireland	.....	2,803	733	13,976
Bermuda	.....	314	250	.....
Canada	90,665	140,893	26,943	207,941
Costa Rica	.....	3,251	444	.....
Guatemala	.....	116	.....	.....
Honduras	.....	638	.....	.....
Nicaragua	.....	484	.....	.....
Panama	300	174	15	6,175
Salvador	.....	.....	22	.....
Mexico	18,179	7,665	3,339	15,863
Miquelon, Langley, etc	1,050	.....	.....	.....
Newfoundland and Labrador	2,550	.....	.....	170
Barbados	.....	7	.....	.....
Jamaica	56	.....	105	.....
Trinidad and Tobago	112	378	.....	.....
Other British West Indies	106	45	.....	.....
Cuba	24,656	24,068	3,519	24,497
Dutch West Indies	.....	100	.....	.....
French West Indies	.....	85	.....	.....
Haiti	.....	.....	307	.....
Dominican Republic	2,250	281	360	1,454
Argentina	13,140	8,848	706	15,161
Bolivia	650	171	500	1,440
Brazil	12,763	20,473	1,944	3,115
Chile	519	3,377	172	1,171
Colombia	4,631	7,590	228	2,213
Ecuador	935	51	.....	.....
British Guiana	.....	312	.....	.....
Paraguay	.....	358	.....	.....
Peru	6,027	7,019	2,592	5,838
Uruguay	1,700	1,098	26	.....
Venezuela	2,324	606	330	466
China	27,052	6,202	2,700	35,722
Kwantung	.....	.....	1,255	4,000
British India	46,106	23,386	1,237	104,788
Straits Settlements	.....	490	103	2,104
Other British East Indies	.....	.....	22	.....
Dutch East Indies	2,241	1,159	4,657	4,279
Hongkong	.....	572	595	.....
Japan	61,518	66,182	15,690	271,640
Turkey in Asia	3,300	150	.....	.....
Australia	5,517	30,217	10,658	10,896
New Zealand	6,212	3,924	1,036	1,093
French Oceania	.....	.....	.....	965
Philippine Islands	9,522	2,955	1,565	21,104
Belgian Kongo	4,944	.....	.....	.....
British West Africa	30	.....	.....	.....
British South Africa	5,159	11,086	1,818	9,451
British East Africa	.....	566	.....	.....
French Africa	787	.....	.....	.....
Portuguese Africa	3,650	348	108	1,867
Egypt	850	.....	1,050	1,571
Total	$829,434	$1,318,478	$276,057	$1,919,421

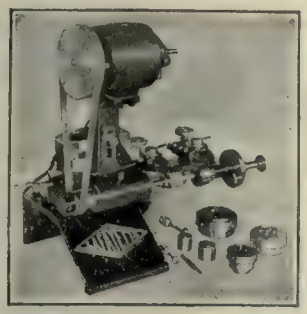
Condensed-Clipping Index of Equipment

Patented Aug. 20, 1918

Grinding Attachment, Button Die

Lafayette Tool and Equipment Co., 21 South 12th Street, Philadelphia, Pa.

"American Machinist," July 22, 1920

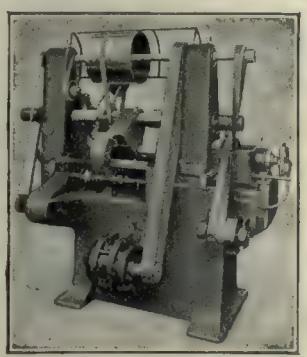


The attachment comprises an index plate, a set of nine die holders, a graduated adjustable feeding device for the rack work holder, chucks and abrasive pencils. The die holders will accommodate A. S. M. E. standard and fractional dies, and the index plate is drilled for both three- and four-grooved dies. The work, while held rigidly in the die holder, is controlled by the index plate which can be set to suit the various widths of flutes in the dies to be ground.

Grinding Machine, No. 15, Bryant Chucking

Bryant Chucking Grinder Co., Springfield, Vt.

"American Machinist," July 29, 1920

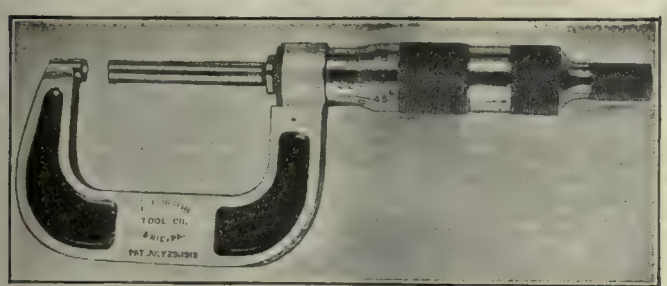


The machine is self-contained, and is furnished in two types—a single-spindle machine for grinding holes only and a double-spindle machine for both hole- and face-grinding. The illustration shows a rear view of the No. 15 single-spindle machine with motor attached. Two speeds are provided for the work spindle and two traverse speeds for the wheel slide. The wheel-spindle drive shafts are mounted in ball bearings of inclosed type. Specifications: Chuck range, 12 in. Grinding length, 9 in. Work spindle, 150 and 300 r.p.m. Wheel-slide travel per revolution of work, $\frac{1}{16}$ and $\frac{5}{16}$ in. Weight, net, 3,000 lb. Floor space, 36 x 84 in. Motor recommended, 2 hp. 1,720 r.p.m.

Micrometer, Blush Multiple

A. T. Blush Tool Co., 1145 West 11th St., Erie, Pa.

"American Machinist," July 29, 1920



The micrometer illustrated herewith can be used to measure from 0 to 2 in. without any attachment. The spindle has a screw of 20 threads per in., while a separate screw of 40 threads per in. is used for traversing the thimble.

Torch, Pumpless Blow

Pumpless Blow Torch Co., Phipps Power Bldg., Pittsburgh, Pa.

"American Machinist," July 29, 1920



The torch does not require preliminary pumping and pre-heating. The fuel used is butane, obtained from natural gas and reduced by pressure to a liquid. Two ducts lead from the fuel chamber to the burner; one from the top and one from the bottom. To start the torch, the valve in the upper duct is opened, allowing the gas to flow directly to the burner where, upon ignition, it burns with a clear steady blue flame at a temperature of 2,240 deg. F. After burning for a minute or two the burner becomes hot, the valve in the lower duct is then opened and the upper one closed, allowing the liquid fuel to flow to the burner where it is volatized by the heat.

Press, Verson No. 00 Power Bench

La Salle Machine Works, 3013 La Salle St., Chicago, Ill.

"American Machinist," July 29, 1920



This machine is adapted for blanking, forming and other press operations and can handle such light work as is often done on a larger machine. The clutch is made of tool steel and hardened. It is simple in construction and of the positive type. It is provided with an automatic safety device which disengages the clutch at each revolution of the press whether or not the treadle is released. The machine is of the open-back type, and permits feeding the work either from right to left or from front to back. The press can be furnished with a table and legs if desired. Specifications: Stroke of slide, $\frac{3}{4}$ in. Adjustment of slide, 1 in. Width of opening through back, $3\frac{1}{2}$ in. Finished surface of bed, 7 x $5\frac{3}{4}$ in. Diameter of hole in bed, $1\frac{3}{4}$ in. Diameter of shaft, 2 in. Flywheel, 10 in. diameter; face, 2 in.; speed, 250 r.p.m.

Toolholders, Rouillard Universal

Rouillard Tool Corp., 608 Chestnut St., Philadelphia, Pa.

"American Machinist," July 29, 1920



The holes for the cutters in both holders besides being reamed are partially squared with a broach so that they will hold square, round or octagon stock equally well. The set-screws are of the hollow-head type with fine pitch S. A. E. threads, but square-headed screws can be used if preferred. In addition to the regular line of cutters for turning and boring, special attachments such as knurling and gooseneck turning and threading tools, are furnished when required. The toolholders are drop-forged and pack-hardened and are made in seven sizes; the smallest, No. 0, is $\frac{3}{8}$ x $\frac{3}{4}$ x $4\frac{1}{2}$ in.; the largest, No. 6, is 1 x $1\frac{3}{4}$ x 13 in.

Burner, The Berg

Berg Burner Co., Inc., 100 Emerson Place, Brooklyn, N. Y.

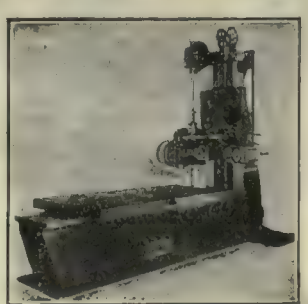
"American Machinist," July 29, 1920



The burner is designed to burn oxy-hydrocarbon-gas that it automatically produces from oil and water. Superheated steam is generated by the burner and combined with the oil flow as it leaves the nozzle. The hydrogen of the steam unites with the hydrogen and carbon of the oil, while the oxygen set free in a superheated state, is said to create perfect combustion when the torch is ignited. The correct mixture of oil and steam, also the proper degree of heat is obtained by manipulating the two needle valves at the top, the lower valve being provided merely as a blow-off. The burner will operate in any position and is designed to consume either the cheapest distillates or refined oils but not gasoline or kindred products.

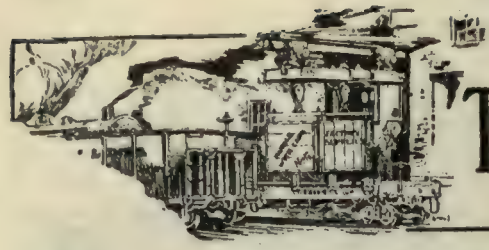
Milling Machine, Newton Special

Newton Machine Tool Co., Inc., 23d and Vine Sts., Philadelphia Pa. "American Machinist," July 29, 1920



The machine was designed for milling slots in motor rotors. The spindle is driven by a phosphor-bronze worm-wheel, and hardened steel worm, the worm having roller thrust-bearings and running in a bath of oil. The spindle is hollow to accommodate a draw-in-rod and the spindle nose has a Morse taper hole and a face keyway. The spindle saddle is counterweighted and has power rapid traverse in both directions, a safety feed stop being provided so that the downward rapid traverse cannot be careslessly engaged to the injury of cutters or work. Specifications: Feed of spindle saddle, 24 in. Maximum distance center of spindle to top of table, 24 in. Side adjustment of spindle, 2 in. Center of spindle to face of upright, 12 in. Work table, 54 x 96 in.

Clip, paste on 3 x 5-in. cards and file as desired



THE WEEKLY PRICE GUIDE

IRON AND STEEL

PIG IRON—Quotations compiled by The Matthew Addy Co.:

	Current	One Year Ago
CINCINNATI		
No. 2 Southern	$45.60	$29.80
Northern Basic	42.80	27.55
Southern Ohio No. 2	46.80	28.55
NEW YORK—TIDEWATER DELIVERY		
2X Virginia (Silicon 2.25 to 2.75)	49.65	31.90
Southern No. 2 (Silicon 2.25 to 2.75)	49.70	33.95
BIRMINGHAM		
No. 2 Foundry	42.00@44.00	25.75
PHILADELPHIA		
Eastern Pa., No. 2x, 2.25-2.75 sil.	46@48 25*	30.65
Virginia No. 2	45.00*	30.85
Basic	44.50†	29.90
Grey Forge	43.50*	29.90
CHICAGO		
No. 2 Foundry local	44.25	27.25
No. 2 Foundry, Southern	47.00	31.75
PITTSBURGH, INCLUDING FREIGHT CHARGE FROM VALLEY		
No. 2 Foundry	45.65	28.15
Basic	44.40	27.15
Bessemer	44.90	29.35
MONTREAL		
Silicon 2.25 to 2.75%	43.25	.....

* F.o.b. furnace. † Delivered.

STEEL SHAPES—The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses at the cities named:

	New York			Cleveland		Chicago	
	Current	One Month Ago	One Year Ago	Current	One Year Ago	Current	One Year Ago
Structural shapes	$4.47	$3.97	$3.47	$5.00	$3.37	$3.97	$3.47
Soft steel bars	4.62	4.12	3.37	4.50	3.27	3.87	3.37
Soft steel bar shapes	4.62	4.12	3.37	...	3.27	3.87	3.37
Soft steel bands	6.32	5.32	4.07	6.25	.....	.....	.....
Plates, ¼ to 1 in. thick	4.67	4.17	3.67	4.50	3.57	4.17	3.67

BAR IRON—Prices per 100 lb. at the places named are as follows:

	Current	One Year Ago
Mill, Pittsburgh	$4.25	$2.62
Warehouse, New York	4.57	3.37
Warehouse, Cleveland	3.52	3.22
Warehouse, Chicago	3.75	3.37

SHEETS—Quotations are in cents per pound in various cities from warehouse; also the base quotations from mill:

Blue Annealed	Large Mill Lots Pittsburgh	New York Current	New York One Year Ago	Cleveland	Chicago
No. 10	3.55-7.00	7.12@8.00	4.57	8.10	7.02
No. 12	3.60-7.05	7.17@8.05	4.57	8.15	7.07
No. 14	3.65-7.10	7.22@8.10	4.67	8.20	7.12
No. 16	3.75-7.20	7.32@8.20	4.77	8.30	7.22
Black					
Nos. 18 and 20	4.20-6.20	8.30@9.80	5.30	8.70	7.80
Nos. 22 and 24	4.25-6.25	8.35@9.85	5.35	8.75	7.85
No. 26	4.30-6.30	8.40@9.90	5.40	8.80	7.90
No. 28	4.35-6.35	8.50@10.00	5.50	8.90	8.00
Galvanized					
No. 10	4.70-8.00	8.80@11.00	6.20	9.00	8.15
No. 12	4.80-8.10	8.90@11.00	6.25	9.10	8.20
No. 14	4.80-8.10	8.90@11.10	6.30	9.10	8.35
Nos. 18 and 20	5.10-8.40	9.15@11.40	6.60	9.40	8.65
Nos. 22 and 24	5.25-8.55	9.30@11.55	6.75	9.55	9.05
No. 26	5.40-8.70	9.45@11.70	6.90	9.70	9.20
No. 28	5.70-9.00	9.75@12.00	7.20	10.00	9.50

Acute scarcity in sheets, particularly black, galvanized and No. 16 blue enameled.

Automobile sheets are unavailable except in fugitive instances, when prices are 9.45c per lb. for No. 16; 9.50 for Nos. 18 and 20, and 9.55c for Nos. 22 and 24.

COLD FINISHED STEEL—Warehouse prices are as follows:

	New York	Chicago	Cleveland
Round shafting or screw stock, per 100 lb. base	$6.25	$5.80	$6.00
Flats, square and hexagons, per 100 lb. base	6.75	6.30	6.50

DRILL ROD—Discounts from list price are as follows at the places named:

	Per Cent.
New York	50
Cleveland	50
Chicago	50

NICKEL AND MONEL METAL—Prices in New York, in cents per pound:

Nickel	
Ingot and shot	43
Electrolytic	45

Monel Metal			
Shot and blocks	35	Hot rolled rods (base)	40
Ingots	38	Cold rolled rods (base)	55
Sheet bars	40	Hot rolled sheets (base)	55

Special Nickel and Alloys	
Malleable nickel ingots	45
Malleable nickel sheet bars	47
Hot rolled rods, Grades "A" and "C" (base)	60
Cold drawn rods, grades "A" and "C" (base)	72
Copper nickel ingots	42
Hot rolled copper nickel rods (base)	52
Manganese nickel hot rolled (base) rods "D" — low manganese	64
Manganese nickel hot rolled (base) rods "D"— high manganese	67

Domestic Welding Material (Swedish Analysis)—Welding wire in 100-lb. lots sells as follows, f. o. b. New York: ⅛, 8½c. per lb.; ¼, 8c.; ⅝ to ½, 7½c. Domestic iron sells at 12c. per lb.

MISCELLANEOUS STEEL—The following quotations in cents per pound are from warehouse at the places named:

	New York Current	Cleveland Current	Chicago Current
Openhearth spring steel (heavy)	7.00	8.00	9.00
Spring steel (light)	10.00	11.00	12.25
Coppered bessemer rods	9.00	8.00	6.75
Hoop steel	6.57	6.50	5.32
Cold-rolled strip steel	12.50	8.25	10.75
Floor plates	6.80	6.[illegible]	6.77

PIPE—The following discounts are to jobbers for carload lots on the Pittsburgh basing card, discounts on steel pipe, applying as from January 14, 1920, and on iron pipe from January 7, 1920.

Inches	Steel Black	Steel Galvanized	Inches	Iron Black	Iron Galvanized
BUTT WELD					
⅛ to 3	54–57½%	41½–44%	¼ to 1½	24½–34½%	8 –18½%
LAP WELD					
2	47 –50½%	34½–38%	1¼	.....	.....
2½ to 6	50 –53½%	37½–41%	1½	.....	.....
7 to 12	47 –50½%	33½–37%	2	20½–28½%	6½–14½%
13 to 14	37½–41 %	.....	4½ to 6	22½–30½%	9½–17½%
15	35 –38½%	.....	2½ to 4	22½–30½%	9½–17½%
			7 to 12	19½–27½%	6½–14½%
BUTT WELD, EXTRA STRONG PLAIN ENDS					
⅜ to 1½	52 –55½%	39½–43%	¼ to 1½	24½–34½%	9½–19½%
2 to 3	53 –56½%	40½–44%			
LAP WELD, EXTRA STRONG PLAIN ENDS					
2	45 –48½%	33½–37%	1¼	.....	.....
2½ to 4	48 –51½%	36½–40%	1½	.....	.....
4½ to 6	47 –50½%	35½–39%	2	21½–29½%	8½–16½%
7 to 8	43 –46½%	29½–33%	2½ to 4	23½–31½%	11½–19½%
9 to 12	38 –41½%	24½–28%	4½ to 6	22½–30½%	10½–18½%
			7 to 8	14½–22½%	2½–10½%
			9 to 12	9½–17½%	5½–+2½%

	New York Black	New York Galv.	Cleveland Black	Cleveland Galv.	Chicago Black	Chicago Galv.
⅜ to 3 in. steel butt welded	40%	24%	40%	31%	54%40%	40%@30 %
2½ to 6 in. steel lap welded	35%	20%	42%	27%	50@40%	37½@27½%

Malleable fittings. Classes B and C, banded, from New York stock sell at plus 32%. Cast iron, standard sizes, net.

METALS

MISCELLANEOUS METALS—Present and past New York quotations in cents per pound, in carload lots:

	Current	Month Ago	Year Ago
Copper, electrolytic	19.00	19.25	21.75
Tin in 5-ton lots	49.00	61.50	70.00
Lead	9.25	9.00	5.50
Zinc	8.05	8.70	8.00
ST. LOUIS			
Lead	8.90	8.87½	5.25
Zinc	7.70@8.40	8.37½	7.65

At the places named, the following prices in cents per pound prevail, for 1 ton or more:

	New York Current	New York Month Ago	New York Year Ago	Cleveland Current	Cleveland Year Ago	Chicago April 8 Current	Chicago April 8 Year Ago
Copper sheets, base	33.50	33.50	29.50	32.00	33.50	36.00	36.50
Copper wire (carload lots)	31.25	31.25	26.50	29.50	29.50	27.00	25.00
Brass sheets	28.50	28.50	23.00	29.00	29.00	27.00	28.00
Brass pipe	33.00	33.00	34.00	34.00	36.00	35.00	37.00
Solder (half and half) (case lots)	38.00	33.00	45.00	40.50	41.00	38.00	41.00

Copper sheets quoted above hot rolled 16 oz., cold rolled 14 oz. and heavier, add 2c.; polished takes 5c. per sq.ft. extra for 20-in. widths and under; over 20 in., 7½c.

BRASS RODS—The following quotations are for large lots, mill. 100 lb. and over, warehouse; net extra:

	Current	One Year Ago
Mill	25.00	19.00
New York	27.00	21.50
Cleveland	27.00	30.00
Chicago	26.00	30.00

SHOP MATERIALS AND SUPPLIES



ZINC SHEETS—The following prices in cents per pound prevail:

Carload lots f.o.b. mill 12.50

	Warehouse			
	—In Casks—		— Broken Lots —	
	Current	One Year Ago	Current	One Year Ago
Cleveland	15.00	12.95	15.50	13.30
New York	14.00	12.00	14.50	13.00
Chicago	15.00	16.50	15.00	16.00

ANTIMONY—Chinese and Japanese brands in cents per pound, in ton lots for spot delivery, duty paid:

	Current	One Year Ago
New York	7.50	8.37½
Chicago	7.75	10.00

OLD METALS—The following are the dealers' purchasing prices in cents per pound:

	— New York —			
	Current	One Year Ago	Cleveland	Chicago
Copper, heavy, and crucible	16.25	16.75	15.50	15.50
Copper, heavy, and wire	15.25–15.75	15.75	15.00	15.00
Copper, light, and bottoms	13.00	13.50	13.00	14.00
Lead, heavy	7.00	4.62½	7.00	7.50
Lead, tea	5.00	3.75	5.00	6.00
Brass, heavy	10.25	10.00	11.00	15.50
Brass, light	7.75– 8.00	8.00	8.00	9.50
No. 1 yellow brass turnings	9.00– 9.50	9.00	8.50	9.50
Zinc	5.25	4.25	4.50	5.50

ALUMINUM—The following prices are from warehouse at places named:

	New York	Cleveland	Chicago
No. 1 aluminum, 98 to 99% pure, in ingots for remelting (1-15 ton lots), per lb	33.00	34.00c.@35.00c.	33.50

COPPER BARS—From warehouse sell as follows in cents per pound, for ton lots and over:

	Current	One Year Ago
New York (round)	38.00	25.00
Chicago	29.00	28.00
Cleveland	32.00	33.00

BABBITT METAL—Warehouse price per pound:

	—New York—		—Cleveland—		— Chicago —	
	Current	One Year Ago	Current	One Year Ago	Current	One Year Ago
Best grade	90.00	90.00	61.00	80.00	60.00	75.00
Commercial	50.00	50.50	21.00	18.50	15.00	15.00

SHOP SUPPLIES

NUTS—From warehouse at the places named, on fair-sized orders, the following amount is deducted from list:

	— New York —		— Cleveland —		— Chicago —	
	Current	One Year Ago	Current	One Year Ago	Current	One Year Ago
Hot pressed square	+ $6.00	$3.25	$ .50	$2.25	List	1.05
Hot pressed hexagon	+ 6.00	2.70	.50	2.25	List	.85
Cold punched hexagon	+ 6.00	3.25	.50	2.25	List	1.00
Cold punched square	+ 6.00	2.70	.50	2.25	List	1.00

Semi-finished nuts, ⅜ and smaller, sell at the following discounts from list price:

	Current	One Year Ago
New York	30%	50–10%
Chicago	50%	50%
Cleveland	50%	60-10-10%

MACHINE BOLTS—Warehouse discounts in the following cities:

	New York	Cleveland	Chicago
½ by 4 in. and smaller	+ 20%	20%	20%
Larger and longer up to 1½ in. by 30 in.	+ 20%	20%	10%

WASHERS—From warehouses at the places named the following amount is deducted from list price:

For wrought-iron washers:

New York..... list Cleveland..... $2.50 Chicago..... $3.00

For cast-iron washers, ½ and larger, the base price per 100 lb. is as follows:

New York..... $7.00 Cleveland..... $4.50 Chicago..... $4.75

CARRIAGE BOLTS—From warehouses at the places named the following discounts from list are in effect:

	New York	Cleveland	Chicago
½ by 6 in. and smaller	+ 20%	35%	10%
Larger and longer up to 1 in. by 30 in.	+ 20%	20%	5%

COPPER RIVETS AND BURS sell at the following rate from warehouse:

	Rivets		Burs	
	Current	One Year Ago	Current	One Year Ago
Cleveland	20%	20%	10%	10%
Chicago	net	20%	net	20%
New York	25%	40%	net	20%

RIVETS—The following quotations are allowed for fair-sized orders from warehouse:

	New York	Cleveland	Chicago
Steel ⅜ and smaller	List Net	40%	30%
Tinned	List Net	40%	30%

Boiler, ½, ¾, 1 in. diameter by 2 to 5 in. sell as follows per 100 lb.:

New York..... $6.00 Chicago..... $5.62 Pittsburgh..... $4.50

Structural, same sizes:

New York..... $7.10 Chicago..... $5.72 Pittsburgh..... $4.60

MISCELLANEOUS

SEAMLESS DRAWN TUBING—The base price in cents per pound from warehouse in 100-lb. lots is as follows:

	New York	Cleveland	Chicago
Copper	34.00	34.00	35.00
Brass	33.00	34.00	34.00

The prices, of course, vary with the quantity purchased. For lots of less than 100 lb., but not less than 75 lb., the advance is 1 c.; for lots of less than 75 lb., but not less than 50 lb., 2½c. over base (100-lb. lots); less than 50 lb., but not less than 25 lb., 5c. should be added to base price; quantities from 10-25 lb., extra is 10c.; less than 10 lb., add .15–20c.

Double above extras will be charged for angles, channels and sheet metal mouldings if ordered in above quantities. Above extras also apply to brass rod other than standard stock sizes—stock sizes being considered as ¼-2 in. inclusive in rounds, and ¼-1½ in., inclusive, in square and hexagon—all varying by thirty seconds up to 1 in. by sixteenths over 1 in. On shipments aggregating less than 100 lb., there is usually a boxing charge of $1.50.

LONG TERNE PLATE—In Chicago No. 28 primes from stock sell, nominally, for $12.50 per 100 lbs.

In Cleveland—¢10 per 100 lbs.

COTTON WASTE—The following prices are in cents per pound:

	— New York —			
	Current	One Year Ago	Cleveland	Chicago
White	15.00@17.00	13.00	16.00	11.00 to 14.00
Colored mixed	9.00@14.00	9.00–12.00	12.00	9.50 to 12.00

WIPING CLOTHS—Jobbers' price per 1000 is as follows:

	13½x13½	13½x20½
Cleveland	55.00	65.00
Chicago	41.00	43.50

SAL SODA sells as follows per 100 lb.:

	Current	One Month Ago	One Year Ago
New York	$3.00	$3.00	$1.75
Philadelphia	2.75	2.75	1.75
Cleveland	3.00	2.50	2.75
Chicago	2.75	2.50	2.00

ROLL SULPHUR in 360-lb. bbl. sells as follows per 100 lb.:

	Current	One Month Ago	One Year Ago
New York	$3.90	$3.90	$3.65
Philadelphia	3.65	3.65	3.62
Chicago	4.10	5.00	4.12½

COKE—The following are prices per net ton at ovens, Connellsville:

	July 8	July 1	June 24
Prompt furnace	$17.50@$18.50	$17.50@$18.50	$15.00@$16.00
Prompt foundry	18.00@ 19.00	18.00@ 19.00	16.00@ 17.00

FIRE CLAY—The following prices prevail:

		Current
Ottawa, bulk in carloads	Per Ton	$8.00
Cleveland	100-lb. bag	1.00

LINSEED OIL—These prices are per gallon:

	— New York —		— Chicago —	
	Current	One Year Ago	Current	One Year Ago
Raw in barrels (5 bbl. lots)	$1.48	$2.15	$1.67	$2.53
5-gal. cans (without cans)	1.51*	2.28	1.92	2.73

*To this *oil* price must be added the cost of the cans (returnable), which is $2.25 for a case of six.

WHITE AND RED LEAD—Base price per pound:

	— Red —				— White —			
	Current		One Year Ago		Current		One Year Ago	
	Dry	In Oil	Dry	In Oil	Dry and In Oil		Dry and In Oil	
100 lb. keg	15.50	17.00	13.00	14.50	15.50	13.00		
25 and 50-lb. kegs	15.75	17.25	13.25	14.75	15.75	13.25		
12½-lb. keg	16.00	17.50	13.50	15.00	16.00	13.50		
5-lb. cans	18.50	20.00	15.00	16.50	18.50	15.00		
1-lb. cans	20.50	22.00	16.00	17.50	20.50	16.00		

500 lb. lots less 10% discount. 2000 lb. lots less 10–2½% discount.

NEW and ENLARGED



Edited by
L·V·FLETCHER

Machine Tools

The following concerns are in the market for machine tools:

Conn., Shelton—P. H. Martin, 62 Union St.—one engine lathe with about 10 in. swing (used preferred).

Md., Baltimore — The Baltimore & Ohio Ry., Baltimore and Charles Sts.—planers.

Md., Baltimore — The Maryland Motor Corp., 631 Munsey Bldg.—10 piston lathes, 3 duplex milling machines, grinders, 3 multi-spindle high speed drill presses and 3 heavy duty drill presses.

N. Y., New York (Borough of Brooklyn) —The Ideal Clamp Mfg. Co., 200 Bradford St.—one 6 in. stroke geared power press (new).

N. Y., New York (Borough of Manhattan) —The Milholland Machine Co., Room 602, 111 Bway., A. Brown, Purch. Agt.—
Three 23 x 8 in. bed engine lathes.
One 32 in. crank shaper.
One 40 in. x 10 in. bed engine lathe.
Three 42 in. vertical boring mills.
One 36 in. throat double end punch and shear.
One 2 in. single head bolt cutter.
One 24 in. drill press.
One 32 in. draw out shaper.
Two 24 in. x 10 ft. bed engine lathes.
Two 1½ in., four spindle bolt cutters.
One 3 spindle, independent feed drill.
One 20 in. x 8 ft. bed engine lathe.
One 2 head rod drill press.
One 36 in. cold saw.
One combined horizontal and vertical milling machine.

Pa., Philadelphia — The Acme Gear Co., 7th and Wood Sts.—complete draw-in attachment, range ⅝ to ¾ in. inclined by 16ths.

Pa., Philadelphia—M. J. Dougherty, 1618 Washington Ave.—general line of machine tools.

Pa., Philadelphia—T. H. Livezey & Co., 1215 Filbert St.—one 24 in. x 20 ft. engine lathe (new).

Pa., Philadelphia — The Tabor Mfg. Co., Tacony St.—one 1,200 lb. power hammer.

Ala., Mobile—The Kelly Dry Dock and Shipbuilding Co.—equipment for ship repair plant (new) with either 240 v. or 110 v. 3 ph. a.c. motor drive or belt drive.

Tenn., Memphis—The Kayne & Bowler Co.—one 5 ft. radial drill.

Va., Richmond — G. C. Josephus, Laurel and Broad Sts.—welding and other machinery for repair work.

Va., Richmond—The Seventh St. Garage Co., Inc., 7th and Leigh Sts., J. B. Blackburn, Purch. Agt.—complete equipment for repair work.

Va., Richmond—The Stutz Motor Co., 1800 West Broad St., J. R. Pope, Purch. Agt.—complete equipment for repairing motor cars.

Ill., Alton—The Gillespie Eden Corp.—one Natco 20 spindle rectangular head radial drill (new).

Ill., Chicago—The Mercory Mfg. Co., 4118 South Halsted St.—one 12 spindle adjustable drilling machine, 18 x 24.

Ill., Chicago — The M. Metzger Co., 209 South Green St., one horning press.

Ill., Dixon—The Reynolds Wire Co.—one 32 or 36 in. swing engine lathe, short bed, hollow spindle attachment, also one boring mill with 36 in. swing.

Mich., Detroit—The Ajax Pattern Wks., 133 Fort St.—pattern working equipment.

Mich., Detroit—The Barnes Pattern and Machine Co., 995 Gratiot Ave.—miscellaneous equipment.

Mich., Detroit—The Bell Pump and Mfg. Co., 74 East Fort St.—miscellaneous equipment for manufacture of pumps, including ⅝ in. cold roll rounds 20½ in. or longer.

Mich., Detroit—P. Leamiller, 373 Clay Ave.—one small foot power lathe similar to Barnes 4½ (new or used).

O., Cleveland—The Amer. Tube and Pipe Bending Co., Cuyahoga and Mahoning Aves. —one 4 or 6 in. pipe cutting and threading machine with reaming attachment, two 2 in. pipe threading machines, single or double head, with reaming attachment, one 3 in. pipe cut off machine and two high speed power cold saws, capacity up to 6 in pipe (new or used), either 220 v. d.c. motor drive or belt drive.

O., Columbus—The Columbus Anvil and Forging Co., 117 West Frankford St.—one No. 4 Brown & Sharpe grinding machine (new).

O., Columbus—The Norris Mfg. Co., 1424 East Cherry St., G. E. Norris, Purch. Agt.—drill press, shaper and other machinery.

O., Columbus—The Standard E. Z. Rim Co., 630 Columbus Savings and Trust Bldg., J. F. Devers, Purch. Agt.—one drill, one punching machine and one band saw.

O., Springfield—The Springfield Advance Machine Co.—one 500 to 10,000 lb. board drop hammer (used).

Wis., Milwaukee—I. H. Diehal, 1538 Hopkins St.—one 16 in. jointer and one pony planer.

Wis., Milwaukee—The Heil Co., 26th and Montana Aves., H. Winton, Purch. Agt.—one 12 ft. power brake for ⅝ in. material, punch for punching 1 in. hole in ½ in. material, and ½ in. gate shear.

Wis., Milwaukee—The Holm Radiator Co., 228 3d St., H. H. Holm, Purch. Agt.—power shears and punch presses.

Wis., North Milwaukee—P. S. Sorenson, 327 Western Ave.—one planer and one resaw.

Wis., Two Rivers—The Bd. Educ.—machine shop equipment.

Kan., Kansas City — The Kansas City Boiler Works Co., 14 Garfield Ave.—cranes, punches, shears, rolls, lathes, drill presses, boring mill and benders.

Minn., Duluth — The Marshall Wells Co., Lake Ave., S.—one 75 lb. and one 100 lb. Bradley strap hammer (new).

Minn., Minneapolis—The Bd. Educ., 305 City Hall, K. E. Alexander, Purch. Agt.—
Standard grade and high school machine tool equipment for September, 1920, term, $9,800, including belt lacing machine, gear and angle cutters of various sizes, miscellaneous types and numbers of hand, automatic and twist drills, face plates for Oliver lathe, gauges, grinder wheels, lathe chuck, reamers, saws, threading tools, threading tool cutters, side tool cutters, cut-off tool cutters, extension shaper tools, vises, etc.
New machine shop equipment for Bremer junior high school, $3,500.
Equipment for North high school for study of gas engines, $3,000.
Items of machinery to enlarge equipment in various shops already established in high schools, $17,200.

Minn., Minneapolis—The A. C. Dunn Mfg. Co., 1118 3d Ave., S.—circle shears.

Minn., Minneapolis — The Natl. Machine and Tool Co., 249 3d Ave., O. H. Thomas, Purch. Agt.—one No. 3 punch press, Consolidated or American Can Co., and one light 4 spindle drill press (used).

Mo., St. Louis—The Beall Pressed Steel Co., 4500 North 2d St.—
One punch press, 12 in. throat, capacity 2½ in. hole in 1½ in. sheet.
Several Ferracute No. 2P or 3P punch presses (or similar).
One rotary shear for ¼ in. mild steel (all new).

Mo., St. Louis — The Steiner Mfg. Co., 4100 North 21st St.—one 18 x 24, 12 spindle, adjustable drilling machine, capacity up to ⅝ in.

Tex., Houston—The Kreiter Machine Co., 205 San Jacinto St.—two Heald, Landis, or Brown & Sharpe grinding machines (used).

Cal., San Francisco—The Berger & Carter Co., 365 Market St.—one 1½ in. triple head bolt cutting and threading machine.

Ont., Toronto — The Canadian National Railways, E. Langham, Purch. Agt.—
One 80 in. drive wheel lathe, motor drive.
One 34 in. x 12 in. gap lathe.
One 24 in. x 12 ft. engine lathe.
One 24 in. shaping machine.
One 36 in. upright drill.
One 1,000 lb. steam hammer.
One 36 in. x 8 ft. planer.
One cast iron car wheel boring machine.
One car wheel hydraulic press, motor drive.
One double end car wheel axle lathe.
One triple head bolt threading machine (all new or used).

Ont., Toronto—The A. R. Williams Co., 64 Front St.—one 2 in. triple head bolt threading machine.

Machinery

The following concerns are in the market for machinery:

N. J., Newark—A. W. Moore, 22 Green St.—small pneumatic core making machines for automobile cylinders and Mumford. Grimes, Pridmore or Tabor pneumatic roll over molding machines to jar and roll over 1,500 to 2,000 pounds.

N. Y., East Syracuse—The Benedict Mfg. Co., W. J. Hanlon, Purch. Agt.—machine for grinding knives.

N. Y., Syracuse—The Syracuse Washing Machine Corp., 507 East Water St., H. C. Cock. Purch. Agt.—nickel plating and galvanizing machine.

N. C., Greensboro—H. B. Worth—woodturning lathes and miscellaneous equipment for manufacture of handles.

Ill., Chicago—D. Levi & Co., West 40th St. and Packers Ave.—packing house equipment.

Ill., Peoria—The Rueckheim Bros. & Erkstein—special box dies with ½ in. steel cutting and creasing blades for manufacture of cardboard boxes.

O., Columbus — The Franklin Brick and Tile Co., Columbus Savings and Trust Bldg., R. S. Dingledive, Purch. Agt.—brick making machinery.

O., Columbus—The Williams Milling Co., Columbia Bldg., J. B. Wolf, Purch. Agt.—machinery for flour mill.

Wis., Milwaukee—J. Mahler, 2621 Lisbon Ave.—one baling machine.

Wis., Milwaukee—Water Dept., City Hall, F. J. Murphy, Purch. Agt.—one ton crane.

Wis., Stevens Point—The Piffner Lumber Co., 225 Franklin St.—woodworking machinery.

Ark., Little Rock — E. L. Bruce, East 17th St.—one automatic glue jointer.

Ont., St. Thomas — The Canada Iron Fdry., S. Gilbert, Mgr.—iron working machinery.

Que., Montreal—The L. R. Steel Co., Ltd. —woodworking equipment.

Metal Working

NEW ENGLAND STATES

Conn., Bridgeport—A. Aldo, 1699 Madison Ave., will soon award the contract for the construction of a 1 story, 100 x 110 ft. garage, on North Ave. and Sedswick St. Estimated cost, $50,000. F. A. Cooper, 1024 Main St., Archt. Noted Aug. 5.

Conn., Bridgeport—H. H. McCathron, 72 Knowlton St., will build a 1 story, 60 x 220 ft. forge plant, for the manufacture of boilers, etc. Estimated cost, $20,000.

Conn., Hartford—The Frasse Steel Corp., 45 Boulevard, has awarded the contract for the construction of a 1 story, 35 x 105 ft. addition to its factory. Estimated cost, $25,000. Noted April 15.

Conn., Hartford — A. Goldstein, Maple Ave., will soon award the contract for the construction of a 1 story, 110 x 150 ft. garage. Estimated cost, $100,000. F. C. Walz, 407 Trumbull St., Archt. Noted Jan. 29.

Conn., Hartford—Ryan & Delaney, c/o J. C. Walz, Archt., 407 Trumbull St., will soon award the contract for altering present building and constructing a 1 story, 65 x 120 ft. garage on High St. Estimated cost, $35,000.

Conn., New Haven—The Capitol Garage, 168 Columbus Ave., will build a 1 story, 35 x 80 ft. addition to its garage. Estimated cost, $10,000.

Conn., New Haven—The Fritzell Brass Fdry. Co., 33 Chestnut St., has acquired the plant of the International Leather and Belting Corp., on Middletown Ave., and plans to remodel same for its own use. Fletcher Thompson, Inc., 1089 Broad St., Bridgeport, Engrs. and Archts.

Mass., Chelsea—M. Rosenthal, 64 Hawthorn St., will build a 1 story, 65 x 130 ft. garage on Essex St. Estimated cost, $35,000.

Mass., Everett — The National Garage, School St., has awarded the contract for the construction of a 1 story, 60 x 120 ft. garage on Boulevard. Estimated cost, $25,000.

Mass., Gardner—The Central Oil & Gas Stove Co. has awarded the contract for the construction of a 3 story, 65 x 150 ft. factory on Plant St.

Mass., Malden—I. Meyer, 2 Irving St., has awarded the contract for the construction of a 1 story, 70 x 150 ft. garage on Eastern Ave. and Ferry St. Estimated cost, $25,000.

Mass., Methuen—R. Webb is having plans prepared for a 1 story garage on Lowell and Arnold Sts. Estimated cost, $20,000. Private plans.

Mass., Springfield — The Wallace Realty Trust Co., 392 Main St., has awarded the contract for altering and building a 1 story, 35 x 80 ft. addition to its garage on Water St., also altering its boiler house on Pynchon St. Estimated cost, $26,500.

MIDDLE ATLANTIC STATES

Md., Baltimore—The Boyden Steel Corp., Keyser Bldg., has been incorporated with $100,000,000 capital stock and plans to build a plant for the manufacture of railroad equipment trucks, etc. G. A. Boyden, R. Ramsay, Keiper Bldg., and T. G. Lurman, 808 St. Paul St., directors.

N. J., Edgewater — The United States Aluminum Co. plans to build a large addition to its plant.

N. J., Jersey City—J. T. Ryerson & Sons, 230 West Side Ave., manufacturers of steel, plan to build an addition to their plant. Estimated cost, $50,000.

N. J., Trenton—The Mueller Machine Co., Ward Ave., manufacturer of clay, tile and linoleum machinery, is having plans prepared by N. A. K. Bugbee Co., Engrs., 206 Hanover St., for the construction of a 1 story, 100 x 200 ft. machine shop and a 2 story, 50 x 100 ft. office building. Estimated cost, $40,000.

N. Y., Jamestown—The Jamestown Malleable Iron Products Corp., 306 Fenton Bldg., will receive bids until August 16 for the construction of a 2 story, 290 x 300 ft. plant for the manufacture of malleable iron castings. A. E. Schobeck, Secy.

N. Y., New York (Borough of Brooklyn) —The Brownsville Assets Corp., c/o P. Steigman, 690 Bway., Brooklyn., will build a 1 story, 100 x 160 ft. garage at 150 Crescent St. Estimated cost, $50,000.

N. Y., New York (Borough of Brooklyn) —J. Schkelnick, 37 Van Buren St., will build a 1 story, 100 x 100 ft. garage on Moore St. Estimated cost, $60,000.

N. Y., New York (Borough of Bronx) —A. Camp, c/o Dunnigan & Crumley, Archts., 394 East 150th St., will build a 1 story, 50 x 100 ft. garage on Fordham Rd. Estimated cost, $38,000.

N. Y., New York (Borough of Manhattan) —M. Miller, 935 Intervale Ave., will build a 1 story, 100 x 135 ft. garage on Park Ave. and 184th St. Estimated cost, $60,000.

N. Y., New York—The S. & Z. Bldg. Co., c/o J. M. Felson, Archt., 1133 Bway., will build a 3 story garage and service station on Manhattan Ave. and 130th St. Estimated cost, $120,000.

N. Y., New York (Borough of Manhattan) —S. Varschleisser, 215 East 67th St., will build a 1 story garage. Estimated cost, $50,000. Noted July 1.

Pa., New Castle — The Johnson Bronze Co., South Mill St., will soon award the contract for the construction of a 2 story, 52 x 68 ft. core building, a 2 story, 32 x 62 ft. machine shop and a 1 story, 68 x 101 ft. foundry. Estimated cost, $125,000. E. D. Chase, 645 North Michigan St., Chicago, Ill., Archt.

Pa., Philadelphia—The Blumenthal Bros., Margaret and James Sts., have awarded the contract for the construction of a 1 story, 60 x 100 ft. garage and machine shop. Estimated cost, $20,000. Noted Aug. 5.

Pa., Philadelphia—The Hulburt Oil and Grease Co., Inc., Trenton and Erie Sts., has awarded the contract for the construction of a 2 story, 45 x 90 ft. repair shop.

Pa., Philadelphia — The McCraffrey File Co., 5th and Berks Sts., will soon award the contract for the construction of a 2 story, 80 x 80 ft. garage. Estimated cost, $20,000. Private plans.

Pa., Philadelphia—The Quaker City Cab Co., 1211 Vine St., is having plans prepared for the construction of a 1 story, 90 x 140 ft. garage on Vine and 12th Sts. Estimated cost, $15,000. J. Sauer & Co., Denckla Bldg., Engrs. and Archts.

Pa., Philadelphia—G. Shear, 549 South Redfield St., has awarded the contract for the construction of a 1 story, 40 x 225 ft. and 40 x 110 ft. garage at 6028 Pine St. Estimated cost, $23,000.

SOUTHERN STATES

Ga., Atlanta — The Red Diamond Motor Corp. has awarded the contract for the construction of an assembling plant. Estimated cost, $300,000.

MIDDLE WEST

Ill., Chicago—A. Fesel, c/o J. K. Neebe, Archt., 2522 Aubert Ave., will soon award the contract for the construction of a 1 and 2 story, 100 x 108 ft. garage on Western St. near Montrose St. Estimated cost, $75,000.

Ill., Chicago—A. P. Freeman, c/o Levy & Klein, Archts., 111 West Washington St., has awarded the contract for the construction of a 1 story, 85 x 115 ft. garage at 23-29 North May St. Estimated cost, $35,000.

Ill., Chicago—The Independent State Garage, Kedzie and Grenshaw Sts., will soon award the contract for the construction of a 1 story, 100 x 175 ft. garage on Madison and Keeler Sts. Estimated cost, $65,000. A. Himmelblau, 179 West Washington St., Archt.

Ill., Chicago—The Kipps Express & Van Co., 6436 South Ashland St., has awarded the contract for the construction of a 1 story, 100 x 123 ft. garage at 6436 South Ashland St. Estimated cost, $25,000.

Ill., Evanston (Chicago Station)—The Buick Motor Co., c/o A. Sandegren, Archt., 25 North Dearborn St., Chicago, has awarded the contract for the construction of a 1 story, 50 x 120 ft. garage on Davis and Oak Sts. here. Estimated cost, $25,000.

Mich., Detroit — The Detroit Insulated Wire Co., Wesson and Albert Sts., has awarded the contract for the construction of a 3 story, 40 x 80 ft. factory and office building. Estimated cost, $80,000.

Mich., Detroit — The Wood Hydraulic Hoist & Body Co., 1789 Warwick Ave., has awarded the contract for the construction of a 2 story, 140 x 400 ft. factory. Noted June 17.

Mich., Detroit — The Zenith Carburetor Co., Hart Ave., will soon award the contract for the construction of a 2 story, 60 x 117 ft. factory. Estimated cost, $70,000. Smith, Hinchman & Grylls, 710 Washington Arcade, Engrs.

O., Akron—The United Machine and Mfg. Co. has had preliminary plans prepared for a 100 x 200 ft. foundry. Estimated cost, $100,000. L. E. Griffith, Pres.

O., Alliance—The Transue Williams Co., manufacturer of steel forgings, has awarded the contract for the construction of a 1 story, 100 x 200 ft. factory. Estimated cost, $75,000.

O., Cleveland—The Baker Rauch & Lange Co., 2180 West 25th St., manufacturers of electric vehicles, will soon award the contract for the construction of a 4 story, 64 x 110 ft. factory on West 25th St. and Chatham Ave. Estimated cost, $100,000. G. S. Rider & Co., Century Bldg., Archts.

O., Cleveland—The Cleveland Hardware Co., East 49th St. and Lakeside Ave., has awarded the contract for the construction of a 1 story, 49 x 197 ft. garage on East 80th St. and Averna Ave. Estimated cost, $40,000.

O., Cleveland — The Cleveland Wrought Products Co., 3590 West 58th St., has awarded the contract for the construction of a 1 story, 56 x 145 ft. factory. Estimated cost, $50,000.

O., Cleveland—The Cuyahoga Sheet Metal Co., 7908 Quincy Ave., has awarded the contract for the construction of a 1 story, 34 x 60 ft. factory. Estimated cost, $12,000.

O., Cleveland—The Exide Battery Co., 5125 Perkins Ave., has awarded the contract for the construction of a 2 story addition to its factory. Estimated cost, $60,000.

O., Cleveland — The Kaynee Co., 6925 Aetna Rd., will soon award the contract for the construction of a 1 story, 60 x 180 ft. box factory and garage, on Aetna Rd. and Bway. Estimated cost, $60,000. E. C. Seitz, Treas. Lockwood, Green & Co., Bangor Bldg., Cleveland, Engrs. and Archts.

O., Cleveland—The Ohio Electric Controller Co., 5900 Maurice Ave., has awarded the contract for the construction of a 2 story, 38 x 110 ft. addition to its factory. Estimated cost, $60,000.

O., Cleveland — The Republic Electric Mfg. Co., 1820 East 18th St., will soon award the contract for the construction of a 3 story, 50 x 50 ft. factory and 50 x 50 ft. office building, on East 18th St. and Chester Ave. Estimated cost, $100,000. L. Griesser, Pres. J. M. Dyer, Amer. Trust Bldg., Archt.

O., Cleveland—The U. S. Molding Machine Co., 968 East 69th St., plans to build a 1 story addition to its factory. Estimated cost, $50,000.

O., Cleveland—The West Steel Castings Co., 805 East 70th St., has awarded the contract for the construction of a 1 story, 20 x 71 ft. garage. Estimated cost, $10,000.

O., East Cleveland (Cleveland P. O.)—The Electric Vacuum Cleaner Co., Ivanhoe Rd., has awarded the contract for the construction of a 1 story, 65 x 80 ft. factory. Estimated cost, $25,000. Noted April 15.

O., East Cleveland (Cleveland P. O.)—The Shield Bldg. Co., 1753 Doan Ave., is preparing plans for the construction of a 1 story, 100 x 100 ft. commercial building and garage on Euclid and Superior Aves. Estimated cost, $30,000. Private plans.

Wis., Cudahy — The Worthington Pump and Mchy. Co. will soon award the contract for the construction of a 3 story, 60 x 170 ft. pattern shop.

Wis., Milwaukee—S. Buchbinder, 545 Van Buren St., has awarded the contract for the construction of a 1 story, 65 x 70 ft. garage on Martin St. Estimated cost, $15,000. Noted July 29.

Wis., Milwaukee—The H. N. Davis Co., 129 Michigan St., will soon award the contract for the construction of a 2 story, 60 x 110 ft. factory on 32d St. for plating and polishing.

Wis., Milwaukee—The Ford Motor Co., Blvd. and Woodward St., Detroit, Mich., plans to build a 2 story, 60 x 150 ft. addition to its assembling plant on Kenilworth St. here.

Wis., Milwaukee — The Kickhaefer Mfg. Co., 201 Oregon St., is building a 1 story, 60 x 142 ft. factory on Reed St. for metal stamping. Estimated cost, $45,000.

Wis., Milwaukee—The A. E. Martin Fdry. and Machine Co., 705 Park St., will soon award the contract for the construction of a 1 story, 30 x 145 ft. addition to its foundry. S. F. Kadow, 97 Wisconsin St., Archt.

Wis., Neillsville — The Duplex Storage Battery Co., 537 Edison St., Milwaukee, will soon award the contract for the construction of a 1 story, 100 x 300 ft. factory here.

Wis., North Milwaukee — The Bernert Mfg. Co., 489 12th St., has awarded the contract for the construction of a 1 story, 60 x 120 ft. foundry. Noted May 27.

Wis., Plymouth — The Service Motor Co. plans to build a 4 story, 60 x 200 ft. garage. Estimated cost, $100,000.

Wis., Two Rivers — The Bd. Educ. will soon award the contract for the construction of a 3 story, 144 x 199 ft. high school to include a machine shop and power house. Estimated cost, $400,000.

Wis., West Milwaukee (Milwaukee P. O.)—The Chicago, Milwaukee and St. Paul Ry., Construction Dept., Union Depot, is preparing plans for the construction of a 1 story, 100 x 500 ft. shop for repairing cars.

WEST OF THE MISSISSIPPI

Iowa, Davenport — G. A. Koester, c/o Davenport Roofing Co., has awarded the contract for the construction of a 3 story, 65 x 150 ft. garage on Front St. Estimated cost, $150,000.

Kan., Kansas City — The Kansas City Boiler Works Co., 14 Garfield Ave., is building a 1 story, 40 x 60 ft. and 40 x 198 ft. plant. Estimated cost, $40,000. E. L. Hudson, Genl. Mgr.

Mo., Monett—The St. Louis & San Francisco Ry., Frisco Bldg., St. Louis, has awarded the contract for the construction of a 1 story, 16 x 72 x 110 ft. machine shop and a 16 x 27 x 80 ft. roundhouse. Estimated cost, $40,000.

Mo., Newburg—St. Louis & San Fransico Ry., Frisco Bldg., St. Louis, has awarded the contract for the construction of a 1 story, 16 x 27 x 110 ft. roundhouse and a 16 x 27 x 80 ft. machine shop. Estimated cost, $40,000.

Mo., St. Louis—The F. Adams Electric Co., 3640 Winsor St., has awarded the contract for the construction of a 1 story, 147 x 190 ft. factory. Estimated cost, $150,000.

Mo., St. Louis—The Brecht Co., 1201 Cass Ave., has awarded the contract for the construction of a 2 story, 107 x 130 ft. machine shop. Estimated cost, $80,000.

Mo., St. Louis—The Eagle Motor Truck Corp., 6154 Bartmer Ave., plans to build an additon to its plant.

Mo., St. Louis—The Heine Safety Boiler Co., 5319 Marcus Ave., has awarded the contract for the construction of a 1 story factory. Estimated cost, $25,000.

Mo., St. Louis—The Landes Machine Co., 407 Gano St., has awarded the contract for the construction of a 1 story boiler and machine shop at 4929-31 North 2nd St. Estimated cost, $6,000.

Mo., St. Louis — The Urbauer Atwood Heating Co., 1446-50 South 2d St., has awarded the contract for the construction of a 2 story, 60 x 108 ft. factory. Estimated cost, $12,000.

Tex., Beaumont — The Oil City Brass Wks. is building a 90 x 200 ft. foundry and machine shop. Estimated cost, $25,000.

CANADA

Ont., Hamilton—The Steel Works of Canada, Harvey Lane, will soon award the contract for the construction of a 2 story steel plant and foundry. Estimated cost, $300,000.

General Manufacturing

NEW ENGLAND STATES

Conn., Bridgeport — The Amer. Fabrics Corp., Connecticut Ave. and Waterman St., will soon award the contract for the construction of a 1 story, 60 x 166 ft. factory, for the manufacture of lace. Estimated cost, $50,000.

Conn., Hartford — The Home Tourist Candy Co., c/o Backoff, Jones & Cook, Archts., Union Bldg., Newark, N. J., will soon award the contract for the construction of a 2 story, 60 x 100 ft. factory. Estimated cost, $50,000. Noted June 3.

Conn., Naugatuck—The Naugatuck Chemical Co., Elm St., has awarded the contract for the construction of a 2 story, 50 x 60 ft. factory for the manufacture of mineral flour, on Elm St. Estimated cost, $60,000.

Mass., Wakefield—The Heywood Bros. & Wakefield Co., Gardner, Mass., manufacturers of chairs, will soon award the contract for the construction of 6 dry kiln buildings and an addition to its plant here. Lee & Hewitt, 1123 Bway., New York City, Archts.

R. I., East Greenwich—The Greenwich Mills, Division St., will soon award the contract for the construction of a 4 story, 80 x 90 ft. addition to its textile plant. Estimated cost, $50,000. Noted Aug. 5.

MIDDLE ATLANTIC STATES

N. J., Jersey City—The Cotton Textile Co., 383-385 Cator Ave., plans to construct 4 factory buildings. Estimated cost, $50,000.

N. J., Trenton — The Hamilton Rubber Mfg. Co., Mead St., has awarded the contract for the construction of a 2 story, 20 x 40 ft. addition to its factory, for the manufacture of tires. Estimated cost, $15,000.

N. J., Trenton — The Thermoid Rubber Co., Whitehead Rd., has awarded the contract for the construction of a 1 story, 80 x 200 ft. addition to its new plant. Estimated cost, $50,000.

Pa., Coraopolis—The Domestic Refrigerating Co. will soon award the contract for the construction of a 1½ story, 60 x 100 ft. factory. Estimated cost, $40,000. The Brandt Clapper Co., Park Bldg., Pittsburgh, Archts.

Pa., Philadelphia—The Keystone Spinning Mills, 1631 North 2nd St., has awarded the contract for altering its plant and building a 2 story, 60 x 95 ft. warehouse, on Turner and Palethorpe Sts.

MIDDLE WEST STATES

Ill., Chicago—The F. H. Hill Co., Washington and Morgan Sts., manufacturer of coffins, has had plans prepared by Waltersdorf & Bernard, Archts., 38 North La Salle St., for the construction of a 7 story, 34 x 88 ft. factory. Estimated cost, $75,000.

Ill., Chicago—D. Levi & Co., West 40th St. and Packers Ave., has awarded the contract for the construction of a 3 story, 115 x 170 ft. packing plant, on West 39th St. and Emerald Ave. Estimated cost, $350,000.

Wis., Campbellsport — The White House Milk Products Co., West Bend, is having plans prepared by M. Tullgren & Sons, Archts., 425 East Water St., Milwaukee, for a 1 story, 50 x 100 ft. plant.

Wis., Rice Lake—The Twentieth Century Silo Co. is planning to build a stave mill on Bracklin St. and Kern Ave. A. C. Robarge, Secy.

Wis., Sheboygan—The Columbia Rubber Works, 176 16th St., Milwaukee, plans to remodel and build an addition to its factory. Estimated cost, $100,000. Juul & Smith, 805 North 8th St., Archts.

WEST OF THE MISSISSIPPI

Minn., Minneapolis—Roach Tisdale & Co., 528 North 3d St., is planning to build a 5 story, 50 x 150 ft. factory on 5th Ave. and 3d St. for the manufacture of candy. Estimated cost, $200,000. E. E. Tisdale, Secy., Butler Bros. Bldg. Co., 1001 Exchange Bank Bldg., St. Paul, Archts.

Mo., Kansas City — The Feeder Supply Co., 532 Live Stock Exchange Bldg., has purchased a site on Duncan Ave. and plans to build a mill. Estimated cost, $150,000.

Mo., Kansas City—The Irving Pitt Mfg. Co., 8th and Locust Sts., is building a 6 story, 132 x 132 ft. factory for the manufacture of loose leaf binders. Estimated cost, $500,000.

Mo., St. Louis—The Schulz Belting Co., 4th and Boston Sts., has awarded the contract for the construction of a 1 story, 25 x 50 ft. factory, on South 4th St. Estimated cost, $6,000.

CANADA

Ont., Grimsby—The Grimsby Pickle Co. will soon award the contract for the construction of a 3 story, 40 x 80 ft. factory. Estimated cost, $40,000.

Que., Montreal—The L. R. Steel Co. Ltd., will soon award the contract for the construction of a woodworking plant.

FOREIGN

Alaska, Unalaska Island — The Amer. Whale Products Co., 8 South Dearborn St., Chicago, Ill., will soon award the contract for the construction of a whale oil plant on Udagak Bay, here, to include refinery, fertilizer plant, oil tanks and storage buildings. Estimated cost, $1,000,000 Waltersdorf & Bernard, 138 North La Salle St., Chicago, Ill., Archts.

SEE SEARCHLIGHT SECTION

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August 19, 1920 **American Machinist** Vol. 53, No. 8

Machining Monel-Metal Castings

By A. J. HANLON
Technical Department, International Nickel Co.

Monel metal is being put to many uses, the number of which is constantly increasing. Any collection of facts relative to machining this metal is a worthy addition to our present rather incomplete information. The article here presented furnishes specifications for lathe tools for turning and threading monel-metal castings. There is also information concerning lubricants.

MONEL metal is an individual alloy possessing distinctive machining qualities. Castings, when machined on the lathe, require tools with rounded cutting edges, pronounced back slope, or top rake, and keen cutting angles; also a first-class quality of high-speed steel properly hardened and tempered, and comparatively low cutting speeds. Ease of machining is a function of the physical properties of a metal. Experiments made in our own laboratory indicate that cast monel requires more power to machine than mild steel. This power comparison should not be confused with machining methods for these two metals as they are entirely dissimilar.

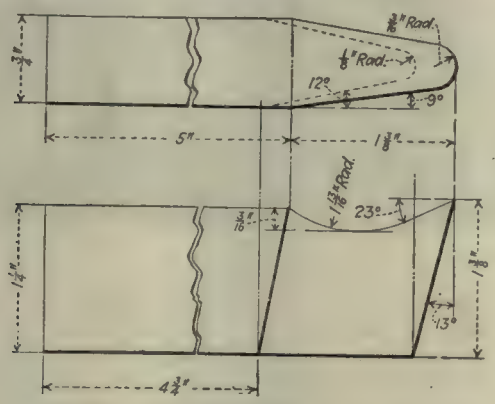


FIG. 1. LATHE ROUGHING TOOL

Angular Shapes of Tools

Cast monel, due to its extreme toughness, requires tools with keen cutting angles. This necessary keenness may be best obtained, without weakness of cutting edges by grinding the lathe tools with certain angular shapes. Tools so shaped permit the use of higher cutting speeds with a minimum of regrindings, both factors of extreme importance in economical shop production practice.

In Figs. 1 to 4 the important angles for roughing and threading tools (both solid tools and tool bits) are specified. The use of a toolholder with $\frac{3}{8}$-in. and $\frac{5}{8}$-in. bits in itself furnishes sufficient top rake without grinding. The Armstrong toolholder, for example, holds the bit at a 30-deg. angle.

The roughing tool (Fig. 1) is ground with a 13-deg. clearance angle and 23-deg. top rake. The nose is tapered gradually at an angle of 9 deg. from a plane parallel to the side of the tool and the cutting edge is rounded, with $\frac{3}{16}$-in radius. The sides on the nose are ground with gentle slope from top to bottom to obtain the 9- and 12-deg. angles shown. Both angles are measured from a plane parallel to the side of the body of tool. Cast monel metal when turned, gives a long, tough chip. The large rake or back slope ground in the roughing tool helps materially to get rid of this chip by curling it. In that way it is prevented from concentrating the heat generated over the least sectional area (the lip surface),

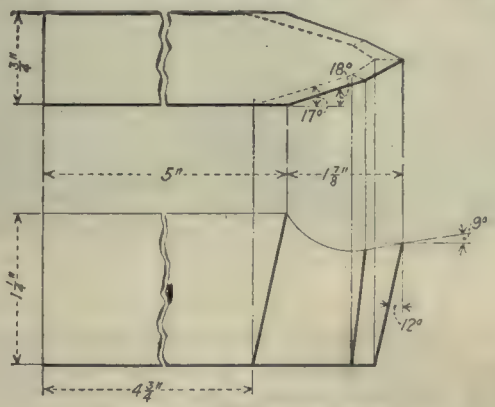


FIG. 4. THREADING TOOL

resulting in greater life under working conditions. The clearance angle is made small for the purpose of strengthening the tool, in fact, just large enough to preclude any possibility of rubbing the flank of the tool against the work. When machining a casting with a particularly hard outer skin, the cutting edge may be more blunt with beneficial results. This is secured by grinding the flank of the tool. A tool of this description has less tendency to cut cleanly but is stronger, better withstanding the hard knocks encountered in cutting the skin of any casting, due to sand holes or surface defects.

For either $\frac{3}{8}$- or $\frac{5}{8}$-in. bits, Figs. 2 and 3, the clearance

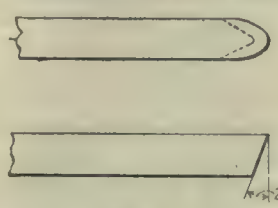


FIG. 2

FIG. 2. $\frac{3}{8}$-IN. ROUGHING TOOLBIT

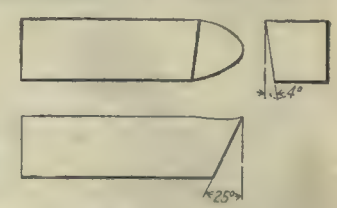


FIG. 3

FIG. 3. $\frac{5}{8}$-IN. ROUGHING TOOLBIT

angle must of necessity be larger than that for bar stock tools, due to the position in which these are held in the toolholder. As no top rake is ground in the tool, this larger clearance angle of 25 deg. does not weaken it. With a $\frac{5}{8}$-in. bit, 4-deg. side slope should be ground back from the cutting edge in order that the chip may better free itself.

The threading tool, Fig. 4, on account of its pointed cutting edge, has a greater tendency to crumble. For this reason, rake and clearance angles are decreased to 9 deg. and 12 deg. respectively. Side rake, 17 deg. and 18 deg., is measured from a plane parallel to the side of the body of the tool and is obtained by grinding the side of the nose on a gentle slope from top to bottom. The point of the tool may be ground for any standard thread desired.

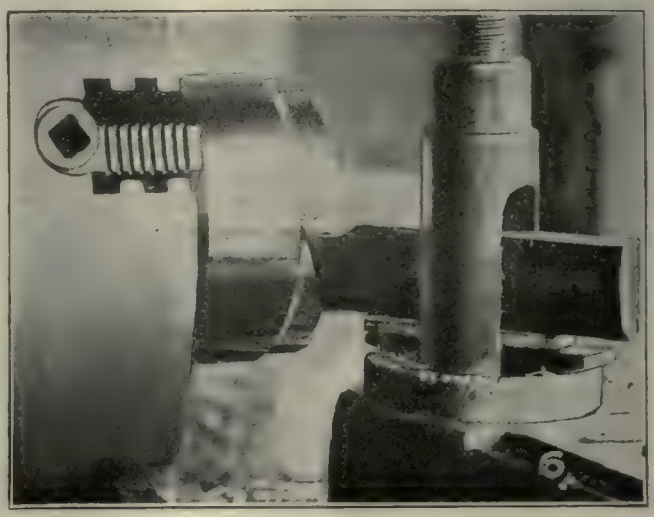
The best method of dressing the tool is to turn up the nose or point $\frac{1}{8}$ in. above the body of the tool. By plunging it into fish oil. The temper was then drawn at 1,000 deg. F. (dark red) the tool being allowed to cool slowly in a closed box. Tempering the tool relieves the strains in the metal, giving it a tough rather than hard cutting surface and materially lessens the number of regrindings necessary for a given amount of work. This hardening procedure follows the general course as laid down for the majority of high speed steels.

Among the high-speed steels which have given satisfaction in cutting cast monel metal, are the Maximum 000L, Peter A. Frassee and Co.; Triple Mushet, B. M. Jones and Co. and Rex AA, Crucible Steel Co. of America.

Grinding Tools

The tool should first be ground on a dry emery wheel, not being held firmly against the wheel but moved over its surface. The wire edge should be removed on either





FIGS. 5 AND 6. TURNING A MONEL-METAL PLUG ON AN ENGINE LATHE

so doing the maximum number of regrindings with one dressing may be obtained. The roughing tool shown in Fig. 1 is correctly dressed. The threading tool shown in Fig. 4 has been ground a number of times. With an equal number of grindings the roughing tool would assume a similar shape, in the relation of the nose of the tool to the body. Tools should leave the smithshop with approximately the same angles as the finished tools are to have, to avoid waste on the emery wheel. Forging temperatures for most high-speed steels lie between 1,750 and 1,850 deg. F. (yellow heat). During forging operations the temperature should not be allowed to drop to less than 1,600 deg. F. (light cherry or red). In Figs. 1 and 4 the noses are shown dressed straight with the body of the tool. For greater facility, when machining small castings, it is good practice to turn the nose of the tool to the right through an angle of 45 deg. from a plane parallel to the side of the body of the tool.

Hardening and Tempering

On account of the toughness of cast monel, it is very essential that the high-speed tool steels used in machining should be tempered or toughened after initial hardening. With one particular steel, namely Maximum 000L, excellent results were obtained with the following heat treatment. The temperature was slowly raised to 1,800 deg. F. (yellow heat) and then quickly to 2,300 deg. F. (white heat) and the tool cooled by a common wet grindstone or an oilstone. Care should be taken not to burn the cutting edges. The sides of the flank should be ground first, then the lip or rake angle, and finally the edge should be rounded. On subsequent grindings, approximately the same angles should be retained.

Feeds as shown in the table are recommended. These figures are based on the experiences of a large number of firms. They are for dry cutting. Cooling solution permits the use of higher surface speeds. It will be noticed that a good average speed of 60 in. per minute, $\frac{1}{8}$-in. cut and $\frac{1}{32}$-in. feed should be used. To secure a better finished surface, a light cut may be taken with small feed and high speed.

The tool should have a true solid bearing on the tool

FEEDS AND SPEEDS FOR TURNING

Cut-Inches	Feed-Inches	Cutting Speed Feet per Minute
$\frac{1}{16}$	$\frac{1}{16}$	150
	$\frac{1}{32}$	120
$\frac{1}{8}$	$\frac{1}{16}$	100
	$\frac{1}{32}$	90
	$\frac{1}{64}$	75
$\frac{1}{4}$	$\frac{1}{16}$	85
	$\frac{1}{32}$	70
	$\frac{1}{64}$	50
$\frac{1}{2}$	$\frac{1}{16}$	75
	$\frac{1}{32}$	60
	$\frac{1}{64}$	45
	$\frac{1}{8}$	40
$\frac{3}{4}$	$\frac{1}{16}$	50
	$\frac{1}{32}$	40
	$\frac{1}{64}$	30

support, which should extend as nearly as possible to a point directly beneath the cutting edge. The body of the tool should be greater in height than in width. The cutting edge should be set slightly higher than the center of the work to obtain the greatest shearing effect. No hard or fast rule can be laid down, as this height will differ with varying diameters. On small work where a full cut must be taken, with the danger of a dog or chuck interfering with tool carriage before its completion, the roughing tool may be set on an angle up to 30 deg. For threading all the way to chuck or dog, a threading tool dressed with nose offset should be used.

Lubricants

For ordinary lathe work, cast monel metal may be cut dry very satisfactorily. The use of a lubricant is sometimes preferable. Among those on the market that have been found to give excellent results are: For cutting, Houghtons' Soluble Oil, 1 gallon to 10 gallons of water, E. F. Houghton & Co.; Equinox No. 1, Lindsay McMillan Co.; Oakite, Oakley Chemical Co. For threading, Cresol No. 1 Soluble Oil, emulsion of 15 parts water to 1 part creosol No. 1. For cutting and threading, Top Cutting Oil, Frontier Manufacturing Co. For general work, machine oil.

Examples of Work Done With Tools Recommended

In Figs. 5 and 6 are illustrated the turning operation on monel-metal plugs which have successfully replaced bronze plugs, in connection with Burton's gasoline stills used in the petroleum refining process. The two machining operations necessary, turning to size and threading, are done on an engine lathe. The plug casting is gripped on the square head by a 4-jaw chuck. The tool is turned sidewise at an angle of 30 deg. to prevent interference of chuck and carriage. There is little tendency to dig in, and a wide, tapered chip is removed, thinnest at the finishing point.

A $\frac{1}{8}$-in. cut is taken with $\frac{1}{32}$-in. feed at 60 surface feet per minute. The point of the tool is set $\frac{1}{8}$ in. higher than the center of the work, to obtain the maximum shearing effect. A cut of this size is, in most cases, sufficient to allow the cutting edge of the tool to penetrate under the tough skin of the casting, into the more uniform metal beneath.

The great advantage of the top rake in the lip surface of tools is clearly shown in Figs. 5 and 6. The chip is curled and thrown to one side with the least injury to the cutting edge. Keenness of the cutting edge is thus retained over the longest period of time with resultant good surfacing.

For the threading operation a tool with the nose turned to the right at an angle of 45 deg. is used. The finished thread is completed in three or four passes. The chip curls up very much as does the chip from the roughing tool.

A Well-Developed Technical High School

By Fred. D. Hood
Head of Mechanic Arts Department of Los Angeles Polytechnic High School

The work of training young men for the machine business in these days is a very absorbing and important subject. The part which our public schools, some of them at least, are contributing to this end makes it reasonable to expect for the future a better grade of mechanic than is produced by our present-day apprenticeship system, if, indeed, there is such a thing. The latter remark, of course, does not apply to the results obtained in some of our large and long-established concerns, which are both effective and, to some extent, philanthropic. Their chief fault is that they are not numerous enough. For a full and systematic training in the machine business, and in other lines as well, so far as a thorough groundwork in the leading principles and a well-rounded education is concerned, the public school, in my opinion, can do more effective work and can do it on a larger scale than can any other organization at present.



FIG. 1. THE WOOD SHOP AND PATTERN SHOP



FIG. 2. STUDENTS AT WORK IN THE FOUNDRY

The Los Angeles Polytechnic High School was established at its present location in 1905, the Mechanic Arts Department consisting of a woodshop and patternshop 60 x 70 ft. in size, a forge shop 30 x 70 ft., a foundry 30 x 70 ft. and a machine shop 60 x 70 ft. A mechanical and electrical engineering laboratory 40 x 100 ft. in size was added in 1911, much of the equipment for it being made in the school shops.

Fifteen separate four-year courses comprise the curriculum of the school and for two of these, mechanical engineering and vocational machine shop, the major work is given in the Mechanic Arts Department. The object of the former course is to give good, sound training in the elementary principles of the design and construction of general machinery, including steam and gas engines, pumps and the machine work connected with dynamos and motors. In the latter course the

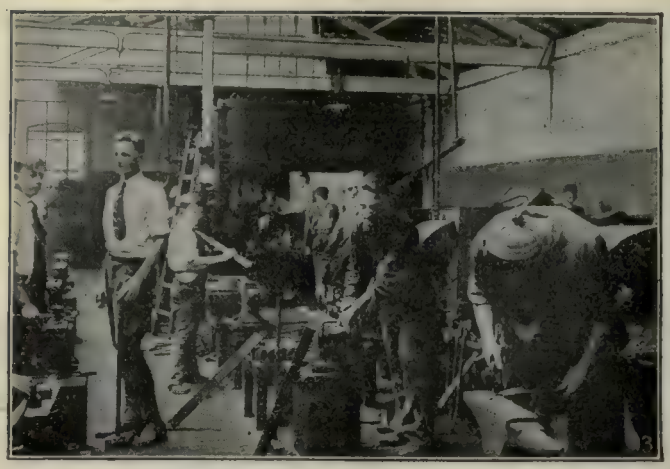


FIG. 3. ACQUIRING FIRST-HAND INFORMATION ABOUT BLACKSMITHING



FIG. 4. VIEW OF THE MACHINE SHOP WITH THE STUDENTS AT WORK

work is confined largely to Simon-pure machine-shop practice, meeting the requirements of the Smith-Hughes Act. The engineering laboratory, which is perhaps unique in schools of this type, gives good opportunity for the application of shop practice in the installation, adjustment and operation of machinery, as well as furnishing an incentive to the machine-shop students for the building of machines and equipment.

Properly correlated mechanical drawing, mathematics, physics and other technical studies, as well as the academic subjects, round out and balance these courses.

A large majority of high school students either drop out of school, or, if they do complete the course, never carry their systematic training any further. This makes it incumbent upon the school to offer a course which gives the greatest measure of usefulness, in terms of earning capacity, for the time spent. Such a course should be self-contained in every step and capable of being turned to practical use at any time as contrasted with a course which bears fruit only after an extended and tedious process.

While a boy should get all the training he can while the getting is good, attend the best university in the country and graduate if possible, the best provision we can offer should be extended to that large number who we know will never gain the high institutions, yet who are, in the main, altogether worth while. Judging from the experiences of those students who have gone out from the school, this kind of thing is reaching the people, for not a few return, either to complete their course or to take advanced work in the same line.

The school runs practically twelve months in the year, night and day. It enrolls over 2,100 pupils in the day school and over 3,000 pupils in the night school and is free to all.

The accompanying illustrations show some views of the shops and of the kind of work being carried on.

Why the Blueprint?

By L. N. Gillis

I have noticed articles by several contributors on the question of "Why the Blue Print?" the first one being by Frank Richards on page 871, vol. 52 of the *American Machinist*. It seems to me that, so far, your contributors have all overlooked one of the best ways for making drawings for use in the shop. I refer to the reproduction of drawings by the direct photographic copying process, as done with the photostat and other like machines.

During the war, it was my fortune to have charge of the drafting office of the National Research Council. When I took charge of the office, I found the sizes of drawings, prescribed by the man who had started the work, were standard sizes adopted from the drawings used in a sewing machine factory. I also found that the institution possessed a photostat machine of large size, and it was a simple matter to establish sizes for the drawings that would correspond with the standard sizes on the photostat scale. Then the drawings, either pencil drawings or tracings, could be laid on the photostat board and all reduced to 18 x 22 in., or a half or quarter thereof. When using the half size either two prints were made at a time or the half-size shield was put on the photostat. This method enabled as many reproductions to be made directly from the drawing as were necessary for our purposes; and, in addition, if a change was made on any drawing, the same could be reproduced without making a new zinc plate or a new photographic plate, since the printing was done directly on the photostat paper.

Moreover, the cost of this work is very little more than the cost of the ordinary blueprint, and is certainly much less than would be the case with any small number of reproductions made by either a zinc-plate process or a photographic process on glass to any reasonable size. There is a happy medium between a small photograph and a blanket-sized blueprint that can very readily be reached with the photostat; and, in addition, it is possible to do with this latter class of reproduction all that can be done with either the zinc- or photographic-plate process without requiring the lines and figures to be made abnormally large and heavy, since the drawing reproduced in this way to a size 18 x 22 in. comes out very distinctly, even though the drawing itself may be 48 or even 60 in. long. Again, convenient portfolios may be made up, all of 18- x 22-in. size, showing all of the drawings for any particular machine or apparatus.

Of course, it is to be understood that, where small details are made, they can either be photographed to full size or reduced from the original by placing a number of them on the printing board of the photostat. There are a number of machines of this class in the market, and, so far as I can find out, are all about equally good, and the operation is extremely simple in almost every case.

Superchargers for Airplane Engines*

By SANFORD A. MOSS
West Lynn, Mass.

A supercharger supplies air to the carburetor at sea-level pressure in high altitudes, thereby maintaining the engine power at sea-level value, and causing a considerable increase of speed.

AN AIRPLANE flying at high altitude is in an atmosphere of comparatively low density. For instance, at 20,000 ft. altitude the density is practically half that at sea level. This means that a given volume contains half as much actual air by weight. The cylinders of an airplane engine are therefore charged with an explosive mixture which has about half the value of a charge at sea level. The engine actually delivers about half of its sea-level power at 20,000 feet. At high altitude the resistance of the air to the motion of the airplane is decreased directly in proportion to the decrease of density. The power required for a given airplane speed is therefore greatly reduced. However, the engine power has been so reduced that the usual net result is a considerable decrease in airplane speed. When the engine power is maintained at the sea-level value, there is, however, a considerable increase of speed at high altitude. Filling the cylinders of an internal-combustion engine with a charge greater than that which would normall yoccur, is called "supercharging."

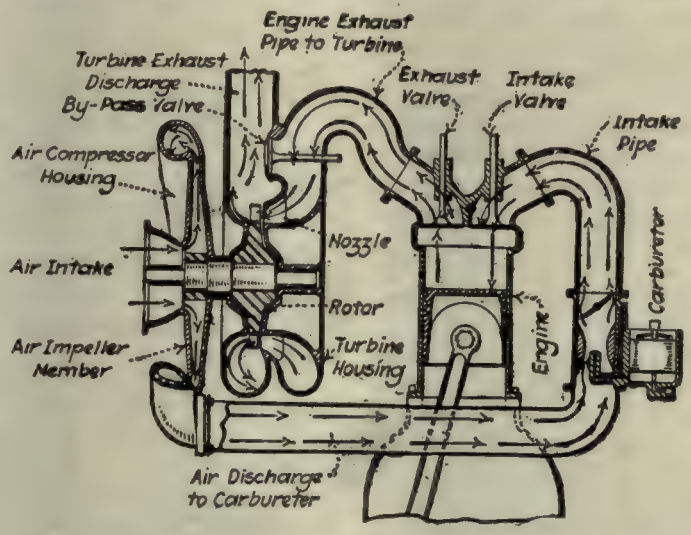


FIG. 1. DIAGRAMMATIC SKETCH OF AN AEROPLANE ENGINE EQUIPPED WITH A SUPERCHARGER

The centrifugal compressor is an apparatus similar to the fan blower except that the shape of the impeller blades and the passages leading air to and from the impeller are so arranged as to give efficiency very much greater than that of the usual type of fan blower, so that the apparatus forms a satisfactory means for compressing air to appreciable pressures. A line of single-stage centrifugal compressors has been developed for compressing air from 2 to 5 lb. per square inch above atmosphere, to be used for many industrial purposes; as well as a line of multi-stage machines for compressing air and gas up to pressures of 30 lb. per square inch above atmosphere.

The turbo-supercharger is a combination of a gas turbine and a centrifugal compressor, arranged as part of an airplane gasoline engine. The hot products of combustion from the engine exhaust are received upon the turbine runner and furnish power whereby is driven a centrifugal compressor mounted on the same shaft, which compresses air for supply to the carburetors. In Fig. 1 is shown an airplane engine equipped with a turbo-supercharger. The exhaust of the engine is received by an exhaust manifold which leads it to a nozzle chamber carrying nozzles which discharge it onto the buckets of a turbine wheel. On the same shaft with the turbine wheel is the impeller of a centrifugal compressor. This compresses air from the low-pressure atmosphere to approximately normal sea-level pressure and delivers it to an air-discharge conduit which supplies the carburetors.

The turbine nozzles are of such area as to maintain within the exhaust manifold and nozzle box a pressure approximately equal to that at sea level. The difference between this pressure and the altitude low order to avoid back pressure drop for the exhaust gases which furnishes the power that operates the system. Due to the respective temperatures this power input suffices to give the desired compression and also to supply the inevitable losses. However, in order to avoid back pressure on the engine, above the normal sea-level value, both turbine and compressor must be designed with utmost attention to efficiency. With an efficient arrangement the engine when at high altitude exhausts at normal sea-level pressure and receives its air at the carburetor at normal sea-level pressure. Hence, normal sea-level power is delivered at all altitudes up to the maximum for which the supercharger is designed, so that the plane speed will increase uniformly as the altitude density decreases.

The General Electric superchargers thus far constructed have been designed to give sea-level absolute pressure at an altitude of 18,000 ft. which requires a compressor that doubles the absolute pressure of the air.

This pressure ratio, with the quantity of air involved, means about 50 shaft-horsepower input for the compressor. The design of a complete power plant of this size to suit an existing airplane engine, with such weight and location as will not impair the flying characteristics of the plane, has, of course, offered many problems. The possibility of driving the compressor of the supercharger by engine power, instead of by the exhaust gases suggested itself. Much experience with the operation of the gas turbine, however, led the writer to prefer its problems to those of the driving mechanism of a supercharger operated from the engine. The turbine involves merely the addition to the compressor of a single extra wheel, designed for the con-

*From an extract published in *Mechanical Engineering*, of a paper on "The General Electric Turbo-Supercharger for Airplanes," contained in the May, 1920, issue of the *General Electric Review*.

ditions, with no extra bearings. The engine-driven scheme involves a 50-hp. transmission with a multiplicity of gears, bearings, clutches, belts, and the like. These offer more or less drag on the engine when the supercharger is not in use at low altitudes, and very serious problems of acceleration when the supercharger is to be thrown into action, since the engine will be then running at its full speed of about 1,800 r.p.m.

The exhaust manifold and nozzle box have proven to be a very efficient exhaust muffler and conductor. Such a muffler and conductor are needed in any event, and the design of means for withstanding the increased pressure difference of the turbo-supercharger has been successfully accomplished.

Power for Turbo- and Engine-Driven Superchargers

An efficient turbo-supercharger theoretically deducts from the indicated-horsepower of the airplane engine an amount corresponding to the difference between sea-level absolute pressure and altitude pressure. There is this additional back pressure during the exhaust stroke. The theoretical power available for driving the turbo-supercharger is greater than this, however, owing to the fact that there is available not only the energy due to the direct pressure difference mentioned, but also the energy of perfect expansion from the higher to the lower pressure. If there were no turbo-supercharger the engine would waste this energy in sudden pressure drop as the exhaust valve opens. The turbine can utilize this energy. The sum of these two amounts of available energy, multiplied by the efficiency of the turbine wheel, gives the shaft power delivered to the compressor.

For an engine-driven supercharger compressor there is greater engine indicated power due to a lower exhaust pressure. However, the shaft power for the super-charger compressor must be transmitted through the engine connecting rod and crankshaft, with losses, and then through the supercharger driving mechanism with additional losses. The total shaft power thus subtracted from the engine, multiplied by the efficiencies of these two transmissions, gives the shaft power delivered to the compressor. This is the same as for the turbo-supercharger. For a Liberty motor of 400 hp. and sea-level power at 18,000 ft. altitude, this power is 50 hp.

The comparison, then, is as follows: The turbo-supercharger subtracts from the engine indicated power, adds power of expansion which would not otherwise be used, and has turbine wheel losses. The engine-driven supercharger puts this indicated power through the engine (with some additional loads on the pins and bearings) and has engine and transmission losses.

With usual efficiency there is probably not a great difference between the gross subtraction from engine power in the two cases. There is then the disadvantage of transmitting the supercharger power through the engine pins and bearings, as well as through some mechanism between engine and supercharger, to be compared with the collection of the hot gases under pressure (with muffling advantages) and delivery to the turbine wheel. As already mentioned, practical success to date is in favor of the turbo-supercharger and the writer feels that this is really due to its innate superiority.

Engine-driven superchargers with positive-pressure blowers have been proposed. These have the additional disadvantage that with the desirable pressure ratios of about two to one there is an appreciable compression loss due to the fact that the machine only displaces air and has no direct means for compression.

Supercharging engines of various kinds, in which the engine crankcase or the engine cylinders themselves are arranged for additional compression, have been shown to give excessive weight and complication as compared with a turbo-supercharger.

Development of the Turbo-Supercharger

The machines used thus far have been designed to give sea-level pressure at 18,000 ft. altitude, which corresponds to a pressure ratio of about two. The rated speed for these conditions is 20,000 r.p.m. Sea-level pressure has readily been obtained up to 22,000 ft. altitude. The control is entirely by hand operation of waste gates, which permits of free escape of some of the exhaust gases.

The entire apparatus, exclusive of exhaust manifold and air-discharge conduit, weighs about 100 lb. The exhaust manifold and air conduits have nearly the same weight as equivalent parts with no supercharger.

The turbine and compressor wheel have diameters somewhat less than a foot. The present design has been hampered by necessity for accommodation to existing engines and planes. It is proposed, however, to construct apparatus in which engine and supercharger are integral, with all parts arranged for the full possibilities of the combination.

In the combination under consideration the airplane, propeller, engine, radiator, cooling system, and supercharger are so intimately associated that no adequate tests can be made without the complete system in operation at full speed at altitude. During the initial development of the Liberty motor a testing expedition had been sent to the summit of Pike's Peak, and it was decided to repeat this performance with the supercharger. Fig. 2 shows the motor truck that was prepared for the expedition and Fig. 3 the way it was left after each day's work. The Liberty motor carrying the supercharger was mounted on a cradle dynamometer, with scales and all arrangements for accurate measurement of power, gasoline consumption and the like. In fact, a complete testing laboratory was provided. The motor truck was shipped by rail to Colorado Springs, and then proceeded by its own

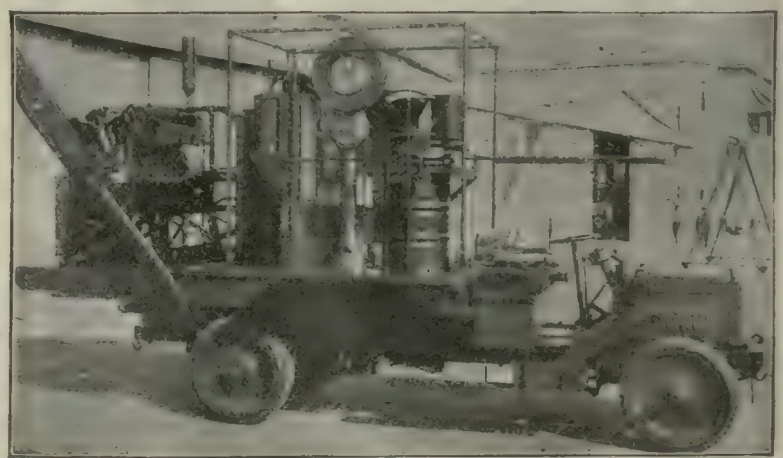


FIG. 2. MOTOR TRUCK PREPARED FOR EXPEDITION TO SUMMIT OF PIKE'S PEAK FOR TESTING LIBERTY MOTORS

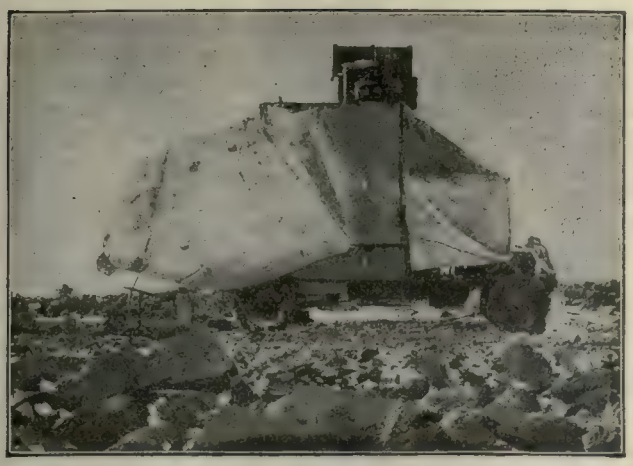


FIG. 3. SHOWING WAY IN WHICH MOTOR TRUCK OF FIG. 2 WAS LEFT AFTER END OF DAY'S WORK

power to Pike's Peak summit on the "Pike's Peak Auto Highway," a well-constructed but very tortuous mountain road 28 miles long. The summit has an altitude of 14,109 ft. and it is the highest point in the United States easily reached by road.

The testing work at the summit lasted through September and half of October, 1918. The usual difficulties with experimental work were, of course, encountered with the addition of many delays, due to the cold and snow, and distance from repair shops. The apparatus was finally arranged to give good mechanical operation and it was found possible at the existing altitude of 14,000 ft. not only to supercharge so as to give full sea-level power, but also to overcharge so as to cause the engine to preignite.

It was agreed that results of the tests warranted the immediate installation of the supercharger on an airplane, and arrangements for doing this were in progress when the armistice caused a cessation of the work. After the armistice, careful re-examination of the situation resulted in resumption of the work in the early part of 1919. Various rearrangements were made in view of the experience gained at Pike's Peak and the apparatus was finally installed on an airplane. After a number of tests on the ground, flight tests were made.

It soon developed that a very appreciable increase of power was easily obtained when the supercharger was opened up. The whole airplane installation was not properly arranged to take advantage of this power, however, and changes were necessary in the radiator, cooling system, propeller system and gasoline tank.

Supercharger Performances

The supercharger which has been used to date in flight tests was primarily desired for high speeds at altitudes of 18,000 to 22,000 ft. The Le Pere plane on which the installation was made had a ceiling of about 20,000 ft. with two men, and a speed at this altitude of 70 miles per hour. With the supercharger in use, a speed of about 140 miles an hour has been attained at 22,000 ft. As already pointed out, this has been attained with various parts of the plane installation in a partially developed state. Theoretical computations have been made showing that much higher speeds at high altitudes are to be expected. The progress of the flight tests to date indicates that the theoretical expectations will be fully realized.

The making of high altitude records has been very attractive and the supercharger has, of course, been used for this purpose as well as for the speed courses mentioned. Successively higher altitudes have been reached as experience has been gained regarding the manipulation of oxygen, gasoline, and other details.

On Feb. 27, Major Schroeder made a flight alone, attaining an actual height above the ground finally computed as 36,130 ft. (6.85 miles). The lowest temperature reached was minus 67 deg. F. At the maximum altitude his oxygen apparatus failed and he became unconscious and lost control of the plane, which fell almost vertically. As he neared the earth he partly recovered consciousness and, at an altitude of about 3,000 ft., succeeded, in a half-dazed semi-automatic way, in righting the plane and making a good landing in his own field, again becoming unconscious. He was taken to a hospital in a serious condition, but has since almost completely recovered. The supercharger, engine, and plane were in perfect working order after the flight.

At the maximum altitude attained, recording instruments showed that the plane was still climbing at the rate of about 125 ft. per minute and it was estimated that an altitude of 40,000 ft. would have been attained if the oxygen apparatus had not failed.

In the May issue of the *General Electric Review* there also appears a reprint of a paper on "Superchargers and Supercharging Engines," by Major George E. A. Hallett, U. S. A., presented at the annual meeting of the Society of Automotive Engineers, Jan. 7 and 8, 1920. Major Hallett, who is Chief of Power-Plant Division, U. S. Air Service, deals at some length with the various methods employed in supercharging and refers to the work of the U. S. Air Service on the Rateau type of turbo-compressor, under the supervision of E. H. Sherbondy, prior to that undertaken by Dr. Moss. Commenting on the working of the Moss supercharger, he says:

> It would naturally seem at first thought that the extremely low temperatures always found at great altitudes would make possible the easy solution of cooling problems, but in reality the low density of the air reduces its heat conductivity and capacity for heat absorption to such a point that a supercharged engine developing sea-level power at 20,000 ft. requires a little *more cooling surface* than it does when developing normal power at sea level.
>
> The Liberty engine and many others run best with a water temperature of about 170 deg. F. To maintain the cooling water at this temperature in the reduced atmospheric pressure at 25,000 ft. it is necessary to use several pounds of air pressure in the radiator to prevent the water from boiling away. Very effective radiator shutters are needed when the engine is throttled to make a descent from altitudes over 20,000 ft. to prevent the water in the radiator from freezing before warmer air is reached.
>
> Contrary to expectations, the Moss turbo-compressor now being tested at McCook Field does not complicate the pilot's controls. On a normal engine the pilot handles the throttle and the altitude carburetor control which thins down the mixture as he ascends. With the turbo-compressor the altitude control becomes unnecessary up to the altitude at which the engine can no longer deliver sea-level power but is used, as with a normal engine, if the plane is driven higher.

As to the future of the supercharger, Major Hallett says:

> The uses of the supercharger for military service can be divided into: First, for airplanes in which it is desired to reach extreme altitude; second, for airplanes in which it is desired to increase the rate of climb and horizontal speed and therefore maneuverability at altitudes where it is intended to fight; and, third, for airplanes which carry large loads such as bombers, which normally are handicapped by

having a very low ceiling and whose entire usefulness would, if larger engines were installed to pull them to a higher ceiling, be lost on account of the large amount of fuel and other material that would have to be carried, thus decreasing their radii of action.

In the first case it is believed that a special supercharger can be built that will make feasible much greater altitudes than any that have been attained with the present General Electric turbo-compressor; and it is considered essential that we have airplanes capable of reaching very great heights. In the second case, it is pointed out that military machines not fitted with supercharging engines, when fighting at an altitude of 20,000 ft. or more, are so near their ceiling that their rate of climb, speed, and maneuverability are comparatively poor, but the use of a supercharger seems to overcome this difficulty easily.

The use of superchargers in commercial airplanes of the future is assured because superchargers will make possible far *more miles per hour* and *more miles per gallon* with a given engine and airplane, and speed is the main advantage of air over other kinds of transportation. It is thought by many qualified judges that by flying at a sufficient height with a supercharged engine and a suitably designed airplane, a speed of 200 m.p.h. can be maintained.

In the heavy-load-carrying type of plane which must necessarily cross mountains or perhaps fly above storms and clouds, the necessary height can be reached with smaller, cheaper, and more economical engines if they are fitted with superchargers. It is obvious that in really long cross-country flights or trans-continental flights, with mail or passengers, the logical course is to fly at 25,000 or 30,000 ft. altitude where the resistance to speed is low and great speed can therefore be attained provided the engine can deliver high power economically, which it can do if equipped with a supercharger.

The Machinist and the Guard

By Val Klammer

Any mechanism exposed to hazardous contact is like a savage dog, harmless only when securely muzzled.

In the campaign against accidents much importance is placed upon the proper guarding of dangerous machinery, and it is only right that such should be the case; no one can deny that unguarded machinery takes a heavy toll of human life and causes much unnecessary suffering. If a man is injured by a train of gears, a guard over the gears will prevent many injuries to other men, but there is no magic charm about it, no guarantee that it will always effectively protect the worker. It is a fallacy to believe that any dangerous condition can be removed by the erection of a guard.

Safety in a machine shop is not obtained by simply placing guards on the machines, no matter how expensive the guards may be. The desirable state of safety and absolute freedom from accidents is only obtainable by guards plus something else, a something without which the installation of safety devices is but a waste of time, money and material.

A large machine shop in Pennsylvania was inspected by a state inspector who presented a voluminous report calling for numerous guards on the various machines. The management expressed its surprise in suitable terms, but finding that state laws demanded the guarding required gave its approval to the order. Thousands of dollars were spent on the guards and Mr. State Inspector finally pronounced the shop to be thoroughly guarded in accordance with the standards. Every gear, every belt and pulley, did its little bit inside a cage.

One year later Mr. State Inspector again appeared at the machine shop and presented a report which caused more consternation than the first. Of the many hundred expensive guards only a few were found to be intact; the rest were missing or in a badly broken condition. This made the management gloomily seek an answer to the eternal question "What's the use?" and think bitter things about the machinists for whose benefit the guards were installed. That is where the management made its big mistake; the guards were not installed for the benefit of the machinists but because state laws demanded it. The wastage of guards was due to the lack of one very important thing—the *co-operation* of the worker.

One curious fact which is repeatedly forced upon the attention of those engaged in accident prevention is that the first man to remove a safety device or render it ineffective is the man for whose protection the device is provided. A machine guard is primarily provided for the protection of the machinist, and yet he will frequently remove the guard and forget to replace it. This neglect or thoughtlessness is a serious matter; in the State of Pennsylvania the removal of a safeguard is considered a misdemeanor punishable by fine or imprisonment.

Employers have frequently accused workers of lacking interest in their own safety, and there is some degree of truth in the accusation, but it is not entirely through lack of interest that guards are lost or destroyed. The "take-a-chance" spirit is peculiarly American and is undoubtedly the cause of many accidents, but it is not this spirit which is chiefly responsible. The real reason is that there exists in every man a certain love for the old order and a distrust of the new, a preference for things as they have been for many years. Old "Bill" now runs a modern lathe but he has a secret longing for his old machine, the rattling product of a bygone age, and proudly tells of what he did, not what he does.

Opposition to safety devices is natural and should be looked for when any devices are to be installed, but the machine guard will never be of permanent value until the machinist has overcome this feeling of opposition. The first step in guarding any dangerous mechanism is not in designing the guard but in convincing the machinist that the guard is necessary for his safety and the safety of his fellow-workers. Before a safety device is installed it must be "sold" to the men who will profit by it. There is another reason for opposition to safety devices, a reason which is frequently overlooked by those who accuse the machinist of negligence—and that is the bad design of guards. No machinist can be expected to take great care of anything which interferes with production or prevents quick access to any part of the machine.

In the installation of machine guards new hazards are sometimes created. The guard may be placed too near moving parts and be caught and destroyed, or it may not give sufficient clearance to the machinist's hands while operating the machine. If a machinist pulls a lever or turns a wheel and lacerates his hands against the guard the great chances are that the guard will soon find its way to the scrap pile.

The ideal guard is strong and will not fall to pieces under the vibration and heavy usage of a machine shop; it is made of some material which will not obscure the parts guarded; it is well provided with doors to permit immediate access to the machine for the incidental changing of gears and the oiling of bearings. It takes the guard plus the co-operation to produce safety.

Some of the Shipbuilding at New Orleans During the War

By FRED H. COLVIN
Editor, *American Machinist*

Those who were busy making munitions of various kinds were not aware of the large amount of war work done in the Southern States. As an example New Orleans did its full quota in repairing and building ships at its various yards.

ONE of the well-known yards for ship repairs is the Johnson Iron Works, with its principal plant in Algiers, just a short ferry ride across the bend of the Mississippi from New Orleans proper. Here they handle a large amount of repair work and also have another yard for building hulls on Bayou St. John. Here were built some of the fabricated ships of the Emergency Fleet Corporation. Side launching was necessary owing to the lay of the land in this yard. Inclined runways are used in yards of this type as can be seen by views showing launching of the two boats.

Some idea of the difficulty of securing material can be had from the fact that the boiler shown in Fig. 1 was fabricated in Montreal, Canada, and the plates shipped to the Johnson Works for assembly.

The Johnson yard also built a number of good-sized tug boats, building the engines as well as the hulls. One of these engines is shown behind the propeller in Fig. 2. They are of the compound type and have an extremely large expansion ratio, the high pressure cylinder being 18 and the low pressure 38 in. in diameter, with 26-in. stroke. These engines develop 500 hp. with 150 lb. of steam, running at 112 r.p.m.

The propeller shown is a type which has been used quite extensively by the Johnson company, on account of its having removable blades so as to allow replacement



FIG. 1. BOILER READY FOR INSTALLATION

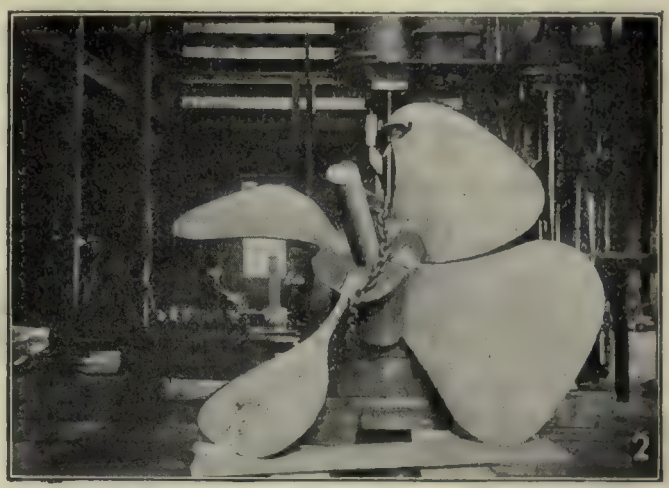


FIG 2. PROPELLER AND ENGINE



FIG. 3. A NORMAL SIDE LAUNCHING



FIG. 4. ALMOST AN ACCIDENT

in case of injury to a single blade. The blades fit into a dovetail and are keyed into position, the keys being quite easily removed in case replacement becomes necessary.

Figs. 3 and 4 show two launchings of tugs, the first being a perfectly proper and normal launching of the tug "Delanco." This figure also shows the bottle used in christening still swinging from the bow. Fig. 4, however, shows what narrowly missed being an expensive accident, but which fortunately only caused a momentary scare, from which no damage resulted. This is the tug "Delaplaine," which is of the same design as the "Delanco."

This unusual launching was the result of one of the cradles slipping off the runway, which caused the hull to shift and roll into the position shown before striking the water. Fortunately it righted instantly and no damage resulted.

A Short Proof for Long Division

By Walter R. Meyer
Chief Tool Designer, R. K. LeBlond Machine Tool Co., Cincinnati, Ohio

Modern practice demands efficiency in all branches of work, and any method or idea tending to increase the production of any employee, in any capacity, increases the efficiency of the business. With this idea in mind, the writer wishes to submit the following method of proving long division, in the hope that it may give the designer, draftsman or tool engineer a short cut in his mathematics.

When I wish to positively prove a calculation I desire to see it in plain figures, thereby eliminating mistakes on slide rules or in the use of logarithms. The advantage of this method, that of simplicity, is self-evident, as it relies on nothing but plain addition for positive proof. Being so simple, I dare say that it is not new; but to the best of my knowledge it is not generally used.

The method will be shown by the use of the following numerical example. Dividing 1.25 by 0.98362, the quotient is 1.2708, with a remainder of 15704, as can be seen by the work given later. The proof of this would be 0.98362 times 1.2708, plus the difference 0.000015704, which gives 1.25, the original dividend. But this number has already been obtained in our division, so that the terms and final remainder can be totaled, disregarding the dividend and the remainders which are shown in italics in the following example:

```
0.98362) 1.250000000 (1.2708
           98362
          ------
          266380
          196724
          ------
          *696560
           688534
          -------
            802600
            786896
            ------
             15704
          ---------
Proof:   1.250000000
```

Further explanation is unnecessary, but I may add that should there be a mistake in subtraction or multiplication it would show up in the addition and it would be in the column in which the first deviation of the sum from the dividend occurred, when reading from the right. For illustration, suppose that the remainder *696560* marked * in the example was, due to a mistake in subtraction, made to read *695560*. The result would be:

```
0.98362) 1.250000000 (1.2707
           98362
          ------
          266380
          196724
          ------
          *695560
           688534
          -------
            702600
            688534
            ------
             14066
          ---------
Proof:   1.249900000
             *
```

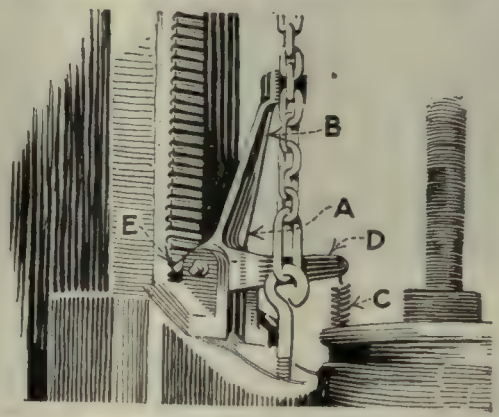
The appearance of the 9 in the total indicates a mistake in the column marked by the star, and the error in subtraction can be quite easily located. The writer hopes that others may find this method as useful as he has found it.

[Editor's Note. The preceding article appeared on page 157 of the July 22 issue of the *American Machinist*, and it is here reprinted on account of typographical errors printed at that time.]

Safety Device for a Multi-Spindle Drilling Machine

The *National Safety News* shows the accompanying illustration of a safety device applied to the head of a multi-spindle drilling machine.

The head of the machine carrying the drills, is supported by a chain, the other end of the chain having



THE SAFETY DEVICE

a counterweight attached to it. The head is raised and lowered by the usual rack and pinion.

As originally constructed, if the chain should break there would be nothing to prevent the head from falling and damaging the tools or injuring the operator or both.

The safety device consists of the two armed lever *A* pivoted to the head in the manner shown. The arm *B* is held against the chain by the pull of the spring *C* attached to the arm *D*. While in this position, the dog *E* is held clear of the rack teeth.

Should the chain break the spring would pull down the arm *D*, bringing the dog into the rack teeth. Downward movement of the head would cause the device to revolve until the arm *D* came in contact with the head, when the dog acting as a pawl would prevent the head from falling.

Chart for Computing Planing Time

By J. B. CONWAY

The construction and use of a chart for computing the cutting time required for planer jobs is covered in this article. The information is, of course, not new, but it is presented in a way which should make it of use to shop men.

THE accompanying chart is designed for rapidly computing the cutting time required for planing a surface when the other factors entering into the calculation are known, and from it the time in minutes or hours can be readily ascertained. In order to make such a calculation the following factors must be known: W the width in inches; L the length in feet; f the feed in inches per stroke; v the forward or cutting speed in feet per minute, and V the return speed in feet per minute.

W and L, of course, are determined by the dimensions of the part to be machined, f by the conditions presented by the construction of the part and the material to be cut, as is also v, the cutting speed, and V is determined by shop practice and the construction of the particular planer in question. For instance, several planers in the same shop may have different values for V, and the ratios of v to V, or the forward to return speed of the planer platen will vary accordingly, as 2:1, 3:1 or 4:1. Unless all of the planers in the department have the same ratio of v to V it becomes necessary to take these factors into consideration separately for the different machines.

The Ordinary Formula

The formula ordinarily used for calculating the time required for planing is: $T = \frac{WL}{f} \times \left(\frac{v + V}{vV}\right)$, and this may be still further reduced to $T = \frac{WL}{f} \times C$ when $C = \left(\frac{v + V}{vV}\right)$.

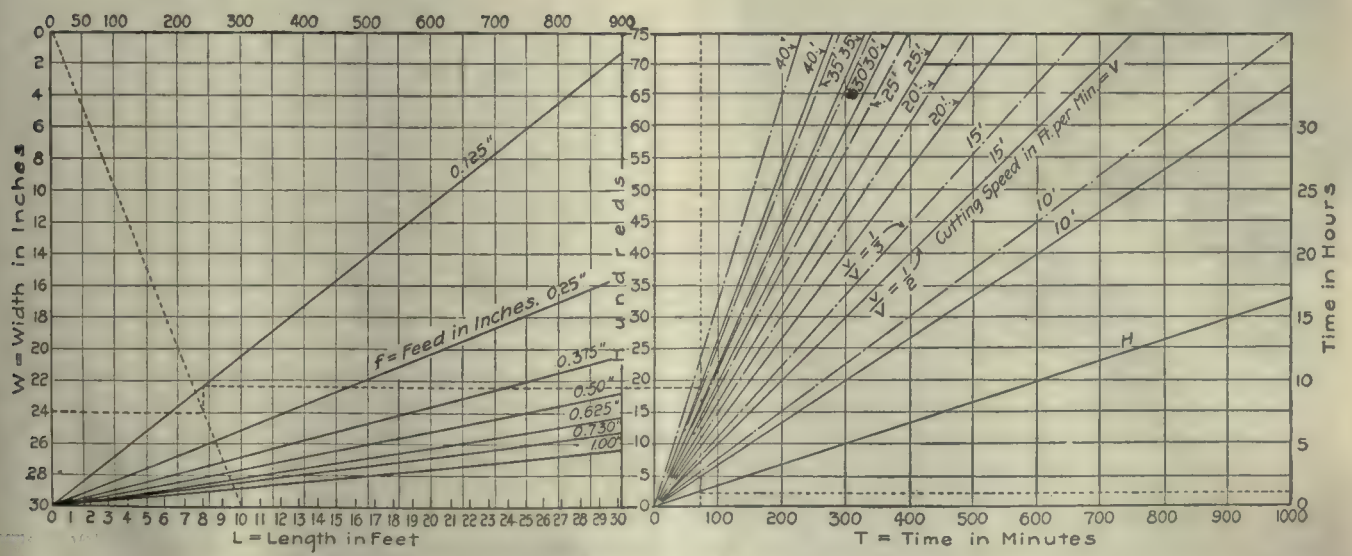
As an example let us assume, $W = 24$ in.; $L = 10$ ft.; $f = 0.125$ in.; $v = 40$ ft. per minute, and $V = 80$ ft. per minute. Then $T = \frac{24 \times 10}{0.125} \times \frac{40 + 80}{40 \times 80} = 1{,}920 \times 0.0375 = 72$ min., or $\frac{72}{60} = 1.2$ hr.

The same result can be obtained from the accompanying chart, as follows: With the straight-edge or celluloid triangle connect the length in feet, L, with zero at the upper left-hand corner; on the left scale find the width in inches, W, and read to the right until this line intersects the diagonal line formed by the straight-edge; thence along this vertical line until it intersects one of the diagonal lines representing the feed in inches, f; then, reading across to the right from this intersection, the result is found on the middle vertical scale. Continue from this value to the right until the line intersects one of the diagonal lines corresponding to the cutting speed in feet per minute, v, and thence to the scale at the bottom and read T, or time in minutes. If the time in hours is sought, follow the vertical line from time in minutes until it intersects the diagonal line marked H, and across from this intersection to the right-hand scale and there read T in hours and hundredths. (Follow broken line and arrowheads on chart.)

The diagonal lines in the right section of the chart represent the cutting speed for two ratios of v to V, namely, 1:2 and 1:3, the solid lines being the former and the dot and dash lines the latter. Other ratios could be added, but, for the sake of simplifying the chart here, only two are given.

Construction of the Chart

To construct the chart proceed as follows: On the left-hand margin, to any convenient scale, lay off the width in inches, or W. On the lower margin lay off the length in feet, using any convenient scale, and on the top margin place the results of $W \times L$, this scale will be governed by the size of the scales used for W and L.



A CHART FOR COMPUTING THE TIME REQUIRED FOR PLANING

It is not necessary to incorporate in the chart the vertical scale in the middle, but, if desired, it is determined by dividing the minimum and maximum results for WL by the minimum and maximum values for f, and a scale adopted that will keep these values within the confines of the chart. The diagonal lines for f may then be put in.

The next step is to plot the other half of the formula, or $\frac{v+V}{vV}$. It will be found more convenient to solve this, thereby obtaining the values for C, mentioned above. These values, or ratios, have been worked out and can be obtained from the accompanying table.

TABLE SHOWING THE VALUE OF C FOR VARIOUS RATIOS OF v TO V

v Ft.	*V Ft.	Ratio	C	Ratio	C	Ratio	C
10	20	1:2	0.150	1:3	0.133	1:4	0.125
20	40	1:2	0.075	1:3	0.066	1:4	0.0625
30	60	1:2	0.050	1:3	0.0445	1:4	0.0417
40	80	1:2	0.0375	1:3	0.0333	1:4	0.0313
50	100	1:2	0.030	1:3	0.0267	1:4	0.0250
60	120	1:2	0.025	1:3	0.0222	1:4	0.0208

* The values for V for the other ratios have not been given, and to obtain them it is only necessary to multiply w by 3, 4, or any number representing the proportion.

Then, to any scale, lay off horizontally the maximum number of minutes required, which is obtained by multiplying the values on the middle scale by C. The diagonal lines represent the values of C, and can be readily laid off by multiplying any value on the middle scale by any value of C, and then marking this value at the intersection of the horizontal line extending to the right of the value on the middle scale with the vertical line representing the time in minutes. Through this point of intersection, draw a line connecting zero and the top scale, as shown.

The scale at the extreme right is the time in hours, and is the quotient of the values on the bottom scale divided by 60 min. Determine the maximum time in hours and lay this off to any suitable scale, then plot the line H by locating the values of minutes divided by 60 at the intersection of the vertical and horizontal lines representing minutes and hours, respectively.

Comparison of Values

A little thought given to a comparison of the values of C will disclose the fact that with a ratio of 1:3, as compared with a ratio of 1:2, there is a decrease in the time of 11.3 per cent, and with a ratio of 1:4, as compared with 1:3, a decrease of 16.6 per cent is shown. Further comparisons show at just what ratio will the shortest time be obtained commensurate with other conditions.

Inertia and Initiative

By Entropy

Some twenty years or more ago Elbert Hubbard wrote the "Message to Garcia." There is no doubt but that it stirred many men to action for it was cleverly written and in a style that could hardly miss its mark no matter how little educated the reader might be.

Some one ought to write a "Message to Garcia" for the benefit of the employers of these many messengers. Some one ought to point out to them that just so far as they stifle initiative themselves they hinder not only their own progress but the progress of the Nation.

How many times men take new jobs with every intention and desire to make things hum, who strip for action only to find themselves facing stone walls of ancient and more or less honorable precedent. They find these stone walls back of hedges of attractive green shrubbery, but the shrubbery only conceals the walls and does not make them one whit easier to scale.

Our Inclination to Lag

We are all more or less inclined to drag and lag behind. Inertia is a valuable force, but there is a tremendous waste in overcoming it when it gets in the way of progress. In things mechanical we are overcoming it. We knew a few years ago that mechanical flight was impossible. It was, until the traditions of a hundred years gave way and the internal combustion engine, which was only slightly antedated by the steam engine, awoke from its slumbers and developed into the low-weight power plant of today, and the art of flying became a possibility. The advent of the new alloy steels has made possible construction which was not even dreamed of a few years ago, and today the proposition to send a rocket to the moon does not appear at all a visionary thing, though in the time of Jules Verne it could be put over only as a story.

But with all this progress in material things our mental processes do not seem to advance. The philosophies of Socrates are accepted by about the same proportion of people as in his times. We seem to be able to change our environment but not ourselves. We cling to the "way we used to do it" with the greatest tenacity, so great in fact that the only progress possible seems to be made by those who rush in "where angels fear to tread." Pure ignorance seems to be the requisite for anyone who would advance our ways of business thinking, and that coupled with a hide so thick that no arrows of scorn and derision can penetrate.

The result is that we grow old before we are aged. Every avenue through which a man who is in the least degree sensitive can advance is closed, and he is kept in a low position until he is so thoroughly tamed that he is one of the regulars and can be depended upon to think in any given emergency as the founder of the firm thought a hundred years ago.

When Men Had to Find New Methods

There was a time, when the country was younger, when men had to find ways to do things for themselves rather than be taught the old way. That was in the time when men were subduing the fields of New England, and piling up stone walls separating the fields from each other, which now serve so useful a purpose for building roads. Then these men had to make shoes and they invented new ways to make them because they did not know the old ways. They invented the factory system because they did not have time enough each to learn to make a pair of shoes clear through. Today we have two quite distinct classes of manufacturing, the old established class which covers nearly all the necessities of life except a few that have just recently become classed as such, and the newer lines which have not as yet become standardized. We are apt to think of these latter in terms of crudity, and to hope for the time when they will also be standardized. Is there not something wrong with our rush for uniformity? Is not the handicap of increased difficulty of progress enough to more than overbalance the present cheapness of manufacture?



The Evolution of the Workshop—XIII

By H. H. MANCHESTER

The American metal-working industry in the period from 1840 to 1860 was characterized chiefly by the developments of quantity production and the system of interchangeable-parts manufacture. Inventions were many and far-reaching in scope and the growth of the industry was astounding, the progress made in the production of firearms furnishing a good criterion of this.

(*Part XII appeared in last week's issue.*)

AS IN the previous decades, the progress in metal-working machinery may be judged largely from the methods in use in making firearms, for in spite of the development of the steam engine and the railroad, munitions of war were still the metal productions which required the greatest exactness, and the field to which the greatest attention was given.

Firearms were becoming more and more interchangeable in their parts. The Jenks carbine and pistol, made by the Ames Manufacturing Co., was so exactly constructed that ten guns could be stripped at any time and reassembled indiscriminately. This was attained, however, principally by jigs and a fine set of gages. In the same year the new percussion musket manufactured at the Springfield armory was also made with interchangeable parts.

In 1846 de-carbonized steel was put into use by the Remington's. In the same year at that factory Albert Eames was using a strap drop for die forging. A compound-crank drop was employed by E. K. Root in 1850. The illustration, Fig. 83, shows a high frame with four pillars, at the top of which were the driving shaft and crank. Each machine had four drops.

A profiling machine for straight edging, shown in Fig. 84, was designed by F. W. Howe, and made use of by Robbins & Lawrence at Windsor, Vermont, in 1848. This machine seems to have been first used in the Springfield armory the next year, as there is an entry in the account book there at that date for work on such a machine. Two years later edging machines were in use in Sharp's Rifle Works at Hartford.

In 1850 a four-spindled vertical machine for boring rifle barrels was introduced by F. W. Howe at Windsor,

The manufacture of the early locomotives was accomplished only with the greatest difficulty. The plane work at first had to be done by chipping and filing, hand planing and slabbing. The earliest power planer built

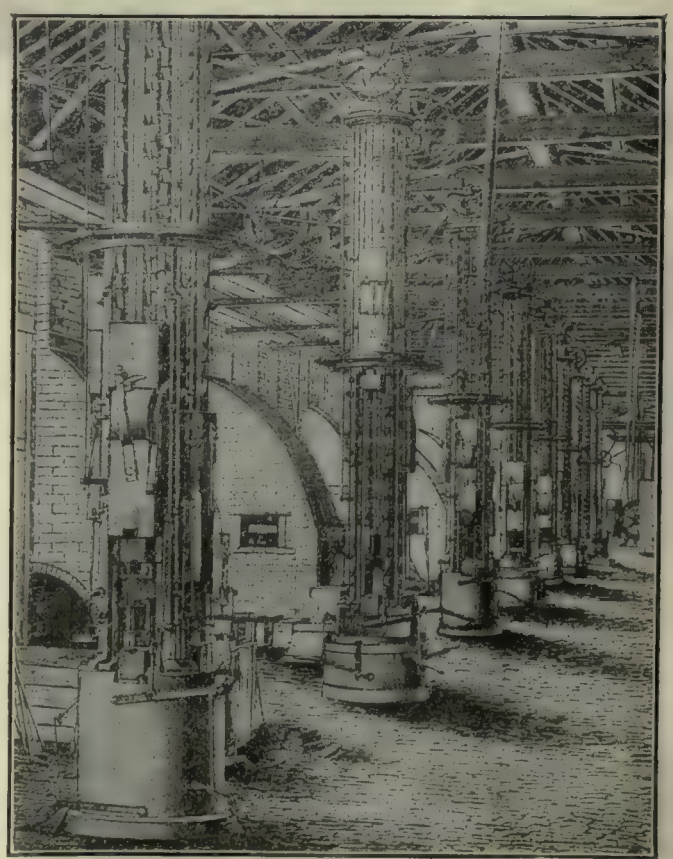


FIG. 83 COMPOUND-CRANK DROP-FORGING MACHINES OF 1850

in the United States seems to have been in the fall of 1839 at Chelmsford, Massachusetts, where in 1880 it was still doing good service in the shops of Silver & Gay. When built this was properly considered a wonderful mechanism, planing 22 ft. long, 3½ ft. wide, and 3½ ft. high. It was used for some years in making machinery for the Concord railroad shops, and for the shops of the Erie railroad at Dunkirk.

In locomotive manufacture we find a power press for wheels at Windsor in 1848, as well as large horizontal lathes for boring car plates. Vertical turning and boring machines for locomotives were employed at least as early as 1850.

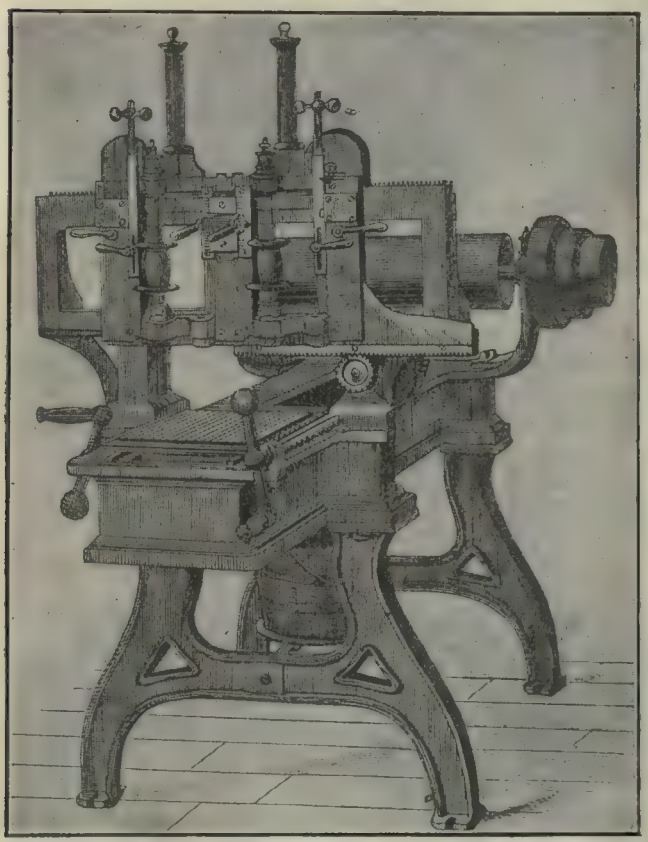


FIG. 84. F. W. HOWE'S STRAIGHT-SLIDE EDGING OR PROFILING MACHINE, 1848

The first rolling of heavy iron rails of the T shape took place in 1844. A machine for making railroad spikes was patented by J. H. Swett in 1851, and one for heading bolts by Nathan Stark in the same year.

Patents of the Forties

Some conception of the demands and ideas of the time may be gathered from the more important patents.

In 1840 William Field took out a patent for screw augers. The same year a saw-filing machine was invented by E. Carver. In 1841 J. J. Howe patented a machine for making pins, while J. F. Wells patented one for dovetailing and tenoning. The next year W. F. Steiger received a patent for fluted nails and bolts.

In 1843 a machine for making horseshoes and another for links of chains were patented by J. F. Winslowe and Thomas Osgood, while Henry Burden took out an improvement on his horseshoe machine. The steam-driven forging machine, shown in Fig. 85, was developed at about this time.

In 1845 we find a self-adjusting screw finisher invented by Cullen Whipple, and a machine for making forks patented by S. H. Gilman. In 1847 a method of welding cast- and malleable-iron or steel was patented by William Marten, and the next year Vaughn and Winslowe patented a process for welding iron pipe. A new type of wire-nail machine, shown in Fig. 86, was also brought out.

Census of Occupations

Most interesting data connected with machine shops included in the census of 1850 is embraced in the tables giving the number of persons engaged in different occupations. According to these there were then not quite

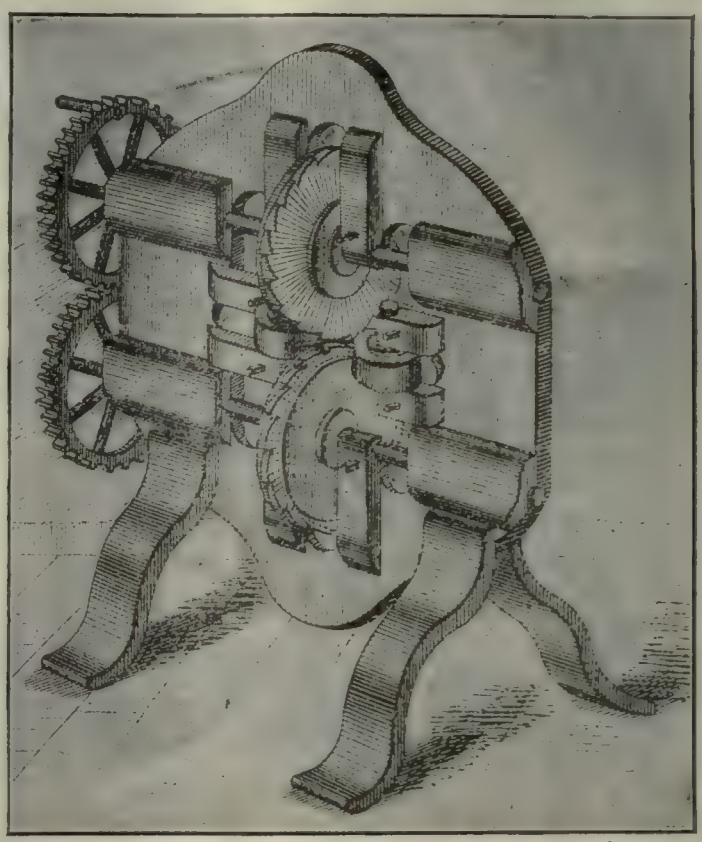


FIG. 86. A WIRE-NAIL MACHINE OF 1848

a hundred thousand blacksmiths and "whitesmiths" in the country. There were 24,000 machinists of which Massachusetts had 5,245 and New York 5,163. The millwrights numbered 9,613, and the general iron workers about 5,000.

There were said to be 3,843 gunsmiths, while the turners numbered only twenty less. As we have noted previously, the nail makers were comparatively numerous, though of course only a few when contrasted with their numbers today. There were said to be 2,046 in this trade. The toolmakers were enumerated as 1,191.

The occupations including between five hundred and one thousand workers were the cutlers, hardware makers, and saw makers. Those having between one hundred and five hundred were the armorers, wire workers, razor makers, file cutters, scale makers, wire makers, and screw makers. Those trades with not even one hundred, which were still considered important enough to list, were the safe makers, steel manufacturers, lathe makers, screw makers, pin makers, and needle makers.

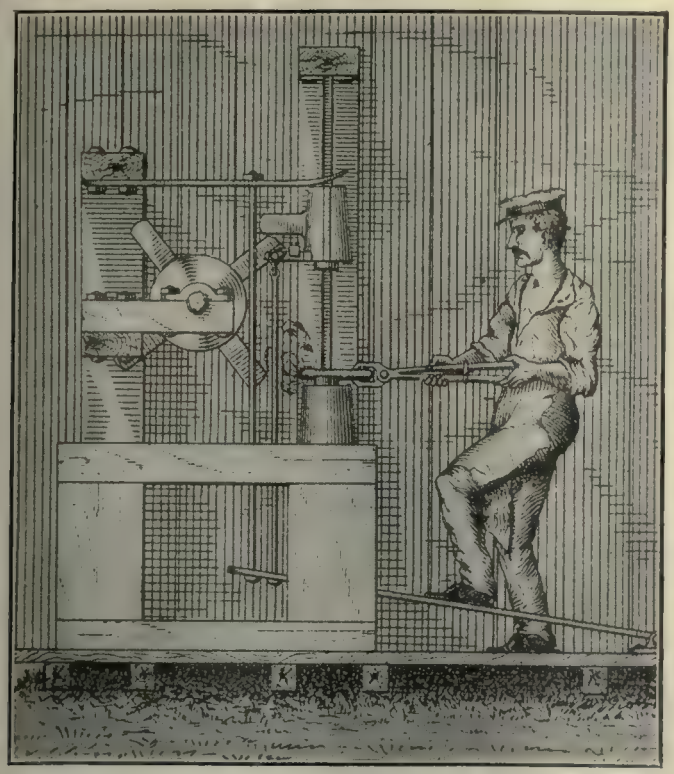


FIG. 85. A STEAM-DRIVEN FORGING MACHINE OF 1843

A general impression of the manufacturers of the United States at about that time is contained in a report of a British commission which inspected many of the shops in this country after the exposition of 1851. The report is by Whitworth and Wallace and was published in abstract in 1854. Whitworth paid particular attention to machinery, while Wallace devoted his investigations to other fields. What struck Whitworth particularly was the attempt to make machines as automatic as possible. As striking examples he mentions a machine for making ladies' hair pins used by Blake & Johnson at Waterbury, Conn., and one for shanking buttons which was set up in the same town in the plant of Benedict & Burnham. In the latter plant brass kettles and pans were not cast, but spun by being revolved under pressure until they assumed almost any desired shape.

In Pittsburgh Whitworth was interested in a machine for making railroad spikes. These weighed 1½ lb. each, and were turned out at the rate of fifty per minute. He said that seven men could make five tons of spikes a day. He found many self-acting machines for cutting nails in another establishment at Pittsburgh, and practical automatic machines which made rivets, weighing seven to a pound, at the rate of eighty a minute. In another place he found hook-and-eye machines making a hundred a minute. In Connecticut several plants were stamping out the works for brass clocks.

In general he says, however, that there was little cast steel made, and that the engine tools were lighter and less accurate than in England. The proportion of slide to hand rests on lathes in the United States was greater than in England. Planing and drilling machines for iron were common, but there were few horizontal or vertical shaping machines.

Whitworth enumerated in detail the seventeen processes used in the Springfield armory in the making of gun stocks. All were carried out by machinery which was based on the use of a forming or shaping machine that was developed from the principle of Blanchard's lathe. With the aid of these machines it then took slightly over twenty-two minutes to make a gun stock.

Developments in the Fifties

The decade preceding 1860 contained some developments presaging the present-day machine shop. Fig. 87 shows a machine for nicking screw heads. In 1852 we hear of a universal milling machine put into operation by Frederick W. Howe, and a lathe with a double turret set up by E. K. Root at Colt's armory.

The next year a rifling machine cutting three grooves simultaneously was designed at the Frankford arsenal in Philadelphia, and the next year a somewhat similar one was put in use by H. D. Stone at Windsor, Vermont. The latter was afterwards employed for the Springfield rifle. The interchangeability of American firearms had created a great impression abroad, and in 1855 Great Britain was supplied with 20,000 Enfield rifles which had this characteristic. The American universal milling machines were sold abroad at $850 each, and many orders were also placed for the Blanchard stock machine.

In 1854 we find Robbins and Lawrence building for sale the so-called automatic turret lathes. This was another very important step toward quantity production, which was becoming the distinguishing characteristic of the American factory.

In 1855 we hear of milling machines being made by George S. Lincoln & Co., of Hartford. In 1858 H. D. Stone designed a turret screw-making machine which was constructed by James & Lamson of Windsor, Vermont. Barrel rolling was introduced into the Springfield armory by J. T. Ames in 1860.

Patents of the Fifties

The patents of the 50's also indicate an increase in the interest taken in metal-working machinery.

In 1852 we find patents for screw threading by Cullen Whipple. The lathe for turning polygonal forms, shown in Fig. 88, is traced to this same period. The next year a patent for chain making without welding



FIG. 87. A MACHINE FOR NICKING SCREW HEADS, 1850

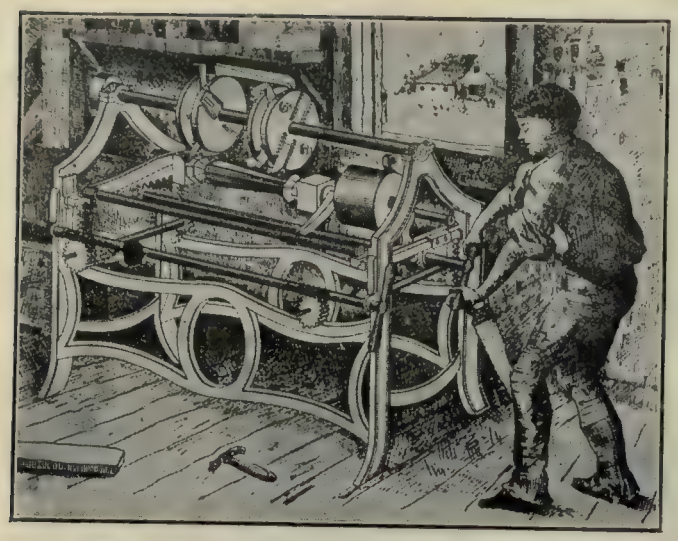


FIG. 88. TURNING POLYGONAL FORMS, 1852

was taken out by Christian Sleppy, one for a nut-making machine by Carter and Reese, and for a punching machine by Davie and Stephens. In 1854 a lathe for interiors was invented by Teale & Tyler, and J. A. Roebling patented his method of making wire rope.

A patent for a dove-tailing machine was given to T. H. Hurley in 1855, and one for a rifling machine to E. K. Root. The next year a machine for forging thimbles was patented by Corliss & Harris, and a machine for making brass kettles by Blakesley, Platt & Jordan. Fig. 89 shows a hub-mortising machine patented in the same year. Isaac Lindsley invented a method of carving wood in 1857, and a still more automatic lathe was patented by John McNary in 1858. The following year we find S. P. Ruggles improving the punch and stamp press, and the next year Milo and Charles Peck improving the drop press.

Shops of the Period

A work by E. T. Freedley, published in 1856, purported to give brief accounts of the leading machine shops of that date. According to this, the shop then equipped to build the heaviest machinery was I. P. Morris & Co., of Philadelphia. They were said to have a planer weighing 75,000 pounds and planing 32 by 8 ft., a boring mill able to bore a cylinder 16 ft. in diameter and 17 ft. long, besides heavy slotting machines and many other machine tools of their own make. The plant next best suited for general heavy work was that of Betts, Pusey & Co. of Wilmington, Del., who made a specialty of iron steamers and engines.

There were seven concerns producing chiefly stationary steam engines. Among these William Burdon of Brooklyn was mentioned as remarkable in making fifty of one pattern at a time. Two other very important ones were Thurston, Gardner & Co., and Corliss & Nightingale of Providence.

Four plants were said to be principally concerned with marine engines, of which the two chief were Reaney, Neafie & Co., Philadelphia, and the Shepard Iron Works of Buffalo. Locomotives were made by as many as twelve concerns, which indicates that there had been no more consolidation among these than among the railroads themselves. The chief plant of this sort in Pennsylvania was that of M. W. Baldwin & Co., Philadelphia, and the principal one in New York was the Schenectady Locomotive Works.

The chief plants making machinists' tools, according to Freedley, were Gage, Warner & Whitney, Nashua, N. H., which had been longest in the business, William Sellers & Co., Philadelphia, the Meriden Machine Co., in Connecticut, and Thayer, Houghton & Co., as well as Wood, Light & Co., in Worcester.

J. A. Roebling of Trenton had been making wire rope since 1842, and the New York Wire Rail Co. was weaving wire into gratings and fences. The first iron frame building had been put up by Bogardus of New York, and J. L. Jackson was specializing in structural iron there.

The stamping of brass works, which was well established in clock making, was just being introduced for producing works in quantities for watches.

Details of the 1860 Census

The details of the census of 1860 give some idea of the growth at that date. In each case a plant is listed under its principal product.

There was $1,778,000 worth of steel produced. Small as this seems, it was ten times as much as in 1850. There were 1,173 shops doing general machinist and millwright work, having a total value of $46,644,000. There were 443 shops producing general hardware, with a value of $6,700,000; firearms were manufactured in 239 shops to a value of $2,342,000; axes and edged tools were made in 166 shops, with an estimated product of $3,244,000; and there were 99 shops which made $9,857,000 worth of nails and spikes.

The development of railroad equipment shops may be judged from the fact that there were nineteen plants making locomotives to the number of 470, and with a value of $4,867,000.

Sewing machines, which were a comparatively new article of manufacture, were produced in seventy-four shops whose output was estimated at $4,248,000. There were fifty-eight factories constructing threshers and separators, and forty for reapers and mowers, all of which were just coming into extensive use.

There were seventeen plants for the manufacture of car wheels, forty for springs, and fifty-four for nuts and bolts, the total product in each line amounting to a little over $2,000,000.

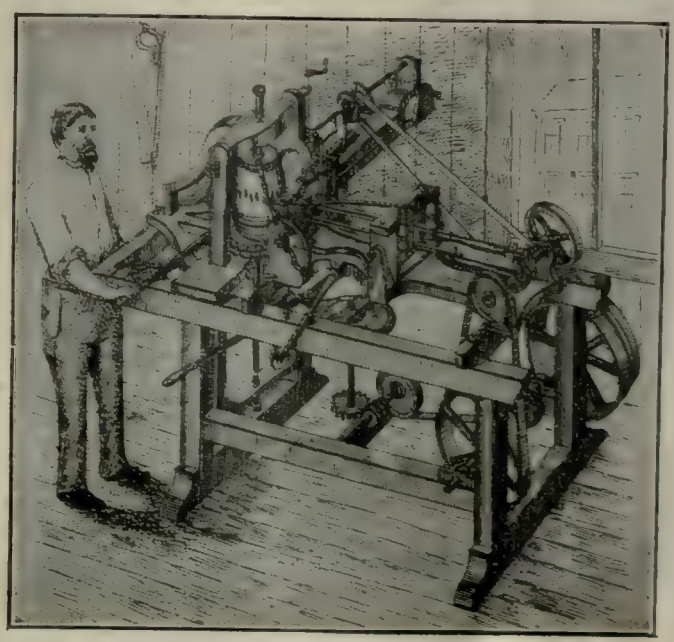


FIG. 89. A HUB-MORTISING MACHINE, 1856

Industries with an output of from one to two million dollars were iron forging with fifty-six shops, cutlery with fifty-one, saws with forty-two, and scales and balances with forty-three plants.

Industries with a production of less than a million dollars were malleable iron castings made in twenty-six shops; carpenters' tools made in thirty-three shops; and machinists' tools made in seventeen shops, one of which in Philadelphia produced almost half the total output. The industries of less importance than those mentioned were too many to permit of their treatment, but the census showed that great development was going on in all lines of metal working.

Crankcase Boring Fixture with Adjustable Supports

By I. B. Rich

The supports *J* with the jaws *F* have to be removed while the crank case is being placed in position, and is then replaced and the lower supports brought up into contact with the boring bars while the work is being done.

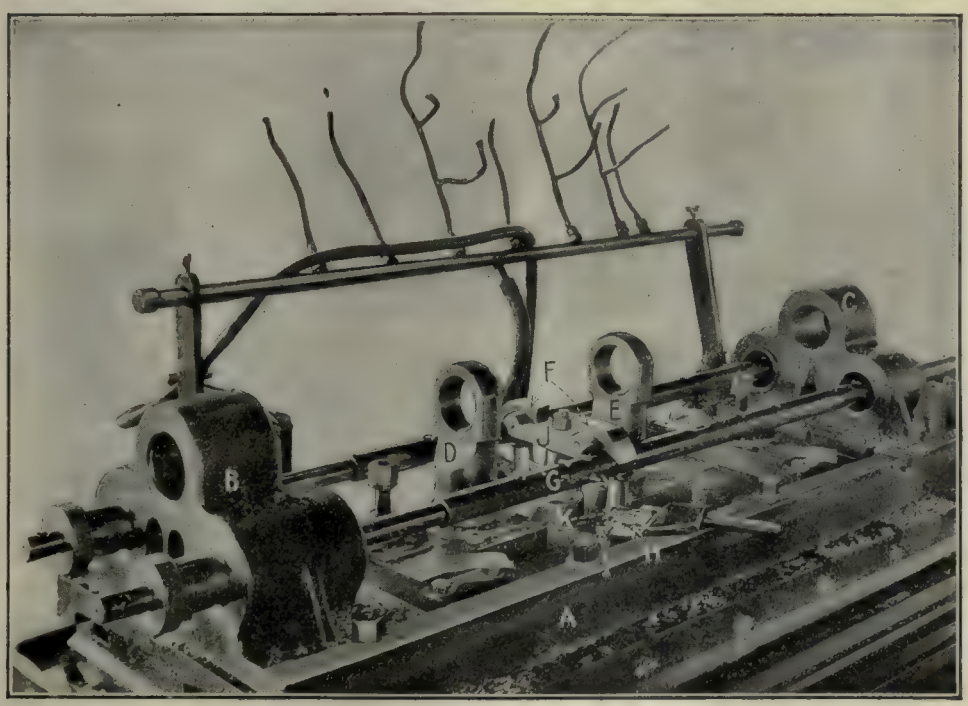


FIG. 1. BORING FIXTURE FOR CRANKCASES

It will be noted that careful provision is made for lubricating the various cutters by means of the piping shown at the back of the fixture in Fig. 1. These are now turned up out of the way in order to allow a crank case to be easily put in position. Each pipe is provided with the correct number of outlets to lubricate each cutting point, and an ample supply of lubricant is provided by the holes and the large pipe which forms the support. The two camshaft boring bars are simply shown in position to illustrate the way in which they are supported, it being, of course, necessary to remove them before putting the crankcase into position.

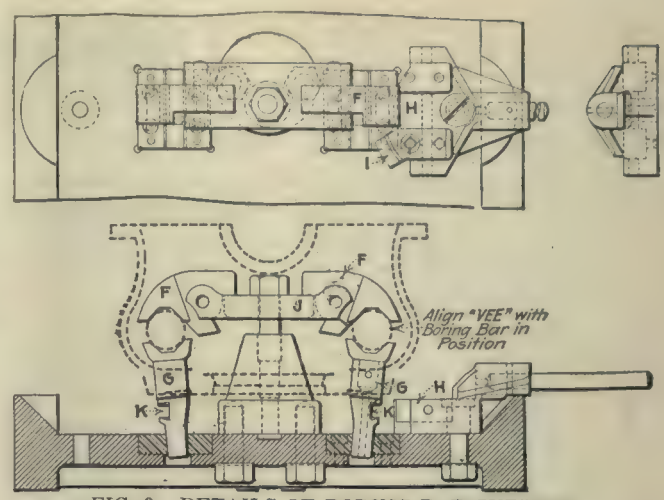


FIG. 3. DETAILS OF BORING-BAR SUPPORT

The illustrations show a very substantial fixture used by the Pierce-Arrow Motor Car Co. in boring its six-cylinder crankcase. This consists primarily of the bed *A* and the two heads *B* and *C* with the supports *D* and *E* for the main boring bar. Figs. 1, 2 and 3 have corresponding letters, so that the details will be easily distinguished. This fixture bores for the main bearings and also both camshaft holes, the motor being of the T-head type. Substantial bushings are provided, as can be seen.

One of the interesting features of this boring fixture is the central support for the two camshaft bars at *F*. Fig. 3 shows the details of this support, which consists of the crossbar *J* carrying the arms *F*, while the lower support *G* is located and held in position by the swinging locks *H* carrying the projections *I* which fit into the opening *K* and hold the lower supports firmly in position during the boring operation. These precautions against springing greatly reduce the time required in assembling the parts.

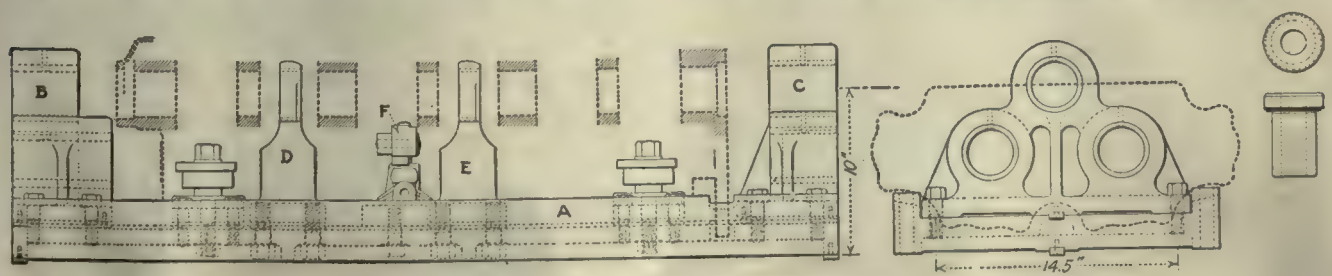


FIG. 2. GENERAL DETAILS OF FIXTURE

Toolroom System

By E. E. HIRSCHHAUTER

The system described in the following article has been in successful use for the last five years in one of the biggest gas-engine shops in the country. It may help others who are organizing or re-organizing toolroom systems.

THE engineering department, when completing the design for a new type of engine, notifies the planning department, which in turn gives the tool division a complete set of blueprints, fixes the date the tools should be ready for production and makes out the orders for purchased material.

The head of the tool division goes over the blueprints and makes sketches of the tools required, which he submits to the conference for discussion. If acceptable he then has individual tool orders made out for every tool required, on the form shown in Fig. 1, giving the number of pieces per month, saving estimated, and the cost of the new tool. The order is now sent to the general superintendent and general manager for approval and then forwarded to the cost department, where an expense number is assigned and entered on the form shown in Fig. 2. From here the order is sent back to the tool division which now has the authority to proceed with the work.

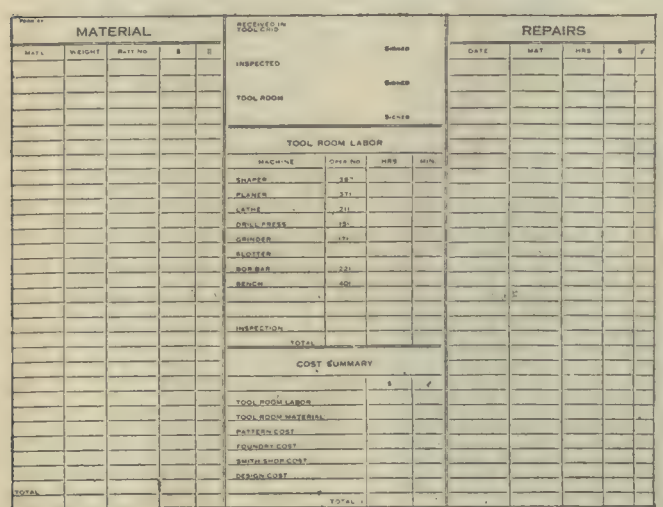


FIG. 1. TOOL ORDER AND RECORD

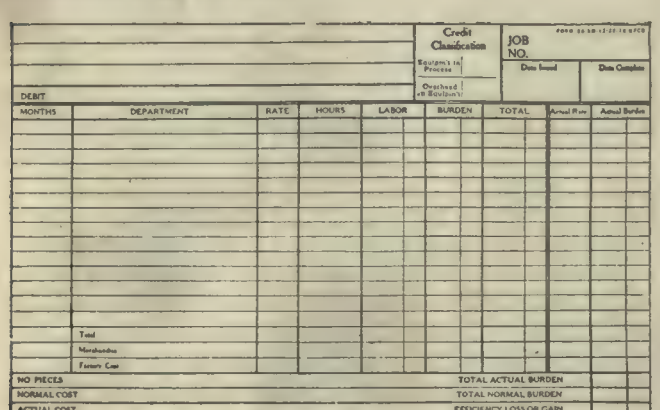


FIG. 2. COST CARD



FIG. 3. RECORD OF DRAWINGS, PART NUMBERS AND SYMBOLS

On the drawings there is a stock list giving the *finished* over-all dimensions of the various pieces to be machined, thus making it easy to order stock from this list.

Fig. 3 is the record card used for recording drawings and part numbers or symbols. Only two records are kept, one for the drawing number and one for the part number. The tool number and pattern number correspond with the drawing number. Should it be required to have more than one tool or pattern number on one drawing, as many dash numbers as required can be attached to the original number. For instance, if the drawing number is 2531 and there are three tool numbers, they will then be 2531-1-2-3. There is only one form used for both records. If used as a drawing-number record, there is placed an x on top of drawing number in the right-hand corner, and the card is filed in the drawing-number file. If used, a part-number record, an x, is placed over part number and filed in the respective file. The same form is also

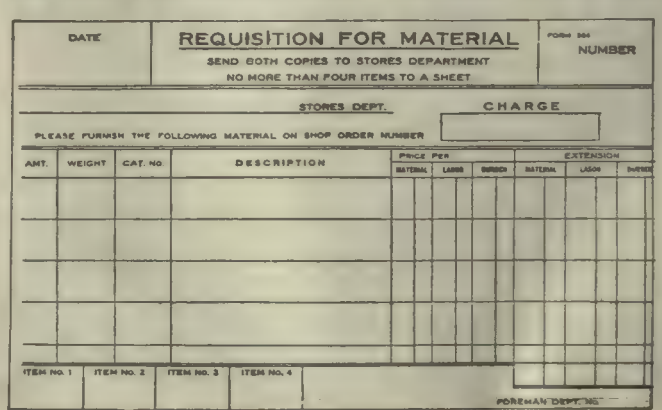


FIG. 4. MATERIAL REQUISITION

Board No.	Symbol	Bin No.
Description of Tool		Order No.

No. Pcs.	Mat.	Size or Patt. No.	Date Received

		Clock No.	Oper. No.
	OUT IN		
	OUT IN		
	OUT IN		
	OUT IN		
	OUT IN		
	OUT IN		
	OUT IN		
	OUT IN		
	OUT IN		
	OUT IN		
	OUT IN		
	OUT IN		

FIG. 5. THE BIN TICKET AND TIME CARD

used for recording drawings and sketches pertaining to machine repairs by simply placing an x over machine number and filing away in the machine repair file.

Requisitions Made Out from Blueprints

When the drawing is completed, blueprints are made, and the tool-division clerk proceeds to make out material requisitions in duplicate on the form shown in Fig. 4. Small screws, cotter pins, etc., are not ordered here, as it has been found more expedient to have a small stock in the toolroom crib from which the men can draw. If a pattern or forging has to be made, a blueprint attached to a departmental order is sent to the pattern or forge shop.

For making out the board and bin tickets, the form shown in Fig. 5 is used. This ticket has a board number with a letter prefixed for each department. The bin number corresponds to an empty bin in the toolroom racks, Fig. 6, and to enable the tool-design clerk to keep track of the empty bins, he is provided with a board that has as many holes as there are bins in the toolroom rack. When he assigns a bin to a certain job, he places a wooden plug in the desired hole in the board and puts that number on form, Fig. 5.

The tool order with all blueprints, material, requisitions, etc., is then sent to the toolroom foreman, who first of all looks over the material requisitions to find out if any scrap material on hand could be used. If there is none available, he sends these requisitions to the store, retaining a copy for checking purposes. Board ticket, Fig. 5, is placed on the control board and the order is attached to the proper bin. The blueprints are also placed in the bin.

First Operations After Delivery

As fast as the material is delivered it is placed in the bin and checked off on the bin ticket; thus the foreman can at any time see what has been delivered and what is still due.

When all the material has been received the job is ready to get started. Should turning be the first operation, all the pieces to be turned accompanied with the blueprint will be handed to a lathe hand who has to go to the toolroom clock and ring in on the back of board ticket, Fig. 5. On completion of this operation the man rings out and hands the pieces to the foreman, who, after a quick inspection, sends them back to the bin. This prevents the material from getting lost or misused. Of course, sometimes it will be necessary to have more than one man working on the same job, and in that case as many board tickets as required can be added to the first one.

After the tool is completed and inspected, a delivery slip with two copies is made, the original is retained in the toolroom for reference, one copy accompanies the tool to the tool crib, and one is sent to the efficiency department. The tool order is also taken along and the receipt of the tool is signed for on the back by the tool-crib tender and superintendent.

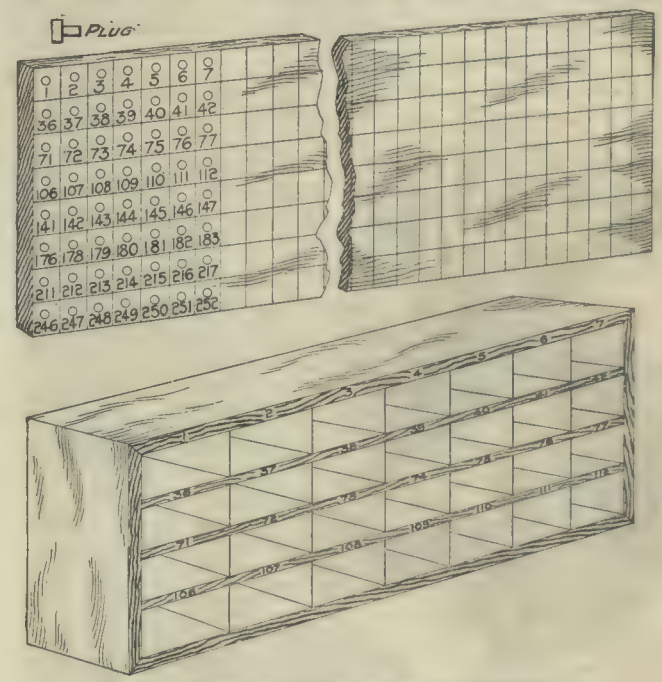


FIG. 6. THE BIN AND CONTROL BOARD

MOTOR NO	REPAIR ORDER	MACHINE NO
DEPT.		DATE
MACHINE REPAIR	MOTOR REPAIR	BELT REPAIR / TOOL REPAIR
REPAIR PARTS AS DESCRIBED BELOW AND CHARGE TIME AND MATERIAL TO		

FIG. 7. REPAIR ORDER

Form 37, 6M 1-20 SPCO.

MACH. NO._____

PLANNING DEPT.

Monthly Machine Lost Hour and Cost Record.

DATE	LOST HOURS: MACH. BELT REP.	MOTOR REP.	TOOL REP.	OPER.	PROD.	TOTAL HRS.	REPAIR COST: MACH. BELT REP.	MOTOR REP	TOTAL REPAIR COST	TOTAL COST
1										
2										
3										
4										
5										
6										
7										
8										
9										
10										
11										
12										
13										
14										
15										
16										
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20										
21										
22										
23										
24										
25										
26										
27										
28										
29										
30										
31										
TOTAL										

VALUE PER HOUR_____

FIG. 8. MACHINE-REPAIR CARD

The tool order and board and bin tickets are then returned to the tool-design clerk, who figures up the time and cost of material, forgings and patterns and enters these items on the back of the order form, Fig. 1. He also pulls the plug from the board, Fig. 6, thereby releasing this bin and putting it at the disposal of new work. The tool order is then filed in the permanent file in the tool-design department.

For repairs the form, Fig. 7, is used. On receipt of a tool repair the toolroom clerk makes out form, Fig. 5, for the control board, stamps a number on this ticket and on the repair order and sends the copy back to the issuing foreman, who, through this number, can at any time inquire about the progress of the repair.

The tool to be repaired together with the order is then placed in the bins reserved for repairs and all necessary material ordered. The number stamped on the order is also put on the material requisitions in order to keep the material from getting mixed up.

Every day the finished repair orders are sent to the planning department where the tool repairs are posted on the back of form, Fig. 1, and the machine repairs posted on form, Fig. 8. From this form, at the end of the year, the totals are transferred to form, Fig. 9.

Form 37, SPCO.

REPAIRS AND LOST HOURS

YEAR	MACH. & BELT REPAIR: MATL. & LABOR	LOST HOURS	TOTAL COST	MOTOR REPAIR: MATL. & LABOR	LOST HOURS	TOTAL COST	TOOL REPAIR: LOST HOURS	COST	OPERATOR: LOST HOURS	COST	PRODUCTION: LOST HOURS	COST	POSSIBLE HOURS	TOTAL COST OF LOST HOURS	% EFFICIENCY
1920															
1921															
1922															
1923															
1924															
TOTAL															
1925															
1926															
1927															
1928															
1929															
TOTAL															
1930															
1931															
1932															
1933															
1934															
TOTAL															
GRAND TOTAL															

FIG. 9. ANNUAL REPAIR COSTS

Looking Backward

By Harry B. Stillman

Some of these older shop men who sigh for the good old days will grant that the present-day method of providing drinking water for the employees has something on the old-time unsanitary method of years ago. They will agree that the modern bubbler, or the sanitary cup, is miles ahead of the old water pail and its boon companions the rusty dipper and the unclean glass. The unwholesome practice of using a common drinking vessel and the consequent risk of contagion was quite usual in most shops twenty-five or thirty years ago.

Every plant under modern management has its own method of serving drinking water to the workers, either by means mentioned above or by some other custom that at least carries out the principles of sanitation. Every employee who punches a time clock where I am employed enjoys the privilege of drinking good cold water, as near pure as well water could reasonably be expected to be, that is pumped from a number of artesian wells located where danger from pollution is very slight. To guard against contamination the company keeps a watchful eye on the purity of the water by having it analyzed every so often, and the result of the test is posted on the bulletin board so that the employees can read and satisfy themselves on that score.

While we are on the subject of water I would like to call the attention of those old timers to the many improvements that have taken place the last twenty-five years in the means provided for the shop-worker to wash up. Take for example the modern shop sink, large enough to accommodate a dozen men on a side with an adequate supply of hot and cold water always on tap, where the washer can splash around at his heart's content. Compare it with the old-style wash-bucket that was usually to be found in the shops of the smaller towns years ago. Or compare the wash-rooms and lavatories found in some of the progressive plants of today with the dinky little two-man sink that stood service in the old days for a room full of employees.

I recollect a job of filing castings which fell to me nearly twenty-five years ago, and how I used to slink down in the seat of the street car on my way home from work, hoping that none of my acquaintances would board the car and see me with my face and hands smudged with the grime of cast iron. There was only one small sink in the shop for about thirty men, and were I to wait my turn it would have meant the loss of my car. Nowadays a man can be covered with grease and grime at quitting time and yet leave the factory all spick-and-span with a bath, hair combed, a shine, clothes brushed and everything but having his nails manicured. Perhaps we'll get that later.

Making a Pressed-Steel Base for an Electric Fan

By H. JAY
Sales Manager, The Acklin Stamping Co., Toledo, Ohio

This article tells of a stamping process for producing the base of an electric fan, the method being different from that usually employed for making such parts. The sequence of the operations and the tools used are shown in the accompanying drawings.

THE manufacture of a pressed-steel electric-fan base presents a problem that not only is interesting from the viewpoint of stamping but also offers a very good example of the economy of substituting this method of production for the casting or spun form. In this particular instance, where the base itself is given a high-class enamel finish, there is a considerable saving in grinding and buffing the piece before the enamel is applied. Furthermore, the weight of the finished stamping is less than that of a corresponding casting, and the method of cutting slots and holes is cheaper than if a milling machine and drill press were used.

The accompanying sketches show the general types of tools used in making the various reductions, as well as the dimensions of the part produced by each tool. The material specification calls for cold-rolled deep-drawing strip steel of 0.095 per cent carbon. Steel of this grade properly worked produces a stamping with a surface which can be enamelled with very little buffing.

The first operation is that of cutting the blank, which

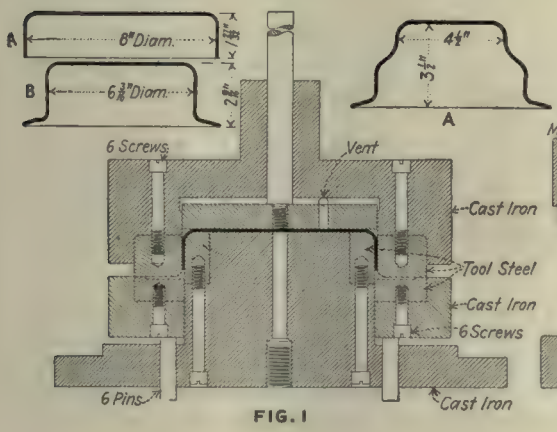


FIG. 1

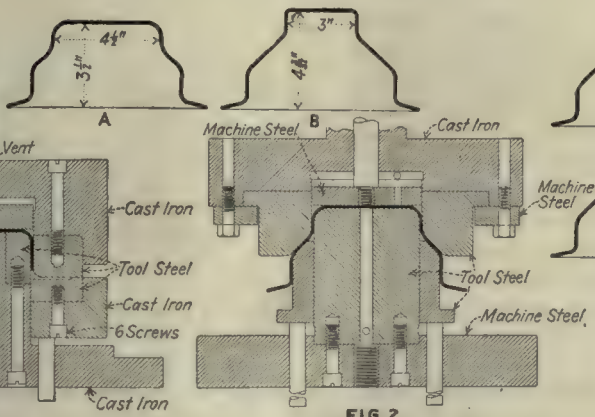


FIG. 2

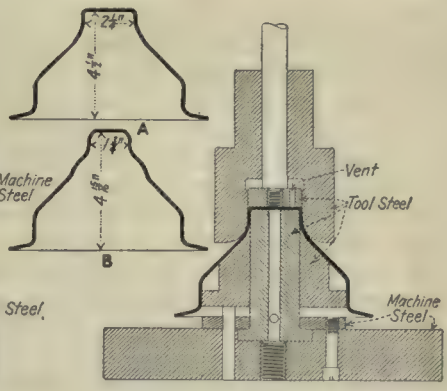


FIG. 3

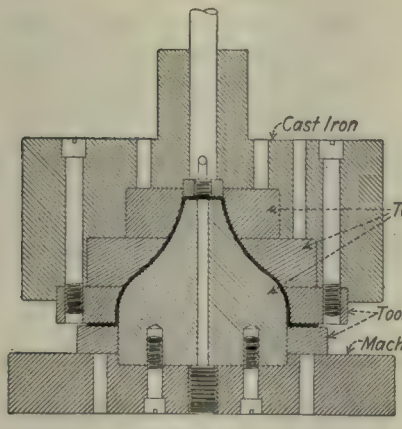


FIG. 4

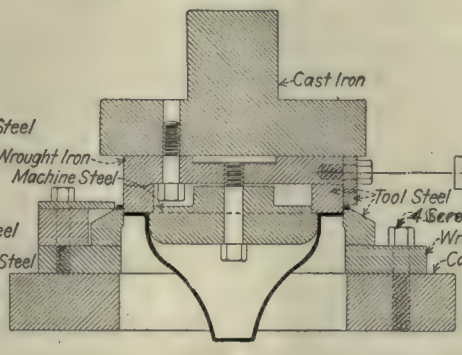


FIG. 5

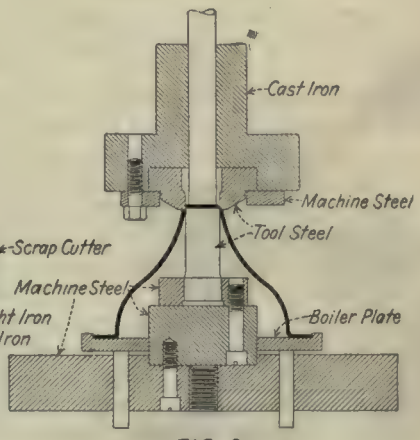


FIG. 6

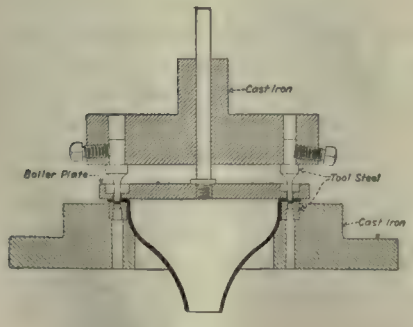


FIG. 7

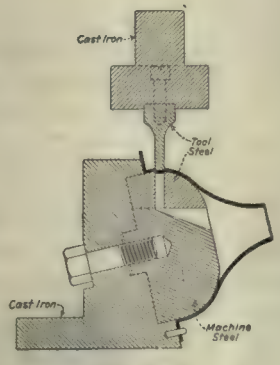


FIG. 8

FIGS. 1 TO 8. SEQUENCE OF OPERATIONS FOLLOWED IN MAKING THE PRESSED-STEEL BASE FOR AN ELECTRIC FAN, SHOWING THE TOOLS USED

Fig. 1—The first drawing operation. Fig. 2—The third drawing operation. Fig. 3—The fifth shaping operation. Fig. 4—The final forming operation. Fig. 5—Trimming the edge of the flange. Fig. 6—Punching the hole in the nose. Fig. 7—Punching the holes in the flange. Fig. 8—Punching the slot on a horn die.



FIG. 9. THE FINISHED BASE

in this case is 10½ in. in diameter. A standard type of blanking tool is suitable for the work, one being used in which the punch and die are each made up of composite forgings of wrought iron and tool steel, which forms the cutting edge.

The first draw is made in the second operation with a drawing die, as shown in Fig. 1. All parts of the die are constructed of cast iron faced with tool steel. A single-action press is used, and the die operates quite similarly to the ordinary spring drawing die. The pressure necessary for holding the blank is applied to the draw ring by the six pins shown which rest upon the upper of two plates, which are not shown in the illustration, and between which the rubbers are held. As the punch descends, the edge of the blank is held with a pressure which increases as the rubbers are compressed, and there is no chance for the edge of the work to wrinkle, even as the drawing becomes harder and deeper.

The knockout pad, shown resting on the work on top of the plug forming the die, serves to release the work from the punch in case it should stick when the punch ascends. In Fig. 1, *A* shows the part after the second operation; while in the third operation the piece is reduced still further with a tool which is similar in construction and operation to that first used, its shape being shown at *B*.

The reduction in the fourth operation, Fig. 2, starts the piece toward its final shape. It is important that the correct radii be selected for the punch and plug so that the proper reductions will follow. The die is similar to those previously used except for the tool-steel plug and draw ring and a machine-steel base. The draw ring is used to center up the work before the reduction starts. The next reduction is handled in much the same manner, the shape of the work being given at *B*, Fig. 2.

A further reduction is made in the sixth operation, Fig. 3. Here, again, care must be used in selecting the radius of the punch so that the stamping comes out with a nice flare. The nose of the piece is then reduced more like its final shape in the seventh operation, *B* in Fig. 3 showing the stamping after this stage.

If the various reductions have been properly made the stamping now takes it final shape in the next operation. The stamping die, Fig. 4, has a machine-steel base and a tool-steel draw ring with just enough motion to raise the stamping off the plug at the finish of the stroke. A plug to conform to the finished shape is made of tool steel and the punch is built up of tool-steel sections. This is a type of construction that was developed during the past war in work on shell casings for the Government. The hardening of a punch of this size in one piece invariably means that warping follows and the center portions do not always receive the proper treatment. If the sections of the built-up punch are hardened separately, these objections are entirely eliminated. The operation of the die reduces the stamping to its final finished shape and flattens out the flange on which the base rests. The regular form of knock-out is used in the punch.

After trimming the flange, the base is complete, except for the various piercings necessary to conform to the fan manufacturer's designs. For the trimming operation itself, the work is inverted, Fig. 5, and a drop-through type of die is used. Production is thus increased by permitting the stamping to drop through the bolster to a receptacle and by facilitating the removal of the trimmed scrap by cutting it with two wedge-shaped scrap cutters. The method of piercing the hole in the nose is shown in Fig. 6 and that used for the small holes in the base appears in Fig. 7, the construction being plainly shown.

For the slot and holes which provide for the switch lever and electrical cord, the piercings are performed on an ordinary type of horn die, Fig. 8, with a cast-iron holder, machine-steel horn and tool-steel die and punch.

The Finished Stamping

Fig. 9 is reproduced from an untouched photograph of the finished stamping. Examination will show that it is entirely free from reduction marks and that the gage of the metal is uniform. This is the result of careful consideration in selecting the radii of the various punches and dies for the drawing tools.

The tools and stamping described in this article were designed and produced in the shops of the Acklin Stamping Co., Toledo, Ohio, where considerable work of this nature has been done with a view toward speeding up production and reducing manufacturing costs. The advantages to be gained by using pressed-metal parts are becoming more evident, and this fan base is just one example of the many types of parts which can be produced by this speedy and economical method of manufacture.

Economy in Cutting Bar Stock

By I. B. Rich

Having a large number of gears to be made from 4-in. bar stock, it was decided to cut off the blanks on a hacksawing machine. A careful analysis of the time taken, and the efficiency of the hacksaw blades resulted in some rather interesting data. It was found that while some blades would make as high as twenty cuts before becoming too dull for use, it was not found to be economical to use them for this length of time. Experiments were made, changing the blade after making eight cuts, and with other numbers up to twenty for the maximum life of the blade.

After considering the time required in making the cuts and the cost of new blades it was found to be most economical to change the blade after twelve cuts, and this is now the regular practice in the shop of the Johnson Gear Works, San Francisco, Cal. The tests were made by the superintendent, Walter I. Brown.

Make Employees Read the Plant Paper By Telling About Their Babies

By Frank H. Williams

PEOPLE are always interested in babies. Folks like to know about new babies in the families of their friends or in the families of their fellow workers. They like to know what these babies have been named, what they look like and everything else connected with them.

And right here is a hint for the editors of internal house organs or plant papers. Put a lot about the employees' babies into the publication if you want to make the employees read the paper.

This is one of the schemes used with great success by the editor of the *Bowser Booster*, published by S. F. Bowser & Co., of Fort Wayne, Ind., for its employees.

The Bowser plant employs about 1,500 men in its home plant. It manufactures gasolene tanks and pumps, and it is up against the usual sort of thing experienced by manufacturers who try to increase morale and interest among employees by the publication of a plant paper.

Every month—the *Bowser Booster* is issued once a month—the editor runs at least one page of pictures of employees' babies. If there are enough pictures two pages are run. The pictures used are not conventional gallery photographs, but the unconventional, natural pictures which fond parents or relatives snap when the baby is least aware of what is going on. Such pictures give a life and snap to the page which ordinary gallery photographs would never have. Under each photograph run some snappy sort of caption. For instance, under a photograph of a tiny tot who looked particularly pugnacious this caption was run: "Want A Fight?" Then followed the name of the infant and the names of his parents. Under a picture of a little boy all tightly bundled up for winter was run a caption which was particularly appropriate at the time the picture appeared. This caption was "All Ready for a Coal Strike." Following the caption, of course, came the name of the child and the names of the parents.

In addition to running pictures of the babies, the publication faithfully chronicles the arrival of infants in the families of its employees. This chronicle is made as readable and as interesting as possible. For instance here is the way a typical month's issue chronicled births.

"On the ninth of last month there arrived at the home of Mr. and Mrs. H. C. Slater, a daughter, Eilene May. Mr. Slater is one of the boosters in the sundries department.

"It is not at all surprising that Ned Witte, of the yard department, better known as 'The Flying Dutchman' should come to work with a big smile and a box of cigars. Who wouldn't if he were the proud daddy of a baby girl?

"Louis Krimmel, of the factory office force, gave off six feet of blushes and several kinds of stammers last week when he tried to explain to Joe Smith, of the stationery stock room that his requisition calling for '1 doz. Rubber Nipples' should have been for 'erasers' instead of nipples, but his confusion gave him away and he has to fess up to having become daddy to a nice baby on the twelfth of last month."

Recently S. F. Bowser, the president of the concern, started the Bowser Loan and Trust Co., for the convenience of employees and people of the neighborhood. The Bowser plant, it might be noted, is located in the southwestern part of the city, a considerable distance from the center of the town, and in a locality which is so much distinctly its own section that it has the name of Bowserville.

After the inauguration of this trust company the *Booster* announced that it would celebrate the advent of every baby in the family of an employee by starting a savings fund for the baby in the trust company. This announcement and the details concerning it were couched in the following words:

"When the new baby arrives, you have a sense of hilarity and joy, of course. But with it all is also a sense of great responsibility that rests upon dad's shoulders. The future is a great unknown, stretching away and away, far beyond the ken of any man.

"Men who are thoughtful on this subject become possessed of a strong desire to begin NOW, immediately, to provide in some way for the future of that baby boy, —that baby girl—and yet it does not readily appear just how the future of the child can be safeguarded.

"The *Booster* wants to help solve this problem, or at any rate, one phase of the problem, and the following standing offer is made:

1. For each birth reported promptly to the *Booster* by the father, an employee of S. F. Bowser & Co., Inc., Fort Wayne, Ind., five dollars will be deposited in the name of the child in the Bowser Loan & Trust Co.

2. When the child is one year old, the *Booster* will authorize the Bowser Loan and Trust Co. to add one dollar to the account, provided there has been deposited by the father during the year previous, *FIVE* dollars or more for the child and provided the bank book is presented at the bank for such addition upon the first birthday of the child or promptly thereafter.

3. When the child is two years old, the *Booster* will add two dollars to the account provided again that the father has placed another five dollars to the credit of that account during the second year of the child's life and provided again the bank book is presented at the bank on the birthday of the child or promptly thereafter.

4. Three dollars will be added on the third birthday, four dollars on the fourth and five dollars on the fifth, always provided at least five dollars has been added by the father during each one of the years, currently as passed over.

5. The *Booster* feels that, after the fifth birthday the father should continue his practice of adding to the child's saving fund—but the *Booster* will not make any further deposits for the child.

6. This further provision is made, however: The deposits made by the *Booster* and the required minimum yearly deposits of five dollars by the father may not be withdrawn until the child is six years old unless the father discontinues his employment with S. F. Bowser & Co., Inc. If the father does, after the first birthday of the child, discontinue his employment with the company, ALL the money may be withdrawn (in-

cluding the *Booster* deposits), or the father may continue the account in the Bowser Loan & Trust Co. It is to be understood, however, that the *Booster* will not continue its yearly additions to the account after the father has left the employ of the company. It is to be understood further that in case the father leaves the employment of the company before the first birthday of the child, the original *Booster* deposit of five dollars is forfeited and reverts to the *Booster*.

7. Four per cent interest will be paid on each account.

8. First notice of the child's birth must be sent to the *Booster* which will make the first deposit and send the bank book to the father. On the first birthday of the child and on each succeeding birthday, to and including the fifth, the father will not be required to do more than go to the bank to have the new *Booster* deposit entered in the bank book.

By this plan, it can be seen, the *Booster* during the course of five years deposits $20 to the child's credit provided the father during the same period deposits $25. Therefore at the fifth birthday there would be $45 on deposit to the credit of the child in addition to the accrued interest.

Pages for the Home

In addition to arousing interest among employees by this emphasis on babies, the *Booster* also increases interest in the homes of employees in the publication through the use of children's and home pages. On the children's page appear little puzzles to which answers are given the following month. And on the home page appear tested recipes which are sent in by wives of the employees.

To arouse the interest of the children, prize contests are frequently run for them. One of these recent contests was on the topic "What My Daddy Does at Bowser's." As prizes in this contest deposits of $3, $2 and $1 in the savings account department of the Bowser bank were offered for the three best letters. The prize winning letters were, of course, published in a subsequent issue of the *Booster*.

This emphasis on babies, children and the home in the *Bowser Booster* has the very desirable effect of making employees and the members of employees' families not only read the *Booster* but look for its appearance and welcome its advent enthusiastically. It gives a warm, intimate, personal touch to the publication and also arouses in the minds of the readers the idea that all Bowser employees are members of a big family.

Surely there is a hint in all this for editors of such internal house organs or shop papers which are not registering as emphatic hits with its employees as might be wished.

Why not take a leaf from the experience of this publication and run a page or two of baby pictures every now and then? There isn't a single father or married man in the plant who won't be interested in seeing pictures of other employees' babies. And, in the great majority of cases, the employees will not only be interested in the pictures themselves but will take the publication home to show to their wives and families. And when the employees get to the point of preserving the plant publication and showing it to members of their immediate family and to relatives and acquaintances, then the plant paper may be safely declared to be a success.

What Is a Machine Tool?

By Frank C. Hudson

It is one thing to have a fairly definite idea of what one means, either as to machine tools or anything else, but it is quite a different and much more difficult proposition to formulate a definition which will convey the same idea to others, and at the same time not be capable of construction into an entirely different meaning. The definition of machine tool has long bothered many of us who are engaged in this line, and it is quite probable that the definition given by A. L. De Leeuw on page 106 of the *American Machinist* for July 15, 1920 is as clear and as comprehensive as it is easy to formulate.

The one particular loophole which appears to me in this definition is the use of the words "removal" or "removing," either metal or other material. The punch press is unquestionably a machine tool although many have barred it from the list, but is it not equally a machine tool when it is used for drawing, bending or otherwise forming metal or other material, as when cutting with the aid of punches and dies?

I am well aware that widening the scope of the definition includes forging hammers (and forming machines) of all kinds. But, on the other hand, Mr. De Leeuw's definition admits shearing machinery, even billet shears, which the makers of precision lathes would object to having mentioned in the same breath with their own product.

My addition to Mr. De Leeuw's third definition would make it read: "A machine tool is a machine *capable* of removing metal from a piece or of otherwise changing its form, and containing means for holding, guiding and controlling the work, or tool, or both."

This definition could, of course, be stretched to include rolling mill machinery, but on the other hand, it seems necessary if we are to include some of the minor machines (such as the swaging machine which must be accurately built to give the desired results) which are playing an increasingly important part in our work.

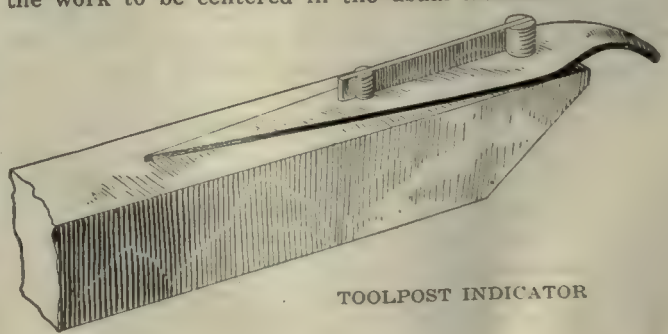
After talking with many builders of what we normally call machine tools, it seemed as though most of them desired a classification rather than a definition.

Indicator for Truing Up Work on Lathe

By Adolph Grimm

The illustration shows an indicator such as is used for centering lathe work. It can be made by any mechanic and if the work is carefully done the tool will be quite accurate.

The indicator is held in the toolpost and applied to the work to be centered in the usual manner.



TOOLPOST INDICATOR



The Human Element

By Elmer W. Leach

WHEN Kaiser Bill started so much trouble a few years ago it was quite apparent to everyone that he had absolute confidence of victory. He was playing a game for which he had made many, many years of preparation and with the science of which he was thoroughly familiar.

His long range guns and his intricate concrete trenches and dug-outs were believed to be infallible and impregnable. No one who has had the experience of going into those dug-outs and seeing the electric lights, the ventilating systems, and such luxuries as pianos and pool tables will say that Heine's head was thick and flat like his feet.

But when the doughboys got into the game they simply spoiled everything for poor Heine. The very first one of the "big shows" taught them that concrete trenches are no stronger than the men holding them, and long range guns no better than the fellows who man them. And after the boys got that idea they had caught the winning spirit, and all Germany couldn't stop them.

Viewed for what it was called, "a war machine," the German army was wonderful. The construction of their guns, their shells, their planes, was wonderful. The German army did not fall down through blunders in mechanical design, decidedly not. Every time the German army made a big mistake, it was a mistake in psychology—they didn't get the right advance dope on what their men would do under the circumstances.

Uncle Sam understands men; his army is not a "machine" nor is it advertised for its well-developed machinery or ordnance. No, our old Uncle Samuel takes due recognition of the human element in his army and pins his faith on his good, strong, red-blooded American men.

No government can guarantee the comforts of home to men under fire, but the fact that so many poor devils were tickled to death to be taken prisoners by our men seemed to let the cat out of the bag. Von Hindenburg failed to realize the true importance of his men, and so he did not have them back of him in spirit or in deed. As for our American commander, the public knows by now what the boys endured for him so that we might gain the victory which we all wanted.



"We ought to be able to get it for you,—were the biggest cold-roll people in the world."

Now all of this is merely the introduction to my article proper. Maybe it is too lengthy, but here is what I am driving at—how many manufacturers there are just like Kaiser Bill who are foolish enough to believe they can be successful in business by worrying about their machines and forgetting about their men.

Recently when I called on a local representative of one of the large steel companies in an attempt to locate some particular sizes of cold-rolled steel, the young lady who was alone in the office said, "Well, we ought to be able to get it for you, we're the biggest cold-roll people in the world." And I replied, "Well, we're the smallest machinery people in the world." And we are. Another company in this city making the same sort of machinery has about 300 men on the payroll. We have 11 men on our payroll including the writer and one other member of the firm; so you see that as yet we really are pretty small.

About two months ago the assembly foreman from this other company came to us saying he was looking for work. Figuratively we were knocked off our feet. He had been with that company seven years, now had about 25 men under him, his work was entirely that of supervision; and yet here he was asking us to take him on.

We put him to work doing our assembling, and frankly, I have never seen a man so interested in a "job" as this man is.

Last week we advertised for lathe men and we suffered another shock, for among those who applied for work was the crack screw-machine operator from this other plant. He wanted to come with us in preference to staying with the larger place. I had quite a talk with him before taking him on. I said to him:

"C——, I worked for that company for five years myself. During that time I received raises in pay, I was promoted, they sent me to conventions for them and out on the road to the four corners of this country. I was pretty young, but they trusted me with all the responsibility I would accept. I left them not because I had some grudge against them, but because I was presented with the opportunity of going into business for myself.

"You say you are dissatisfied over there. Well, we haven't the beautiful and well-equipped buildings that they have, we haven't the new and up-to-date machine tools they have, we haven't any of the luxuries or conveniences you can get over there. We can't promise you piece work right away, we can't promise you that you can look forward to a foreman's job for as yet we haven't any foreman, in fact, we can't even start you out with as much money as you are getting over there. And yet you seem anxious to make the change."



THE SENSIBLE WORKMEN HAVE RAISED FAMILIES AND BOUGHT HOMES OF THEIR OWN

I had been over to visit this company's new plant less than a month before. It was beautiful. I believe their new machine shop is the finest one I have ever seen. And so I couldn't help asking in conclusion, "What in thunder is the matter with that place anyway?"

And so he told me his story of why he was dissatisfied, and why he was willing to go from such a large plant to such a small shop.

He said to me, "I'll tell you, Leach. I went with them three years ago as a machinist. You were with them at the time and you know what they did when the shop foreman quit and got a job with the steel company because he was more sure of being exempted over there, they hired some outsider and put him in as foreman. Later on they needed an inspector, and again it was an outsider with no knowledge whatever about this game. When their assembly foreman left them a couple of months ago to come over with you they tried to make a foreman out of some outsider who didn't know that kind of machinery from balloons. And what happened? That Saturday two men on the floor were fired and five others quit, and on Monday morning Mr. New Foreman came in and got his tools.

"They even advertise now for jig designers and toolmakers without stopping to inquire whether any of us fellows know anything about that sort of thing.

"I know what their idea is. They say outside men bring in outside ideas, and that puts new life into the business. Maybe it does, but it sure takes the pep out of us boys at the machines. The 'Steel' gives a hundred dollars each month to the man who turns in the best suggestion. Maybe I could offer a few sincere suggestions about things I see that aren't going just right, but why should I when the 'Supe' would get all the credit?

"And their bonus system. It was a flat 10 per cent of our pay paid each six months. It was pretty nice to have those big checks to look forward to, but we knew we had them coming whether we worked or loafed, and honestly, I don't believe the company got any increased production out of us.

"So they cut that out and put us at piece work. We thought that was going to fix us up in fine style, but I have tried it for two months now and their rates are so impossible that I haven't made one cent more than I did on straight salary."

He probably said many more things and he might have had a lot of kicks he didn't tell me about; but he said quite enough to point out the "nigger in the woodpile." That organization is putting a lot of capital into plant and equipment, and is not spending one cent of money or one minute of time in the interest of the welfare of the employees.

We are gravely concerned at this present time with the problem of "unrest." It seems to me that what the men are asking is this, "Just give us a square deal, that's all we want. If we make lots of money for you, go fifty-fifty on a part of it. If we make still more money for you, take care of us a little better. Put part of it into our pay envelopes, and part of it into real, honest, human-being treatment."

Of course that isn't the complaint of the radical, "hollering" group of today. But the writer is proud to wear the button of a Legionnaire, and men who have slept in mud are not bothering to listen to the kicks of such grumblers.

But the sensible workmen, those who have put in long years learning a skilled trade, those who have raised families and bought a little home of their own, those who really have something at stake in this good old country of ours, all they are asking for is a square deal.

There was a time when a manufacturer talked of labor as the same kind of a commodity as tool steel or milling machines. True, labor is a commodity, but it is more than that; it is the human element in our business, the largest item in our check books and the most important factor with which we deal. We are good enough to put cooling compound on our tool steel to keep it from getting hot and we give the milling machines a squirt of oil each morning so they won't holler. And can't we realize that it is far more profitable and much less expensive to keep our men from "getting hot and hollering."

As I said before we are pretty small, with our payroll of only eleven men. But recently one of those men showed us a saving of sixteen cents a machine on one of our products by getting away from a certain waste of material, which we had not noticed was unnecessary. It amounts to a saving of several dollars a week, and we are putting five of those dollars into his check each week to show him we want more of those ideas.

Another young man showed up one noon with cigars and the announcement of an eight-pound baby girl at his home. We put five cents an hour more on his checks after that noon on the assumption that he would want to work just a little harder with that little girl at home. And the way he "digs in" has shown we were correct. None of his jobs have increased in cost because of that five-cent increase in hourly rate.

Our attorney is drawing up for us what we plan to call an "Investment Certificate." It will amount in a way to a hundred-dollar share in the business, although it will, of course, carry no voting power. We shall probably give one of those certificates to each man who is with us for a certain length of time, and to all the men we shall extend the privilege of buying as many more as they can afford. The dividend, as on common stock, will increase in proportion to the profits of the company.

We got the idea from a concern with about a hundred people. The secretary told the writer that the first month the plan was tried out those one hundred people scraped up the sum of $28,000 and invested in those certificates.

What we like about the idea is that it gives each individual an incentive to do as much as he can with the knowledge that he will profit in real money in his pocket through his endeavor to make money for his employer.

Maybe we are all wrong. Kaiser Bill would probably have told us so back in 1914. At any rate, we are going to get some new machines and a new building as soon as we can; but right now we are going to try to give the proper regard to the human element and invest a little money in a good, sound, dividend-paying business deal—the square deal.

Notes From Our Field Editor—Machinery in Portland and Seattle

The machine situation in the extreme Northwest, with centers about Portland and Seattle, is somewhat different from that found further down the coast. There is more of an air of retrenchment and uncertainty or pessimism as to the future than was evident in either Los Angeles or San Francisco.

The Portland shipbuilding program is practically completed but it so happens that one of the plants, that of the Willamette Iron Works, made such a record during the war that it is still filled with orders for boilers for ships being built in San Francisco. In Seattle, however, the shipbuilding business is practically at a standstill, this being attributed in some quarters to the failure of the banks and moneyed interests to back up a local concern which had secured orderes for enough ships to keep its yard going at a good rate.

This has its effect on the demand for machine tools and, coupled with a growing caution about placing orders for future delivery, has slowed down orders and inquiries. Unfortunately, there is not much manufacturing in either Portland or Seattle, although there is more machinery used in connection with the lumber interests than we of the East are apt to realize. Logging and saw-mill machinery, to say nothing of the machinery used in wood-working plants, all require more or less repair and replacement, and this means machine tools and smaller supplies, such as drills and taps.

Building Wood-Working Machinery

Wood-working and logging machinery is being built in increasing quantities in spite of the handicap of not having raw material as a native resource. This handicap is believed by some to be possible of removal as it is hoped that iron may be produced in sufficient quantities and of the proper quality, to meet the requirements. Lack of transportation facilities is said to be the greatest obstacle at the present time. Coal mines exist and are being worked to some extent but not sufficiently to be much of a factor as yet even though over four million tons are claimed for them. Then, too, it is uncertain as to the coal being suitable for smelting purposes. In spite of this, however, machinery of types similar to that built in the East, is being manufactured in increasing numbers.

The garages are equipped in much the same way as further South. Cylinder and crankshaft grinding machines, together with other high-class equipment, are found even in comparatively small shops. But real manufacturing shops, even of small things, are fewer than in California. In view of this and of the apparent lack of opportunity for machine sales, it is surprising as well as gratifying to learn that the estimated sales of machine tools in Washington and Oregon, are about a million and a half dollars annually. This, of course, includes Spokane, which is my next stop and which may have somewhat different conditions.

Another factor which is affecting this district is the situation in the fish industry, which, next to lumber, is probably the greatest industry in this section. The sale of canned fish to foreign countries has been very large in the past but the handicap of the present rate of exchange has affected this so badly that canning and canning machinery is more quiet than it has been for some time.

Thirty Millions in Idle Ships

Coming back to the question of shipping, it is interesting to note the claim that Seattle built and delivered to the Government 20 per cent of all the merchant vessels built by the United States during the war period. Whether this includes the 45 wooden ships now lying anchored in the harbor, in various stages of completion, is not known.

The building of these ships is said to represent about $30,000,000, which probably includes yard equipment in addition to the ships themselves. But no matter what it represents, it is a striking example of the inevitable cost of war, and should give an added incentive to the efforts being made to find a more economical (not to mention humane) method of settling national differences. Thirty million dollars would go a long way to help our educational systems, our post offices, our public roads or other useful projects for national benefit.

The field for machine tools is increasing, however, and is bound to grow in spite of temporary set-backs. It is a great mistake not to keep in touch with this section of the country as it is well worth knowing better.



Horizontal Boring Machines for Manufacturing

By FRED H. COLVIN
Editor, *American Machinist*

It has been the custom to consider the high-grade horizontal boring machine as a part of toolroom equipment or at most to be used where there is quite a variety of work to be done. This article, however, shows how one of the largest builders of motor cars and motor trucks uses it as a strictly manufacturing machine.

WHILE the use of high-grade horizontal boring machines in manufacturing is unusual, it is even more so to find them staggered in the same way as is usual in automatic screw machines. Fig. 1 shows a general arrangement of five Lucas boring machines grouped for motor-truck work. The machine in the foreground is set up with a special boring fixture for handling the worm-gear drive bracket shown in Fig. 2. This carries the worm at the top, while the bearings for the wormwheel, which drives the rear axle, are carride in the two bearings *A* and *B*. This shows the construction, including the way in which the bearing caps are held in position.

The fixture is mounted on the revolving table shown at *A*, Fig. 1, which can be easily swung at right angles, so that the boring-machine spindle can drive either boring bar in its correct position and secure the proper meshing of the worm and wormwheel.

A Ball-Bearing Fixture

A view of the fixture itself is shown in Fig. 3, with the two bars in position, while Fig. 4 shows it with some of the cutters in place, at *A* and *B*, as well as the stops such as at *C*, *D*, *E* and *F*. The form of cutter used is shown in the group at *G*, some of these being for straight boring while others are simply counterbores,

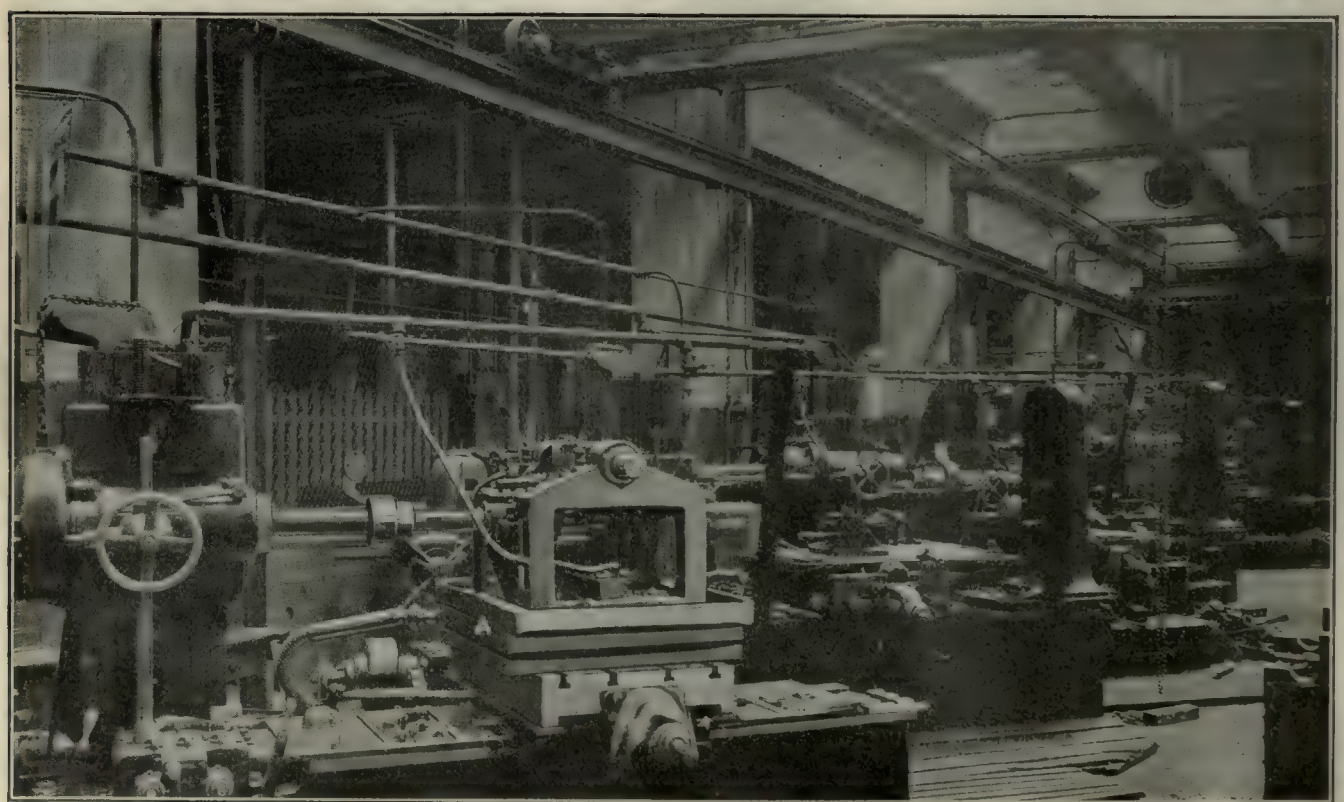


FIG. 1. GENERAL VIEW OF BATTERY OF BORING MACHINES

AUTOMOTIVE CONSTRUCTION



FIG. 2. THE WORM-GEAR BRACKET

which are used for what we might call back facing. It will be noted that each bushing is provided with ball bearings and an oil cup to insure thorough lubrication, to prevent abrasion of the bars, and to insure accuracy and long life.

Details of Construction of Fixtures

Details of the construction of these fixtures are shown in Fig. 5, but particular attention should be directed to the bearings shown in section. These bushings are mounted on large double-row self-aligning SKF bearings, and oil grooves are provided at each end for retaining the lubricant. It will also be noted that return

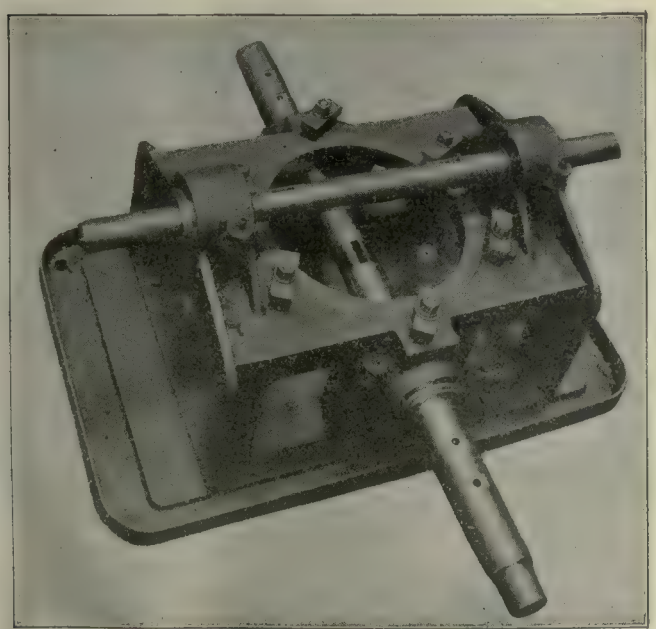


FIG. 3. BORING FIXTURE WITH BARS IN PLACE

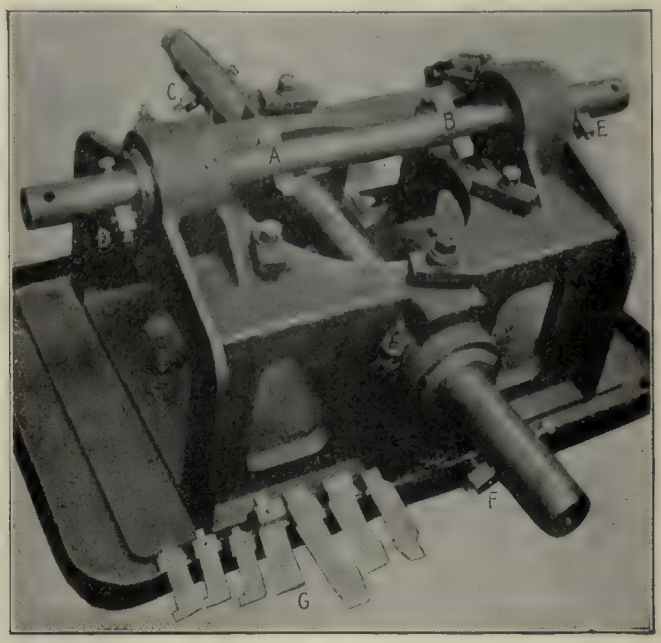


FIG. 4. CUTTERS AND STOPS IN THE BARS

oil holes are provided as at *A*, *B* and *C*, so that oil can hardly escape beyond the first groove in any case. A few outside dimensions are given to give an idea of the size of the fixture.

In order that the bolt holes and dowel holes in the driving housing shall be in correct relation to the worm and worm gear, special attention is paid to the fixture for drilling these holes in the flange. Fig. 6 shows the assembled fixture. The seats for the wormwheel bearings are carefully located on the cones *A* and *B*, these being located on an accurately made mandrel which fits the pocket at each end, as can be seen. These are faced with hardened-steel plates to secure accuracy, while the turned flange of the gear housing rests on the drilling fixture and is clamped in position by the four clamps *C*.

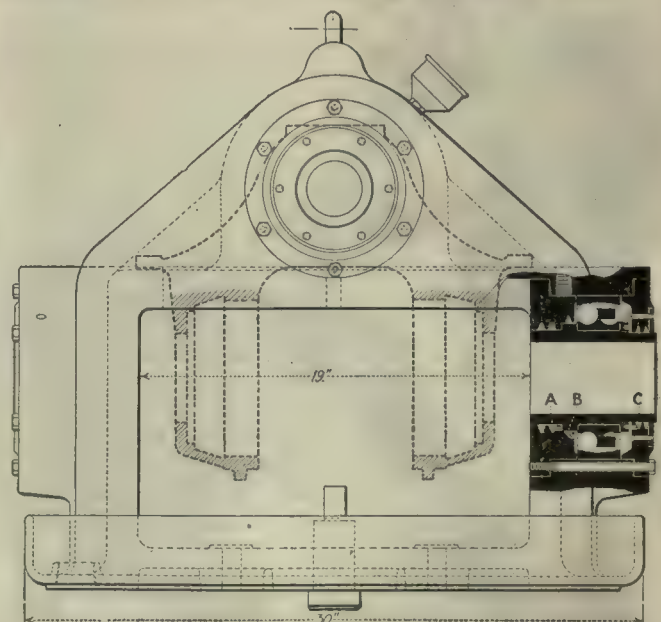


FIG. 5. DETAILS OF BORING FIXTURE

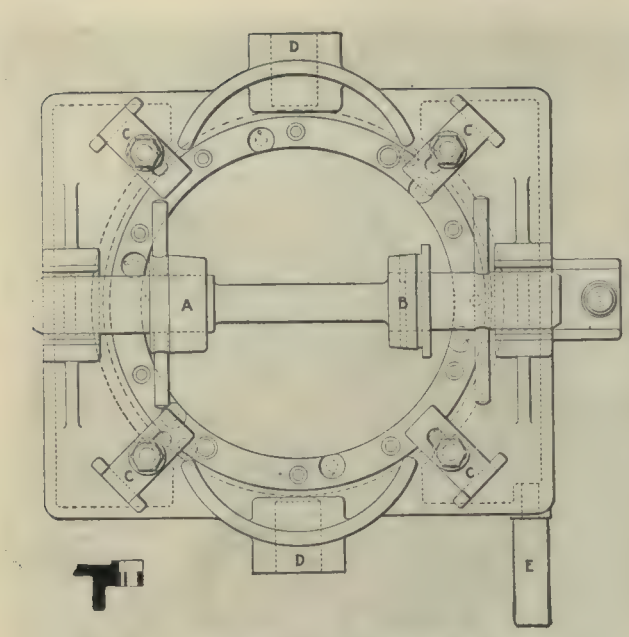
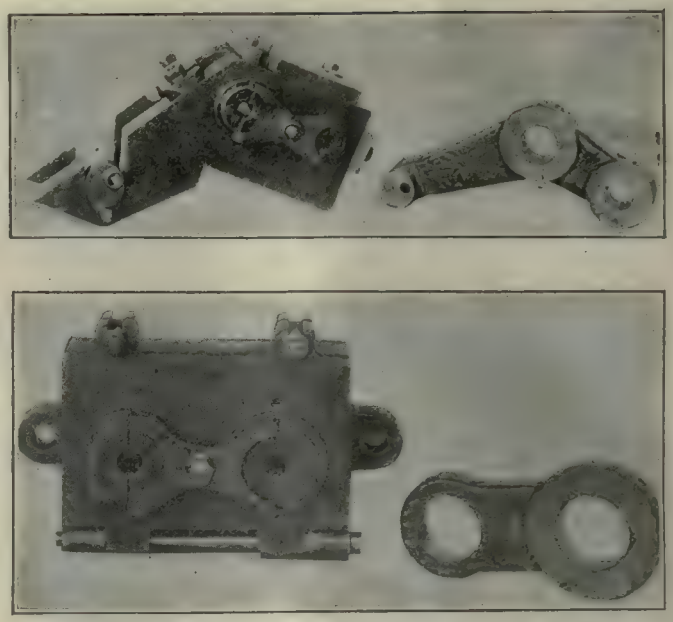


FIG. 6. DRILLING FIXTURE FOR FLANGE



FIGS. 2 AND 3. DRILLING JIGS FOR TOGGLE LEVERS

The fixture is handled by studs placed in the pocket *DD*, while the handle *E* affords a good grip and allows it to be easily guided into correct position on the drilling-machine table or elsewhere.

Some Special Jigs Used in the Manufacture of Pneumatic Tools

By Harry Fox

In the manufacture of pneumatic tools, the Baird Pneumatic Tool Co., of Kansas City, uses several hundred jigs, three of which are here illustrated.

Fig. 1 shows a tool for boring, turning, and facing the shoulder of a brass bushing, all in one operation. It is designed to be bolted to the compound rest of the lathe to which it is adapted by a pair of studs set in a T-shaped strip, fitted to the T-slot of the slide, the height being so calculated as to bring the center of the tool to the center line of the machine and centered up cross-wise with the tail center.

Four toolbits disposed at an angle of 45 deg. are set in the shell. One-sixteenth of an inch in advance of these bits there is placed a hardened ring gage which is the exact outside diameter of the finished bushing. This also acts as a steadyrest for the bushing. The bits are held by setscrews in suitable bosses cast upon the shell and serve to turn the outside of the shell, while four shorter toolbits in the central head take care of the boring. There are four guide pins spaced in between the four last mentioned toolbits.

The bronze casting is held in and rotated by the chuck upon the spindle nose while the carriage is advanced by means of an automatic feed. A bushing is therefore finished complete in one pass of the tool on and off the work.

Two of each of the two sets of four tools are so arranged as to remove the stock, leaving $\frac{1}{32}$ in. for finish, which is in turn taken off by the other two sets of cutters, thus finishing the bushing inside and out to the exact diameter. The finished bushing is shown in the picture to the left of the tool.

In Figs. 2 and 3 may be seen jigs for drilling and counterboring the toggle links that are a part of the pneumatic riveting machine. One of these is of the closed box type with hinged lid, and the other is open box with the work held in place by swinging, or bridge-links, of which there are two, both carrying drill bushings.

Both these jigs are fitted with slip bushings held in place and prevented from turning by spring yokes. The jig shown in Fig. 3 has an adjustable bushing for drilling the eccentric hole in the knuckle. The holes served by the bushings in the bridges are for setscrews and absolute accuracy of their position is not always essential.

These jigs are used in the manufacture of parts of the Baird Pneumatic Tool Co.'s product and were designed by the factory superintendent, W. T. Flood.

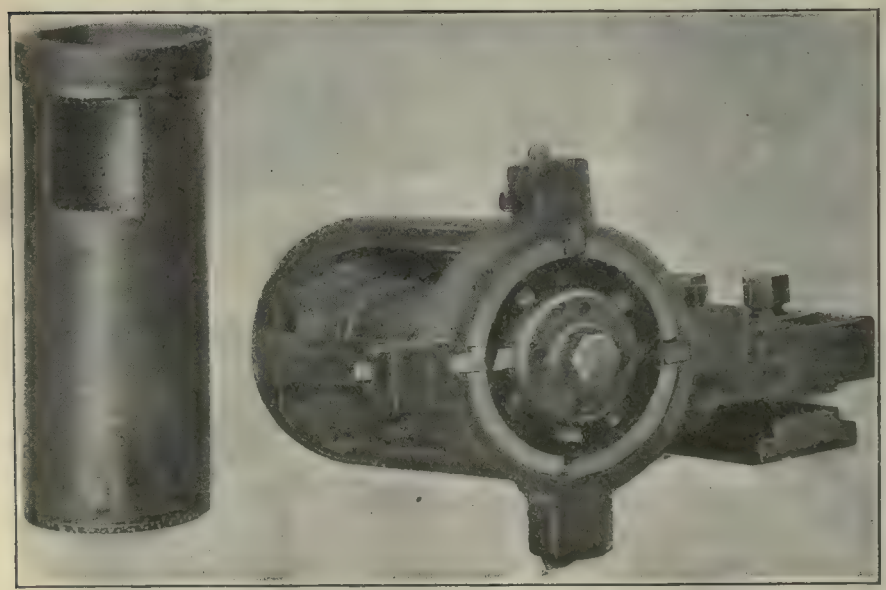


FIG. 1. TOOL FOR TURNING, BORING, AND FACING A BUSHING



Planing a Large Gear With a Small Planer

By George G. Lennig
Master Mechanic, Electric Hose and Rubber Co.

In order to salvage several large cast-iron cut-tooth spur gears from which teeth had been broken, the mechanical department of the Electric Hose & Rubber Co. of Wilmington, Del., used the method here described, with satisfactory results.

The broken teeth were filled in by the oxy-acetylene welding process. A special mandrel, shown in Fig. 1 (a), was made, having a flat-topped coarse thread that would not be injured by coming in contact with the V-blocks. Upon this mandrel the gears were mounted one at a time. As some of the gears had been faced on only one side of the hub, it was necessary to have a flange with $\frac{7}{8}$-in. screws in it, on the cone used on the rough side, in order to be able to make the gear-rim run true with the axis. The gear, after the mandrel was fastened in it, was blocked up on a crib with V-blocks under the mandrel, as shown in Fig. 2. After being adjusted and aligned with the planer bed, the gear was secured in place by several small planer jacks acting on the teeth.

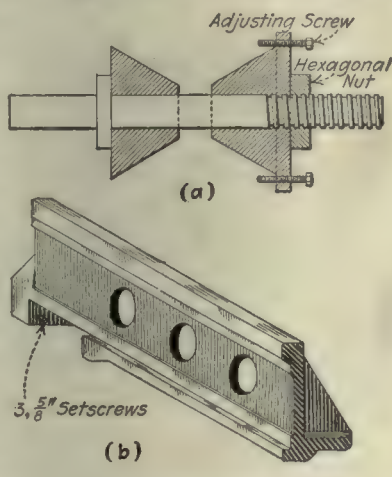


FIG. 1 (A). MANDREL FOR HOLDING GEARS. (B) ARM FOR HOLDING TOOL HEAD

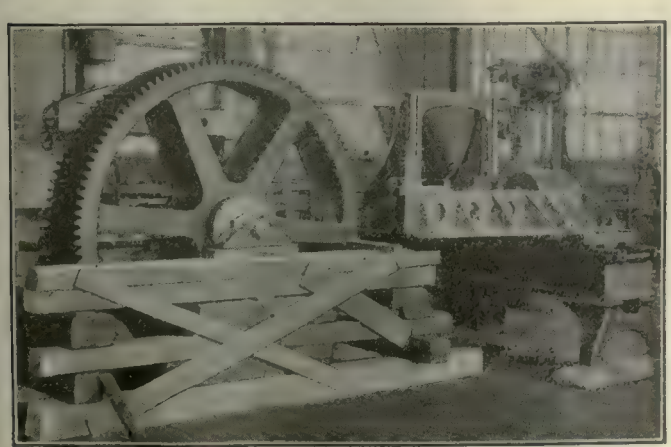


FIG. 2. SET-UP FOR PLANING GEAR TEETH

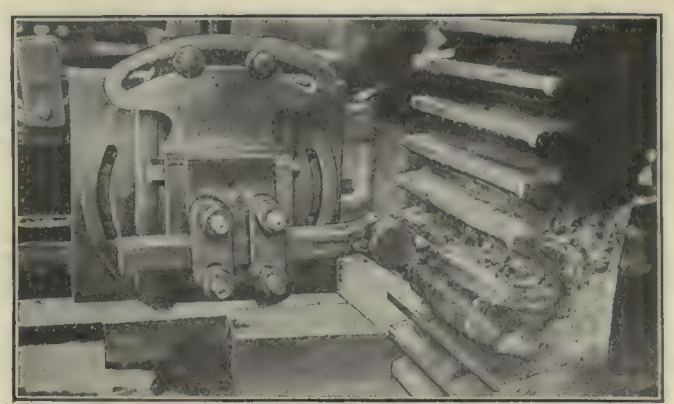


FIG. 3. VIEW OF THE TOOL AND THE WELDED TEETH

The cast-iron arm, shown in Fig. 1 (b), was bolted to the planer bed and the cross-rail and head were fastened to it, as shown in Fig. 3. The table was weighted down with about a ton of forgings, and it was found necessary to slow the planer down to about one-quarter of its customary speed. The cast-iron arm was not made especially for this job, being used on general repair work. It did not need to extend as far as it did from the planer table. However, there was very little vibration.

The gear shown has a pitch diameter of 72 in. and a 14-in. face and weighs about 3,800 lb., and when in operation it is geared direct to a 150-hp. motor on a rubber-mill drive. The planer is an ancient 26 x 26 in. Pratt & Whitney machine with a 6-ft. bed; notwithstanding its years, it is a strong puller and remarkably accurate for such an old tool. Several methods, such as chipping with air and hand hammers and grinding with emery wheels, have been tried for finishing welded teeth, but so far the method just treated has been found the most satisfactory.

Lathe Equipped with a Boring Table

By E. A. Dixie

The illustrations show an old Pratt & Whitney lathe whose principal job for many years has been accurate boring, usually on models from which boring jigs are made to suit the production machines. In spite of the

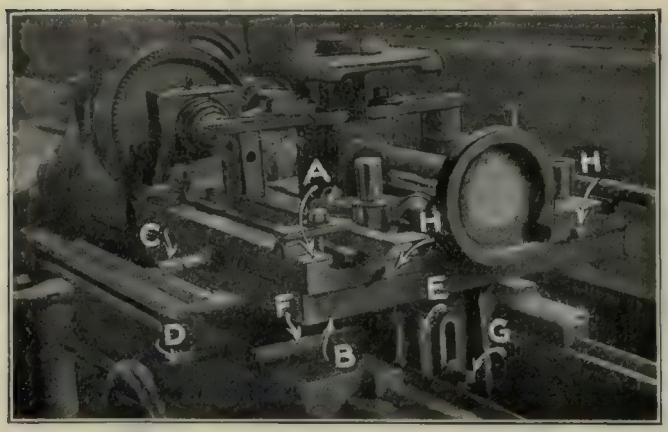


FIG. 1. LATHE EQUIPPED WITH A BORING TABLE

fact that we have several first-class horizontal boring machines, the old P. & W. lathe is seldom idle.

The table *A* is 20 x 20 in. and slides on the base *B* across the bed. The end of the cross adjustment screw is shown at *C*. The squared shaft *D* runs to the center of the base and has a bevel gear which meshes with the elevating screw. Two vertical members *E* are disposed on each side of the bridge *F*, their upper ends being secured to the base *B* and their lower ends bound together by a yoke. Slides for the members *E* are provided on the deep bridge *F*. When adjusting for height two binding screws *G*, one on each side of the bridge, are loosened and the table adjusted to height by a crank applied to the square shank *D*. When the correct height is obtained the screws *G* are tightened. The cross slide is provided with a gib which is adjusted by the two screws *H*. These screws are loosened for adjusting the cross slide, and when correct cross adjustment is obtained they serve to securely bind the cross slide in place. At present this machine swings about 20 in., but the foreman in charge of the department tells me that he is going to block the heads up so that the machine can handle work 36 in. in diameter. This means of course to the center of a 36 in. circle and not to bore holes of that diameter, as the machine is neither stout enough nor is it required to bore such large holes, its capacity in that direction being about 12 inches.

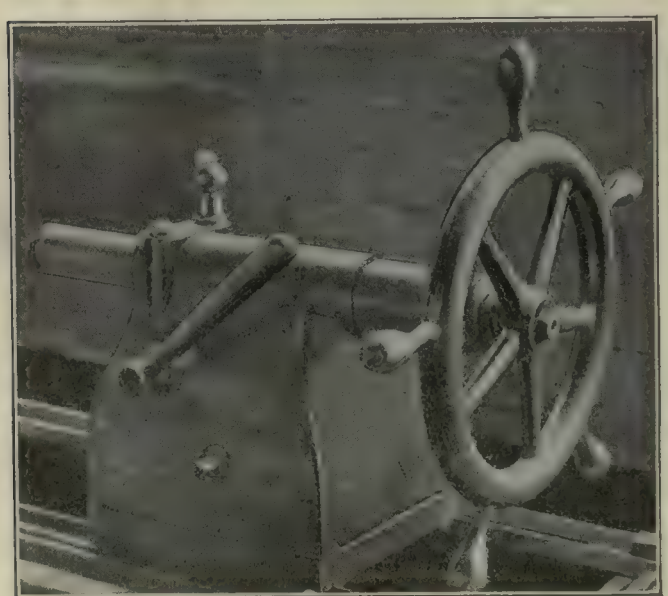


FIG. 2. SENSIBLE HANDWHEEL FOR THE TAIL SPINDLE OF A BORING LATHE

Formerly this lathe was much used for boring with tools secured in or clamped to the tail spindle. Any one who has done this sort of work with the ordinary smooth round-rimmed handwheel knows what a tedious job it is to feed the tool. Some oldtimer not only put a big handwheel on the tailstock but he also put pilot-wheel spokes in it as shown in Fig. 2.

Is This a Punch-Press Job?

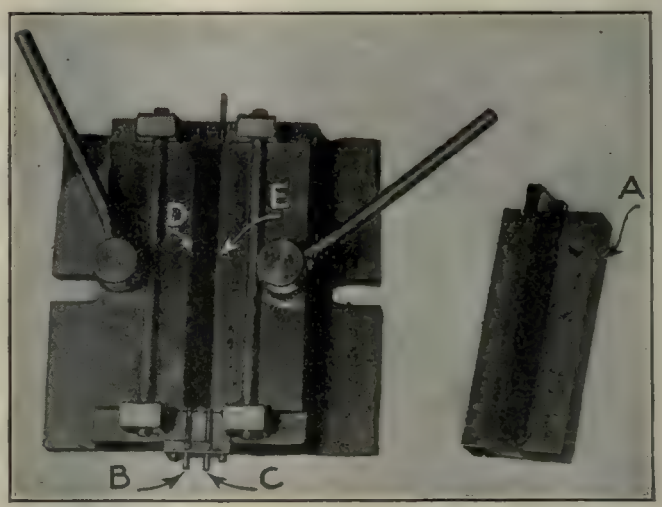
BY JORAN KYN

Under the above title on page 1267, Vol. 52, of the *American Machinist*, F. C. Hudson shows a rod with a flat on it and says he is punching the flats on two rods at once.

Will Mr. Hudson tell us how successful his method has proved?

We undertook a similar job and tried punching but the punch broke, the break being shown at *A* in the accompanying illustration in which the construction of the press tools is also shown.

The two rods *B* and *C*, were placed in grooves in the



THE PRESS TOOLS, SHOWING THE BROKEN PUNCH

die and firmly held by the clamps *D* and *E*. Perhaps our punch did not have enough shear. At present we are milling the flats on the rods, but are looking for a better and cheaper method.

Is there any way in which the work can be done by cold swaging? Any suggestion as to the best and cheapest way of doing the job will be welcome.

Flanges for Friction Pulleys

BY JOHN S. WATTS

THE designing of cast-iron flanges for friction pulleys appears a simple problem at first sight, but it is not so in reality, for unless the stresses on the bolts and flanges are carefully considered the probability is that they will be made too light and ultimate failure will result.

The weakness in most designs is that the bolts are made too small, the size apparently being based on the theory that the shearing stress on the bolt is the governing factor. Experience in operating these friction drives, however, has proved that the bolts carry the load as a beam with a uniformly distributed load.

This is the basis upon which the table, Fig. 1, has

been calculated. The load upon the bolts is that due to the tractive effort on the face of the pulley multiplied by the ratio between the radius of the pulley and the radius of the bolt circle. With a cast-iron pulley and a strawboard or fiber pinion the maximum tractive effort will be about 80 lb. per inch of width, but to make sure I have used a factor of 100 lb. per inch.

To find the load on the bolts we use the formula:

$$L = \frac{P \times A}{B}$$

Where L = load on bolts in pounds;
P = pull, or tractive effort on pulley face;
A = diameter of pulley in inches;
B = diameter of bolt circle in inches.

This load is assumed to be equally distributed among all the bolts and the diameter of the bolts is determined by the formula for a beam with a uniformly distributed load supported at each end, which formula is:

$$\frac{L}{n} = \frac{8 \times f \times Z}{l}$$

Where f = stress;
Z = modulus of section of bolt;
l = length between flanges;
n = number of bolts.

Obviously, the diameter of the bolt calculated from this formula will be more than strong enough to resist the shearing strain.

The diameter of the flanges is such as to allow a projection of ¼ in. of fiber above the flange for the smallest diameter and it may extend up to 2 in. above the flange as a maximum. This gives the greatest possible range of sizes for the smallest number of flange patterns, as the fiber cannot be depended upon to withstand the strain if allowed to project further than two inches. The sizes given in the table are therefore suitable for all sizes of friction pulleys up to 18 in. in diameter which is as large as fiber frictions are usually made. The two largest sizes of the pulley flanges given in the table are for use with wood pulleys, the purpose of which will be taken up later. At the same time these two largest sizes may be used for friction pulleys and are calculated in the same way as the others.

The face of the fiber is made ½ in. wider than the working face of the cast-iron pulley it is to drive, to prevent any danger of the cast flanges coming into contact with the pulley as the fiber becomes worn down

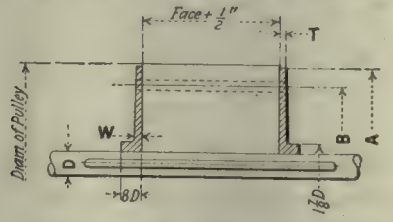


TABLE OF PULLEY FLANGES

Diam of Pulley	A	B	BOLTS 9" Face	12" Face	14" Face	16" Face	18" Face	20" Face	22" Face	24" Face	T	W
6" to 9½"	5½"	3½"	Four ⅜"	Four 1"							⅜"	¾"
10" to 13½"	9½"	7¼"	Four ½"	Four ⅞"	Four 1"	Four 1"	Four 1⅛"	Six 1"	Six 1⅛"	Six 1⅛"	½"	⅞"
14" to 17½"	13½"	10⅝"	"	"	Four ⅞"	"	"	"	"	"	½"	⅞"
18" to 25½"	17½"	14¼"	"	"	Four 1"	"	"	"	"	"	¾"	⅞"
26" to 35½"	25½"	22½"	"	"	Four 1⅛"	"	"	"	"	"	¾"	1"
35½" to 72"	35½"	32"	"	"	Four 1"	Four 1⅛"	Four 1¼"	Six 1⅛"	Six 1¼"	Six 1½"	⅞"	1⅛"

FIG. 1. TABLE FOR COMPUTING BOLT SIZES FOR FRICTION DRIVES

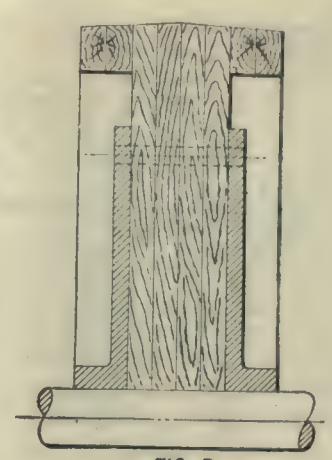


FIG. 2

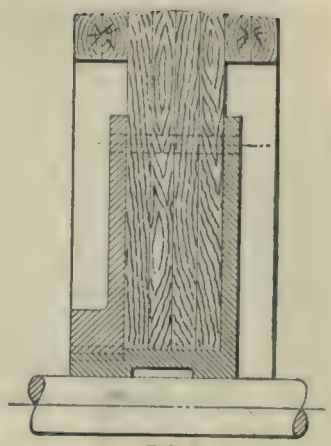


FIG. 3

FIG. 2. SECTION SHOWING CONSTRUCTION OF WOOD PULLEYS FOR EXTRA HEAVY WORK. FIG. 3. ARRANGEMENT OF FLANGES WHERE SPACE IS LIMITED

in size. The thickness of the flanges at the rim is calculated for a maximum compressive stress imposed by the bolts of 2,300 lb. per square inch, basing the calculation upon the load due to the widest face—namely 12 in. face for the pulleys, 6 to 9½ in. in diameter, and 24 in. face for the other sizes. When a narrower face is used the stress will be less but it would not pay to carry more patterns for the small amount of material that would be saved by having thinner flanges for the narrower faced pulleys.

The thickness of the flange where it joins the boss is that calculated to withstand a pull of 100 lb. per inch of face with a maximum stress of 2,300 lb. per square inch. This thickness is determined by calculating the diameter of the smallest shaft that will transmit the torque which the narrowest pulley can impose. This gives the smallest boss that will be used and calculating the load at the diameter of boss due to the tractive effort on the face of the largest pulley will give us the maximum strain at this point. The thickness of the flange, multiplied by the circumference of the boss and by the stress allowed of 2,300 lb. per square inch, must equal this maximum strain.

The sizes of the boss are determined by the diameter of the shaft, and the patterns should be made with the boss loose so that the different diameters of bosses can be attached to the pattern to suit varying diameters of strength if made equal to one and seven-eighths times the diameter of the shaft and the width of the boss should be 0.8 times the diameter of the shaft, which will make the keys in the two flanges capable of transmitting the full strength of the shaft.

For work in cold climates the regular cast-iron or steel belt pulley will not grip, owing to frost coating the surface of the pulley with a thin coat of ice, and it is therefore necessary for saw mills and stamp mills at gold mines, where pulleys may have to work in very low temperatures, to use a pulley built of pine or spruce and nailed—not glued—together, as shown in Fig. 2.

As the maximum belt pull will be about 90 lb. per inch width of face the same pulley flanges will do for the belt pulleys as we have specified for friction pulleys; but the larger sizes of belt pulleys usually are made with the outer face overhanging three inches or so on each side, thus reducing the stress on the bolts.

For extra heavy work, such as the driving pulleys on a large stamp mill, a somewhat more expensive style of pulley flange is used, like that shown in Fig. 3.

EDITORIALS

More Machine Tools for Airplane Work

THE latest development in airplane construction is full of promise in many ways. The all-metal planes which are now flying in various parts of the country make, according to one of the most successful plane builders, all our existing planes out of date and obsolete.

The new planes are not only more substantial and free from dangers from fire, but are surprisingly more efficient in every way. The single wings, for it is a monoplane, are internally braced and are so rigid that they require no guy wires or outside supports of any kind and yet are almost unbelievably strong.

This elimination of guy wires and outside struts, cuts down the parasite resistance to such an extent that the performance per horsepower, both as to weight carrying and speed, is far ahead of anything which has gone before. This, as well as its increased durability, of course, brings the commercial uses of the airplane in many fields appreciably nearer. For in place of the ribs built up of small wooden sections, and their covering of cloth, we have a mechanical construction of far greater strength and durability.

It is only fair to those whose efforts developed the present wooden and cloth construction, to give them full credit for the way in which they secured ribs and wings which were remarkably strong when we consider the material and the many small pieces used in the building. But just as the steel car has replaced its wooden predecessor—so must the metal plane come into its own as soon as the necessary materials can be secured in sufficient quantities.

The machine-tool builder is particularly interested in the advent of the metal plane, because it directly affects his business. Metal plane construction means the installation of metal-working machines, either machine tools themselves or machines which must be made by them. In any case the machine building industry is bound to be directly affected to an extent which was impossible as long as the wood and cloth construction held sway. This is a matter for congratulation, not only because of its direct value to the machine building industry, but because it marks a decided advance in the service which we may expect from airplane development.

F. H. C.

Interchurch Report on Steel Strike

THE Interchurch World Movement, for some time looked upon with suspicion by sober-minded church and non-church people, has deepened this suspicion by its recently issued report on the steel strike. While the report is sponsored by Bishop McConnell, Dr. Daniel A. Poling, Dr. McDowell, Bishop Bell, Bishop Williams and others, there is no evidence that these men did any investigating of actual conditions on their own account. Instead, they depended largely on the reports certain "investigators" made to them. These investigators, some of whom have frequently contributed radical articles to newspapers and magazines, apparently set out to prove one side of the case only—and this against the steel companies. That some of the conditions in the steel district needed adjusting, no one acquainted with them will deny, but the report of the Interchurch Committee is so biased and so manifestly absurd in several instances that it is its own answer.

E. V.

Engineers and a Bamboo Fence

THE conference of engineering societies in Washington, D. C., June 3 and 4, which resulted in the organization of the Federated American Engineering Societies, brought out some very keen thought from many good speakers. Among them was Marshall O. Leighton, representing the Washington (D. C.) Society of Engineers, who used an illustration that is peculiarly appropriate in explaining the inertness of the engineer as concerns taking his rightful place in public affairs. Said Mr. Leighton: "A few days ago I read an account of an experience of Sir Charles Napier, who, in the course of an elephant hunt in Bengal, captured alive a number of fine specimens. He was perplexed by the problem of keeping his elephants confined pending arrangments for their transportation, and the difficulty was finally solved by following the suggestion of a native, which was to build a light bamboo fence around them. Those big animals powerful enough to have walked through that fence without even realizing that they encountered any obstruction, remained peaceably within the enclosure until their master had otherwise provided for them. For a long time prior to the reading of that account I had semiconsciously been seeking a visualization of the American Engineer. My search stopped right there. Engineers as a class—strong, intelligent, accomplished and well poised—have been confined by a bamboo fence. They have taken it for granted, as did Napier's elephants, that, because the fence is there, it must logically be strong enough to keep them within one enclosure."

It is not amiss to refer to this quotation, when at the same time referring to an invitation recently issued by the Joint Conference Committee, which is caring for the affairs of the F. A. E. S. (The invitation is published on p. 379). This invitation is issued to the engineering and allied technical organizations and asks them to become charter members of the federation. Such a move is getting down to definite action.

The invitation was not issued immediately, or even shortly, after the conference because it was desired to give the delegates time to get home with their reports, to give the press time to express its opinions and to give the committee time in which to formulate and mail data supplementing the reports of the delegates. All of these things have been done—and now action has been invited.

There remains to be disposed of, by the invited societies, the item of the bamboo fence which may be represented by any one, or a combination of several things. Among them are the failures to realize the intended scope and future value of the federation; incomplete knowledge of what this organization is and what it

stands for; reluctance to part with the dollar or dollar and a half which must be advanced for each member of a member-society.

This fence should not exist. Practically one hundred per cent of the technical and engineering magazines reported the Washington meeting in detail. The constitution and by-laws have been published in the *American Machinist* and in pamphlet form. The Joint Conference Committee has been busy with its publicity on the organization, so that no points should remain obscure. So far as the fee of a dollar or a dollar and a half is concerned, a little calm thought in which the small sum mentioned is visualized in comparison with the service —service to *somebody* (remember the object of the organization) which it will obtain, will show that this subject may be dismissed at once.

It is to be hoped that if the bamboo fence exists it will be torn up by no uncertain action, and that there will be a whole-hearted, favorable response to the invitation of the Joint Conference Committee.

L. C. M.

The Passing of Our Pioneers

ONE by one the pioneers of the machine-tool industry are passing away and in another column of this issue we regretfully record the death of Amos Whitney.

To many of our older readers—and alsa their number is growing less—the notice of Mr. Whitney's death will be read with sadness. No obituary less than a volume could do justice to the memory of Amos Whitney nor to the influence of his personality on the development of precision and labor-saving machine tools. As the shop executive of the Pratt & Whitney Co., Mr. Whitney has probably turned out more men who have filled executive positions in manufacutring establishments than any one man in the United States. Mr. Whitney's quiet, gentle and unassuming manner endeared him to a lot of friends. There are in existence several shops in Hartford started by him in connection with some of his old friends, ostensibly because he wanted something to do but in reality because he wanted to establish these same old friends in business for themselves. Such was his generosity, quietly performed and known only to those most intimately acquainted with him.

Our old-time mechanics—the pioneers of the industry —will all soon have passed away. Men like Amos Whitney, F. A. Pratt, J. R. Brown, Lucien Sharpe, Richmond Viall, J. H. Holloway, John E. Sweet, John A. Brashear, Alexander L. Holley, George R. Stetson and a host of others need no monuments to perpetuate their memories —their everlasting monuments are in their lives and their work, and the world is better for their having lived.

S. A. H.

A Question in Factory Management

By W. Burr Bennett

THERE is a moot point in factory management that the writer has never seen discussed in any article or in any text-book on management. To explain: all plants, both large and small, are from time to time confronted with the problem of establishing a department for a class of work which is new. For example, suppose we take the case of a shop that has never done any nickel plating.

It is decided to install a small nickel-plating department, even though at the time there is not enough work to keep one man busy continuously. The equipment is installed and the work comes along through the shop.

A man is needed and the factory manager or superintendent picks out a man who is given the proper training to handle the job. This man can handle all of the work, say in two hours per day, but it will be only a matter of time until the output of the shop will be great enough to employ him full time, with perhaps some additional help. Under these conditions, is it cheaper in the long run to put a man on this work for the two hours, letting him complete his day in his regular department, or to let him stay on the nickel-plating work all day, even though he is busy on actual production only two hours?

Disinclination of Men to Work at Other Trades

Of course we must discount the disinclination of men to go on any work outside of their trades and the edict of the trades unions to that effect; however, we would hardly put a skilled mechanic, such as a full-fledged pattern-maker on this work but rather an inexperienced man just starting in some department. Also we must forget the logical suggestion that if a plant has so little nickeling to do it should be done outside. We have taken nickel plating as an example and intend the question to cover only cases where the work cannot be secured outside.

Will Skill Be Developed?

In the first case the man will probably do only partial justice to the two jobs, while in the second he will develop such skill as is necessary by being right there when there is work to do and by keeping the equipment of the new department in working shape. Is the man actually creating a working asset by studying his job during the hours outside of his actual production, so that he will be able to go ahead rapidly when the work is needed, or is he a burden on the already long suffering "overhead"?

A small point in factory management, perhaps, but one that we have had to confront at least six times in the last year. What is the experience of other executives in this matter?

A Problem in Change Gearing

By N. C. Pickwick

WHILE there is, of course, nothing new in the method of finding change gears given by J. Crommell, on p. 832 of the April 15 issue of *American Machinist*, such contributions always bring to mind the value of the slide rule for problems of this kind. I have advocated the use of said instrument for this purpose for more years than I care to remember, and am glad to find its utility in this connection is now being more widely appreciated.

Take Mr. Crommell's second problem: to find wheels to cut 6.83 turns to 1 in. with a 7 lead screw. Set 6.83 to 7, and looking along the scales we find 40 and 41 are in almost exact alignment. Similarly, with the third problem; required 22 turns in 5.12 in. with a 5 lead screw. Setting 4.296 to 5, we find 55 and 64 are a better pair of wheels than Mr. Crommell's 30 and 35. Providing, as it does, a table of ratios, the slide rule lends itself admirably to all problems of this description.

WHAT to READ —for the man in a hurry



Suggested by the Managing Editor

AN ARTICLE differing somewhat from those usually featured opens this issue. It was written by A. J. Hanlon of the International Nickel Co. and is headed "Machining Monel-Metal Castings." It gives specifications for lathe tools for turning and threading monel-metal castings, treats of hardening, tempering and grinding the tools and gives information on lubricants. The occasional user of monel metal or the man who is using it for the first time will be glad to clip this article for his planning or production department.

What to read was not a difficult matter to decide two hundred years ago when books were few and magazines unheard of. It is far different now when so much reading matter is offered to pass the time pleasantly or profitably as the reader chooses. We are doing our utmost to make the "American Machinist" not only profitable but indispensable as a clearing house of ideas and news of the machinery world. This page is the editors' advertisement of their section of the paper. It gives the high spots.

Interest in technical educational ventures has been pronounced for many years, yet at present it is growing rapidly. "A Well-Developed Technical High School," by Fred D. Hood, page 343, tells of the objects and operation of the Los Angeles Polytechnic High School. This is only a short article, but add it to your collection of educational data and watch for others to come—there are several on apprenticeship courses being prepared.

"Superchargers for Airplane Engines," by Sanford A. Moss, begins on page 345. The greatest interest in airplane development at this time concerns its commercial uses. That the supercharger will probably play an important part in commercial planes is evidenced by quoting from the article. "The use of superchargers in commercial airplanes of the future is assured because superchargers will make possible far more miles per hour and more miles per gallon with a given engine and airplane, and speed is the main advantage of air over other kinds of transportation. It is thought by many qualified judges that by flying at a sufficient height with a supercharged engine and a suitably designed airplane a speed of 200 m.p.h. can be maintained."

"The Machinist and the Guard," by Val Klammer, page 348, is a reminder to the machine operator concerning guards which are designed and placed for his protection. Mr. Klammer says that safety is not obtained by simply placing guards on the machine, and that freedom from accidents is only attainable by guards *plus* something else—this something else being the co-operation of the machinist.

A retrospective article by Fred Colvin appears on page 349. To pause a moment to look over its illustrations and read the few explanatory paragraphs will provide a pleasing relaxation from the more technical pages. "Some of the Shipbuilding at New Orleans During the War" is the title of this story of war-time work.

There frequently exists the necessity for the shop or the planning department to quickly compute planing time. J. B. Conway has drawn a chart on which the time may be directly read, when the controlling factors are known. The chart and explanation of its construction and use are given in the article "Chart for Computing Planing Time," beginning on page 351.

H. H. Manchester's thirteenth part of the "Evolution of the Workshop" series begins on page 353. It deals with the decades from 1840 to 1860. The predominant influence of firearms on machine design and development and the progress of production on a "manufacturing basis" are described.

E. E. Hirschhauter, in "Toolroom System," page 358, presents a system which has been in successful use for the last five years in one of the biggest gas-engine shops in the country. System means everything in a toolroom. You may get just the tip you need from this article.

'Making a Pressed-Steel Base for an Electric Fan" is the title of H. Jay's article on page 361. "The manufacture of a pressed-steel electric fan base presents a problem that not only is interesting from the viewpoint of stamping but also offers a very good example of the economy of substituting this method of production for the casting or spun form," says Mr. Jay. This may be true of similar work which you are contemplating.

Plant papers have been the subject of much consideration as to their value and how to make them "take." S. F. Bowser & Co., of Fort Wayne, Ind., have thought out some stunts which are not at all bad. Frank H. Williams tells of them—page 363.

Elmer W. Leach has a "Human Element" story on page 365. It is worth reading for that pleasant glow of warmth it exudes, but it is otherwise valuable, too.

SHOP EQUIPMENT NEWS

-Edited By-
S. A. HAND

SHOP EQUIPMENT • NEWS •
A weekly review of modern designs and • equipment •

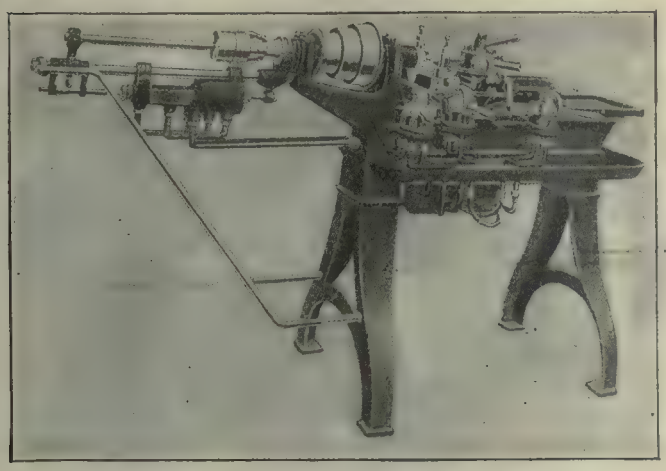
Descriptions of shop equipment in this section constitute editorial service for which there is no charge. To be eligible for presentation, the article must not have been on the market more than six months and must not have been advertised in this or any previous issue. Owing to the news character of these descriptions it will be impossible to submit them to the manufacturer for approval.

• CONDENSED • CLIPPING INDEX
A continuous record of modern designs • and equipment •

Moretti Hydraulic Turret Lathe

Alfred Herbert, Ltd., Coventry, England, with offices at 54 Dey St., New York City, has placed on the market the turret lathe illustrated herewith.

The machine was designed by an Italian and is intended to be operated by men disabled in the late war. The cross-slide, turret and chuck are operated hydraulically by means of cylinders and pistons controlled by conveniently placed valves. A minimum pressure of 75 lb. is required for operation. The drive is by 3-step cone pulley. The turret slide is provided with individual automatic stops.



MORETTI HYDRAULIC TURRET LATHE

Specifications: Swing over bed, 12 in. Bore of chuck, ⅞ in. Hole through spindle, 1 in. Turret; stroke, 3 in.; diameter, 5 in.; tool holes, 1 in. Range of feeds to cross and turret slides, ¾ to 80 in. per min. Floor space, 2 ft. x 5 ft. 8 in. Weight; net 770 lb.; shipping, 1,000 lb. Cu.ft., 60.

Westinghouse Dry-Type Electric Glue Pot

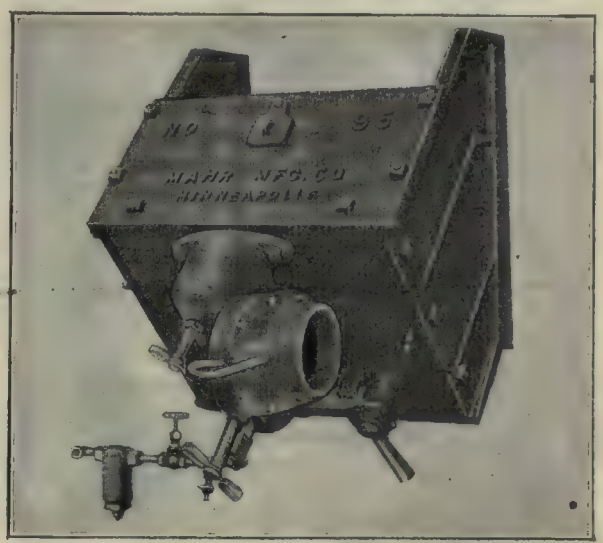
The Westinghouse Electric and Manufacturing Co., East Pittsburgh, Pa., has placed on the market a two-quart size, electrically heated, dry-type glue pot, of the type illustrated and described in the *American Machinist* of March 20, 1919. The time taken to heat the glue by this type of pot is approximately 15 minutes. Sizes made, 1 pint, 1, 2 and 4 quarts.



WESTINGHOUSE DRY-TYPE ELECTRIC GLUE POT

Mahr Calorizor

This device, built by the Mahr Manufacturing Co., Minneapolis, Minn., is a combination of oil atomizer and gassification and combustion chambers for attachment to industrial furnaces. It is made in the angle and straight types. The former, which is illustrated, is recommended for annealing, plate-heating, and heat-treating furnaces, and for core ovens, while the straight type is for use on drop-forging and hammer furnaces, or for any other high-temperature work where a strong reducing action is required.



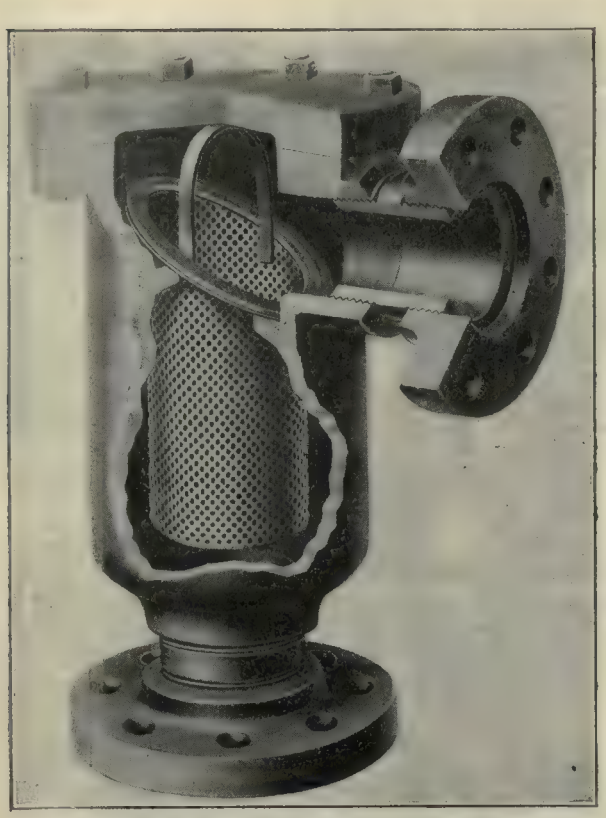
MAHR ANGLE-TYPE OIL-FURNACE CALORIZOR

Low-pressure air is used for both atomization and combustion, the pressure being not less than 8 oz. per square inch. The calorizers will handle any grade of oil, or gas can be used by making a slight change in the calorizer. They are built in three sizes, with oil consumption capacities for the straight type of 5, 8 or 12 gal. per hour, and for the angle type of 4, 7 or 10 gal. per hour.

Griscom-Russell Strainer

The Griscom-Russell Co., 90 West St., New York, N. Y., has placed on the market the strainer shown in the accompanying illustration. It is intended for use in straining both oil, as in a lubricating, fuel or quenching oil system, and water, as on a supply line from a river or lake.

The body of the strainer is cast iron and the strainer



GRISCOM-RUSSELL SINGLE-UNIT STRAINER

basket is perforated sheet steel, the basket being lined with wire mesh when the strainer is used on an oil line.

The strainers are made with either screw or flange joints, for pressures up to 300 lb. per sq.in. They are furnished in a range of sizes to fit pipe from 1 to 6 in. diameter, the smallest size weighing 15 lb. and the largest 550 lb.

The strainer may be installed as a single unit or in a set, consisting of two strainers and two three-way valves with the necessary connections. The use of the set permits the cleaning of either of the two units without interruption of the service.

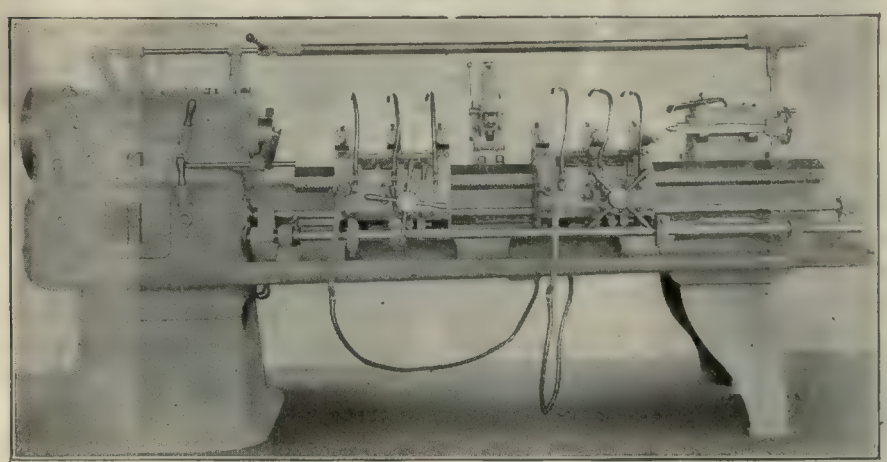
Four-Inch Lo-Swing Lathe

The Fitchburg Machine Co., Fitchburg, Mass., has added to its line the 4-in. Lo-Swing lathe shown in the illustration.

This machine, like the others of its type described in earlier issues of the *American Machinist*, has a constant speed drive and the speeds are controlled by the two upper levers in the headstock, while the feeds are controlled by the two lower levers. With the drive pulley running at 500 r.p.m. six speeds varying from 38 to 316 r.p.m. and nine feeds from 0.007 to 0.120 in. per rev. of the spindle are available. The two carriages, each carrying three tools, run on heavy V's so located that the carriages can be run past the tailstock. The carriage feed gears are driven through Oldham couplings which avoid the necessity of exact alignment. The feed reverse is by sliding gears in the apron. Flexible tubes carry a liberal supply of coolant to the tools and to the tail center.

The shipper rod runs the whole length of the machine and controls a double knuckle-joint clutch in the drive pulley.

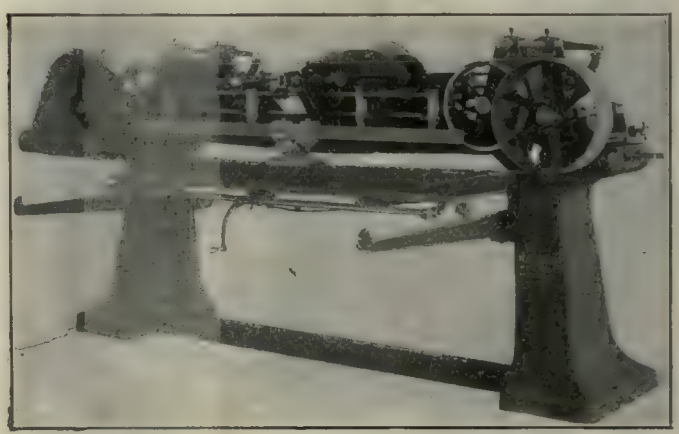
The lathe swings 4-in. in diameter and is made in three lengths to accommodate work up to 60, 80, or 108 in. between centers. The 60-in. lathe requires a floor space of 37½ x 123 inches.



4-IN. LO-SWING LATHE

Mattison No. 124 Automatic-Stroke Belt Sander

The illustration shows the No. 124 automatic-stroke belt sander built by the Mattison Machine Works, Rockford, Ill. Hand-stroking is eliminated by the use of a device which automatically moves the sand-belt across the surface being sanded. The columns of the machine are mounted on a cast-iron base. A heavy casting, on which all of the power-drive mechanism is mounted, extends across the top of the machine, joining the two columns. At each end of the casting, the heads for the sand-belt pulleys are mounted on ways to permit adjustment of the belt tension.



MATTISON NO. 124 AUTOMATIC-STROKE BELT SANDER

The shoe for applying the sand-belt slides on a bar extending across the front of the machine, and is driven with a rapid reciprocating motion by a steel belt running over two flanged pulleys. The pulley shafts carry pinions that are reciprocated by a pair of geared quadrants, the stroke of which can be varied to suit the length of the work. The levers, pulleys, slide and other parts connected with the shoe,

which is mounted on ball bearings, are made of aluminum.

A lever at the front of the machine enables the operator to control the motion of the shoe. The mechanism is counter-balanced, so that light pressures can be readily applied to the work.

When extra sanding is required in spots on a surface, the sanding shoe may be disengaged from its driving belt and passed back and forth by hand. Two speeds are provided for the sanding shoe, so that when it is working with short strokes the speed may be doubled, which lessens the possibility of its being held too long on one spot.

The work is carried on a light table mounted on ball-bearing rollers. The arms which support the table may be adjusted for height by means of screws located in the columns. Stops are provided to hold the work in position, being adjusted by a lever at the front of the table.

An Invitation to Join the F. A. E. S.

The invitation which follows has been mailed to the engineering and allied technical organizations, asking them to become charter members of the Federated American Engineering Societies:

My dear Sir:

The Joint Conference Committee of the American Society of Civil Engineers, the American Institute of Mining and Metallurgical Engineers, the American Society of Mechanical Engineers, and the American Institute of Electrical Engineers, acting as the *Ad Interim* Committee in accordance with the authorization of the Organizing Conference held in Washington, D. C., June 3-4, 1920, extends to your organization a cordial invitation to became a Charter Member of The Federated American Engineering Societies, and to appoint delegates to the first meeting of the American Engineering Council, of which due notice will be given, to be held in the Fall of this year.

There has been previously sent to you an abstract of the minutes of the Organizing Conference, at which there were in attendance 140 delegates, representing 71 engineering and allied technical organizations. It was the unanimous opinion of the Conference that there should be created an organization

> "to further the public welfare wherever technical knowledge and engineering experience are involved and to consider and act upon matters of common concern in the engineering and allied technical professions"

and that this organization should consist of societies or affiliations, and not of individual members.

On the basis of these fundamentals, the attached Constitution and By-Laws were unanimously adopted by the Conference. These contain full information concerning The Federated American Engineering Societies, the American Engineering Council, its Executive Board, and of the various officers and committees. The basis of representation therein stated for the American Engineering Council is one representative for from 100 to 1,000 members and an additional representative for each 1,000 members or major fraction thereof.

At the gathering in Washington, which was the greatest event in the history of the engineering and allied technical organizations in this country, steps were taken which created "The Federated American Engineering Societies," which will have a far reaching influence on the future of these professions. The fact that this action was taken without a dissenting vote indicates that the psychological moment had arrived and that there was a unanimous desire on the part of the representatives of these professions for the organization formed.

The Joint Conference Committee, the *Ad Interim* Committee, would ask each organization invited to take favorable action in the matter of membership in the organization at the earliest possible moment and to advise the committee promptly of the names of the delegates who will attend the first meeting of the American Engineering Council in November of this year.

The Joint Conference Committee is confident that with the universally acknowledged need for such an organization, there will be a prompt affirmative response to this invitation.

Very truly yours,
JOINT CONFERENCE COMMITTEE
of
American Society of Civil Engineers,
American Institute of Mining and Metallurgical Engineers,
American Society of Mechanical Engineers,
American Institute of Electrical Engineers.

Tapping Acme Threads in Motor Jack Bushings

BY H. W. ARMSTRONG

It was necesasry to tap, per week, about 1,000 bushings as shown in Fig. 1, for our motor jacks, a very difficult operation on which we had four concerns under contract at different times, each of whom, after trying out the proposition, rejected it as being too difficult and unprofitable. Then we undertook making them in our own shop, the taps being furnished by one of the well-known companies specializing in that line. The operation consisted of holding the bushings to be tapped in a lathe chuck which was attached to a drill press, and putting five taps through them in proper order.

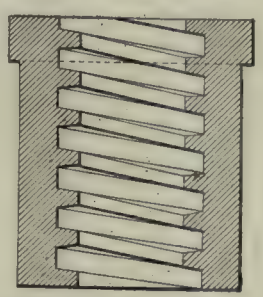
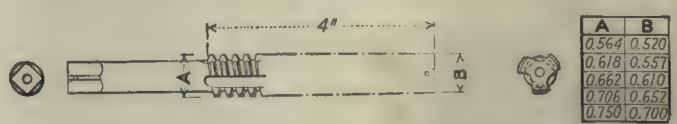


FIG. 1. MOTOR JACK BUSHING

The tap sizes were $\frac{3}{4}$ in. 4 pitch, $\frac{3}{4}$ in. 5 pitch, and 1 in. 5 pitch—all Acme thread as illustrated in Fig. 2. We tried these taps and others which we made in our shop and broke so many that we were ready to quit. Our greatest production was seventy-five in nine hours plus two or three broken taps. The taps being expensive and the production very low the cost was prohibitive



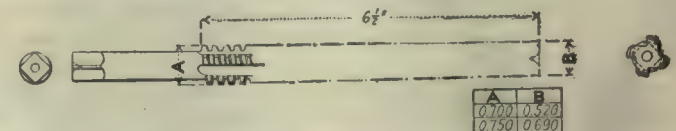
A	B
0.564	0.520
0.618	0.557
0.662	0.610
0.706	0.652
0.750	0.700

FIG. 2. DESIGN OF TAP FIRST USED

and we had to devise some other means. This we did, making the taps as in Fig. 3, and using only two instead of five.

They were made longer, every tooth filed on the top and sides for clearance, and the taps hardened and drawn to a dark straw, nearly a brown. The workman very seldom breaks one now and production has increased from 75 to 360 in nine hours.

The cost of making a set of the new style taps, two in a set as against five in the old, is much smaller than the cost of the old style taps made outside.



A	B
0.700	0.520
0.750	0.690

FIG. 3. DESIGN OF IMPROVED TAP

What Other Editors Think

A Billion and a Half More for the Railroads and Every Cent of It Needed.

(From the *New York Sun*)

A BILLION and a half of new railroad revenue at one stroke of the pen fairly staggers the imagination. This is a full quarter of the towering income of the United States Government, which to a large extent still scandalously continues on a war basis. With the existing revenue of the roads it equals the whole income of the Government and more. It surpasses the total wealth of many great nations of the Old World.

But let no man deceive himself with the horseback opinion that this prodigious revenue now given to the carriers as a populous and opulent nation might pour out treasure for war is going to turn a flood of riches into the coffers of the roads and the pockets of the stockholders. Anybody that indulges in such imaginings simply does not know what has happened to the American transportation system generally since the World War came down upon mankind. Perhaps the average person cannot realize what has befallen it in particular since the United States Government on January 1, 1918, took over the operation of the roads. It is not merely a tale of amazing, incomparable spending. It is a tragic history of astounding, fabulous, all but incredible financial wreck and ruin.

Time was, and only just before the war, when $3,000,000,000 of operating revenue covered all the expenses of maintenance of way and all the expenses of maintenance of equipment, provided for all supplies and paid all wages—paid all operating expenses, paid, besides, all taxes, all interest on billions of debt, all dividends on billions of stock, and built up all surplus accounts.

But in the brief interval from the very year before the war—when the total operating expenses, including all wages and all of anything, passed for the first time $2,000,000,000—the railway payrolls alone have shot up into the dizzy realms of approximately $4,000,000,000 a year. This, stupendous though it be, is not all. Coal has gone up by the hundreds of millions. Similarly rails, locomotives, freight cars, passenger cars, all equipment and supplies have gone up. Some costs have merely doubled; some have not stopped when trebled.

Under the avalanche of expenditures which have overwhelmed them the railroads of the United States, the great and powerful as well as the small and weak, have been in desperate straits. Had it not been for the United States Treasury running rivers of the taxpayers' money into their exhausted tills the roads could not, many of them, have met their monthly bills; they could not, more than a few of them, have scraped up their current payrolls; they could not, some of them, have kept on running.

And the plain truth now is that even with this new billion and a half of revenue the roads are not all going to be rich or so much as prosperous. They are going to dig themselves out of their financial drifts only with travail and care. They are going to be strong and sound and effective again only when the blight of that terrible experience has worn itself out, when the workers have come back to their old alacrity, loyalty and efficiency, when wracked roadbeds have been built up again, when overstrained equipment has been restrained, when shattered morale has been revitalized.

So this billion and a half of new revenue, which might seem at first blush to assure adequate and immediate recreation of the carriers in the American substance and the American spirit, is sorely needed, every penny of it. The great bulk of even so vast a sum, in fact, already is swallowed up. It is gone in new wages—the more than $600,000,000 awarded the other day—in new costs of coal, new costs of construction, new costs of maintenance of everything, new costs of all supplies still rolling up.

Not only have dividends been cut or abandoned by the tens of millions, and not only would interest have been defaulted far and wide but for the Government's guaranty which expires at the end of this month. Renewals and repairs have been foregone on much of what was once our most magnificent railroad property. Extensions and betterments have become only a mockery. And withal, there is now, without counting the new wage increase of $600,000,000 a year, and for months there has been, a persistent deficit of hundreds of millions for the bleeding United States Treasury to make up and then take out of the pockets of the national taxpayers. All these tens and hundreds of millions must now be cared for out of the new revenue.

Nobody need expect, therefore nobody who comprehends the gravity of this situation will agree that the American railway system is yet on a clear track, fit at once for perfect service at top speed. But, by the wise and necessary act of Congress and by the heroic measures of the Interstate Commerce Commission in compliance with the new law, the roads in the darkest hour of their existence are saved.

And nobody shall gainsay that it is a colossal transportation bill which the American people are now to pay. But, at that, it will be far cheaper for them than a decaying plant, demoralized organization and collapsing service. The best, the fastest and the safest transportation is a national necessity at any cost.

It is an imperative necessity of the industry of the public, the business of the public and the bread and butter of the country that the American railway system should work right. The country cannot buy right, the country cannot sell right, the country cannot live right unless the railroads are doing their work. And under private management, with income enough to pay their way, they can. They must; they will.

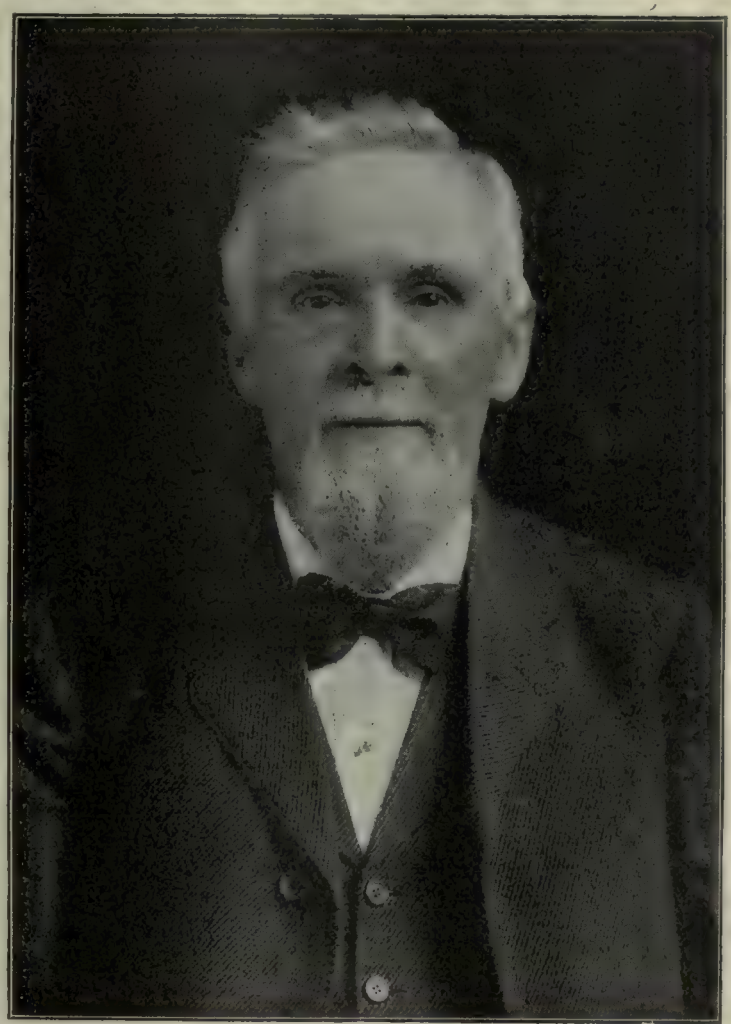
If we can get the roads back to doing their work and if the roads can get the men, so utterly demoralized during Government operation, back to their old time efficiency the American public's transportation bill may fall again—some day, not soon. The damage which has been done is too deep to be repaired for a long time.

Amos Whitney

AMOS WHITNEY died at the Poland Springs House, Poland Springs, Me., August 5, after an illness which had lasted about four weeks. He was 88 years old.

Mr. Whitney came from distinguished Colonial and English ancestry. Whitne-on-the-Wye, from which the family takes its name, is mentioned in the Doomsday Book. One Sir Randolph Whitney accompanied Richard Coeur de Leon to the Holy Land and was there victorious in a single-handed combat with three Saracens—one of them a brother of Saladin.

One of Sir Randolph's descendants came to America in 1635 and was known to the Plymouth colonists as John Whitney. In this country the family has continuously held a prominent and substantial place—many of its members showing decided mechanical tastes, as Eli Whitney, inventor of the cotton gin, Baxter D. Whitney, the Winchendon machine builder, and—Amos Whitney.



AMOS WHITNEY

Although the name of Amos Whitney is inseparably connected with the city of Hartford, Conn., and the Pratt & Whitney Co., he was born in Biddeford, Me., on Oct. 8, 1832. Moving to Lawrence, Mass., he was apprenticed at the age of fourteen to the well-known Essex Machine Co. of that city, going to Hartford in 1852, at the age of twenty. There he was employed at Colt's Armory, at that time the Mecca of many New England mechanics, where he met Francis A. Pratt and Asa S. Cook. Pratt left shortly afterward to take charge of the Phœnix Iron Works (now the Taylor & Fenn Machine Co.), run by Levi Lincoln and his two sons, George S and Charles L. Mr. Cook in 1853 also went to the Phœnix works, as a contractor, taking young Whitney with him, in spite of his youth, as a full partner. This took something of a struggle on Whitney's part as he was making $8 a day at Colt's and the new job offered only $2 at the beginning. But the future looked promising and he made the change.

As many of the present generation have never seen a contract shop, it may be well to explain that the firm furnished materials, machinery, tools, and shop-room supplies, while the men were directly employed by the contractor. Wages, however, were usually paid by the firm and charged against the contractor's account. At the Phœnix Iron Works Pratt designed the "Lincoln" lathes, the "Lincoln" milling machines and other products of the Phœnix plant. Whether the idea of the milling machine came originally from Windsor, Vt., as some claim, or originated in Hartford, is difficult to prove at this time—but at any rate the machine is known as the Lincoln milling machine all over the globe.

Pratt & Whitney each recognized the ability of the other and they became closely associated. The same ambition which urged Whitney to go to Colt's Armory and later to the Phœnix works, drove him into business for himself, with Pratt. While still at the Phœnix, they formed the Pratt & Whitney Co., hiring a room 40 ft. square nearby and employing two men. There they began manufacturing in 1860. They made a little machine for winding thread known as a spooler. The business grew, soon requiring ten men and outgrowing the original quarters. The next shop was in the Wood Building, which has been the early home of several successful concerns, so that there is a feeling around Hartford that any business starting in the Wood Building is bound to be successful. In the little shop John Johnson, Mr. Whitney's father-in-law, acted as pattern maker, millwright, bookkeeper and handy man generally.

A few years later Pratt & Whitney moved into their own building, the old shop having been destroyed by fire. The first structure of their new plant was built in 1865. The firm was known as the Pratt & Whitney Co., and was incorporated in 1869, with a capital of $350,000. At first the upper floor was leased to the Weed Sewing Machine Co., but after a short time the whole building was needed and the Weed company moved across the river (known as the Hog River by the unregenerate) to what was later part of the plant of the Pope Manufacturing Co. The capital stock was increased, in 1875 to $500,000 and in 1893 to $3,000,000. There has been a constant rapid growth since. In 1893 Mr. Whitney was made vice president. Later he was made president, in which office he continued until January, 1901, when the control of the company was acquired by the Niles-Bement-Pond Company. Mr. Whitney remained as one of the directors. At the time of his death he was president of the Gray Telephone Pay Station Co. and treasurer of the Whitney Manufacturing Co., organized by his son Clarence.

The contract system was in vogue at the Pratt &

Whitney plant, but Mr. Whitney, in addition to being general superintendent, always had a good sized force working directly under him on work that did not lend itself to the contract system. Although he was a strict disciplinarian, tolerating nothing irregular or inferior, on account of his own innate *fairness*, it was the ambition of everyone to work for "Whit" as he was called in loving abreviation.

Everybody has a hobby, and Amos Whitney's hobby (so far as the product of the shop was concerned) was "round corners." Even when the works had grown to employ several hundred men, he always had in his pocket a smooth file with which he would "round over" any sharp corner that did not suit his fancy on any machine in process of making. This hobby was so marked that when he got ready to build his house, everyone said the house would have round corners—but it didn't.

He was a noted machine-tool salesman, and a pioneer in the methods which are now beginning to be understood as correct. He never belittled the other man's machine, never recommended his machine when the other man's machine was better for the purpose and would cheerfully recommend the machine that was best, never asking "What is there in it for me?"

His unbounded optimism was well displayed when the Pratt & Whitney Co. went through its first panic. It kept right on making standard machine tools, but selling almost nothing, until all the available storage room was filled. Then a large space was hired from the Weed Sewing Machine Co. and when this was filled another large space was hired in Colt's "West Armory" and this in turn was filled with finished machinery. It is well to note, as a matter of history and as a suggestion for the future, that when this immense stock began to move it was practically sold out in 30 days.

Mr. Whitney was very fond of horses—though he later said he was glad that he had lived to see the automobile—and the knowing ones who wanted a day off when the shop was busy, always, when possible, timed their requests for absence to agree with the days when there was horse racing.

He was always an early bird, usually the first to reach the shop in the morning, in consequence of which there were few tardy workmen.

It should also be remembered that Mr. Whitney took an important part in the development, in this country, of standard measuring instruments, one of the first moves being a determined effort to secure a standard inch block. His company purchased at considerable expense a standard rectangular bar, 1 in. square and 12 in. long, which had been used as a standard of measurement. Twelve 1-in. cubes were then made as accurately as possible and tested by the 12-in. piece. It was found that the twelve 1-in. cubes were not as long as the single bar, supposed to be exactly 12 in. long. Careful measuring and comparison with such standard instruments as were available led the company to believe that the individual inch-blocks were more nearly accurate than the longer piece, and this was afterward proved by the Rogers-Bond comparator, which was developed in the Pratt & Whitney works.

At that time no one realized the effect of comparatively small changes of temperature on steel, which led to numerous interesting and embarassing situations. Nor was it understood that a plug and ring gage might be put together and prove to be a nice fit if relative motion were maintained, but seize if allowed to remain stationary. The gages exhibited by the Pratt & Whitney Co. at the Centennial Exposition ran up to about 2 in. in diameter. To avoid leaving the hole "bell-mouthed," the ring gages were made with a slight projection on each end, which was afterward ground off. No one understood the effect of aging on steels or the changes that would take place after hardening and Mr. Whitney's own story of his experience with these Centennial gages is of interest. They were finished several weeks before the exposition and all completely tested before laying aside to await shipment. Just before sending them to Philadelphia he picked up a ring and plug gage to make sure it was right but could not make the plug enter. Every plug proved to be large and the gages had to be refinished before sending.

All his life Mr. Whitney was doing something for some one else, but he disclaimed any credit for this, saying "I believe that every dollar I give to help some one who needs it more than I do, will come back."

Mr. Whitney leaves a son, Clarence E. Whitney; a daughter, Nettie L. Whitney; a brother, Major George Q. Whitney of Hartford, and two sisters, Mrs. George H. Carey of New York, and Miss Fannie Whitney of West Newton, Mass.

The Evolution of the Engine Lathe

By L. L. Thwing

In Mr. Franzen's interesting article on engine lathes, on page 184 of the *American Machinist*, an explanation of the derivation of the term is given by associating the development of the lathe with that of the steam engine, suggesting that, since lathes were driven by engines, they were called engine lathes. While it is quite possible that this is true, there are several pertinent facts touching on this question, that are entitled to consideration.

The term "engine lathe" is certainly not as old as the general use of the steam engine. Steam engines were in common use during the Civil War period, and the engine lathes were not, as can be readily verified by an examination of the text and advertising of the trade papers of that period.

"Engine" is not the word applied to power-driven machinery; "steam" is the word. For example, the Naumkeag Steam Cotton Mill at Salem, and the use of the expression "steam looms" by many mill men of English birth.

The word "engine" was formerly used in apparently the same sense as "machine," as, for example, gear-cutting engine, carding engine, rose-turning engine, and even screw-cutting engine.

In Byrnes' Mechanical Dictionary, published by D. Appleton & Co. in 1851, will be found the following in Vol. 1, page 168:

"Lathe, Engine, Figs. 2,511-13.

Fig. 2,511 is a side elevation of the *engine*.

Fig. 2,512 is an end elevation.

Fig. 2,513 is a side elevation of the tailstock."

It will be noted that the word "engine" is used in the same sense as headstock.

Some years ago there appeared in the *American Machinist* an article on old machine tools, which reproduced the manufacturer's advertising circulars, and in these the small lathes were designated as either screw-cutting lathes, or turning lathes, and the large ones as engine lathes.

Business Conditions in England

FROM OUR LONDON CORRESPONDENT

LONDON, July 23, 1920.

THE decision of the Industrial Court against the demand by engineering workpeople for an increase in wage rates will to some extent mitigate commercial difficulties being experienced by machine-tool and other engineering firms in Great Britain who attempt to enter into large contracts for the European continent. Here, as compared in particular with his American competitor, the British manufacturer has been badly handicapped, being unable without serious risk to quote fixed prices for anything outside immediate delivery owing to uncertainties as to the costs of labor and material. Customers in Great Britain of firms who have quoted subject to prevailing conditions at the time of delivery have been irritated to find varying estimates as to increased cost caused by admitted increases in wages of labor and prices of materials. Continental firms have refused to accept delivery, though here the exchange variations have really been the determining cause. At least one heavy-machine-tool firm has therefore quoted what is in effect maximum and minimum prices, stating frankly the increase estimated, and agreeing that the actual price charged should be based on prices at the date of offer, plus a percentage to vary with increase of costs, etc., but in no case to exceed a given amount. In this they did but follow the practice of some electrical firms.

CLAIMS OF WORKPEOPLE

The claim for an increase of 6d. an hour was put forward on the grounds of increased cost of living and of greater wage advances in other trades, and with the view that the general condition of trade justified the increase. On the other hand, the employers, according to the official statement, submitted that advances already made covered the increase in cost of living "and that the commercial position was such that a further advance in wages would be accompanied by grave risks of injury to the engineering trade." The court stated that published returns indicate good employment, but that the employers' evidence showed that "there are already indications in some branches of the industry of a falling off in demand." Accordingly it held that the claims submitted were not established. Whether this decision will meet with general acquiscence on the part of engineering workmen remains to be seen. Meetings are being held throughout the country to consider the matter. Further, the economic effect of the 47-hour week and other problems of engineering employment have been discussed in private conferences between representatives of employers and employed. While agreement may be reached on other matters, the employers' representatives adjourning to consult the federations, the trade unionists remain firm against payment by results.

IRON AND STEEL MARKET REPORTS

From the London iron and steel market reports are a little contradictory; that is to say, decline in prices and in orders offered is shown on the semi-finished side, where as regards pig iron prices remain firm. Larger quantities of American material in a semi-finished state have, it is understood, lately been on offer. On the finished-steel side the demand has lessened and the supply. apparently, increased.

Of the various branches of engineering little that is fresh can be said, but unemployment is being more freely reported from midland towns associated with automobile and cycle industries and from heavier engineering centres farther north. Would-be customers of one or two motor-car firms have had an unpleasant experience for, having paid their deposits, they have learned that the firms concerned have been compelled to close down without delivering the cars. In some cases, apparently debenture holders have prior claim.

That the United Kingdom is regaining its shipbuilding pre-eminence seems to be plainly suggested by figures just published here based on the returns of Lloyd's register. According to this merchant ships building here on June 30 last totalled 3,578,000 tons, the total tonnage being built abroad at the same date being 4,142,000 tons, this not including, however, Germany, as figures are not available. As to the United Kingdom an advance on the quarter is shown, while for the rest of the world a decline was exhibited, a decline which was specially marked in the case of the United States the fall here in the three months being given as 467,000 tons. Japanese figures, too, show a decrease, but increases are indicated both in Holland and in the British dominions. The tonnage now building in the United Kingdom is in fact almost double that at the corresponding period of 1914, but how far recent cancellations of orders have had effect is not clear. At the same time the tonnage building abroad has considerably more than doubled, comparing with 1,441,000 tons in June, 1914.

BRITISH ENGINEERING STANDARDS ASSOCIATION DOING GOOD WORK

The British Engineering Standards Association is continuing its good work and the average British reader of this journal is anticipating with interest the impending publication of the new report on milling cutters and reamers, said to be one of the most comprehensive prepared. During the past twelve months twenty-seven standard specifications have been issued, a further seventy being under revision. In the electrical industry forty-five specifications are in course of preparation, and the work in connection with shipconstruction details and marine engineering is reported to be making good progress. Despite the fact that a large amount of this work is done freely by members (for there are some 300 committees on which the report states sit more than 1,400 men), yet on the year's working there is a deficit of £1,100. An appeal is therefore being made to British engineers so that the £15,000 to £20,000 a year needed to carry on this work may be assured.

A British Empire exhibition will, as announced, be held in London in 1923, one of the objects being "to demonstrate the natural resources of the territories of the empire and the inventive and manufacturing energy of its peoples." The government will probably guarantee £100,000 toward its promotion. This will be granted, however, on the understanding: (1) That an additional sum of £500,000 is secured from other sources; (2) the Board of Trade shall have the right to approve the choice of a general manager of the exhibition and shall be officially represented on the executive council, of whose proper constitution they shall be satisfied; (3) all regulations in connection with the exhibition, such as those affecting the participation of the various parts of the empire and the entry of British exhibitors, shall be subject to the approval of the Board of Trade.

A committee is being appointed by the Board of Trade to consider the policy to be adopted in connection with trade fairs, more particularly as regards districts in which the exhibitions are to be held, trades to be included, and the class of exhibitor to take part. In thus fostering trade exhibitions, etc., the board are but pursuing and improving on a policy they followed for a number of years before the war.

TECHNICAL INSTITUTIONS HAVE RESUMED PRE-WAR PRACTICE

The technical institutions centered in London have resumed their pre-war practice of holding summer meetings in the provinces. Thus the Institution of Electrical Engineers journeyed through parts of the west of England and South Wales, although apparently only 160 persons took part, several of these being ladies. The success therefore is to be regarded as modified. Then the Automobile Engineers went on a week's journey through Sheffield, Derby and

Manchester. Now the Institution of Mechanical Engineers has just been holding its summer meeting in Lincoln, about 190 members, plus 60 ladies, attending. Beside visits to local works this institution has been hearing a number of papers on such subjects as the uniflow steam engine, recent excavator practice, Lincolnshire oil engines, transport by steam vehicles, and the human factor in industry. Other institutions have rather tended to drop the formal reading and discussion of papers during summer excursions.

Olympia Machine-Tool Exhibition

The Machine Tool Exhibition to be held in Olympia, London, W., during September will be preceded by a banquet on Sept. 3.

Under the directorship of Sir J. E. Petavel the National Physical Laboratory, Teddington, appears to be rather less averse from publicity than has been the case in the past and recently the metrology section was thrown open for inspection, engineers and others interested from all parts of southern and midland England responding to the invitations. Of one interesting matter no particulars could be obtained. It is the method developed by A. J. C. Brookes following a suggestion by J. E. Sears, the superintendent of this department, for producing slip gages of the Johansson type which can be "made commercially to an accuracy of one part in a million on all sizes down to 1 in. and uniformly of 0.000001 in. on smaller sizes." A standard on gage being given all smaller sizes can be generated with the "accuracy of one part in a million or one-millionth of an inch." It is understood that a paper on the subject is in preparation and will be read before one of the London technical institution in due course.

Two Comparators for Slip Gages

The exhibits included, by the way, two comparators for slip gages, both designed and made at the laboratory, and capable of detecting one-millionth of an inch. The simpler machine has ball-point faces and measures by local contact only. The other machine has flat faces with special adjustments, and comparisons between slip gages, cylindrical plugs and balls up to 4 in. can be made by it. In the design the elastic strain of the machine itself is recorded, optical indicators being employed.

Another matter of gaging interest in the workshop related to plugs and sockets. As gages for holes, balls have their recognized defects, as of course there is no axial direction about them in comparison with the ordinary cylindrical plug. Again, it is now being generally recognized that they exert a powerful wedging action on the ring, so that a relatively large ball can readily be passed through a relatively small hole. Further, balls are held on handles screwed in and the action of fastening the handle to the ball itself distorts the ball. The fact that expansion is possible with ordinary socket gages was shown very plainly, for a plug known to be larger than the bore of the ring was pushed in by hand, and the difference in outer diameter of the ring before and after was clearly indicated on a minimeter. The laboratory now has a new gage workshop, especially equipped with precision machine tools, English and American, and only just brought into operation. It is in this department that the slip gage process is being developed.

The Manchester Center

Although of late years Manchester as an engineering area may not have expanded as much as its admirers would desire, yet this is hardly true of the Broadheath district, some half a dozen miles or so from the center. Here years ago the George Richards firm found its home and, after some changes of practice, settled down to the production of machine tools, of late more particularly in the form of vertical boring and turning mills, side planers, and surfacing, boring, milling, etc., machines. Opposite them is Luke & Spencer, Ltd., connected with abrasive wheels and certain kinds of grinding machines. The Linotype Co.'s factory, too, has long been a prominent feature of the landscape and Meldrums, Ltd., built a new works at Timperley, near by; while more recently the steam and other gage works of Schaffer & Budenberg were removed here. An addition to the purely machine-tool firms was made when H. W. Kearns & Co., Ltd., also a maker of universal milling, boring and surfacing machines, erected its shops not far from the Richards' buildings. Later still, comparatively near, Smith & Coventry, Ltd., built works for its small-tool section, leaving the machine-tool side in sole occupation of the Salford factory. Omitting from the account minor engineering firms, within the last few months a still larger addition has been made by the Churchill Machine Tool Co., Ltd., which has erected works, now fully occupied, for the production of precision grinding machinery of all kinds. It forms in fact easily the largest concern of this type in Great Britain. Under the control of H. H. Ashbridge, the new works on a single floor covers a space approaching three acres, while much land is available for extensions, some of which is already under way. The small-tool department is just in the finishing stages of building. In short it is concluded that this year will see the whole of the works removed from Pendleton to the Broadheath site. The general manager, S. H. March, is of course well known on your side. The Churchill firm is next door to H. W. Kearns & Co., which again as a neighbor on two sides has George Richards & Co., whose latest foundry is being erected with two light and two heavy bays for a monthly output of about 350 tons.

The Openshaw District of Manchester

Then in the Openshaw district of Manchester, where the Whitworth firm (now Armstrong, Whitworth & Co., Ltd.) always had its center, shops that until recently were devoted solely to war purposes have been converted to machine-tool and small-tool production. We have referred to the small-tool factory organized in what was a shell factory.

Now in the shops formerly devoted to the production of howitzers and relatively light field guns the firm has organized a special machine-tool side, which will, for the present at any rate, be mainly concerned with the production of tools for locomotive and railway shops in general and for shipyard work. It is under the direction of C. D. Andrew, with whom is associated J. Cullimore, both of whom were formerly with the Niles-Bement-Pond organization in Great Britain. Apart from offices the machine-tool works have a floor space of about 130,000 sq.ft. The two-story building used as offices measures 120 x 40 ft., and includes a top-floor drawing office, 100 ft. by the full width, and offices for general and works management and for the estimating, progress, planning and outside supply departments.

Markets have of late been found for the productions of this department in France, Belgium and India, as well, of course, as in Great Britain, including the firm's own works in the Newcastle district. Productions in hand include wheel and wheel center lathes, axle lathes, quartering machines, vertical boring and turning mills, railway-tire drilling and tapping machines, punching machines, planers, radial drills, surface grinding machines, screwing machines, etc. In each case the design is new. Before the end of the year, too, the Victor semi-automatic machine will be placed on the market after redesigning.

Birmingham Small Arms Co. Branching Out

The Birmingham Small Arms Co. is branching out in various ways and its efforts in connection with small tools has already been noted in these columns. In Birmingham it has a series of works, each devoted to a particular purpose, and it has partly built and partly under construction two new works on the Coventry Road, Birmingham, one of which will be used for machine production. Both works are of ferro-concrete construction, but the methods of building differ. In the one case the ordinary system of casting in molds in position on the site is being employed, while in the other case the columns, roof principals, etc., were cast separately and then erected just as if they were of steel, pockets being left in the foundations for the feet of the columns, which were grouted in, the trusses being brought by rail and hoisted into position, etc. The full width of the shop was worked and the roof put on as quickly as possible, so that one end of the shop was in use before the other end was finished.

This building is about 200 x 640 ft., in 20-ft. square bays, and the principals were designed to carry a concentrated load of 2 tons. To prevent freezing of the concrete during the setting (the work being undertaken in winter) the molds employed for the trusses, etc., were heated by steam coils connected by insulated pipes to the boilers some distance away.

The other building now under construction is cast one floor at a time, the necessary molds being erected by traveling cranes running on light rails on the floors being cast. In this way has been completed one of six buildings, all alike, providing a total floor space exceeding 2,000,000 sq.ft. Each unit is built around a courtyard measuring 100 x 200 ft.

Firms Increasing Capital

Thomas Robinson & Sons, Ltd., Rochdale, is the latest engineering firm to appeal to the public for capital. As part of an authorized share capital of £450,000 it is issuing at par 125,000 7½ per cent cumulative preference shares of £1 each and 25,000 ordinary shares of £1 each. Debentures to the extent of £60,000 at 5½ per cent redeemable on Jan. 1 next have been issued. The business was founded in 1838 and in addition to works at Rochdale and offices in London a branch office and works have been established in Sydney, Australia. Profits have been mentioned as follows:

For 1915, £17,668; for 1916, £26,444; for 1917, £19,528; for 1918, £29,635; for 1919, £38,236. The business carried on is mainly the manufacture of woodworking machinery and of flour-milling and grain-cleaning machinery. Deducting debentures, loans, sundry creditors, etc., the net assets are valued at £226,577, this including land, buildings, machinery, tools, patterns, etc., at £111,589, and stocks at home and abroad valued at £195,809.

Armstrong, Whitworth & Co., Ltd., with a total authorized share capital of £11,012,500, of which £10,012,500 has been issued, and £2,500,000 4 per cent mortgage debenture stock issued has been making an issue of £2,000,000 in second mortgage debenture stock at 95 per cent. carrying interest at 6½ per cent and redeemable on or before Jan. 1, 1946. The underwriters, it is gathered, were left with about 72 per cent of the issue. On the other hand, its rivals, Vickers, Ltd., which has a total authorized share capital of £26,500,000, of which £20,679,040 has been issued with 4 per cent first mortgage debenture stock outstanding of £1,250,000, have just had fully subscribed the issue of £1,500,000 7 per cent 7-year notes at 95 per cent repayable at par on July 1, 1927.

How Can We Increase Production?

By George Sydney Binckley

You say you want increased production. Very well. How are you going to get it? We may as well face certain brutal facts. As to your idealism, forget it, for it won't increase production. It isn't what you think men *should* do that is important—it is what they *will* do that counts.

You want increased production. You won't get it by asking it of your men as a duty to mankind in general. Try this argument on your tailor. Try it on the hatter who charges you four prices for a hat. Try it on your men, and they will reason thus: "I have a job, my labor is in demand, and this demand will grow less insistent and profitable to me in proportion to my increased production. Why should *I* speed production?" Try it on some one who controls his market. He will reason to himself thus: "The high price of my goods is due to heavy demand and limited supply. My profits originate in this condition. Why should *I* speed production?

Of course they oughtn't to reason this way—but they do. What are you going to do about it?

The employers of labor have surrendered economic leadership to the trades unions. If things are to be improved—indeed if industrial disaster is to be avoided—this leadership must be *regained* and *wisely used*.

There are three ways by which you can get a man to do what you want him to:

First: If you have the arbitrary power to do so, you may force him to do your will.

Second: You may appeal to his sense of duty or his patriotism.

Third: You may make it worth his while.

The first of these methods is the favorite, but carries the distinct disadvantage that if the position is reversed, you are rather more than less likely to get rough treatment in your turn.

The second is uncertain, erratic and never permanent in its results.

The third is infallible.

This may seem a harsh judgment of human nature, but has the advantage of being the bald truth.

Paying for Service

If you want service from a man, make it worth his while to render it—and you'll get it. If you want to prevent labor turn-over, make the job valuable to the man who holds it. If you want efficiency in field or factory, *pay the efficient men a high wage and fire the dubs.*

If you have a lathe hand who turns out twice as much work per day, in quantity or quality, as the next man, and this next man is worth his wage, don't throw your star man a sop of twenty-five or fifty cents per day more—*pay him what he earns. You get the work—pay for it.* If you do this, *one* of these men will value his job, will boost the factory, and will swear by his boss—and *he* is the man you want to hold.

You want to speed up production: You will never be able to do it by collective bargaining. If you want speed, pick out the men *who can* speed production, *and pay them to do it.* Pay the others what they earn—*no more* and *no less.* If they don't like it, let them go—your policy will promptly fill your factory with the cream of the workers—let the other fellow take the dregs.

Co-operative Individualism

What is needed to speed up production, to avoid labor turnover, and to put industry on a sound basis of efficiency can be summed up in two words—Co-operative Individualism. This simply means the square deal—but the square deal *all round.* It means that a man should be encouraged to do his best by being paid for doing it. It means that the development of individual talent, initiative and ambition cannot be dispensed with in the development and maintenance of industry.

And Co-operative Individualism means the *open shop.* The whole spirit of the closed shop is against individual development, against ambition and against efficiency. As an institution it has convicted itself, and its rules and practices are more directly responsible for underproduction than any other single factor.

Do you want increased production? Then pay for what you get—whether it be the brawn and muscle of the willing laborer, or the brains and ability of an executive.

Do you want a man to work harder? Then make it worth his while and he'll do it.

Otherwise he won't.



Cincinnati Milling Machine Co. Outing

Although there is supposedly a machinist strike on in Cincinnati, no evidence of it is seen at the plants of the Cincinnati Milling Machine Co. and the Modern Foundry Co. who found the opportunity for having a "birthday party." The outing was held at the Cincinnati Zoological Garden on Saturday, Aug. 7, the entire day being filled by a varied program of stunts.

The morning was occupied by entertainment for the women and children, chiefly, a "better babies contest" being the principal feature. The afternoon was enlivened by contests and games of all descriptions. The thing that was particularly pleasing to the employees was that for the first time on record "Lil," the Zoo elephant, was defeated in a tug of war, the foundry huskies being more than a match for her. Music, singing, dancing and fireworks closed a very enjoyable day, the employees' chief regret being that birthdays do not come oftener.

The success of the outing was due largely to the efforts of the committee, with Otto P. Geier as chairman, although the committee was loyally supported by the whole force of the shop. Fred A. Geier, president of the Cincinnati Milling Machine Co. and of the Modern Foundry, who gave the party, received hearty congratulations from his employees and their families. Good fellowship and plant morale were certainly promoted by the party.

Oxweld Co. Moves Export Department to New York

The export department of the Oxweld Acetylene Co., which was formerly located at the company's factory in Newark, N. J., has been removed to the Carbide and Carbon Building, 30 East 42nd St., New York. The department has been reorganized and is now under the direction of R. G. Noble, who will co-operate with the general sales department of the company.

Oxweld equipment is being exported extensively to Cuba and practically every South American country, as well as to Australia, Central America, Hawaiian Islands, South Africa, China, Japan, and even Russia. In many of the large mine, shipbuilding and railroad shops in these countries Oxweld apparatus is standard equipment. In Cuba a large number of the sugar mills have installed complete welding and cutting departments, revolutionizing the repair and upkeep of the heavy machinery used in this work.

Recent reports show that in several instances the entire cost of the Oxweld welding and cutting equipment has been more than paid for through its use in a single instance by keeping the plant running and avoiding costly shut-downs which would have occurred had there been no such installation at the factory.

Millers Falls Co. Adds Hacksaws to Its Large Line of Tools

The Millers Falls Co. has purchased the plant of the West Haven Manufacturing Co. at West Haven, Conn., which for twenty years has been engaged in the manufacture of Universal and other brands of hacksaws, bandsaws and small tools.

The acquisition of this fully equipped plant, which has been making a blade of highest grade for many years, furnishes a firm foundation upon which Millers Falls may build. It enables the Millers Falls Co. to underwrite the quality, design and policies of distribution of this factory's full output. It meets the company's desire to add hacksaws to its line, having been the originators of hacksaw frames and power hacksaw machines. It affords an opportunity for enlarging its capacity—a need that has been urgently increasing in the steady development and growth of the company's business.

Not only will the Millers Falls Co. continue the manufacture of Universal saws but it will also make at its West Haven plant a complete line of both hand and power hacksaws under the "Millers Falls" brand.

The Millers Falls Co. will be operated hereafter through its plant at Millers Falls, its plant at Brattleboro, Vermont, and its new plant at West Haven, Conn.

Robert F. Whitehead Appointed Commissioner of Patents

Recess appointments made by the President on Aug. 9 designated Robert F. Whitehead as commissioner of patents and Melvin H. Coulston as first assistant commissioner. They will take office at once.

Both Mr. Whitehead and Mr. Coulston have been members of the Patent Office staff for more than eighteen years. Each has worked his way up through the various grades of examiner.

Mr. Whitehead is a Virginian and a graduate of the University of Virginia law school. Mr. Coulston is a native of New York and received his legal training at Cornell.

Board Considers Wage Increase for Navy Yard Employees

The Navy Wage Board began hearings Aug. 5 in the matter of wage increases at the various Navy Yards. Over 200 representatives of the various trades employed at the Navy Yards throughout the county were in attendance. The increases requested are from 20 to 40 per cent. Assistant Secretary Roosevelt, who looked in on the meeting, called attention to that fact that wages must be paid from fixed appropriations, so that any increases in wages mean decreases in the number of employees.

Not later than Aug. 20 the Navy Wage Board expects to place in the hands of the Secretary of the Navy its recommendation with regard to wage increases asked by the employees in the various trades at the Navy Yard. The machinists made a general proposal that their wage be increased to $1.25 per hour. J. F. Anderson was the chief spokesman for the machinists.

The demands for increased pay were made in spite of the knowledge that any increases can be met only by reducing the number of employees. Since appropriations are fixed by Congress the immediate result of wage increase will mean the release of enough men to allow the payment of the remaining employees at the higher rate.

The master mechanics ask for a flat rate of $16 per day. H. T. Morningstar of the Washington Navy Yard was the chief spokesman for the master mechanics of all navy yards.

Charles L. Deane, expert in the experimental and research department of the Greenfield Tap & Die Corporation, Greenfield, Mass., died July 13 as the result of an automobile accident two days previous, when his car went over a steep embankment at Colrain. Mr. Deane, who was fifty-nine years old, had been with the G. T. D. since his youth.

The Chicago Machinery Dealers' Association has formed a teaming and machinery-moving corporation to meet the conditions imposed by the strike of machinery movers and teaming contractors. Machinery is moving in Chicago now after having been tied up for three weeks. It is predicted that many economies will be effected by the new teaming contracting concern for both machinery dealers and machinery manufacturers' branch houses; also enabling the teaming company to pay more than the union scale not inclusive of an employees' profit-sharing plan.

LD'S INDUSTRIAL FORGE
News Editor

Ten Ways To Kill a Branch of an Engineering Society

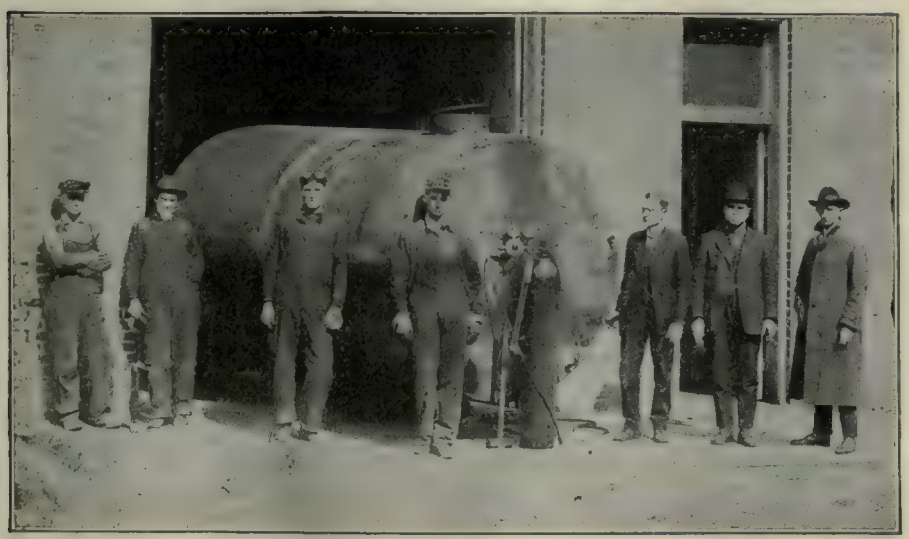
(1) Don't come to the meetings. (2) If you do come come late. (3) If the weather doesn't suit you, don't think of coming. (4) If you do attend a meeting find fault with the work of the officers and other members. (5) Never accept office, as it is easier to criticise than to do things. (6) Nevertheless, get sore if you are not appointed on the committee, but if you are do not attend committee meetings. (7) If asked by the chairman to give your opinion on some matter tell him you have nothing to say. After the meeting tell everyone how things ought to be done. (8) Do nothing more than is absolutely necessary, but when members roll up their sleeves and willingly, unselfishly use their ability to help matters along howl that the branch is run by a clique. (9) Hold back your dues as long as possible, or don't pay at all. (10) Don't bother about getting new members. "Let George do it."—The Engineering Institute of Canada.

Individualism is a fine thing for initiative, but co-operation is necessary for progress.

Uehling Instrument Co. To Exhibit Latest Products

In view of the present great scarcity of fuel and the unusual public interest in the economical consumption of it the Uehling Instrument Co., 71 Broadway, New York, has decided to exhibit its fuel-saving devices at two of the leading expositions of the year; namely, the Chemical Show, Grand Central Palace, New York, on Sept. 20 to 25, and the National Association of Stationary Engineers' Convention, Milwaukee, Wis., on Sept. 13 to 17.

The principal products to be displayed will be the new "Style U" CO_2 recording equipment. This instrument keeps tabs continuously on the largest item of waste in the boiler room; namely, the heat discharged up the chimney, thus enabling the operators to make adjustments that will reduce this loss to the minimum. A gage on the front of each boiler serves as a working guide for the firemen and a recorder in the office of the engineer or superintendent simultaneously makes a permanent record of the performance of each boiler furnace. Other boiler room instruments, including Uehling pyrometers and draft gages, will also be exhibited.



WELDED ASPHALT TANK FOR ROAD WORK

An interesting job recently turned out by the Chattanooga Brazing and Welding Co., Chattanooga, Tenn., is the welded asphalt tank, about 14 ft. long and 6 ft. diameter, shown in the illustration. The tank holds 2,500 gal., and is made of $\frac{3}{8}$-in. steel plate. The shell is composed of four sheets welded together at the circumferential and longitudinal seams; the heads are welded in, and altogether there are about 85 lin.ft. of oxyacetylene welding besides the welds in two pipe racks inside, which support 500 ft. of steam coils. The heads are braced with 2-in. angle irons welded in. The manhole dome, 15 in. diameter, is welded on, and there are nine welded pipe fittings in the steam coils.

Two men built the tank complete in 131 hr., including rolling, drilling, shaping the braces, making studs, tapping holes, riveting, making the door and doing all necessary welding and cutting. Davis-Bournonville welding apparatus was used. The tank is to be mounted on a truck and used for heating asphalt used in repairing roads.

Export Manufacturers To Meet in October at N. Y.

Announcement has been made by the convention committee of the American Manufacturers' Export Association that the eleventh annual convention of the association would be held at the Waldorf-Astoria Hotel in New York on Oct. 14. The convention this year will be limited to a one-day session followed by a banquet in the evening. This will be the first time in the history of the association that the annual convention will continue for one day only.

It is planned by limiting the proceedings to one day to make the convention of more interest and to eliminate many of the unnecessary features which tend to make so many conventions tiresome and uninteresting. Social plans are under way to make the banquet an event in export circles.

Machinery Companies Consolidate for Mass Production

The Austin Machinery Corporation of New York and Chicago officially announces the consolidation of the F. C. Austin Machinery Co., the Linderman Steel and Machine Co., F. C. Austin Drainage Excavator Co., Toledo Bridge and Crane Co., Municipal Engineering and Contracting Co. and other large manufacturers of kindred lines with plants at Toledo, Ohio, Muskegon, Mich., Winthrop Harbor, Ill., and Woodstock, Ont. The combined energy and capacity of these organizations will be devoted to mass production and to supplying the most complete line of earth-moving and concrete mixing machinery to meet an unprecedented period of construction, excavation and irrigation. Distributing points will be extended throughout the world to facilitate the service and distribution of this broad line of contractors' requirements.

The Air Service Mechanics' School, Kelly Field, Texas

The fiscal year of 1921 finds the Air Service Mechanics' School, Training Department of the Air Service Mechanics' School at Kelly Field, Tex., with 410 students enrolled. These students have been drawn from all parts of the Air Service. Some are recruits, while others are members of different tactical organizations. The number of students enrolled in each course is as follows:

Course for airplane mechanicians	154
Course for engine mechanicians	167
Course for auto repairmen	20
Army paperwork and stenography	16
Aircraft armament	31
Awaiting instruction or in hospital, etc.	22
Total	410

In addition to the above there are organized courses for electricians, instrument repairmen, blacksmiths and machinists. Plans of instruction are completely drawn up; hangar space is ready; but the complete list of equipment has not yet been delivered. The course for parachute repairmen has graduated a number of students but at present no classes are receiving instruction in this work. However, the instructors in this course are preparing material for the next class, testing parachutes and repairing chutes for pilots. They are also constructing a double harness which was recently presented at McCook Field, Dayton, Ohio. With this new jumping harness a jumper can release himself at any time in case of landing on a building, in the water or other inconvenient places.

Young Succeeds Colby on Engineering Council

The American Society for Testing Materials has just appointed C. D. Young as its representative on Engineering Council to succeed Albert Ladd Colby. Mr. Young is general supervisor of stores, Pennsylvania System, Broad St. Station, Philadelphia, and vice president of the American Society for Testing Materials.

Oxweld Opens San Francisco Office

The Oxweld Acetylene Co., manufacturer of oxyacetylene welding and cutting apparatus, has established Pacific Coast sales and distributing headquarters at San Francisco, with offices at 1077 Mission St. Additional sales representatives' offices are maintained at the following points: Los Angeles, 646 Maple Ave.; Salt Lake City, 908 Kearns Building; Portland, 90 First St.; Seattle, 433 Pioneer Building.

Leo Romney, with headquarters at San Francisco, is Pacific sales manager. The territory embraces the states of Washington, Oregon, Idaho, Utah, Arizona, California, Nevada and the counties of Lincoln, Sweetwater and Uintah in Wyoming. This territory was formerly served from Chicago and Los Angeles. Removal of headquarters to San Francisco was made necessary to secure a more central location for supplying the company's rapidly growing business in the Pacific states where its apparatus is extensively used in the metal industries and shipyards.

Eisler Enters Engineering Field

Charles Eisler has entered the consulting engineering field and is now devoting his time to designing and developing special and automatic machines for the manufacture of standard, miniature and gas-filled lamps. The organization will also maintain a well-equipped department for manufacturing wire product used in the incandescent lamps for which the very latest machines are being installed. Temporary office, 159 Clifton Ave., Newark, N. J.

Lee Joins Staff of Southwark Co.

James T. Lee has been recently added to the sales engineering staff of the Southwark Foundry and Machine Co., of Philadelphia, Pa. Mr. Lee for several years past was vice president in charge of sales of the Hanna Engineering Works, of Chicago. It is the purpose of the Southwark Foundry and Machine Co. to greatly broaden its field of activity by adding to its present complete line of hydraulic and power machinery a full line of pneumatic and hydro-pneumatic riveters and foundry molding machines.

Business Items

The Southwark Foundry and Machine Co., of Philadelphia, Pa., is adding to its present line of hydraulic and power machinery a full line of pneumatic hydro-pneumatic riveters and foundry molding machines.

The Vermont Tap and Die Corporation is a new organization located in Newport, Vt. It will start manufacturing high-grade taps and dies about Oct. 1. The officers are P. O. Miller, of Prouty & Miller, president; H. E. Paine, vice president and general manager; B. W. Wilcox, of the Gilman Store, treasurer.

The Southern Motor Manufacturing Association, Ltd., Houston, Tex., has broken ground for the erection of two additional units of its plant on the Houston ship canal. Both will be of sawtooth steel construction, one 121 x 480 ft. and the other 75 x 150 ft. The larger will be used for the manufacture of passenger cars and the other as a warehouse.

The Moline Tool Co., Wilson P. Hunt president, has taken over operation of the Moline Machinery Co., stockholders of the later organization being given option of cash sales of stock or exchange for stock issue of the tool company. The machinery company factory will be known as plant No. 2 of the tool company. It will continue the manufacture of special machinery not produced at the tool company's factory.

The Visible Pump Co., Indianapolis, Ind., plans the construction of a factory for the manufacture of gasoline tanks. The company will need a miscellaneous machine equipment for manufacturing purposes.

Work will begin about Sept. 15 on the construction of a new factory building for the Mutual Truck Co. at Sullivan, Ind. The company, according to Robert E. Petrie, president, will need miscellaneous machine equipment for the manufacture of trucks.

The Wert Manufacturing Co., of Kendallville, Ind., has begun work on a factory to manufacture machinery for concrete work. The company will need boilers for power plant, engine-room equipment and miscellaneous machinery for manufacture of concrete machines to cost $200,000.

The Moline Plow Co., Moline, Ill., a subsidiary of the Willys corporation, is in negotiation with the Root & Vander-Voort Engineering Co. for purchase of all its shops except the automobile department. Nearly all motors used in tractors and other machines produced by the Moline Plow Co. have been manufactured at the R. & V. plant.

The Wall Pump and Compressor Co., Quincy, Ill., with $200,000 capital fully subscribed, has leased factory space of 20,000 sq.ft. and expects to be in operation in ninety days. Contracts for machinery have already been let. The company will manufacture dry vacuum pumps and air compressors of all sizes, gas-engine governors and other specialties.

Personals

JOHN M. BILES, general manager, and TORSTEN A. GYLLSDORFF, superintendent of the Detroit Reamer and Tool Co., Detroit, Mich., have recently announced their resignation. They have incorporated the Standard Reamer and Tool Co., at 410-424 Elmwood Ave., Detroit, Mich., to manufacture a complete line of standard reamers, cutters and special tools. The officers of the company are: Arthur J. Stock, president; Torsten A. Gyllsdorff, secretary and superintendent; Frank J. Trippensee, vice president; John M. Biles, treasurer and general manager.

LOUIS A. DELANEY, formerly with the F. X. Hooper Co., Inc., Glenarm, Md., has joined the American Sheet Metal Corporation, Philadelphia, as manager.

W. A. TOOHILL has been appointed sales representative for the Dayton, Ohio, territory for the Quigley Furnace Specialties Co., manufacturer of Q-steel and Q-alloy pots and boxes. Mr. Toohill was for some years metallographist with the International Motors Co. at the Plainfield and New Brunswick, N. J., plants of that company.

WILLIAM P. STOUT has been appointed district manager of sales of the Philadelphia office of the Columbia Steel and Shafting Co., Pittsburgh, Pa., succeeding John T. Seaman, who is now district manager of sales of the Pittsburgh office.

ELTON G. NAZARENE, until recently connected with the Hart-Parr Co., Charles City, Iowa, for a number of years, has been appointed to the faculty of the engineering department of the University of Nebraska as instructor of foundry metallurgy and metallography.

HENRY MCENELLY, for over ten years with the La Pointe Machine Tool Co., of Hudson, Mass., is a partner in and general manager of the Hurlbut-Rogers Broach Co., of Hudson. The company is manufacturing broaches for the trade in a small but well-equipped shop.

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After the Civil War and Now

By H. H. MANCHESTER

This article tells of the economic events following the Civil War, and traces the cycle of business through depression, prosperity, crisis and panic. The fluctuations in wages and prices, both in gold and paper, are given by means of index numbers. The analogy between the conditions then and at the present time is shown, and conclusions as to the future are made.

IN FOLLOWING the evolution of wage and price levels in the May 27 issue of the *American Machinist*, lack of space prevented us taking up the period after the Civil War. There is little doubt, however, that that era offers the closest approximation in the history of the United States to the present period. The question is, however, whether the parallel is close enough to let us judge of the near future by what happened in the decade after the fall of Richmond. What makes this of more than academic interest is that in the decade after the Civil War the United States ran into the panic of 1873, and it is a very live topic today whether or not we are at present bound full tilt toward a similar crisis.

This query makes it well worth while to go into detail concerning the decade or so after 1865.

Conditions Affecting Prices

Although the Civil War in the United States was beyond comparison the greatest war at that time, it was by no means the only one. The various campaigns more or less connected with the name of Garibaldi, which finally brought about the unity of Italy, began in 1860. An invasion of Mexico by France took place in 1862 and continued to 1867. In 1864 Denmark was overwhelmed by an expedition from Prussia and Austria. In 1865 a war began amongst various states in South America.

All of these minor wars tended to increase the demand for munitions, and to decrease the labor available for the production of other goods, and added their weight to that of the Civil War in creating a situation analogous to that caused by the World War.

The course of wages and prices in the United States during the Civil War and the few years afterward was very much mixed up through the influence of the greenback, and the difference in value between gold and paper. Greenbacks first appeared in 1862, and it was not until 1879 that they were accepted at a par value with specie. Prices and wages both rose to a high level in paper, but not so much in gold. For this reason economists long laid the rise of the time to the depreciation of the greenback, but this is not entirely just.

Prices rose also in England, Germany and France, which were on a metal basis. Thus it is probable that the increase in wages and prices during the Civil War was due to increased demands occasioned by the war, the same as the jump in wages and prices occurring during the World War.

To speak more exactly, if we use the wage and price level of 1860 as 100, prices in general in the United States reached their highest level in 1864 at 123 in gold, or at 191 in greenbacks. This was also the high-level year in Europe, where English prices reached 145, in Hamburg 138, and the French prices 129.

The price of metal manufactures and implements in the United States in 1864 reached 180 in greenbacks, but only 116 in gold. In the same year wages in this country had risen only to 126 in greenbacks, and as measured in gold were only 81, or 20 per cent below the 1860 level. Actual wages in 1860 were, in Massachusetts, about $1.75 a day for skilled workmen, at a time when wheat ranged at about a dollar a bushel. Throughout the country the average for skilled workmen in 1860 was probably about $1.40 a day.

Difference Between Value of Gold and Paper

The Civil War ended in April, 1865, and during this year prices in gold in the United States fell practically to their 1860 level, but so great was the difference between gold and greenbacks that in paper they actually rose to 217.

Prices in 1865 also dropped in England to 136, and in France and Hamburg to 112. During the same year prices of metal products in the United States rose to 191 in paper, but actually dropped to below the 1860 level, or to 89 in gold. Thus the first year after the war showed in the United States a rise of prices in paper, but a drop in gold; and in England and Europe a drop in prices, but not to the pre-war level.

Wages in 1865 followed the same course. They rose in paper to 143, but so great was the difference between that and gold that they dropped, as measured in the latter, to 66. In England and France also wages were rising during the Civil War and in the first year or so afterwards, but there are no conclusive figures available on the subject.

General Rise of Prices in 1866

In 1866 the first drop which followed the close of the war reached bottom and a rebound began. In the United States the values of gold and of paper dollars began to come together, with the result that gold prices rose to 136, while paper prices dropped to 191. In the same year the price of metal manufactures and implements rose to 122 in gold, and is given as 171 in greenbacks. Thus in gold, prices did not reach their high level in this country until more than a year after the war.

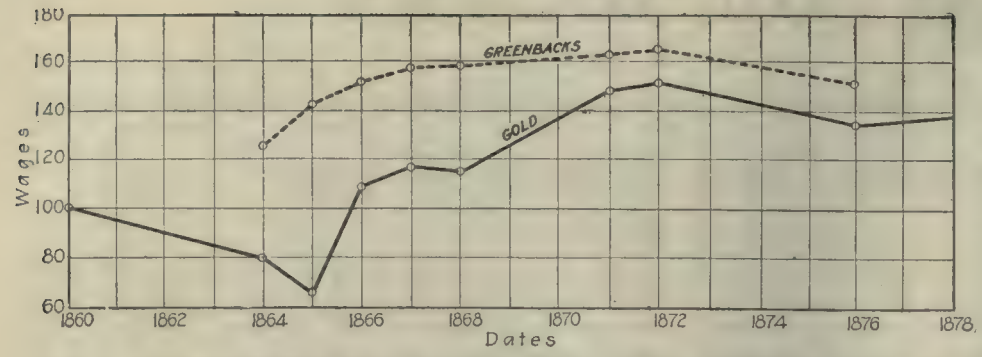


FIG. 1. CHART SHOWING THE VARIATION IN GOLD AND PAPER OF AVERAGE WAGES FROM THE STANDARD OF 1860

Wages showed an even more remarkable rise, as they evinced it both in greenbacks and gold, increasing to 152 in greenbacks and 109 in gold. Thus a year and a half after the war they were higher in both gold and greenbacks than either before or during the war. It may be added that from this point they continued to hold their own, or even rise slightly in greenbacks. Inasmuch as the greenbacks continued to approach closer and closer to gold, the result was that wages in gold rose rapidly, and continued to do so until the panic of 1873. The fact seems to be that the workman had received only greenbacks, not gold; and that the wages which were paid him at first only in depreciated currency had eventually to be paid him in gold.

In England the high point in prices for 1866 seems to have been reached in the spring. This was concurrent with an era of speculation in new fields and in the stocks of new companies. Out of this speculation the first panic to follow the war of secession was in April, when Barned's Liverpool Banking Co. failed for £3,250,000; and then on May 10 Overend, Gurney & Co., of London, failed for £10,000,000. The closing of various banks followed, and almost two hundred companies failed. It would not be stretching the comparison very far to compare this stock company panic in England to the recent panic in Japan, which, likewise, took place only about a year after the close of the war with Germany.

On the Continent the six weeks' war between Prussia and Austria began in June, and it may have been due to this that prices rose slightly during the year in both Germany and France.

Drops Occur in 1867

In 1867 in the United States gold prices dropped to 128, and greenback prices to 172. This decline was continued for the next two years. The price of metal manufactures and implements during this year averaged 120 in gold and 161 in greenbacks. Wages, on the other hand, rose to 117 in gold and 158 in greenbacks.

The *Bankers Magazine* made a quotation from the *Times* of 1867 which illustrates the feeling then current that prices had passed their peak: "The tide is turning. Business is dull—prices are so exorbitant that labor, which commands enormous wages, can scarcely earn a living, the profits of all branches of industry have fallen off, and everybody begins to feel comparatively poor."

In England prices took a sharp drop, due undoubtedly to the panic of 1866, reaching 115 in 1867. The same year prices in Germany dropped to 111, in France to 100.

In 1868, the third year after the war, the latter part of which would correspond to 1921, prices in the United States dropped to 116 in gold and 160 in greenbacks while wages averaged 115 in gold and 159 in greenbacks. Thus the third year after the war, wages and prices had arrived at practically the same point of increase when compared with those of 1860. Although their relative values were the same as in 1860, the difference was that prices were falling and wages still rising.

In England in 1868 prices dropped to 99, and in France to 95, while in Hamburg they remained 6 per cent above the 1860 level.

In 1869, the latter part of which would correspond in our parallel to 1922, prices in gold in the United States reached a low level, from which they began again to rise until 1873. In 1869 they were 113 in gold and 154 in greenbacks. The prices of metal manufactures and implements in this year averaged 104 in gold and 141 in paper. In Europe the rise was already beginning. In England prices averaged 105 in 1869, in Hamburg 110, and in Franch 97. In England, at least, this was a reaction from the panic of 1866.

In the United States the difference in value between gold and greenbacks led to an attempt to corner gold. On Thursday, Sept. 23, gold was advanced from 137 to 144, and on the next day, which has received the name of "Black Friday," to 155, and even to 160. This caused a tremendous turmoil and forced a crisis, but the corner was broken by the government's offer to sell $4,000,000 in gold, which brought the price of gold down in a few minutes to 133. Many stocks, however, dropped along with gold, New York Central, for example, falling from 185 on Friday to 145 the next week. At least fifty failures followed the clash.

From 1870 to 1873 prices in the United States again rose, and in 1870 averaged 117 in gold and 142 in greenbacks. At the same time metal manufactures and implements averaged 105 in gold and 128 in paper.

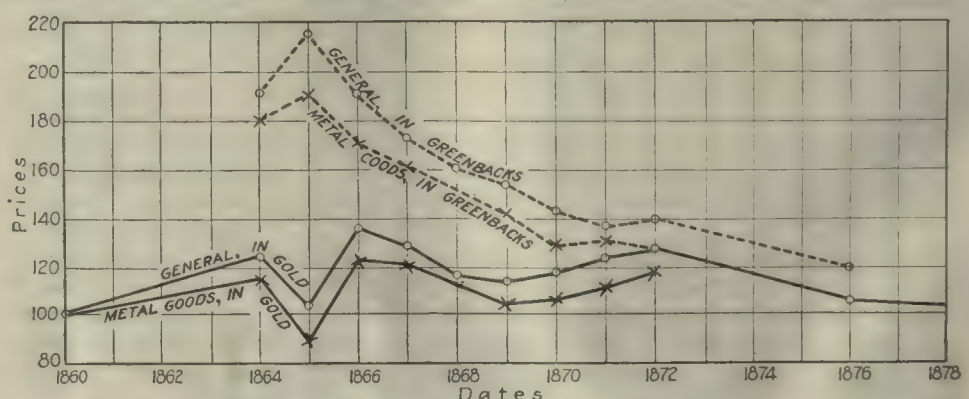


FIG. 2. CHART SHOWING THE VARIATION IN GOLD AND PAPER OF AVERAGE PRICES FROM THE STANDARD OF 1860

In Europe the Franco-Prussian War began in July, 1870, and was practically settled by the surrender at Sedan Sept. 1, though it was January before Paris capitulated. The war was so brief that it had no great effect on prices. In England demand was stimulated and prices remained firm at 105. In both France and Hamburg they receded; in Hamburg to 106, and in France to 94.

In 1871, the sixth year after the war, prices in the United States in gold rose to 123, while in greenbacks they dropped to 136. Metal manufactures rose in gold to 110, the highest since 1867, but in greenbacks dropped to 130. Wages rose both in greenbacks and gold, in the former to 164, in the latter to 148. A boom in railroads began, and the manufacture of iron rails increased from 586,000 tons in 1870 to 737,483 in 1871.

In England prices dropped to 101, while in Hamburg and France they rose about a point.

1872 a Boom Year

This brings us to the boom year of 1872 This year, more than six years after the close of the Civil War, was the highest mark in wages in the United States up to that time, and in prices between 1867 and 1916. Prices then reached 127 in gold and 139 in paper; wages 152 in gold and 166 in greenbacks. Metal products in 1872 averaged 117 in gold and about 127 in paper. Thus in 1869, three or four years after the war, prices reached bottom and began to rise, arriving at a new high level three years later.

In Europe, also, this was a high-price year. In England prices rose to 109, in Hamburg to 117, and in France to 105, more than ten points over the year before.

The prosperity exhibited in 1872 was not so great as to occasion any particular alarm. Both prices and wages were high, but the former were less than 30 per cent over their 1860 level, and, while wages were 50 per cent higher than in 1860, this was considered an evidence of good times rather than a harbinger of disaster.

The West was booming and being rapidly opened up through the construction of new railroads. In the five years preceding 1873, $1,700,000,000 was put into railroads, which was a great amount for that period. The manufacture of iron rails, the type then chiefly in use, rose from 737,000 tons in 1871 to 906,000 tons in 1872, while the price increased from $70 to $85 a ton.

But apparently much of this prosperity was illusory, and was, in fact, merely over-speculation. At all events, in 1873 burst forth probably the most severe panic in our history, the effects of which continued for at least five years.

This panic, however, did not start in the United States. There had been a great development of new

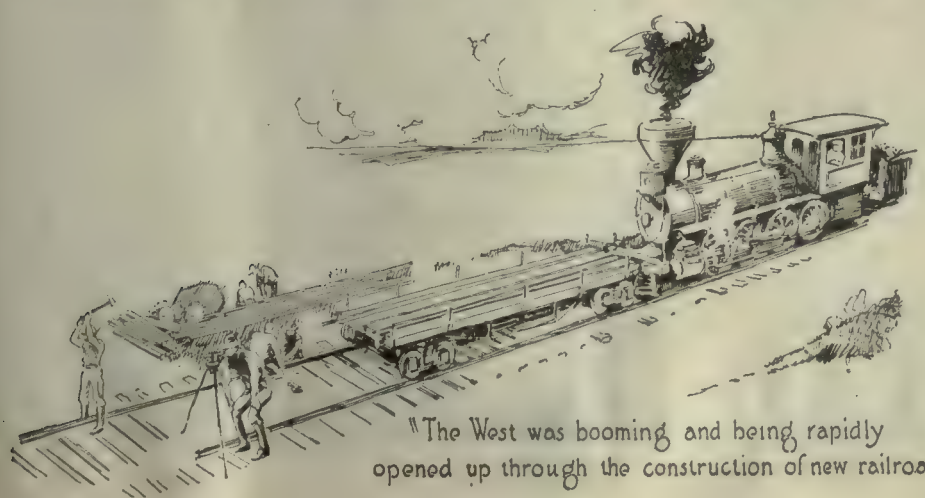


"The crisis spread—many of the banks were compelled to close"

companies and general speculation in many fields. The first center where the boom burst was Vienna. Here on May 8 and 9, 1873, the crisis began with the stock exchange panic similar to that in England in 1869. A hundred or so failures, including both new and old companies, followed. The crisis soon spread to Berlin, Frankfort, Norway, Italy, and in fact the whole continent. England had already had her stocks liquidated by the panic of 1869, so that the one of 1873 did not have so serious an effect there.

The United States, however, paid the penalty of over-speculation in railroads, western lands, oil stocks, and other enterprises which were either slow to be realized upon or utterly impossible. The crisis was precipitated here on September 18 by the failure of Jay Cooke & Co., which had been financing the Northern Pacific Railway. The panic spread rapidly, prices went tumbling, call money reached 180 per cent, eighteen failures took place during the day, the stock exchange closed and was not opened until September 30.

The crisis spread all over the country, many of the banks were compelled to close, and prices everywhere began to fall. The effect is evident in the average prices and wages existing for the next few years. Prices in gold gradually dropped from 127 in 1872 to 105 in 1876, wages receding at the same time from 152 to 135. Wages then began to rise gradually once more, but prices continued their downward tendency until 1896.



"The West was booming and being rapidly opened up through the construction of new railroads"

In 1890 prices averaged 92 and wages 159 in comparison with the 1860 level. In order to connect these figures with the more recent past it may be borne in mind that the price level of 1860 was about 87 per cent of that of 1914.

Similarity of the Two Post-War Periods

Now the practical question growing out of all this is whether we are almost inevitably bound for a crisis similar to that of 1873. It has been quite frequently whispered in certain circles that we are, but a careful consideration of the parallel between the two periods indicates that such a crisis is not at all necessary. The point is that after the Civil War the panic did not come during a fall in prices. It did not take place until after prices had reached bottom and again mounted to a high level.

A comparison of the course followed by prices after the two wars will give us a better idea of what may be expected.

In 1866, the year after the Civil War, prices rose higher than during the war, just as in 1919, the year after the World War, prices rose higher than during the conflict. From 1867, the second year after the Civil War, prices receded from the previous year, but only slightly.

In 1920, the second year after the World War, prices were maintained in the early part of the year, but are showing a tendency to fall during the summer months.

In 1868, the third year after the Civil War, prices dropped more rapidly, and if the parallel is maintained we should expect them to do so in 1921. In 1869 the bottom was reached, which would suggest that prices would reach a low level in 1922, and perhaps begin to rise from that point.

Judging the Future from the Period After the Civil War

We seem to be starting into the period of falling prices without a crisis, though Japan has already suffered one, due to a wild speculation in silk. If the fall in prices in this country continues to be gradual we are not due for a crisis during their recession. If, however, artificial attempts are made to hold prices up, and these attempts fail, as they almost surely will, we will have instead of a flowing river a broken dam and all of its consequences.

From the historical point of view the danger is not during the period of price recession, which seems to have just begun, but later, when things apparently have been readjusted and industry is again mounting by leaps and bounds.

In other words, the panic of 1873 was not a result of the war but of the big boom, which did not take place until after the readjustment of prices. Following this analogy, there is no reason why the recent World War should necessarily be followed by a panic at all, and the year to be afraid of is not so much this or the next, but along about 1925.

A Heavy Gear Cutting Job

By I. B. Rich

All sorts of orders for gears come to the Pacific Gear and Machine Co.'s shop. One of the large gears is shown in Figs. 1 and 2. This is a cast-steel gear for heavy duty work, having 42 teeth of about 3-in. circular pitch, making the diameter about 42 inches.

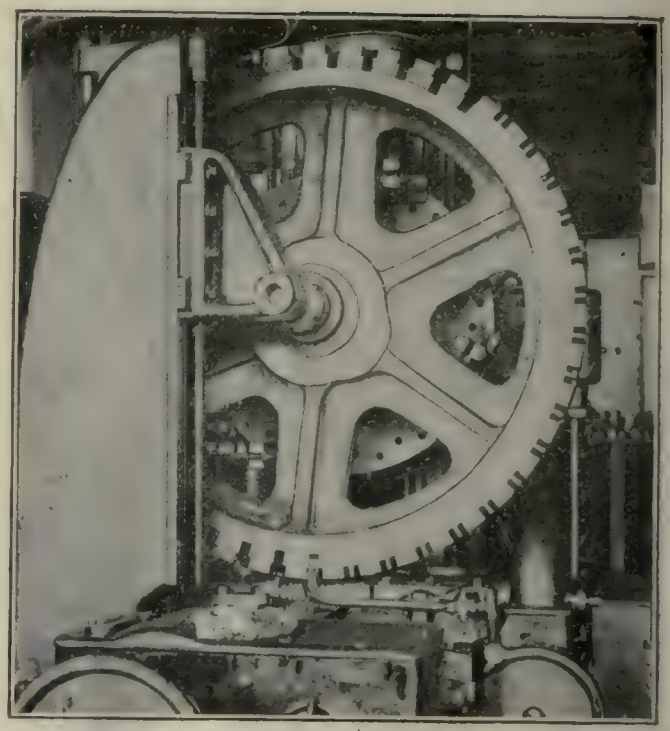


FIG. 1. ROUGHING GEAR TEETH IN TWO CUTS

To make it easier for the regular roughing or "stocking" cutter in this hard material, a preliminary cut is made with a pair of straddle mills. These milling cutters are about ½ in. wide and set to leave a comparatively narrow web as shown. The depth of these first cuts is set to suit the shoulders of the stocking cutter.

This divides the cut between the two operations and makes it possible to cut very coarse pitch teeth on a medium sized machine.

Fig. 2 shows the gear being finished on a Gleason gear tooth planer. The machine shown in Fig. 1 is a Gould & Eberhardt spur gear cutter.

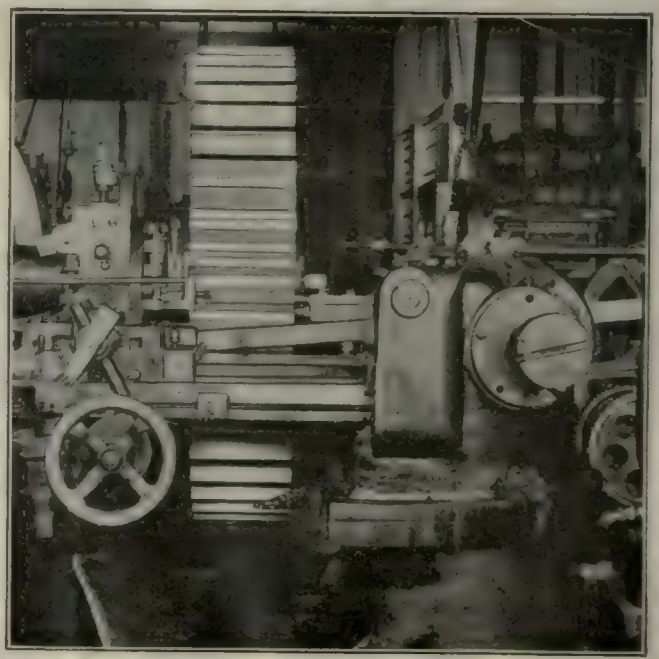


FIG. 2. FINISHING THE TEETH ON A GEAR PLANER

Experimental Investigation of Steel Belting—II

By F. G. HAMPTON, C. F. LEH, and W. E. HELMICK
STANFORD UNIVERSITY, CAL.

FROM *Mechanical Engineering*, July, 1920

At the annual meeting of the American Society of Mechanical Engineers, held Dec. 2 to 5, 1919, in New York, student and junior prizes were awarded to the authors of the following paper. It treats of an investigation undertaken by them at Leland Stanford University as a partial requirement for the degree of engineer. Part I was written by Messrs. Hampton and Leh in 1918, and Part II by W. E. Helmick the year following. The first section dealt with a description of the apparatus employed, the character of the belting, and a discussion of the results obtained in investigating the coefficients of friction and velocity of slip. Part II deals more particularly with a slip of the belting, which the original investigators recognized should be more carefully studied.

(*Part I was published in the Aug.* 12 *issue.*)

IN CARRYING out the work described in Part I both Hampton and Leh realized that certain relationships existed between the horsepower transmitted by the belt, velocity of slip of the belt on the pulleys, and the coefficient of friction, but owing to the very large error in their observed data on velocity of slip, they were unable to find such expressions as have been developed below.

The difference of r.p.m. of the driver and driven pulleys as observed by the above authors was subject to a large error in that the revolution counters used did not read less than unity. One revolution would correspond to a slip of 8.625 ft. per min. were the observation period one minute long, as the circumference of both pulleys was 8.625 ft.

Hampton, realizing that more accurate apparatus was necessary to measure the slip, designed and partly constructed a differential revolution counter that was completed by the author. This revolution counter would indicate one one-hundredth of one revolution difference, with a probable error of 5 per cent. The positions of the idler pulleys reverse the direction of the belt and hence the direction of rotation of the driver and driver pulleys is opposite. The mechanism of the differential, as it is commonly known, is such that the two wheel shafts rotate in opposite directions and with equal r.p.m. when there is no rotation of the ring gear. The driver and driven shafts are connected 1 to 1 to the wheel shafts by light chains and sprockets. Hence, if the driver and driven pulleys are rotating with the same speed, the ring gear is stationary. The pulleys having equal circumferences, no slip would be in evidence. However, as soon as the belt began to slip, the ring gear would rotate in proportion to the difference of peripheral velocity of the two pulleys.

The ratio of the ring gear to the pinion is 1 to 20, and that of the differential gears is 1 to 1, making the ratio of the wheel shaft to the ring pinion 1 to 10. A disengaging coupling is connected to the ring pinion, by means of 1-to-1 sprockets and light chain, and is operated by the solenoid which in turn is controlled by the knife switch. This coupling has twelve teeth on one side and a knife edge on the other, making the probable error 1/24 or 4.16 per cent. In order that the chain be kept tight, a friction brake was put in between the sprocket mounted on this coupling shaft and its supporting standard.

The revolution counter used was one specially constructed for this particular use. The unit wheel being divided into tenths gave a ratio of 1 to 100 from the wheel shaft to the counter. Hence the difference of r.p.m. of the driver and driven shafts was determined quite accurately, that is, to one one-hundredth of a revolution, which in terms of the pulley circumference is 0.0863 ft.

It was found after running some time that the vibration of the chains connecting the pulley shafts to the revolution counter caused them to become stretched in places, effecting a slight rotation of the ring gear first in one direction and then in the opposite. This appeared to vary with the speed, but, as nearly as could be determined, a probable error of from 1 to 2 per cent might be introduced. Through all tests this machine served its purpose very accurately and was a great help in adjusting the load on the Sprague dynamometer, for the point at which the belt began to slip excessively could be observed at a glance. Without this machine the data on the slippage of the belt would be so inaccurate that the results of the tests would have been useless. The material used for belting in this test was clock-spring steel $\frac{3}{4}$ in. by 0.01 in. It is manufactured in this country from Swedish high-carbon charcoal steel, drawn, rolled, ground to size and tempered to a dark blue. It can be obtained in widths of from $\frac{1}{2}$ in. to 3 in. and 0.01 in. thick and costs from 6 to 18 cents per ft.

Tests of this material show the ultimate strength to be over 300,000 lb. per sq.in. and the elastic limit slightly less. The belt used in this test had no permanent set when bent around a radius of $\frac{3}{4}$ in. but would rupture when bent around a radius of $\frac{1}{16}$ in.

When the belt bends around a pulley, as much work is put into bending it as appears when the belt straightens out on leaving the pulley. This is not true of any other kind of belt, as power is required to bend it and again to straighten it out.

The joint used on the belt tested was a silver-soldered lap joint. It proved very satisfactory throughout all tests and showed no signs of necking-in where the temper had been drawn. These joints when tested have an efficiency of about 60 to 65 per cent in pure tension, the rupture taking place on either side of the lap where the metal has been softened.

Owing to the low efficiency of the silver-soldered and brazed joints, a dozen or more riveted joints were constructed. Phosphor-bronze rivets were used and one triple-riveted lap joint by test had an efficiency of 84 per cent, rupture occurring by shearing all the rivets. This joint could not be used on pulleys smaller than 30 in. in diameter.

Other similar lap joints averaged 76 per cent by test when cold-drawn iron wire was used for rivet material.

Owing to the idler pulleys reversing the motion, one side of the belt runs on the driven pulley and the other

side on the driver pulley, consequently it was necessary to have both sides of the belt joint as smooth as possible.

The type of joint used in an installation of steel belting in one of the shops was of the bent cover-plate type and would have been quite successful had the pulley on the motor been of larger diameter. This cover plate was bent to conform with the curvature of the smaller pulley, and the ends were bent up on a radius of $\frac{3}{4}$ in. It appeared that the tangential acceleration of the joint as it came on to the motor pulley kept the joint from following the pulley curvature. This induced flexure in the belt, just ahead of the first row of rivets, and the combined stress of the tension and flexure being in the neighborhood of the elastic limit caused rupture after 15 to 20 hr. operation.

It is the opinion of the author that this type of cover-plate joint would be quite satisfactory for use on pulleys of not smaller radius than 15 in.

Description of Tests

The calibration of the weights and spring balance was made just after the differential revolution counter was completed. The work checked quite well with the calibration made by Hampton and Leh.

Several preliminary runs were then made to determine the capacity of the motor and the variations of speed with load. A preliminary curve run was then made. A tension of 23.6 lb. in the tight side of the belt was selected in order that the tension in the loose side could be made practically zero, allowing an excessive slip. The speed selected would also bring in the characteristics of the motor and allow a certain change in the centrifugal tension of the belt. The curves resulting from this set of values and shown in Figs. 8 and 9 will be discussed below.

The four speeds of the motor with the arrangement of pulleys then on the machine would give belt speeds of about 3,150, 4,710, 6,250 and 9,450 ft. per min. In order that a wider range of belt speeds could be obtained, a large pulley and a small pulley could be placed on the driver-pulley shaft, and with these pulleys belt speeds of 2,080 and 14,500 ft. per min. could be obtained.

Seven runs were made with each velocity for various tensions in the tight side of the belt. The smallest is 23.6 lb. and corresponds to 50 lb. on the weight pan, while the largest is 111.6 lb. and corresponds to 225 lb. on the weight pan. The interpolated results for $T_1 = 99.0$ are given in Table II.

TABLE II. DATA AND RESULTS OF TEST ON 0.75 x 0.01-IN STEEL BELT

Run No.	T_1	T_2*	P	V_d*	Hp_t	u	V_{sc}
R-4	99.0	22.6	120	2,018	4.67	0.482	1.37
	....	23.4	....	3,000	6.98	0.481	2.05
	....	29.0	....	4,600	9.76	0.440	2.88
	....	35.6	....	57,50	11.03	0.376	3.24
	....	56.4	....	8,920	12.76	0.236	3.76
	99.0	43.0	140	2,033	3.45	0.269	1.01
	....	45.0	....	3,070	5.25	0.260	1.48
	....	50.0	.....	4,610	6.84	0.234	2.00
	....	57.0	....	6,040	7.69	0.162	2.26
	....	79.0	....	9,300	5.64	0.092	1.66
	99.0	63.0	160	2,068	2.255	0.145	0.66
	....	65.0	....	3,100	3.195	0.137	0.93
	....	70.0	....	4,680	2.980	0.117	0.87
	....	78.0	....	6,200	3.950	0.084	1.16
	99.0	83.0	180	2,075	1.005	0.057	0.30
	....	85.6	....	3,163	1.286	0.046	0.84
	....	90.8	....	4,740	1.178	0.029	0.35
	....	98.0	....	6,250	0.189	0.004	0.05

*Interpolated values.

The run was always begun at the highest horsepower possible, and from five to six observations made as the horsepower varied to zero. The load could be held quite constant throughout each run when the Sprague dynamometer was separately excited, but near the end of the test period, when the generator was self-exciting, some difficulty was experienced in making all the observations. Before a run was begun, the surfaces of the cork pulleys were always cleaned in order that the conditions of the test might be the same.

The following values were observed and will be discussed below:

$(T)_1$ = tension in lb. on the idler over which the tight side of the belt passes; observed by the weights on the weight pan.

T_1 = corrected tension in the belt in lb. as taken from the calibration curves.

$(T)_2$ = tension in lb. on the idler over which the loose side of the belt passes; observed by the reading of the spring balance.

T_2 = corrected tension in the belt in lb. as taken from the calibration curves.

N = r.p.m. of the driver pulley; observed from the reading of the electrically operated Veeder revolution counter.

n = difference of r.p.m. of the driver and driven pulleys as observed from the differential revolution counter.

A reading of the brake arm on the Sprague dynamometer was also taken and used as a check on the power transmitted.

Notation

T_1 = actual tension in the tight side of the belt in lb.

t_1 = actual unit tension in the tight side of the belt in lb. per sq.in.

T_2 = actual tension in the loose side of the belt in lb.

t_2 = actual unit tension in the loose side of the belt in lb. per sq.in.

T_c = centrifugal tension corresponding to the velocity at which the belt is passing around the pulleys in lb.

t_c = actual unit centrifugal tension in lb. per sq.in.

$T_1 - T_2$ = difference in belt tensions in lb. or the useful force in the transmission of power.

V_d = computed velocity in ft. per min.

V_s = computed velocity of slip of the belt relative to the pulley in ft. per min.

V_{sc} = velocity of slip of the belt in ft. per min. corrected from the curves where hp. $= 0.17T_1^{0.65} \times V_s$.

P = actual tension in the belt producing pressure on the pulley, lb.

p = pressure in lb. per sq.in. per unit length of belt on the pulley face.

W = weight of 1 cu.in. of steel in lb.

g = gravity force.

r = radius of driver and driven pulleys in ft.

u = coefficient of friction.

θ = angle of contact in radius the belt makes on the pulley face.

The computations necessary in working out a set of values involved a great number of operations. An

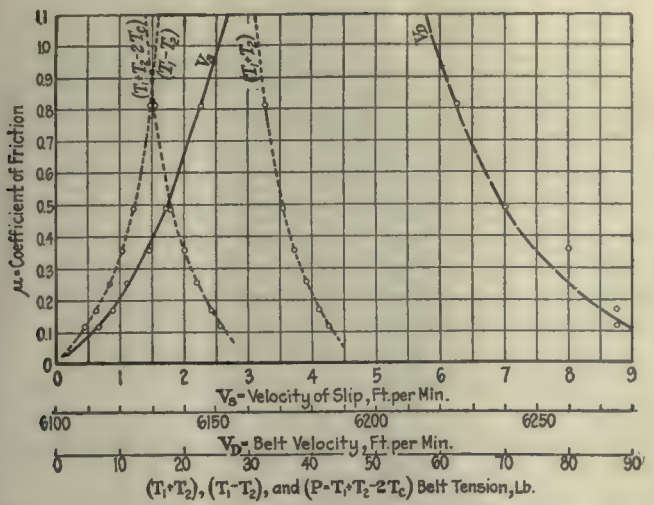


FIG. 8. CHARACTERISTICS OF A 0.75 x 0.01-IN. STEEL BELT

attempt was made to plot curves of various functions that would constantly enter into certain equations.

The values of t_c and T_c were first computed and plotted as shown in Figs. 10, 11, and 12. The equation for unit centrifugal tension is

$$t_c = \frac{12 W V_d^2}{g}$$

where $W = 0.2833$ lb.

$g = 32.2$

and in this equation V_d is in ft. per sec. If V_d is to be used in ft. per min., the equation becomes

$$t_c = \frac{12 \times 0.2833 \times V_d^2}{32.2 \times 3600}$$

$$= 0.0000293\ V_d^2 \text{ lb. per sq.in.}$$

As $T_c = t_c \times A$, the multiplying factor then becomes

$$T_c = 0.0000293 \times 0.01 \times 0.75 \times V_d^2$$

$$= 0.00000022 V_d^2$$

Computations of all observed data were then made and the results tabulated, the equations employed being given below.

Circumference of driver and driven pulleys = 8.625 ft.

$$V_d = \left(N - \frac{n}{2}\right) \times 8.625 \text{ ft. per min.}$$

$$t_1 = \frac{T_1}{0.0075} \text{ lb. per sq.in.}$$

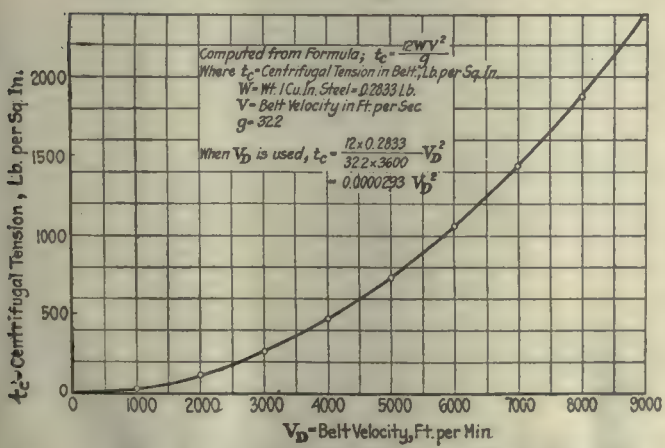


FIG. 10. CURVE OF CENTRIFUGAL TENSION FOR BELT SPEEDS UP TO 9,000 FT. PER MINUTE

$$\text{hp.} = \frac{(T_1 - T_2) V_d}{33{,}000}$$

where $T_1 - T_2$ = force in lb.

V_d = distance.

$$\text{Efficiency} = \frac{\text{hp.} - (T_1 - T_2) V_{sc}}{\text{hp.}} \times 100 \text{ per cent}$$

$$u = \frac{\log_{10} \frac{t_1 - t_c}{t_2 - t_c}}{0.43430}$$

$$V_s = \frac{n}{2} \times 8.625 \text{ ft. per min.}$$

The above equation for u is derived in Smith and Marx's "Machine Design."

Curves of all relations that might possibly exist were then plotted as are shown in Figs. 8 and 9.

The most noticeable relation is that of velocity of slip and horsepower. This curve shows practically straight-line variation up to a certain point where the

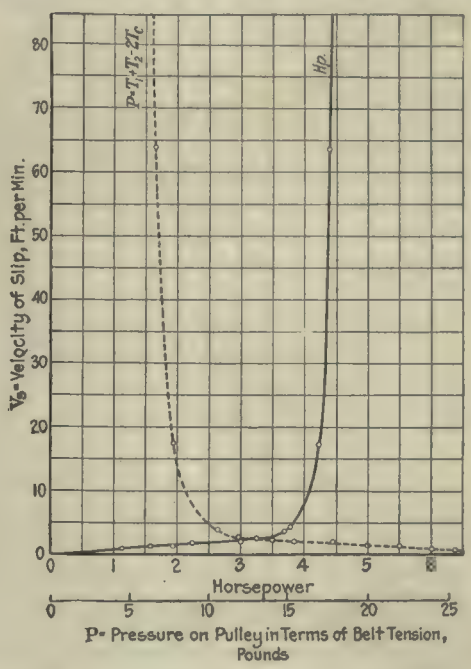


FIG. 9. CHARACTERISTICS OF A 0.75 x 0.01-IN. STEEL BELT

velocity of slip increases very suddenly. Inspection of the data shows that at this point $t_2 = t_c$ and hence there is no pressure on the pulley where the belt leaves the driven pulley. As this is the case, it would be expected that the velocity of slip would become excessive.

The curve of P as a function of slip shows that the pressure decreases with an increase of slip up to a point where the pressure decreases but slightly with a large increase of slip. As can be seen from these two curves, the pressure on the pulley and the horsepower are related, but for the present the most striking relation appears to be in the curve of horsepower and slip.

The relation between the coefficient of friction and velocity of slip apparently exists in Fig. 8. This is a misconception, for the curve should not pass through zero, since the coefficient of friction of rest between cork and steel is not zero. All that this curve indicates is that the coefficient of friction at zero velocity and zero slip is indeterminable, due to other variables. It may also be noted that the belt velocity is not constant and that the pressure varies.

A relation between u and $T_1 + T_2$ was suspected, but after some investigation it appeared that T_c entered into this factor. It was then that the pressure curve was plotted, and although it has no significance as it appears here, it was necessary in the work that was to follow.

Method of Obtaining Results

The first relation that was attempted was that between hp. and V_s. It was noticed that for a constant value T_1 all the points up to certain limits would fall on a straight line. These curves were plotted, the curve for $T_1 = 99$ lb. being shown in Fig. 13. A dashed line

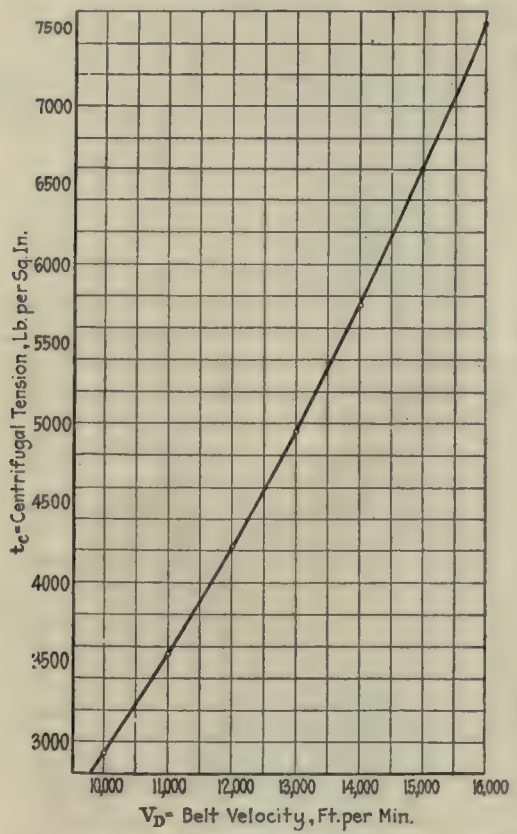


FIG. 11. CURVE OF CENTRIFUGAL TENSION FOR BELT SPEEDS UP TO 16,000 FT. PER MINUTE

was then drawn such that the estimated slope would as nearly as possible coincide with the mean average of the points. In these curves this line is a light dashed one and noted by the word "Estimated." It must be remembered that in these curves all points in the vicinity or above that where $t_2 = t_c$ are not plotted. The figures on the right show the belt velocity and hp. at which $t_2 = t_c$.

When this was done for all values of T_1 the slope was found and tabulated with the corresponding value of T_1. The equation of a straight line passing through zero is $Y = mX$, where m = slope. With this in mind the slope m was plotted as a function of T_1, and resulted in a parabolic curve. To determine the equation of this new curve the data were plotted on logarithmic cross-section paper. The result was a straight line which had 0.17 for its intercept and a slope of 0.65, indicating that the slope m was equal to $0.17\ T_1^{0.65}$.

From this it was a simple matter to deduce the equation

$$\text{hp.} = 0.17\ T_1^{0.65} V_s.$$

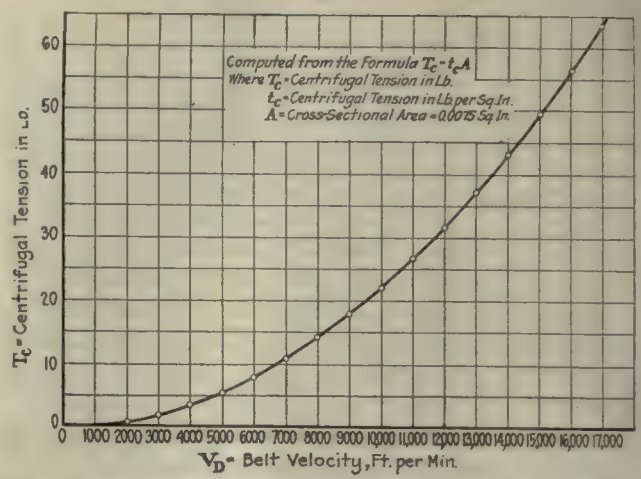


FIG. 12. CURVE OF CENTRIFUGAL TENSION FOR BELT SPEEDS UP TO 17,000 FT. PER MINUTE

As all of the points of the estimated slope m did not fall on the logarithmic curve, another line, the slope of which was computed from the above equation, was drawn on the curves and noted by the equation

The values of the velocity of slip were then corrected by the use of these curves and the corrected value was tabulated as V_{sc}.

Fig. 13 was then plotted to give an idea of the relation of hp. to V_{sc} at various values of T_1. The lines of constant T_1 are shown as solid straight lines. The light dashed lines are lines of constant V_d and the points of intersection with the line of constants V_d were computed from the equations.

$$\text{hp.} = (T_1 - T_2) \times V_d$$

$$T_2 = T_c = 0.00000022 V_d^2$$

The relation of u to V_{sc}, V_d and P was more difficult to determine owing to the large number of variables. An attempt was made to select groups of values from the observed data where two of the values remained constant. This could not be done for enough values to

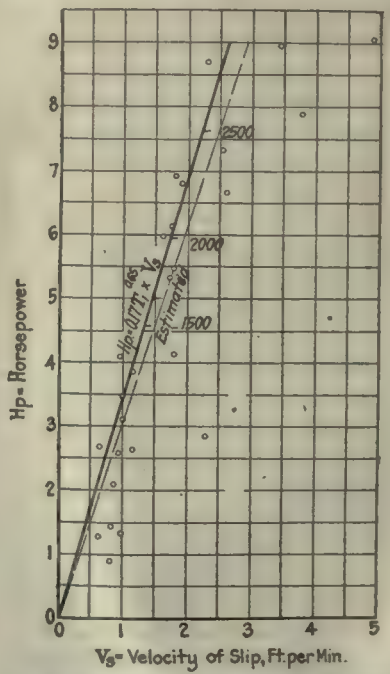


FIG. 13. CURVES SHOWING RELATION BETWEEN VELOCITY OF SLIP AND HORSEPOWER

TABLE III. RELATIONSHIP BETWEEN u AND V_{sc}

Run No.	Constants P	Constants V_d	Variables u	Variables V_{sc}	Relation
R-1	70	5,000	0.143	1.20	
R-2	..	....	0.360	2.75	$u = 0.1\ V_{sc}^{1.375}$
R-1	..	4,000	0.190	1.15	
R-2	..	....	0.465	2.25	$u = 0.155 V_{sc}^{1.375}$
R-1	..	3,000	0.271	1.00	
R-2	..	....	0.515	1.80	$u = 0.223 V_{sc}^{1.375}$
R-1	..	2,000	0.240	0.75	
R-2	..	....	0.550	1.25	$u = 0.386 V_{sc}^{1.375}$

find a relationship between the other two variables, and for a time the solution looked much more difficult. It seemed that new data must be taken or that interpolations must be made from the data already at hand. As the taking of new data, such that two of the variables remain constant, was impracticable for but one observer, interpolated data had to be computed. The values of T_2 and V_d were interpolated from curves and the observed data.

A large number of groups were selected, and in each group two and sometimes three sets of values of the two variables could be obtained when the other two remained constant. These values were plotted on logarithmic cross-section paper and were found to be straight lines having approximately the same slope. For example, the relationship between u and V_{sc} is shown in Table III for one value of the pressure constant throughout the set of groups.

Data similar to those in Table III were obtained for pressures of other values and the relation found. The exponents found in each were averaged and found to be 1.37, it then being evident that

$$u = V_{sc}^{1.37} \times f(P) \times K \times f(V_d)$$

where K is some constant.

The characteristics of the curves plotted of u as a function of V_d and P when V_{sc} was constant, showed that V_d and P varied inversely according to some power. Interpolations and computations similar to the above were made, and it was found that u varied inversely as some constant multiplied by the square root of P. Again the same methods were followed, and it was found that u varied inversely as some constant multiplied by $V_d^{1.5}$.

This gave the equation

$$u = \frac{V_{sc}^{1.37} \times K}{p^{0.5} \times V_d^{1.5}}$$

and 75 values of K were solved from the equation

$$K = \frac{u \times p^{0.5} \times V_d^{1.5}}{V_{sc}^{1.37}}$$

The values varied from 2.71×10^5 as a minimum to 4.04×10^5 as a maximum. The majority, however, were in the neighborhood of the average, which was 3.1992×10^5.

The final deduction of the relation of u to the other variables is given by the equation

$$u = \frac{V_{sc}^{1.37} \times 3.2 \times 10^5}{p^{0.5} \times V_d^{1.5}}$$

Conclusions

The first equation found in this investigation is useful in determining the tension in the tight side of the belt, when a given amount of power is to be transmitted and a reasonable velocity of slip (not greater than 3 ft. per min.) is assumed. The wear on the pulley facings is in proportion to the velocity of slip, and hence it is advisable to keep this value as low as possible to prevent wear. Knowing this tension, the belt may be cut in length by computing the total elongation due to the tension, and the distance that the cork will be depressed due to this tension. The belt may then be joined and placed on the pulleys.

The second equation, while not as practical as the first, is interesting from the technical nature with which the different factors vary the value of the coefficient of friction as the range of power transmission is passed over. The coefficient of friction of rest between cork and steel at a given pressure would not appear to by zero at this equation would indicate were the velocity of slip zero.

The efficiency of transmission was always so near 100 per cent that it was not tabulated in the data. Only in extreme cases did it fall below 98 per cent, and the author spent but little time on this computation.

A Good Method of Numbering and Filing Drawings

By Peter F. O'Shea

In the plant of the Baush Machine Tool Co., Springfield, Mass., each part which has ever been used in the product is given a part number, for instance, *B*885*P*. This part number is the number of the drawing and of the pattern, and at the same time a slight description. It tells what size the drawing is, where to find it, and whether it is the original drawing or a corrected one.

All drawings are divided into classes according to the size of the sheet, each size being denoted by a capital letter. Each sheet is double the size of the class before it. Thus: *B* is 6 x 9 in.; *C*, 9 x 12 in.; *D*, 12 x 18 in.; *E*, 18 x 24 in, and *F*, 24 x 36 in. This initial is prefixed to the serial part number so that anyone will know immediately from the number what the dimensions of a drawing are.

If the drawing still in use is the original one by which the pattern was made the capital letter *P* is added to the number of the part and drawing. If any change has been made, the letter *P* is replaced by *A* for the first change in the pattern, *B* for the next, etc. This prevents mistaking an obsolete drawing for a later one, all the old drawings being saved for reference.

The reason why the code not only describes the size but tells where to look for a drawing is that each size of drawing is filed in a case suitable to it. The larger drawings are filed flat in shallow drawers, or hanging from rods. Small drawings, however, are all filed vertically in drawers in the order of the part numbers. Filing envelopes contain 100 consecutively numbered drawings each. Index cardboards and tabs classify the contents of each drawer and keep the drawings upright and solid without warping or bending them. A great many drawings can be filed in a small space in this way. In fact, the vertical method is so much more compact and easy of reference and altogether preferable that the chief draftsman is extending it to take in drawings of large size. Of course a different set of drawers is used for each size of drawings, although these sets can, however, be combined in a multiple cabinet.

Thus the number on a part tells not only the size of the drawing but which chest and practically which drawer the drawing is in. Anyone in the office may put his finger upon any certain drawing at a moment's notice.

Increasing Production by Safeguarding Power Press Operation*

By A. L. KAEMS
Safety Engineer, Simmons Co., Kenosha, Wis.

The operator of the power press often moves hesitantly because he realizes the dangers that attend his work, and so his production is lessened. In the Simmons Co. plant numerous feeding devices were arranged for the power presses as a measure of safety and their use has resulted in a surprising increase of production.

THE punch press has been one of my hobbies, because as one of the most dangerous machines it offers a great opportunity to show what can be accomplished in saving fingers. Accidents can be prevented by arranging devices to make it unnecessary for the operator to reach into the die space to place the material.

The safety engineer has to contend with, first, the superintendent, who thinks principally of production; second, the men themselves, who are used to doing the work in their own way. One reason why I joined the Simmons company was because of the opportunity offered to prove that certain ideas could be worked out.

Easy Problems Handled First

The easiest problems were handled first, and one of these was the forming operation on the part shown in Fig. 1. These pieces were set in the die by hand, but by turning the die around it was possible to build and use the slide which extends from the front of the die. Now the operator slides the work in by pushing along the pieces in the slide and the danger of injury is greatly lessened.

The part of the die *A*, Fig. 2, was originally the lower die for forming the piece *B*, but by inverting the position of the dies, and mounting the other portion in the bolster, as shown, it was possible to employ a chute for feeding the pieces. After forming they are kicked out automatically and the operator cannot go wrong.

*Paper presented at the summer meeting of the Engineering Section of the National Safety Council at Chicago, June 26, 1920.

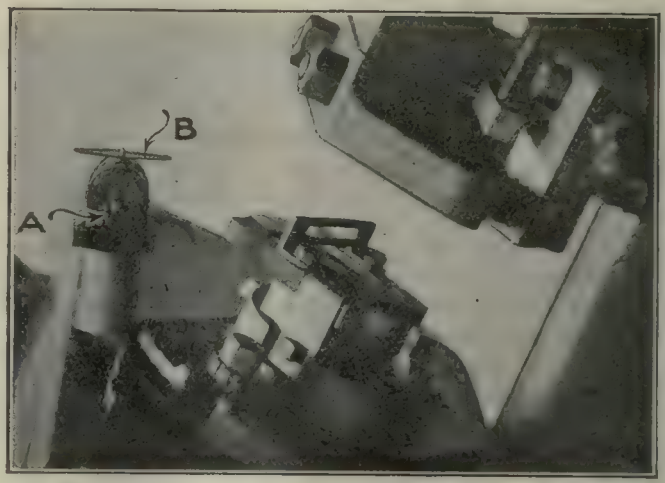


FIG. 2. PRESS ARRANGED FOR SLIDE FEED BY REVERSING PUNCH AND DIE

In planning operations on stock that is already formed it is often necessary to experiment with different kinds of slides, set at different angles, before a slide is obtained that will carry the stock into the die properly. The operation shown in Fig. 1 is an example of this. We didn't make this slide from a blueprint originally, but from a piece of tin which we could bend in different ways until we got it to work right. Then from this model we made the permanent slide which is shown. A feature of this device is that it does away with scrap. With it a man worked for two days without spoiling a piece or missing a stroke of the press.

Safety Feeding Devices That Increase Production

Safety feeding devices have increased our production from 10 to 200 per cent. One man was asked how many pieces he could turn out with the use of

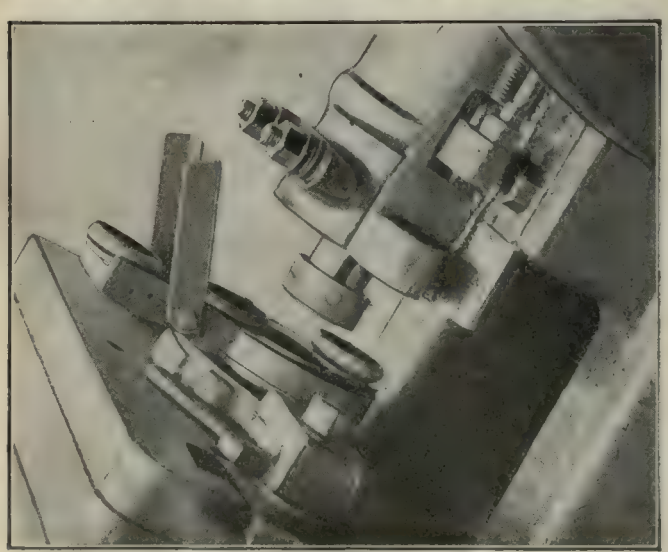


FIG. 1. INCLINED FEED SLIDE FOR FORMING OPERATION



FIG. 3. SLIDE FITTED WITH SPRING BAR TO PREVENT TIPPING OF WORK

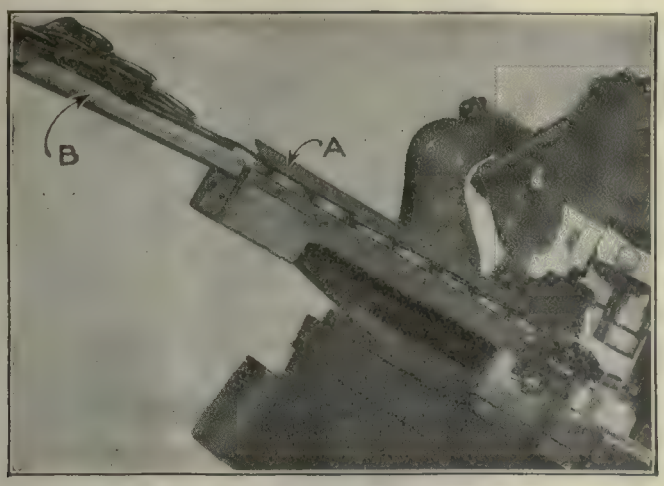


FIG. 4. AUTOMATIC PRESS FEEDER FOR FLANGED PIECES

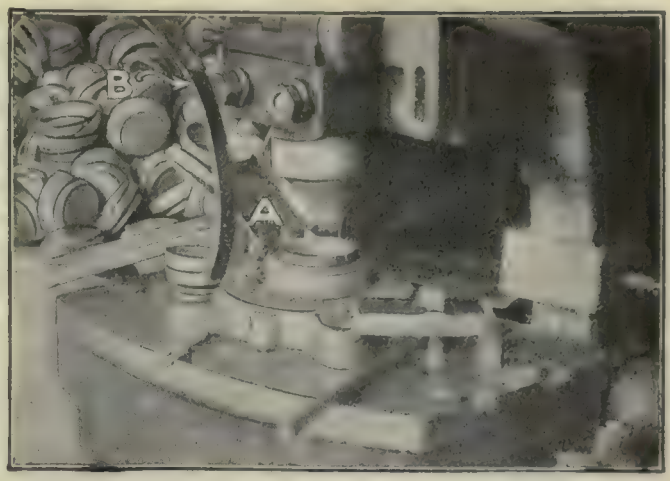


FIG. 6. SLIDE FEED AND HAND KNOCK-OUT WITH SAFETY GUARD

the slide. He replied that he did not know to what extent his output was increased in pieces but that without the slide he used to make 80 cents per hour and that he now makes $2. On another machine we increased the average output from 2,000 to 4,500 per hour. The method of attempting to increase production by getting it out of the men has given way to getting it out of the machine. With hand-feeding the operator had to stop the machine at every stroke but now he can let it run and every stroke counts.

Slides Are Popular

The men like the slides because they increase their wages. One special job that required only 5,000 pieces was set up on the machine in the old way and one of our best feeders was put on it. He refused to work without a slide, so they fixed one up out of a piece of tin sheet.

The pieces shown in Fig. 3 presented a difficulty because when sliding down a chute they would tip over. After a lot of experimenting we put a special side piece in the slide with a spring back of it, to cause a certain amount of friction on the pieces. With this arrangement we can push them through the slide easily. The piece across the farther end of the slide stops the piece of work from tipping over as it drops into the die.

A similar part with a flaring top is handled in a press equipped with an automatic feeding device, Fig. 4. A bar *A* along the top of the slide prevents the pieces from tipping over. The pan *B* at the end of the slide is provided as an aid in feeding.

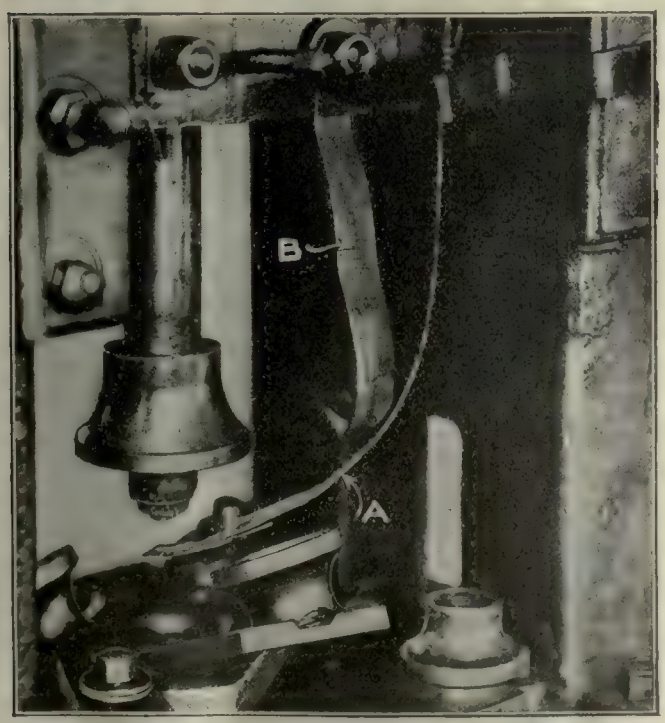


FIG. 5. SPRING KNOCK-OUT TO REMOVE PRESSED PARTS FROM DIES

Trouble with a Slide Feed

In one case, with a slide feed, trouble was experienced in getting the piece exactly in the right place in the die. The piece had a hole in the center so the trouble was remedied by putting a pilot pin on the upper die which exactly centers the piece before the die hits it.

On another job, performed on a vertical press, four fingers were lost last year, so we made a slide to get the material into the die, Fig. 5. The old stripper was not satisfactory because the parts fell back in the die. The piece of spring steel *A* was so attached that the pieces when stripped struck it and bounced off to one side. The piece *B* was fastened to the ram so that it pushed the part *A* out of the way when the ram came down. This looks crude, but it does the work.

One Improvement

Fig. 6 shows a job that is a great improvement although not yet perfect. This is a slide *A* which the operator feeds with his left hand. He knocks the pressed parts out of the way with a stick held in his right hand. The sweep guard *B* has been left on to make sure that the man does not get his right hand under the ram.

This department has about 500 presses and 3,000 dies and in it 24 fingers were cut off last year. We have now run three months without a scratch. Every month a statement is posted showing compensations and doctors' bills and the boys are taking a great pride in their record. We have really only made a beginning since we took the machines that we had and made feeds and kickouts to fit. Eventually we will have real automatic feeds where the stock is put into a barrel and feeds itself.

Activities of American Engineering Standards Committee

FIVE additional bodies have been admitted to representation on the main committee of the American Engineering Standards Committee. They are:

Electrical Manufacturers Council:
(Electric Power Club.
Associated Manufacturers of Electrical Supplies.
Electrical Manufacturers Club).
Fire Protection Group:
(National Fire Protection Association.
National Board of Fire Underwriters.
Associated Factory Mutual Fire Insurance Companies.
Underwriters Laboratories).
National Electric Light Association.
National Safety Council.
Society of Automotive Engineers.

These, with the five engineering societies who founded the committee (American Institute of Electrical Engineers, American Institute of Mining and Metallurgical Engineers, American Society of Civil Engineers, American Society of Mechanical Engineers, American Society for Testing Materials), and the three government departments, added later (Commerce, Navy, and War), make a total of thirteen organizations having representation on the main committee.

Constitution of the A. E. S. C.

The constitution of the A. E. S. C. provides for representation of "groups of organizations." It is the policy of the committee to encourage representation by groups in such a manner that a group shall represent substantially the entire field of a particular industry in order that it may "be of national scope." In the opinion of the committee the group plan makes both for efficiency in standardization work and for effectiveness of representation. The groups are autonomous, such matters as the apportionment of representatives and the allotment of fees among the constituent bodies resting wholly with the group.

International Standardization of Widths Across Flats on Nuts and Bolt Heads as Proposed by Swiss Standards Association

The Swiss Standards Association has addressed a communication to the national engineering standardizing bodies of the various countries, proposing the international standardization of the widths across flats on nuts and bolt heads.

The proposal covers the range of ¼ in. (6 mm.), 3 in. (80 mm.), diameter of bolts. The numerical values proposed are a compromise between the United States Standard, the British or Whitworth, and the metric "Systeme Internationale." The communication was addressed to the standardizing bodies of America, Belgium, England, France, Germany, Holland, and Sweden.

The American Engineering Standards Committee has requested the American Society of Mechanical Engineers and the Society of Automotive Engineers to act as joint sponsors in the matter, leaving the decision to the joint sponsors as to whether a new sectional committee shall be organized for the project, or whether the work should be done by a sub-committee of the Sectional Committee on Screw Threads, for which the same two societies are acting as joint sponsors.

Standardization of Structural Shapes

On the entrance of the United States into the war with the Central Powers there came a demand for immediate increase in ship construction which, in turn, meant increased production by the steel mills. To increase production to the maximum and to simplify order practice, a conference of steel makers was held in Washington on July 2, 1917, at which was adopted American standard practice for structural steel for ships.

The result of this action proved distinctly beneficial both to the mills and the shipyards, but was not followed immediately by a standardization of and a reduction in the number of structural shapes used at the yards, and in consequence the Emergency Fleet Corporation undertook an investigation to ascertain definitely the number of structural shapes used in shipbuilding and the possibility of their standardization and reduction in number. As an outcome of these investigations carried on by Fred T. Llewellyn in the Division of Steel Ship Construction under Daniel H. Cox, manager, it became possible to determine what were the sections in most general use and at the same time were brought out clearly the divergences in the sections rolled by different mills.

At a conference of steel makers held in Philadelphia on Nov. 19, 1918, inasmuch as the British standard sections of ship channels and shipbuilding bulb angles appeared to be better adapted to economical manufacture than the American standard sections and further as the new rolls which had been turned in recent years to produce such sections conformed in general to British standards, it was decided that thereafter American standard sections should be discontinued and that rolls not then to British standards be redressed at as early a date as possible to roll such sections as closely as possible to British standards and this particularly in view of the further fact that the adoption of British standard sections would enable American mills to compete on an even basis for ship steel wherever utilized in shipyards, either at home or overseas.

British Standard Sections

The British standard sections thus adopted as American standards were those adopted by the British Engineering Standards Association as published in 1903, and it was not known that this association had undertaken a revision of the British standard sections in 1913, work on which, however, had been suspended by reason of the war activities. When, however, through the trade press, information as to what had been done in the United States came to the attention of the British Engineering Standards Association, that association advised American steel makers as to the situation and later through their secretary, Mr. LeMaistre, expressed their desire to have the American structural trade co-operate with the British Engineering Standards Association in

the formulation of common Anglo-American standards for structural shapes.

At the instance of the association of American Steel Manufacturers, a sectional committee on steel shapes was organized under the auspices of the American Engineering Standards Committee.

The Sectional Committee gave very careful consideration to the entire routine of structural practice in the United States not only as it affects the profiles of structural shapes themselves, but also as regards methods of order practice, calculation and publication of weights, areas and properties, etc., with the idea to insure as far as possible a complete accord between makers and users wherever the sections rolled in English-speaking lands were used. At its meeting held on April 27, 1920, it formulated its recommendation for submission to its sponsor organizations, to the American Engineering Standards Committee and to the British Engineering Standards Association as a basis for common Anglo-American standards, and its conclusions are now to go before these organizations for further discussion and endorsement.

Features of the Recommendations

The essential features of these recommendations are:

1. The adoption of the decimal system for the expression of dimensions, thicknesses and other elements of order practice.
2. The adoption as an Anglo-American standard of the standard order practice adopted by the Association of American Steel Manufacturers on Feb. 20, 1920, under which structural shapes are to be ordered by weights per foot and not by thickness.
3. The adoption as an Anglo-American standard of American standard practice as it relates to ranges of thicknesses, methods of computation and methods of publication.
4. The adoption of definite ranges in thicknesses of angles and other structural shapes, under which are established two zones of variations between minimum and maximum thicknesses. Under 0.60 in. thick variations are fixed at four one-hundredths inch (0.04 in.) and above 0.60 in. thick at eight one-hundredths inch (0.08 in.).
5. Included in the list of angles is an equal angle (9 x 9 in.) and four unequal angles (8 x 4, 9 x 4, 9 x 6 and 10 x 4 in.) which are not now rolled in United States, but are subject to the considerations which weigh with manufacturers when new rolls are contemplated.
6. The adoption of a new line of bulb angle sections as proposed by the British Engineering Standards Association that are recommended on account of their greater efficiency as compared with present British and American standards.
7. The adoption of a single line of channel sections with a 5 deg. flange taper to displace the present two American lines, the structural line with its flange taper 9° 27′ 42″ and the shipbuilding line with its flange taper of 2 deg. This line of channel sections is not quite in accord with that proposed by the British Engineering Standards Association, but is believed to be more suitable to the requirements of the American trade and better proportioned.
8. The adoption of a new line of beam sections to take the place of the present American standards adopted in 1896. These sections have wider flanges than present American standards and do not agree very closely with the British proposals, but are believed by the Sectional Committee to be more nearly in accord with the recent developments in the fabrication of buildings and bridges.

Standardization of Shafting

The American Engineering Standards Committee has invited the American Society of Mechanical Engineers to act as sponsor for the standardization of shafting. The society has already done a considerable amount of work on a set of standard diameters for transmission and machinery shafting. It is proposed that the work, which will be carried out by a sectional committee, working under the rules of procedure of the A. E. S. C., shall be broadened to include the standardization of the method of determining what diameters of transmission shafting should be used for given loads, the dimensions of shafting keys and keyways, and the setting of dimensional tolerances.

Standardization of Pipe Flanges and Fittings

The committee has also requested the society to assume sponsorship in the standardization of pipe flanges and fittings. In 1914 the society issued a report covering a schedule of pipe flanges and fittings, for diameters from 1 to 100 in. for 125 lb. pressure, and also a schedule for extra heavy pipe, covering a range from 1 to 48 in. diameter, and for 250 lb. pressure. In 1918 a supplementary report was published for working pressures of 50, 800, 1,200, and 3,000 pounds.

While the work has not been active during the last year, it is now proposed that it be continued, the society being formally recognized as sponsor, under the rules of procedure of the A. E. S. C.

Standardization of Plain Limit Gages

A sectional committee of the American Engineering Standards Committee has just been organized to undertake the standardization of plain cylindrical gages for general engineering work, under the sponsorship of the American Society of Mechanical Engineers. The immediate occasion for undertaking the work was a request of the British Engineering Standards Association for co-operation on the subject. The committee held its organization meeting on June 11. It is understood that this committee will recommend to the American Engineering Standards Committee that the scope of the work should be broadened so as to cover all plain limit gages for general engineering work.

The Personnel of the Committee

The present personnel of the American Engineering Standards Committee is as follows:

E. C. Peck, chairman, general superintendent, Cleveland Twist Drill Co.

L. D. Burlingame, vice chairman, industrial superintendent, Brown & Sharpe Manufacturing Co.

H. W. Bearce, secretary, gage department, Bureau of Standards, secretary National Screw Thread Commission.

P. W. Abbott, Lincoln Motor Co.

John Bath, president, John Bath & Co., Inc.

Earle Buckingham, engineer of standards, Pratt & Whitney Co.

Fred H. Colvin, editor, "American Machinist."

W. A. Gabriel, chief draftsman and designer Elgin National Watch Co.

F. O. Hoagland, vice president and works manager, The Bilton Machine Tool Co.

Edward H. Ingram, works manager, The Cleveland Drilling Machine Co.

J. O. Johnson, office of chief of ordnance, War Department.

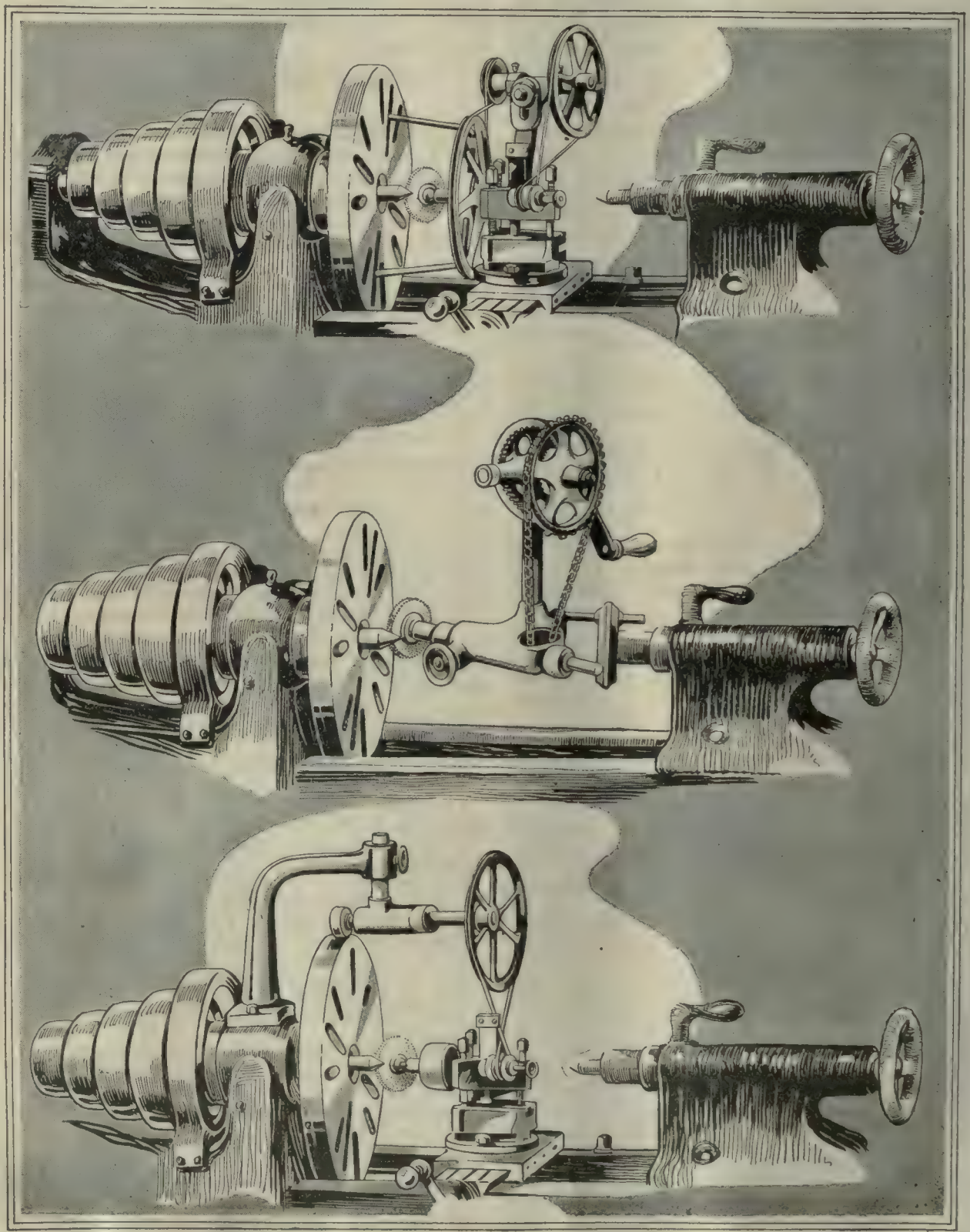
A. W. Schoof, gage engineer, Greenfield Tap and Die Corporation.

G. T. Trundle, consulting engineer, Engineers Building, Cleveland, Ohio.

H. L. VanKeuren, The VanKeuren Co.

FOR SMALL SHOPS *and* ALL SHOPS

By J. A. Lucas



Automatic Electric Arc Welding Machine*

By H. L. UNLAND
Power and Mining Department, General Electric Co.

THE automatic arc welding machine, made by the General Electric Co., Schenectady, N. Y., is a device for automatically feeding metallic electrode wire into the welding arc at the rate required to hold a constant arc length. Under these circumstances the electrical conditions are kept constant and the resulting weld is uniform and its quality is thereby improved. It is possible with this device to weld at a speed of from two to six times the rate possible by skilled operators welding by hand. This is partly due to the stability of the welding conditions and partly due to the fact that the electrode is fed from a continuous reel, thus eliminating the changing of electrodes. The automatic welding machine is adaptable to practically any form of weld from butt welding of plates to the depositing of metal on worn surfaces such as shafts, wheels, etc.

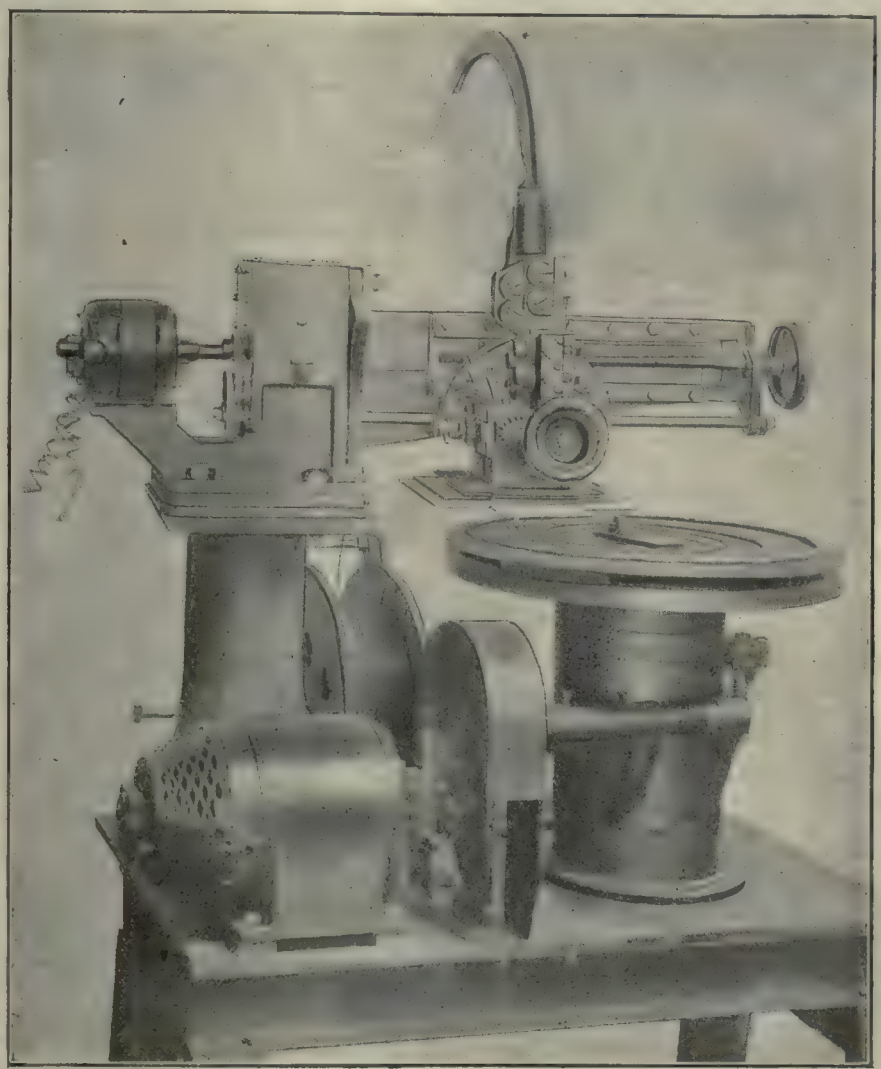


FIG. 1. SPECIAL SET-UP OF MACHINE FOR CIRCULAR WELDING

Everyone who has made any investigation of electric arc welding has noted the wide variation in results obtained by different welders operating, as nearly as can be determined, under identical conditions. This also applies to the operations of a single welder at different times under identical conditions. These variations affect practically all factors of welding such as speed of welding, amount of electrode consumed, etc. When indicating instruments are connected to an electric welding circuit, continual variations of considerable magnitude in the current and voltage of the arc are at once noticed. Considerable variation was found some years ago in the cutting of steel plates by the gas process and when an equipment was devised to mechanically travel the cutting torch over the plate a series of tests to determine the maximum economical speed, gas pressure, etc., for the various thickness of plate were made. The result was that the speed of cutting was increased to as much as four or five times the rate possible when operating under the unsteady conditions incident to hand manipulation of the torch. Further, the gas consumption for a given cut was found to be decreased very greatly. As a result of many experiences an investigation was started to determine what could be done in controlling the feed of the electrode to the electric arc in a metallic electrode welding circuit. An electric arc is inherently unstable, the fluctuations taking place with extreme rapidity. In any regulating device the sensitiveness depends on the percentage of variation from normal rather than on the actual magnitude of the values, since these are always reduced to approximately a common factor by the use of shunts, current transformers, or series resistances. The characteristics of practically all electric welding circuits are such that the current and voltage are inter-related, an increase in one causing a corresponding decrease in the other. Where this is the case it will generally be found that the percentage variation of the voltage from normal when taken at the customary arc voltage of 20, will be approximately twice the percentage variation in current. Further, an increase in arc voltage, other conditions remaining the same, indicates that the arc has been lengthened, thus giving the metal a greater opportunity to oxidize in the arc with a probability of reduction in quality of the weld. The automatic arc welding machine utilizes the arc voltage as the basis for regulating the equipment. The rate of feeding the wire varies over a wide range due to the use of electrodes of different diameters, the use of different current values, etc., caused by details of the particular

*From a paper read before the American Welding Society.

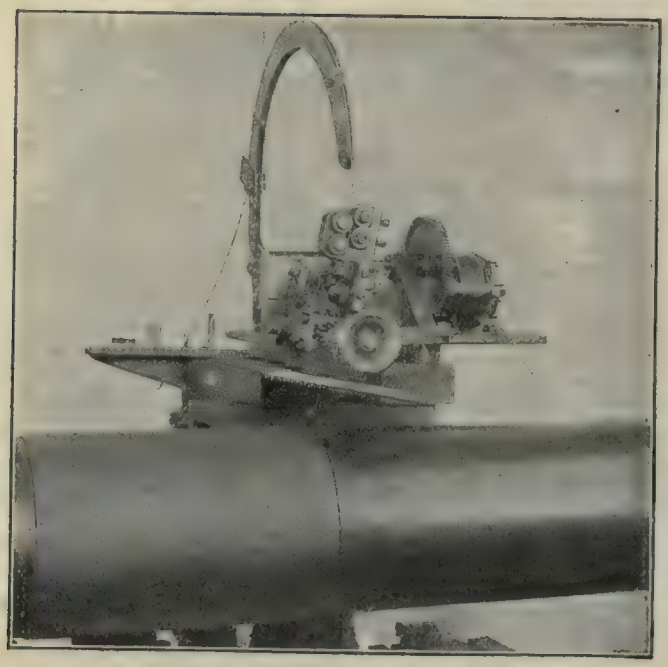


FIG. 2. SET-UP FOR BUILDING UP A SHAFT

weld to be made. The simplest and most reliable method of electrically obtaining variations in speed is by means of a separately excited direct current motor. Thus the operation of this equipment is limited to direct current arc welding circuits, but these may be of any established type, the variations in characteristics of the welding circuits being taken care of by proper selection of resistors, coils, etc., in the control.

The Welding Head

The welding head consists essentially of a set of rollers for gripping the wire and feeding it to the arc. These rollers are suitably connected through gearing to a small direct-current motor, the armature of which is connected across the terminals of the welding arc. This connection causes the motor to increase in speed as the voltage across the arc increases due to an increase in the length of the arc and to decrease in speed as the voltage decreases, due to a shortened arc. A small relay operating on the principle of a generator voltage regulator is connected in the field circuit of the motor which assists in the speed control of the motor as the arc voltage varies. Rheostats, for regulating and adjusting the arc voltage, are provided by means of which the equipment can be made to maintain steadily an arc of the desired length and this value may be varied from over twenty to as low as nine volts. No provision is made in the machine for adjustment of the welding current since the automatic operation is in no way dependent on it. The welding current adjustment is taken care of by the control panel of the welding set. This may be either of the variable voltage or constant potential type but it is necessary to have a source of constant potential to excite the fields of feed motor. It may be possible to obtain this excitation from the welding circuit, but this is not essential. The voltage of both the welding and constant potential circuits is immaterial, provided it is not too high, but these voltages must be known before the proper rheostats can be supplied.

On account of the great variation in conditions under which this welding equipment may be used it is provided with a base which may be bolted to any form of support. It may be held stationary and the work traveled past the arc or welding head may be movable and the work held stationary. These points will be dictated by the relative size of the work and the head and the equipment which may be available. Provision must be made for traveling one or the other at a uniform speed in order to carry the arc along the weld. In the case of straight seams a lathe or planer bed may be utilized for this purpose and for circular seams a lathe or boring mill may be used. In many cases it will be found desirable to use clamping jigs for securely holding the work in shape and also to facilitate placing in position and removing from the feeding mechanism.

In Fig. 1, the welding head is shown mounted on a special device for making circular welds. The work table is driven through a worm and worm gear by means of a separate motor. The welding head may be led along the arm by means of the handwheel, and it may be tilted at an angle of 45 deg. both at right angles to the line of weld and also parallel to the line of weld. Fig. 2 shows the building up of a shaft, the work being mounted on lathe centers and the welding head placed on a bracket clamped to saddle.

Fig. 3 shows a simplified diagram of the control of the feed motor. In this cut *A* is the regulating rheostat in the motor field circuit controlled by the arc voltage regulator *G*; *B* is the adjusting rheostat in the motor field circuit; *F* indicates the feed motor field winding; *M* the feed motor winding; *D* is the resistance in the motor armature circuit to adjust the speed when starting the feed motor before the arc is struck. The open-circuit voltage of the welding circuit is ordinarily considerably higher than the arc voltage. This resistance *D* is short circuited by contactor *X* when the arc is struck. The arc voltage regulator *G* maintains constant arc voltage by varying the motor field strength through resistor *A*. The regulator is adjusted to hold the desired voltage by the rheostat *C*. Permanent resistance *E* is in series with the over-voltage relay *H*, to compensate for the voltage of the welding circuit. Over voltage relay *H* holds open the coil circuit of the regulator *G* until the electrode makes contact in order to protect the coil from burning out.

Observation of indicating meters on the control panel show that the current and voltage are practically constant, but it should be remembered that all indicating meters have a certain amount of damping which prevents observation of the variations which are extremely rapid or of small magnitude. The resultant value as read on the instrument is the average value. Oscillographs taken with short arcs show that notwithstanding the fact that the indicating meters show a constant value, a succession of rapid short circuits is continually

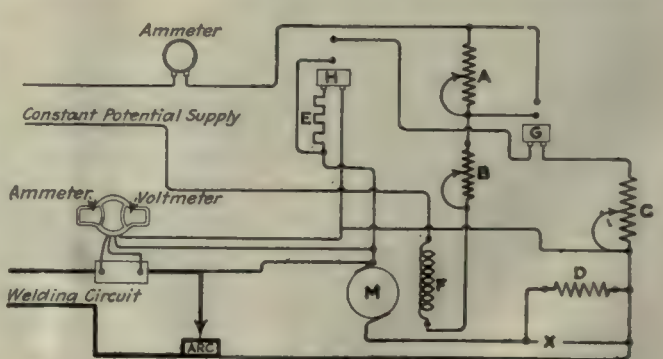


FIG. 3. SIMPLIFIED DIAGRAM OF CONTROL OF FEED MOTOR

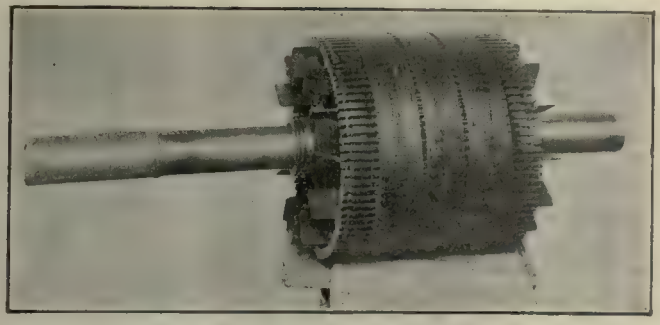


FIG. 4. WORN MOTOR SHAFT BUILT UP

taking place, apparently due to particles of the molten wire practically short-circuiting the arc in passing from the electrode to the work. This is indicated by the fact that the voltage curve fell to zero each time, and accompanying each such fluctuation there was an increase in the current. It was found that with the shorter arc the frequency of occurrance of these short-circuits was considerably higher than was the case when the arc was increased in length. To all appearances the arc was absolutely steady and continuous and there was no indication either by observation of the arc itself or of the instruments that these phenomena were occurring.

Some Work Performed by the Machine

The principal field for an automatic arc welding machine is where a considerable amount of welding is required, the operations being a continuous repetition of duplicate welds. Under these conditions one can economically provide jigs and fixtures for facilitating the handling of the work and the clamping. Thus can be reaped the benefit of the increased speed in the actual welding which would be lost if each individual piece had to be clamped and handled separately.

Examples of different jobs done with this machine, using various feeding and holding methods, are shown in the accompanying cuts. Fig. 4 is a worn pulley seat on an electric motor shaft built up and ready to be returned to size.

It is possible to build up pulley and pinion seats, also worn bearings, without removing the armature or rotor from the shaft and in practically all cases without removing the windings due to the concentration of the heat at the point of the weld. On shafts of this kind, 3 to 4 in. in diameter, the figures are: current 115 amp.; arc voltage 14; electrode $\frac{3}{32}$ in. in diameter; travel, 6 in. per min.; rate of deposit about 2.1 lb. per hour.

Similar work on a 14-in. shaft where the flywheel

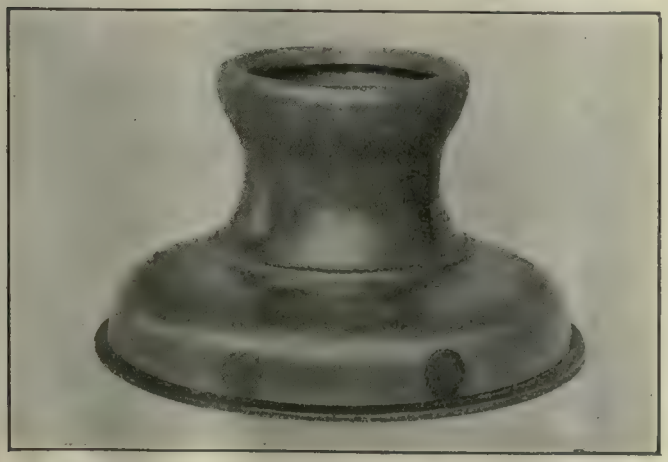


FIG. 6. WELDED AUTOMOBILE HUB STAMPINGS

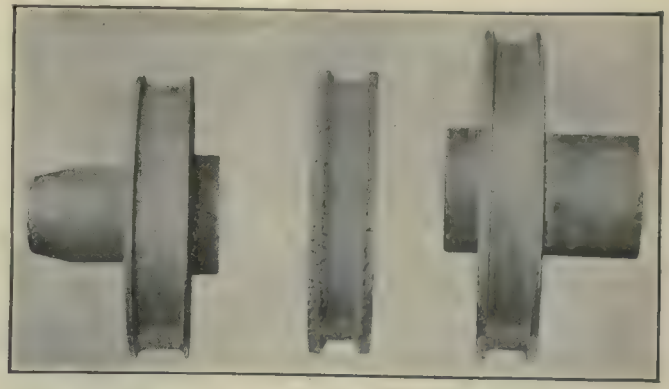


FIG. 5. WORN AND REPAIRED CRANE WHEELS

seat 21 in. long was turned undersize, was as follows: metal about $\frac{3}{16}$ in. deep was deposited over the undersize surface, using current, 190 amp.; arc voltage 18; electrode $\frac{1}{8}$ in. diameter; travel 4 in. per min.; rate of deposit, about 2 lb. per hour; welding time, 16 hr.; machining time, 4 hr.

Fig. 5 shows worn and repaired crane wheel flanges. These are easily handled by mounting on a mandrel in a lathe, and placing the welding machine on a bracket bolted to the cross-slide or the saddle. On wheels of this type 22 in. in diameter, the time taken to weld by hand would be about 12 hr. and by machine 2 hr.; machining time 4 hr.; approximate cost by hand welding $9; by machine $4.

TABLE I. SEAM WELDING

Thickness in Inches	Amperes	Speed, Inches Per Minute
0.040	45 to 50	20 to 30
1/16	50 to 80	15 to 25
1/8	80 to 120	6 to 12
3/16	100 to 150	4 to 6

Fig. 6 is an automobile wire wheel hub stamping, to which a dust cover was welded as shown. Joint was between metal $\frac{1}{8}$ and $\frac{3}{16}$ in. thick. Current 100 amp.; arc voltage, 14; travel 10 in. per min.; electrode $\frac{3}{32}$ in. diameter.

Fig. 7, welded automobile rear-axle housing, $\frac{3}{16}$ in. thick; current 120 amp.; arc voltage 14; travel 6 in. per min.; electrode diameter $\frac{3}{32}$ in.

Fig. 8, welded tank seam; metal $\frac{1}{8}$ in. thick; current 140 amp.; arc voltage 14; travel, 6 in. per min.; time for

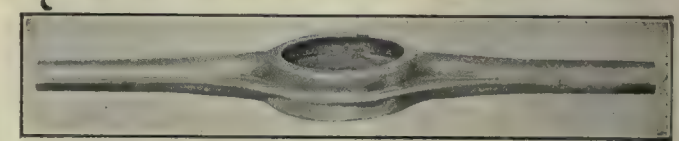


FIG. 7. WELDED REAR-AXLE HOUSING

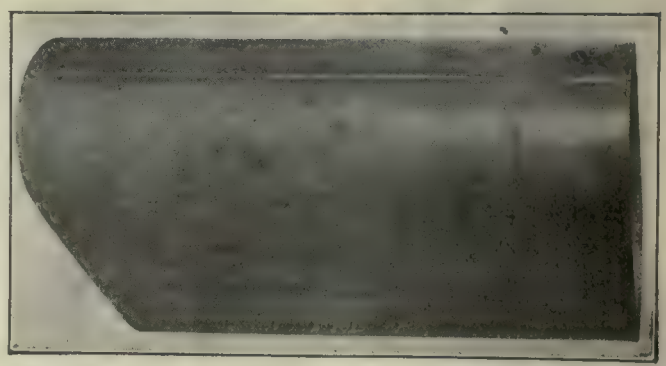


FIG. 8. WELDED STRAIGHT TANK SEAM

TABLE I. BUILDING UP (WHEELS OR SHAFTS)

Diameter or Thick., In.	Electrodes, Dia., In.	Amperes	Speed, In. per Min.	Lb. Deposit Per Hour
Up to 1"	5/32	60 to 90	11 to 13	1.04–1.56
Up to 3"	7/32	90 to 120	6 to 8	1.59–2.1
Over 3"	1/4	120 to 200	4 to 6	2.5 –4.5

welding ten tanks by hand, 4 hrs. 40 min.; by machine, 2 hrs.

Tables I and II give an idea of the speed of welding which may be expected, but it should be borne in mind that these figures are actual welding speeds. It is necessary to have the material properly clamped and supported and to have it travel past the arc at a uniform speed. In some cases the figures given have been exceeded and under certain special conditions it may be desirable to use lower values than those given.

Graduates and Work

By Entropy

About this time almost all of the multitude to whom diplomas were handed last June have spent the last of the allowances that their Dads will stand for and are just about ready to buckle down to work. Many of them dread the plunge, just as many of us look back on our own days in college and wish that we could go back to that state of irresponsibility once more. Their first few months, maybe years, of experience are not likely to do much except make them accept the inevitable. The transition for many is not only a plunge, it is a wet blanket bath.

Why is all this? These boys have spent practically all their lives up to the time of graduation in non-productive effort. They may have worked hard, many have, some at lessons, others in athletics, but it appears to be necessary to hold them in leash for some time, which is surely only another way of shortening their active productive life. For one reason they have to be held up in order that they may age, in appearance and in mental methods. There seems to be no substitute for this process. Men are made by hardships, mental or physical. There was a time when mere progress through school was attendant with some real hardships, but that is not so true now. Fathers are more apt to support their sons in full, loans from various funds are available, and boys who used to pocket their pride and work their way through are less inclined to do so now, and are more likely to stay away. Not having hardships in school they have to have them outside. One young man whom I met the other day is typical of many others. He was so unfortunate as to inherit a little money. He married a girl with a little. This added income has kept him where he did not have to wring the neck of the world to get enough to support the pair, and he has not done it. He has just moseyed along without making fame or money, but always comfortable. My advice, which he will not take, is to invest every cent he and his wife have, and all he can borrow, in some wildcat oil-well stock bought on a narrow margin. Then he will either make enough money so he will not have occasion to work at all or else he will be wiped out and have to go to work for his own benefit to pay up his debts and support his family.

There is another reason why engineering graduates, especially, have to wait for the right opportunity, and that is because they do not on the average, know what the fundamental principles are, either of mechanics or of business, notably the latter. I know that I received my diploma in the regular way, that is without any strings on it by which it could be hauled back, so many years ago that I hate to dwell upon it, and yet it never occurred to me for at least fifteen years to see that any world or country wide affairs had any connection with my earnings or the purchasing power of my money. I always believed that if I did my work well and conscientiously from day to day and never lifted my nose from the grindstone, that I would be a success. At the end of those fifteen years I looked up while the blood dripped off my nose, and noticed that the world had gone right along and that it had seemingly forgotten to wake me up and take me too. That was the time I should have had my diploma, not with the other boys in my class, though there are a few of them who ought not to have theirs even now, and one or two who got theirs at the right time.

It seems to take the most earnest graduates about two or three years to discover that hard work may not necessarily be intelligent work. If a man is set at a job and does it well he is no doubt worthy of his hire, but if he discovers a way to omit this work in part or altogether he has earned the right to promotion. It is not alone doing work that counts, it is finding ways to get things done with less work. Another of the troubles of the young graduate is in getting used to the kind of a world that has been built up outside the college walls. We are not an especially handsome looking lot, some of us wear old clothes to cut down the cost of living, and some because we just never noticed they were old. We have been very busy, and many of us do not remember exactly the intercollegiate record in the pole vault. Not but that we would like to know, but we just don't for the moment. We are all glad to get acquainted with every young graduate. It helps us stay young, but we hate to give up the pile of work in front of us for the sake of hearing the latest news from even our own alma mater. We would rather talk about the exact percentage of nickel in that last lot of shafts and whether or not we could cut it down with safety. Fact of it is we have the very bad habit of talking shop in office hours and we hope he will do the same. And after all we are only waiting with whatever patience we have for the time when we can put Mister College Graduate on some truly responsible work, but we do not dare to until it becomes automatic with him to talk shop whenever he talks at all.

At times some of us say that we wish these boys knew enough to do some specific thing well enough to earn a living at it when they graduate, but we do not really mean it. None of us would be satisfied to have him do it in any but our own way. What we do need is a thorough knowledge and understanding of mechanical principles, and an ability to discover how those principles are at the bottom of our own work. We need new ideas, and we need the effect of fresh new blood, but we are afraid of too much newness of thought, and we know from experience that everything we do now is governed by past experiences, which makes it hard for us to see hopes for success in new designs for old machinery. That is, we feel the need of a certain degree of conservatism, which may consist only of listening to a rehearsal of past failures. I have often envied those shops which preserve a sort of morgue, or museum where are stored samples of all of their own and their competitors' failures, for exhibition. They must have a wonderful value in educating a newcomer.

Psycho-Technics in Germany

By Dr. ALFRED GRADENWITZ

Trade tests and applied psychology are becoming everyday affairs both here and abroad, but we have considered it worth while to print this brief description of some of the simple apparatus used in a German laboratory to pick out the right man for the job, or better, perhaps, to pick out the right job for the man. Whatever else we may think of the German, he is undoubtedly a good laboratory man and his work is worth studying.

TO ECONOMIZE is the one great problem of the day in war-ravaged Europe. To economize not only the scanty raw materials but the human material available for the gigantic task of rebuilding the world. In order that everybody in this connection may render a maximum of service he should obviously be put in the right place to yield the most efficient work.

The ideal solution of the problem would be to make comprehensive tests and tell everybody previous to his entering professional life for which profession the candidate's personal gifts best fit him. Though we have not yet got quite as far as that we are already able to solve the problem in a practical way for some professions, especially the manual trades. Whenever anybody has made up his mind to go in for a given trade we are in a position to tell him after extensive tests whether, and in what degree, he is fit for it. We are able at the outset to discard the unqualified candidates.

Psycho-technics is the name of the young science which has set itself the task of solving this and related problems. Grown out of small beginnings, it is developing with surprising rapidity. Already there are, both in this country and in Europe, a number of industrial works equipped with their own psycho-technical laboratories for the selection of their apprentices and operatives, and in Germany there has for some time been in existence at the Berlin Technical High School a psycho-technical research and testing laboratory,



FIG. 1. TESTING SENSE OF PROPORTION



FIG. 2. APPARATUS FOR TESTING HEARING

conducted by Dr. W. Moede, one of the pioneers of the new science, who found his early inspiration in Taylor's efficiency engineering. The following description will afford some idea of the methods used at Dr. Moede's laboratory, which can be considered as representative of the best practice in German psycho-technics.

Dr. Moede's Tests

The tests discover the physical and mental, as well as the psychic, fitness of the candidate, for apart from intelligence proper there are to be investigated a number of functions of a more psychic kind. The normal fitness, of course, lies outside the range of these tests.

As regards, first, the activities of the senses, the eyesight and hearing should be primarily tested. In the place of the mere visual powers, however, a more complicated faculty is tested, the candidate's sense of proportions, by means of various kinds of apparatus for halving lines and circles, adjusting right angles, gaging diameters, etc., see Fig. 1. The keenness of his luminosity perception is likewise tested by means of a special apparatus.

For testing the candidate's sense of hearing the laboratory uses a simple apparatus consisting of a weight, which by striking a fixed block produces a noise depending on the height of fall, the candidate having to decide whether two successive acoustic impressions are of equal intensity. The apparatus is shown in Fig. 2.

Sensitiveness in Joints

Another point to be ascertained is the sensitiveness in the joints; a technical worker, especially a mechanic, should be able to gage accurately the pressure exerted by a tool. Fig. 3 shows the device used for this test. The candidate turns a handle and feels under the action of a compressed spring an ever-increasing resistance. At the bidding of the experimenter he then withdraws his hand from the handle; the experimenter having turned the handle back into its original position orders the candidate to turn it on again until he feels the same resistance as before. The index tells the experimenter how nearly the two positions agree.

The keenness of the touch is tested in many other ways: by means of a set of metal plates to be sorted according to the relative smoothness of their surface;



FIG. 3. TESTING SENSITIVENESS OF JOINTS



FIG. 5. SLOTTED PLATE FOR DETECTING UNSTEADINESS



FIG. 4. BOLTS AND NUTS FOR DETERMINING SENSE OF TOUCH

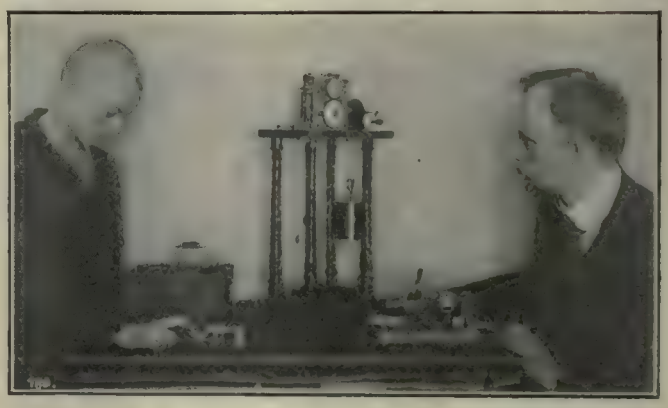


FIG. 6. METHOD OF TESTING PROMPTNESS OF DECISION

of metal sheets to be sorted according to thickness; of a set of cubes of nearly equal dimensions to be arranged according to size. Furthermore the candidate is asked to fit into one another a set of most accurately worked screws and nuts, and to pick out of a collection of mutually resembling objects those actually alike, a more general test affording an idea of the sense of proportions. This is shown in Fig. 4. An extremely accurate apparatus is the Moede Touch Tester, which consists of a hardened and polished ring, inside which a hardened and polished cylinder moves up and down. The candidate is asked to turn the micrometer screw until the cylinder surface is flush with the surrounding ring. Experiments made with this apparatus have shown those possessing the finest touch to be able to find out height differences of 15 ten-thousandths of a millimeter between the two surfaces, while a touch ascertaining differences of 4 thousandths of a millimeter still enables a man to perform the most delicate work.

The Nerve Test

Another faculty required for fine mechanical work is the calmness and steadiness of the hand. In order to test this, Dr. Moede has designed an apparatus, the cover plate of which is connected with an electric bell. The candidate is handed a steel pencil connected with the source of electricity and fitted with an insulated handle; this he has to insert into the various openings and to move along the slots of the plate so that there is no contact. At the slightest trembling of the hand the pencil will touch the plate, thus sounding the electric bell. Fig. 5 shows this device.

The muscle power and endurance of the hand are gaged by compressing a handle and spring, recording the strength expended. Like the aviator, chauffeur and motorman, the man engaged in the mechanical professions will require plenty of nerve steadiness. In order to investigate this factor the candidate is frightened by some means or other—sudden shots, luminous phenomena, etc.—and in a similar manner as in connection with earthquake records a curve is traced which enables the time taken by his nerves to come to rest to be gaged. The presence of mind and promptness of decision are finally tested by means of a thousandsecond clock, the candidate being asked to press a button as soon as a red lamp is lighted so that the time elapsing between the stimulus and the action is read on the clock, as shown in Fig. 6.

Intelligence Test

These tests relating to the working of the senses are supplemented in a most valuable manner by intelligence tests, the "space sense," being investigated by the decomposing and composing of geometrical figures, the engineering skill by the solving of constructional problems, the interpreting of engineering drawings, etc.

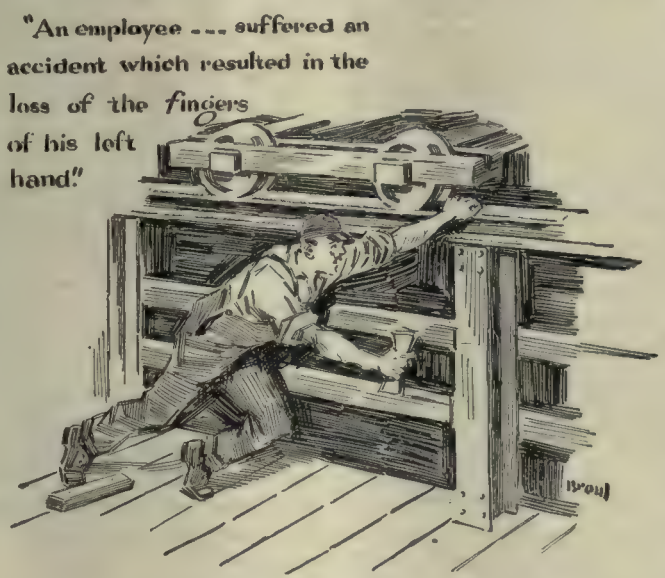
The advances made by the new science are also illustrated by the recent foundation, under the editorship of Dr. W. Moede and Dr. C. Pierkowski, of a special magazine called "Praktische Psychologie."

Judicial Construction of "Machinery of Every Description"

By LESLIE CHILDS

Statutes requiring employers to place safety guards on industrial machinery in order to prevent injury to workmen are usually more or less vague in their wording and difficult to comply with literally. This article takes up a New York case in which a logical and clear conception of the purpose and use of guards on machinery is given.

STATUTES placing a duty upon employers to guard cogs, vats, pans, gearing and "machinery of every description," have been enacted by the legislatures of a great many states. To the superintendent, general manager, or other executive in charge of plants employing machinery the interpretation of these statutes has in many cases proven a sore trial. In particular has the often-used phrase "machinery of every description" been a stumbling block, for it is perfectly obvious to even the layman, that machinery of every description in any industrial plant is not susceptible of being guarded against all possibility of accident, if it is to be used for the purpose of its existence. Cases involving the construction of these statutes have been before the courts upon many occasions; and, while the decisions are not entirely uniform, they approach uniformity as closely as could be expected, when it is considered that each case has been decided in the light of a particular statute and in accordance with possibly a peculiar state of facts.



A leading case on the question, in which it appears that the court pronounced the true rule relative to the construction to be placed upon the phrase "machinery of every description," was that of Wynkoop vs. Ludlow Valve Manufacturing Co., 196 N. Y. 324. The facts involved in this case were substantially as follows:

William Wyncoop, an employee of the Ludlow Valve Manufacturing Co., suffered an accident which resulted in the loss of the fingers of his left hand. It seems Wyncoop, on the morning of the accident, was engaged in drilling valves with a drill press, and, in order to get the required forms for the valves he was going to drill, he made a trip to the room, or space, in which the forms were stored. As he returned, he in some manner slipped, or tripped, and as he did he put his hand on top of the rail upon which a crane truck that was used in the factory was passing. The result was the injury mentioned above.

It appears from the report that the crane was operated from a truck which ran on a track somewhat elevated. The crane was used, as is frequently the case, for lifting and moving heavy weights on the lower floor of the building.

The accident culminated in Wynkoop filing suit for damages against the valve company, alleging that the latter failed to obey the New York labor law, which, among other things, provided that, "all vats, pans, saws, planers, cogs, gearing, belting, shafting, setscrews, and machinery of every description, shall be guarded."

The trial in the lower court resulted in a judgment in favor of the plaintiff Wynkoop, and the valve company prosecuted an appeal to the court of appeals. In passing upon the issues raised, and in particular on the construction to be placed upon the phrase "machinery of every description," it was among other things said:

"There is no testimony in the record to show that it was practical to guard the rail, or that such a rail is now or ever has been guarded in any similar or other factory. The wheels of such truck were from 15 to 18 in. in diameter, and the structure of the truck extended above the wheels, so that it was not possible to guard the track by a covering and continue to use it. . . . The dangers arising from unguarded vats, pans, saws, planers, cogs, gearing, belting, shafting and setscrews is more or less hidden, and consequently, when unguarded, they constitute special and unnecessary exposure to injury. The intention of the legislature in directing that certain things should be guarded was thereby to remove all unnecessary danger to persons employed upon or about such special dangers. Other mechanical appliances constituting similar hazards were doubtless included in the words 'machinery of every description.' Where, however, danger to employees does not exist or is not reasonably to be expected, it is not necessary, under the act quoted, for employers to guard even the enumerated machines or appliances. . . .

"There is no inherent danger in a track upon which a car or truck is run. The danger of remaining on a track when a car of any kind is approaching is neither hidden nor obscure. In this case, as we have seen, the track was elevated higher than an ordinary table, and the defendant's employees were not required to work upon or about it. Any contact with it would have to have been intentional and voluntary, or arise from some intervening accident. . . ."

The court thereupon reversed the judgment rendered in the lower court in favor of Wynkoop and granted a new trial, holding in effect that upon the evidence of record there was no liability resting upon the valve company in this case.

An Important Decision

The value of this decision from the employer's standpoint does not depend upon the particular facts involved, but rather upon the interpretation placed on the phrase, "machinery of every description," in the act referred to.

The court goes directly to the point and in substance says that "machinery of every description" comprehends machinery from the operation of which flows some inherent or hidden danger. In other words, compliance with the statute means simply the exercise of such care, in guarding dangerous machinery, as is reasonably necessary for the protection of men of ordinary prudence and caution.

Section Moduli of Rectangles

By John S. Watts

The chart Fig. 3 which accompanies this article, shows at a glance the modulus of section of any rectangle up to 10 in. in height and 10 in. in width and can be used for other rectangles of unlimited size by simply changing the position of the decimal point, as will be explained further on.

The section modulus of a rectangle is found on the chart at the intersection of the diagonal line representing its height with the vertical line representing the width of the rectangle.

For example, the section modulus of a rectangle 5½ in. high, and 5 in. wide, is shown by the chart to be 25. To use the chart for dimensions above or below its range, all that is necessary, is to remember that the section modulus varies as the square of the height, and that therefore, if we divide the height of the rectangle by ten, to bring it within the range of the chart we must multiply the section modulus as given by the chart, by $10^2 = 100$.

Similarly, if we divide the width of the rectangle by ten, the section modulus on the chart must be multiplied by ten because the modulus varies directly as the width. For example, to find the section modulus of a rectangle 55 in. high by 5 in. wide, we divide the height by 10, and find the section modulus of a rectangle 5.5 in. high by 5 in. wide to be 25, which multiplied by 100 equals 2,500 which is the modulus of section for the rectangle 55 in. by 5 in. It is not always essential to use the figure ten as the divisor, as it may sometimes be more convenient to take half the height or width or some other fraction of that number. But, in any case where the height is divided by a number, the modulus found must be multiplied by the square of that number. And, if the width is divided by a number, the modulus found must be multiplied by the same number.

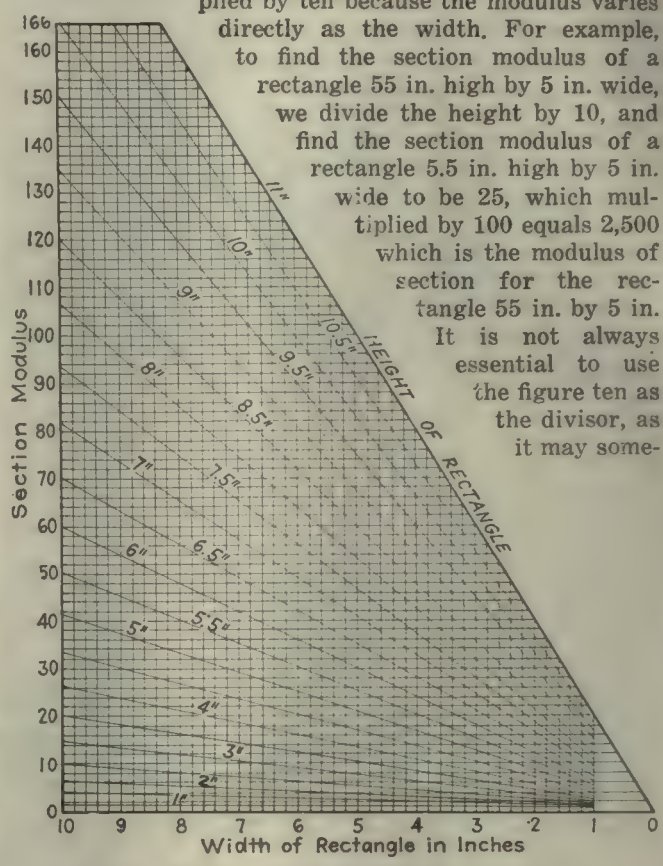


FIG. 3. CHART SHOWING SECTION MODULI OF RECTANGLES

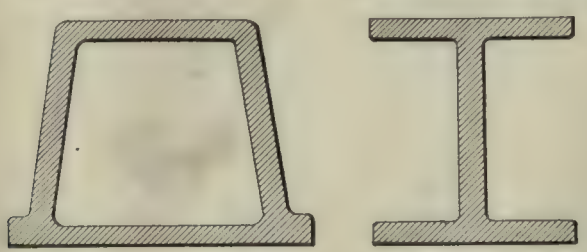


FIG. 1

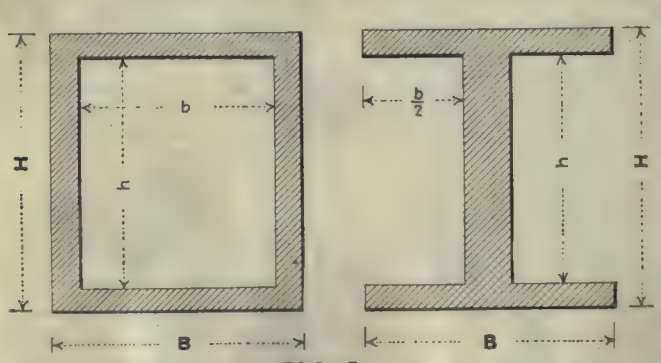


FIG. 2

FIG. 1. SECTIONS OF WHICH MODULI ARE WANTED
FIG. 2. EQUIVALENTS OF SECTIONS IN FIG. 1

For instance, if the rectangle was 5½ in. high by 15 in. wide, we could take one-third of the width, namely 5 in., and finding the modulus to be 25 for a width of 5 in., would multiply it by 3 and so arrive at 75 as the modulus for a width of 15 in.

There are two methods in common vogue for fixing the required thickness and dimensions of bedplates, one, and probably the most common one, is to make the casting of such dimensions as seem to the designer to look about right on the drawing.

The other way is to spend hours calculating the moment of resistance to a degree of exactitude. This is generally not warranted because of the uncertainty as to the actual amount of the strain that will be imposed upon the casting.

While the lack of knowledge of the stress in the bedplate makes it useless to work out the modulus of the section of the bed to an absolutely correct figure, still it is worth while having an approximate figure for purposes of comparison with other beds on machines of different sizes which have been previously built, and which has stood up to the work successfully.

The section of the bed of an average machine to

carry the bearings, etc., is usually made either of a box or "I" section, on the lines of Fig. 1. It requires considerable time to calculate the section modulus exactly, of sections such as these, but they can be converted by eye into an approximately equivalent, uniform shape in a few minutes.

These equivalent shapes will be about as shown in Fig. 2.

The moduli of the sections can be readily calculated. However, even for these simple shapes, most men take more time than is necessary to calculate the modulus, as they use the formula given in the text books, which is a rather tedious one to work out, being $\frac{BH^3 - bh^3}{6H} = Z$

So far as the calculations are concerned, both the above shapes are worked out by the same formula, the "I" section being in reality the same as the box section, except that the metal in the sides of the box is placed central in the "I" section.

Theoretically, therefore, the two sections are equal in strength weight for weight and may be treated alike, although actually the box section is the stronger.

However, a moment's thought will show that it is much less laborious to calculate the modulus for the outside rectangle and deduct from it the modulus of the inside rectangle. With the use of the chart shown this can be accomplished in a matter of a few seconds.

Increasing Production in Johnson's Shop

By John R. Godfrey

Being away quite a little lately, I haven't had a chance to drop in and see how Johnson was coming on with his new ideas of management, but I found him chipper as ever the other day. Seems to have a new lease on life since he began trying to get back into actual touch with the men once more. I didn't have a chance to send in a card because Johnson spotted me through the glass partition and came to the door.

"Come in Godfrey, you old sinner, where in thunder have you been all these weeks, anyhow? I've been just busting to see you and I don't care where you were, its where you *are* that interests me. Now you've got to do some tall listening while I talk an ear off.

"You've been hearing a lot about low production in the shops. More pay and less work, and all that. Well, I guess it's true in many cases, Godfrey, but there is a reason, as the ads say, there always is. Several of them usually. But it isn't necessary. I can show you a dozen shops where production has increased, and one of 'em is right here.

"Why? No secret at all, Godfrey—just plain horse sense. Getting the men interested in the work so they'll work with you, instead of having them indifferent or against you. Just being human, in other words—like we used to be in the days of the small shop. Don't know what would have happened if I hadn't fired these two alleged efficiency bugs. They wanted me to sit in the office and read reports instead of seeing and talking to the foremen in the shop. Bah! A lot they know about human nature, and that has a lot more to do with real production than all their schemes.

"Now I want you to sit in on a conference that will meet here in a few minutes. Keep your eyes and ears open and your mouth shut, and you'll learn a lot."

The conference was about some new fixtures and tools for a new manifold on Johnson's motor. It included the tool designer, the production manager, the foreman of the manifold job and two of his leading workmen. The production manager had a sample of the new manifold, and the tool designer had sketches of the fixtures and tools which he proposed to use on the job. But before these were made or even before the real drawings were made, he talked the job over with the men who were going to use them.

The milling machine man said one of the troubles with the present fixture was that the chips accumulated in the wrong place and interfered with seating the next casting unless the men were very careful. So the tool designer made a change in the fixture sketch to let the chips fall out of the way. Then the foreman suggested that a new kind of boring tool might be tried and as the production manager agreed, another change was made in the sketches. These were then signed, or rather initialed by the production manager, the foreman and his two men, and the tool designer took them back to be detailed and the fixtures and tools sent through the works.

After they had gone, Johnson turned to me with a grin.

"You've no idea, Godfrey, how that little confabulation will help along production on those new manifolds. Under the old, none-of-your-dam-business method, no one in the shop would know a thing about the change unless by accident. When the new manifold came along they'd just naturally oppose it on general principles, same as you and I do when someone suggests shifting the book case to the other side of the room.

"The tools and fixtures would be criticized, and often with justification. 'That —— tool designer thinks he knows it all, but if he'd only cut out chip room here we could handle 'em faster and earn more money.'

"You've heard that sort of thing everywhere, and there is some justification for it too.

"You see, we iron out all those difficulties in these little conferences. Now, when the new manifolds come along, the men are expecting them and anxious to see how the new tools and fixtures work out. They're interested instead of antagonistic, because they've been consulted and have helped to work out the new problems. The new tools have friends at court who are bound to make them work out if it's a possible thing.

"It's just a little problem in human psychology and it's the most natural thing in the world. We growl because men are not as interested in their work as we used to be, and we never give 'em a chance. Some shops don't even let them know what the piece does after it's done. Suppose the boss handed you a job to drill four million five-eighth holes in forgings that you didn't know the name of or where they went. Nothing to do but pull a lever and change pieces from morning till night. Would you be interested? Not so you'd notice it.

"Well, that is just what I'm aiming to cut out. That new manifold job will go through in record time. We've increased production over 50 per cent per man in that department already. Not all by any one thing but by a combination. And most important of all is interest in the job. Then I've added to the pay envelope in proportion to the increased output in the shape of a group bonus. For it's the group that counts. One or two men might double the output on their machines and still not send any more completed manifolds to the

assembling shop. When it's a group affair, the fellow who lays down on the job has a hard time of it with his mates in the gang.

"If he's a good sort and there is an A-1 reason for his dropping behind, you'll see the rest helping him out in various ways. But if he is lazy or incompetent, or a bluffer, it isn't long before he asks to be transferred or quits the job. You don't need any speed boss when the gang are out after bonuses on their output.

"But interest in the job is the main thing and I'll show you some of the things we do in that line. Let's go to the manifold department, seeing that is the one we've been thinking about this morning."

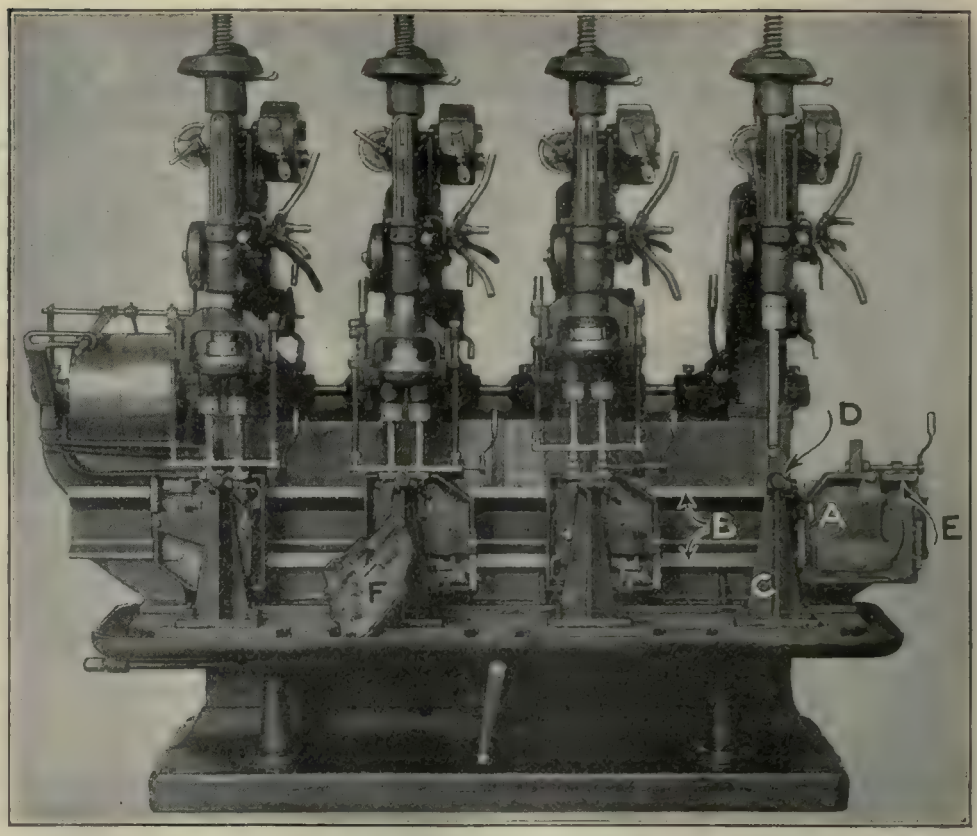
Here I found a good-sized Bulletin Board with a variety of stuff on it but no "Rules and Regulations" or "Don'ts." There was a life-size manifold with a plain English inscription of what it did and why. There were pictures of other types of manifolds and the reasons for not using them. The effect of defective joints and leaky castings was shown.

Then there were photos of Johnson motors in various kinds of service and in different parts of the world. Pleasure boats, fishing boats and the like—all labeled so they all knew what and where they were.

Last, but not least, was a table of motors built each year since 1915, the number of men, the value of the machine equipment and the comparative costs, not only of complete motors, but of manifolds. Each department gave details of the cost of the things they made.

"The men are just as anxious to keep those costs coming down as I am," said Johnson. "And they'd come faster if there was some way of keeping out of their minds the fear of being out of work, of working themselves out of a job. If I could get the manufacturers of this town into some sort of an arrangement which could guarantee continuous work to our regular force, you'd see production costs come down even faster than they are."

If Johnson can put that over he'll win a place in the Hall of Fame.



SPECIAL MACHINE FOR DRILLING BODIES OF AN HYDRAULIC AUTOMOBILE GEAR-SHIFT

Machine for Drilling Gear-Shift Bodies

By J. V. Hunter

A recent development in the automobile field is an hydraulic gear-shifting device, the purpose of which is to eliminate the shifting of gears by hand. The device is made by the United States Auto Gearshift Co., which has lately installed special machine tools in its Eau Claire, Wis., factory to facilitate the manufacture of the parts.

The illustration shows a 24-in., all-geared, 4-spindle gang drill which has been furnished complete by the Barnes Drill Co. with the jig and tools for drilling, reaming and counter-boring the three pairs of small cylinder holes required in the body of the gear-shifting device, which is shown at *F*. The spindles of the machine are furnished with coil springs to facilitate their return. Special auxiliary heads are provided so that the three spindles on the left either drill, bore or ream two holes at a time.

The work is held in revolving jigs *A*, which are mounted on the cross rail *B* on the bed. They are aligned in position on the cross rail by means of the stationary brackets *C* bolted to the table. The brackets have spring-operated stops *D* in their heads which snap into grooves *E* on any one of three sides of the jig, this depending upon which side of the casting is being machined.

Under the first spindle at the left two holes are drilled at a time, using a two-spindle auxiliary head with bushing guides. The jig is then revolved, so that the second and third sets of holes can be drilled. From the first station the saddle carrying the jig slides to a position under the second spindle, where the holes are rough reamed with Kelly reamers, the jig being again indexed to three positions. Under the third spindle the three sets of holes are finish-reamed. The fourth spindle carries a single Kelly reamer, which is used for counter-boring all of the holes. The fixtures are passed off the rail at the right for reloading, and replaced at the left end for starting the sequence of operations with another casting. The production of the machine with a single operator is fifty finished pieces per day.

The auxiliary heads are equipped with special guides for the bushing holder, which cause the bushings to withdraw from the work as the tools are raised.

Purposes of the Federated American Engineering Societies*

IT HAS been apparent for many years that with the constant increase in number of engineering and allied technical societies, each carrying on its work independently of the others, that some form of comprehensive organization was desirable which could speak for these societies in matters of common concern.

There were frequent occasions where united action by these professions was desirable, and as a result of a serious need to meet the conditions arising from the war, the Founder Societies created Engineering Council

"To provide for the consideration of matters of common concern to engineers as well as those of public welfare in which the profession is interested in order that united action may be possible."

This was effected through the agency of the United Engineering Society, of which Engineering Council was made a department. In February, 1919, the American Society of Testing Materials became the fifth member and the American Railway Engineering Association was admitted as the sixth member in April, 1920.

Engineering Council held its first meeting in June, 1917. It has a chairman, two vice-chairmen, who with three other members elected by the Council constitute an Executive Committee. Its principal office is in the United Engineering Societies Building in New York City; since Jan. 1, 1919, it has maintained a branch at Washington, D. C. The officers and members of its 24 committees, membership on which is not limited to representatives on the Council, total 125 engineers representing all parts of the United States.

The appointment by the four Founder Societies of Committees on Development was for the purpose of determining the functions and objects of these societies and of making recommendations as to the changes in their activities that were desirable both as to internal relations and as to their relations to other societies.

Conferees of the four societies met in August, 1919, and organized as the Joint Conference Committee. The purpose of the latter was to determine in what manner these four societies could co-operate in non-technical or welfare work affecting the relations of the engineer to, and his services in public affairs. The committee presented a report to these societies in Sept., 1919, and recommended the formation of a comprehensive organization, the purpose of which should be

"to further the public welfare wherever technical knowledge and training are involved, and to consider all matters of common concern to these professions."

This plan of procedure was approved by Engineering Council at its meeting in October, 1919; the joint meeting, held in New York in January, 1920, of the members of the governing boards of the four Founder Societies and of the American Society of Testing Materials, the members of Engineering Council, and the Trustees of the United Engineering Society, unanimously requested the Joint Conference Committee to call, without delay, a conference of representatives of the national, local, state and regional engineering organizations of this country for the purpose of bringing into existence the comprehensive organization recommended by the Joint Conference Committee.

At the Organization Conference held in Washington June 3 and 4, 1920, in response to the call issued by the Joint Conference Committee, representatives of 71 engineering and allied technical organizations created the Federated American Engineering Societies and provided for the administration of its activities by the American Engineering Council and its Executive Board. The constitution and by-laws were substantially those recommended by the Joint Conference Committee. At its session of June 4, the following resolution was unanimously adopted:

Resolved, That it is the sense of this Organizing Conference that the Joint Conference Committee should be entrusted with making provision for putting the conclusions of this conference of engineers into effect, and that Engineering Council be requested to carry on its work until the new organization has been established, and by all proper means to further the program of the new organization. The Conference further recommends to the contributing societies that they continue supplying the funds required by Engineering Council until its work is taken over by the new organization.

Engineering Council in June, 1920, on the third anniversary of its first meeting, heartily endorsed the Federated American Engineering Societies and the American Engineering Council and authorized "its Executive Committee to proffer and perform on the part of the Council such assistance as may be practicable in completing the work of the Organizing Conference of

What will be the field of activity of the Federated American Engineering Societies? What does the organization intend to do? The work of this organization will be of a kaleidoscopic character, with few fixed lines of activity, its major work depending on conditions as they arise from time to time; it will take over and extend the work of Engineering Council as partially outlined here. What it intends to do is to use its power for the service of the community, state and nation in public affairs wherever engineering experience and technical knowledge are involved and to consider and act upon matters of common concern to the engineering and allied technical professions. In the conduct of many public matters which are essentially of an engineering nature, it is vital to the public welfare that engineers and allied technologists should lead. There will be an increasing number of questions arising in which the opinion of these professions will be of fundamental value to the welfare of the nation and it behooves these professions to so support the Federated American Engineering Societies that it may so function as to supply this great public need. It is only the exceptional individual of these professions who can fail to see that in increased activities in these broader and less selfish fields the standing of the profession will be greatly improved and this of necessity must improve the position of the individual engineer.

*Bulletin No. 3 issued by the Joint Conference Committee.

the Joint Conference Committee of the Founder Societies, in establishing the American Engineering Council."

The following letter from the chairman of Engineering Council requires no comment:

Richard L. Humphrey, Esq., Chairman,
Joint Conference Committee.
Dear Sir:

Permit me to acknowledge receipt of your official communication of July 8 embodying the resolutions of your committee regarding the position which Engineering Council is requested to take until the new American Engineering Council is fully organized.

I am sure that as chairman I voice the opinion of Engineering Council when I state it will do everything in its power to advance the organization of the new Council, to act in the interim, and to facilitate a smooth transfer of activities from the old to the new Council.

(signed) J. Parke Channing,
Chairman.

Thus the way has been opened for the American Engineering Council to succeed Engineering Council as soon as the former is ready to take over the work Engineering Council is now doing, which will probably be on Jan. 1, 1921.

In view of this fact it will be of interest to review briefly what Engineering Council has accomplished in its three years of existence. Under the terms of the charter granted by the State of New York to the United Engineering Society, Engineering Council has defined the field of its activities as follows:

"Council may deal with any matter of general interest for which joint action of two or more of its member societies would have been appropriate, if Council had not been established.

"Council may initiate and carry through projects of the general character defined in the by-laws, for which the necessary financial provision has been made.

"Council may take up, and in its discretion act upon, any matter of general interest referred to it by any member society or by any other society, national, state or local, or by any branch of government, or by any individual or group of individuals."

What Engineering Council Has Accomplished

In a circular issued in December, 1919, outlining the "Aims and Work of Engineering Council," in discussing what Council has done, the following statement is made:

"Specific items of work done are mentioned below. Some of them are more far-reaching in their effects and of greater significance than has been commonly perceived. It is only a partial enumeration: a complete, detailed statement would be tedious. Council's greatest contribution, possibly, although little known, because indirect and intangible, has been the development through its own discussions and those of the governing bodies of its member societies, of the problems involved in bringing together for united action the fragments of a profession so much broken by specialization as is the profession of engineering."

The working together of committees of representatives of the several Member-Societies of Engineering Council has unquestionably had a leavening influence for the betterment of the engineering profession, and Engineering Council has certainly accomplished a work of incalculable value in initiating the joint work of these societies.

It was not until seven months after its organization that funds were available for carrying on the work of Engineering Council. The Secretary states "For 1918, the appropriation for Council averaged 40 cents, and for 1919, 60 cents per individual member of the member-societies." With this limited support, Engineering Council has accomplished a great deal of work; among some of its principal activities may be mentioned:

1. Council furnished to Governmental departments 4,000 names of engineers for technical duties; aided the Navy Consulting Board and the Army General Staff in examining 135,000 suggestions and inventions for war devices, and co-operated with the Fuel Administrator and the Bureau of Mines in conserving coal:

2. Organized Engineering Societies Employment Bureau in November, 1918, which since the Armistice has registered 5,500 engineers and assistants, mostly returned soldiers and naval men, and has aided thousands to positions without charge:

3. Helped secure exemption of engineering students from military service until the completion of technical training:

4. Established an office in Washington, D. C., January, 1919, under the general direction of the National Service Committee. Through this office engineers have been put in contact with the Federal Government as never before, individuals, companies, and societies have been furnished information about the activities of Congress and the departments of the Government, and useful services have been rendered to the Government:

5. For the promotion of a Department of Public Works in the Federal Government, representatives of seventy-four technical societies having 105,000 members, were assembled at the invitation of Council in Chicago, April, 1919, and the Engineers', Architects' and Contractors' Conference created to support the enterprise. Engineers throughout the country have been organized and the co-operation of the Chamber of Commerce, U. S. A., and other business organizations sought. The National Chamber of Commerce, at the request of Engineering Council, appointed a special committee to consider the advisability of submitting a referendum on this subject to all local chambers. This conference, finally organized as the National Public Works Department Association, drafted the Jones-Reavis bill and is advocating its passage for the establishment of a National Department of Public Works, by modification of existing departments:

6. Through a direct appeal to President Wilson, Council brought about a conference of fourteen different Government offices engaged in map making, with the prospect of greatly accelerating the completion of the typographical map of the United States. It is now hoped to have the whole country mapped in a decade and a half; at the former rate, the century would have been finished before the map:

7. Has well advanced a comprehensive, carefully considered scheme for the classification of engineers, with suggestive schedules for compensations. Working in three sections, has dealt especially with engineers on the staffs of railroads, of the Federal Government, and of state and municipal governments, believing that a suitable scheme for these great groups would be applicable to most other groups. Preliminary reports have attracted serious attention throughout the United States and Canada and are constantly in demand. A Committee of the Council is working with the Congressional Joint Commission on reclassification of salaries:

8. Aided in securing increases of pay for some of the railroad technical engineers and certain municipal engineers:

9. Aided in the reinstatement of 350 engineers unfairly dismissed by the City of New York:

10. Has drafted a typical general law for registration of engineers, architects and land surveyors, the result of fourteen months' work by a committee representing all parts of the country and various important branches of the profession. This action was not in advocacy of licensing engineers, but to provide a uniform law for use under circumstances where the passage of a license law is unavoidable:

11. Requested the President to appoint engineer members of the Interstate Commerce Commission and of the International Joint Commission:

12. Assisted the State of New York in preparing a scheme for reorganization of state government:

13. In studying the curricula of engineering schools; making suggestions as opportunity offers:
14. Sent delegates to Washington on the invitation of a committee of the House of Representatives to present testimony before the Committee in favor of a national budget:
15. Participated in organizing the National Board of Jurisdictional Awards in the Building Industry, and has a member thereon:
16. Joined with National Research Council in a report on improvement of the Patent System and practice, on which legislation has been based:
17. Has recently organized a Committee on Types of Government Contracts:
18. Has stimulated and promoted the activities of the engineering societies:

Among the matters now pending before Engineering Council are the following:

a. Classification and compensation of engineers,
b. Licensing of engineers,
c. Water conservation,
d. National board for jurisdictional awards in the building industry,
e. National public works department,
f. Assisting in the preparation of information for the Senate Committee on Reconstruction and Production.
g. Public affairs,
h. Military affairs,
i. New York State Government reorganization,
j. International affiliation of engineers,
k. Curricula of engineering schools,
l. Patents,
m. Payment for estimating,
n. Boston-Washington super-power system,
o. Russian-American engineering co-operation,
p. Types of Government contracts.

Some of the Questions That Have Been Asked

The questions are frequently asked, "What will be the field of activity of the Federated American Engineering Societies?" and "What does the organization intend to do?" The work of this organization will be of a kaleidoscopic character, with few fixed lines of activity, its major work depending on conditions as they arise from time to time; it will take over and extend the work of Engineering Council as partially outlined above.

What it intends to do is to use its power for the service of the community, state and nation in public affairs wherever engineering experience and technical knowledge are involved and to consider and act upon matters of common concern to the engineering and allied technical professions.

In the conduct of many public matters which are essentially of an engineering nature, it is vital to the public welfare that engineers and allied technologists should lead.

There will be an increasing number of questions arising in which the opinion of these professionals will be of fundamental value to the welfare of the nation and it behooves these professions to so support the Federated American Engineering Societies, that it may so function as to supply this great public need. It is only the exceptional individual of these professions who can fail to see that in increasing activities in these broader and less selfish fields the standing of the profession will be greatly improved and this of necessity must improve the position of the individual engineer.

As an illustration of how this increased standing of these professions will be brought about, attention is directed to the meeting of Engineering Council in Washington on April 29, 1920, when it visited the Capitol and called on Speaker Gillette of the House of Representatives and later upon Vice President Marshall of the Senate. The chairman proffered the services of Engineering Council to the houses of Congress on matters upon which engineering advice of a disinterested character might be helpful. Vice President Marshall stated that this unusual and generous offer would be referred in writing to the Drafting Bureau, a new Bureau of the Senate which has charge of the preparation of legislation.

The Engineer's Duty

It is the duty of the engineer to take up public service work. It is incumbent upon him as a citizen to "do his bit," and there is the added responsibility due to his special knowledge and experience which is primarily of importance in the execution of public work.

The Federated American Engineering Societies will speak for a group of citizens who by reason of special training and knowledge represents a high order of intelligence, and who individually and collectively would be derelict in their responsibility for the talents they possess if they did not apply them unselfishly for the common good.

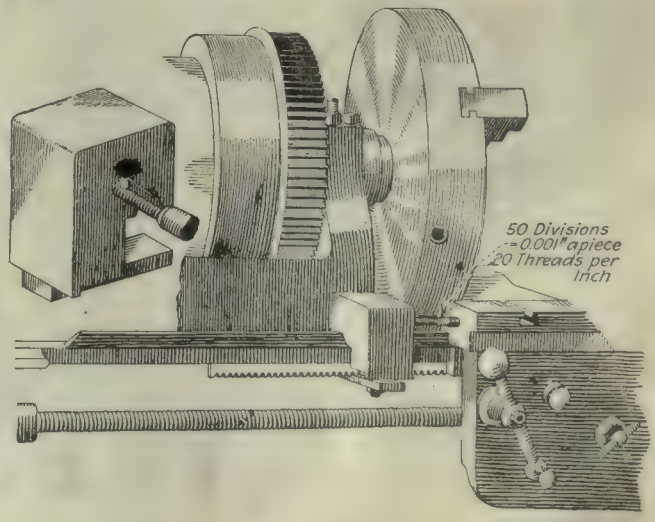
In unity of action there will of necessity be strength and power.

Cutting Off Piston Rings

By Charles D. Folsom, Jr.

On page 1205, Vol. 52, of the *American Machinist*, Roy F. Leighton describes an ingenious indicating gage for setting the parting tool when cutting off rings in a lathe. This device is novel, to say the least; but as the sketch shows a lathe with a compound rest, I am wondering why Mr. Leighton could not have swung the rest around parallel with the spindle and used the micrometer graduations on the feed screw for the spacing. Of course if the lathe had no graduations on the compound rest this would have been impossible; but in that case a micrometer stop such as shown in the sketch would do the work, and would not, I think, take any longer to make than the indicating gage. Also, it would prove useful for a great deal of other lathe work, such as necking shafts and facing flanges to thickness, for which, it seems to me, the indicating gage would not be so convenient.

[Mr. Leighton's sketch did not show a lathe. The introduction of the compound rest is our error.—Editor.]





Cast-Iron and Aluminum Pistons

By FRED H. COLVIN
Editor, *American Machinist*

THE Studebaker piston is of cast iron, and the first operation is the rough-turning of the outside. This and the subsequent operation can be followed in detail, both from Fig. 1 and the halftone illustration. The rough-turning and drilling is being done on a Reed-Prentice special lathe, as shown in Fig. 2. This illustration also shows the mandrel which has expanding jaws so as to center the piston casting from the inside. The piston pin boss slides in the groove *A*, while the inside is centered by the expanding members *B* and *C*. The tooling is not unusual, and the turning operation only requires two minutes. The head is next rough-faced and rounded in another lathe, after which the piston is chucked on a Warner & Swasey turret lathe, and the open end of the skirt reamed and faced. The chucking and tooling is shown in Fig. 3. The crossholes are next rough drilled in a four-spindle Moline drilling machine, as shown in Fig. 4. This also shows the type of fixture used. Each fixture carries four pistons and is quickly handled. The piston-pin boss is centered by a V in the block *A*, and the arm *B* is then swung into place, locking over the stud *C*. The screw *D* forces the block *E* against the end of the piston, straddling the centering boss on the end and holding the piston squarely in place against the end of the skirt. While one lot is being drilled, a second fixture is loaded and the truck shown allows the pistons which have been drilled to be rolled out of the way and a new batch put in place with the least expenditure of time and effort. The pistons are then placed on a convenient conveyor that takes them to the annealing furnaces. The temperature is raised to about 550 deg. F., holding them at this heat for 15 min. They are then sandblasted on the inside and returned to the machining department by a suitable conveyor.

While the controversy is still raging between builders in regard to cast-iron and aluminum pistons, it is interesting to note that both are being used in large numbers and in cars of moderate price. This article describes the methods used by the builders of the Studebaker and the Oakland cars in machining their pistons. A comparison of the two methods used cannot fail to be of interest.

The next machining operation is to grind the open

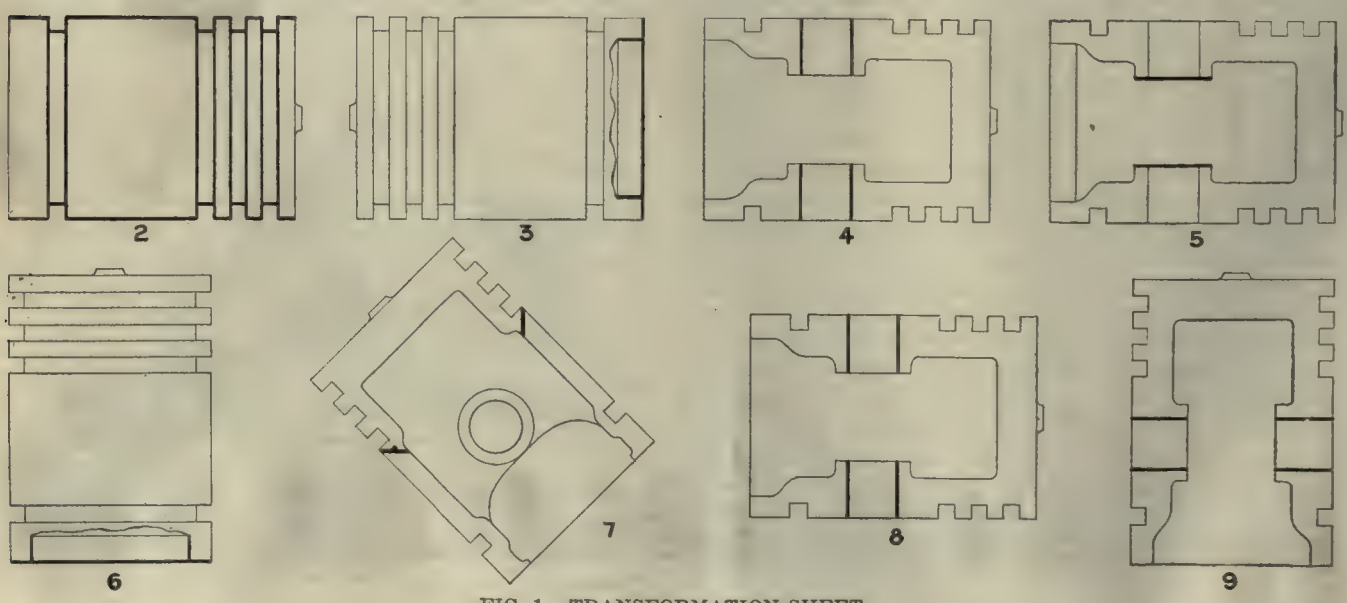


FIG. 1. TRANSFORMATION SHEET

AUTOMOTIVE CONSTRUCTION

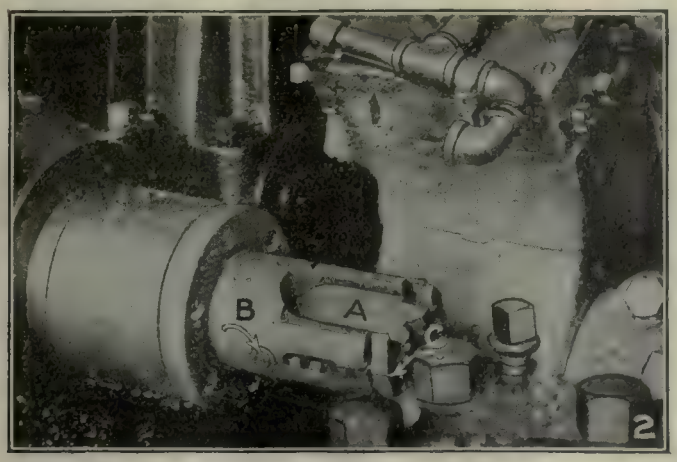


FIG. 2. ROUGH-TURNING AND GROOVING



FIG. 3. BORING THE PISTON

end and face on a Heald internal grinder, after which they are again turned and grooved, the oil groove cut below the lower ring and the boss on the end centered. This centering, it will be noted, is not done until after the pistons have been rough-turned, annealed, and the face of the skirt carefully ground as a permanent working point for future operations.

The outside of the piston is then rough ground, after which the faces and the pin bosses are milled by the attachment shown in Fig. 5, mounted on a Becker-Brainerd hand milling machine. There are two milling cutters one being shown at *A*. The cutters are being supported by the arm *B* which projects inside the piston and driven by gearing in the usual manner from the main spindle, the idler gear shaft being shown at *C*. The piston is located by means of the piston-pin hole, a plunger in the angle plate *D* actuated by the knob *E*, holding it in place during the milling operation.

Then the piston-pin hole or the crosshole, as it is usually called, is bored and reamed in the fixture shown in Fig. 6. This fixture has a locating bushing *A* in the arch *B*, which surrounds the piston, the clamping being done by the swinging arm *C* and the screw *D*, the clamp bearing both top and bottom of the piston. The bushing *A* is used in positioning the piston by means of the hardened steel pin *E*, which can be seen through the opening in the clamp *C*. The reamer is, of course, piloted at its front end by a suitable bushing in the back of the fixture.

The final reaming of the crosshole is a bench operation and is performed by hand.

The drilling of the oil holes is accomplished in the simple fixture shown in Fig. 7. The piston simply rests in the support *A* while the drill bushing is located in the plate *B*. No special indexing is used.

The piston-pin bushings are then pressed in on a small power arbor press shown in Fig. 8. The piston is supported on the angle plate *A*, while the bushing *B*, placed on the end of a plug in the arbor press spindle, is readily forced into position, a friction clutch being used to connect the spindle with the driving mechanism. After this the bushings are reamed in much the same way as is the crosshole as shown in Fig. 6. Then the ring grooves are finished, the outside is finish ground, and an undercut ground on the grooves. After this the pistons are relieved on a grinding machine, the center



FIG. 4. DRILLING THE CROSSHOLES

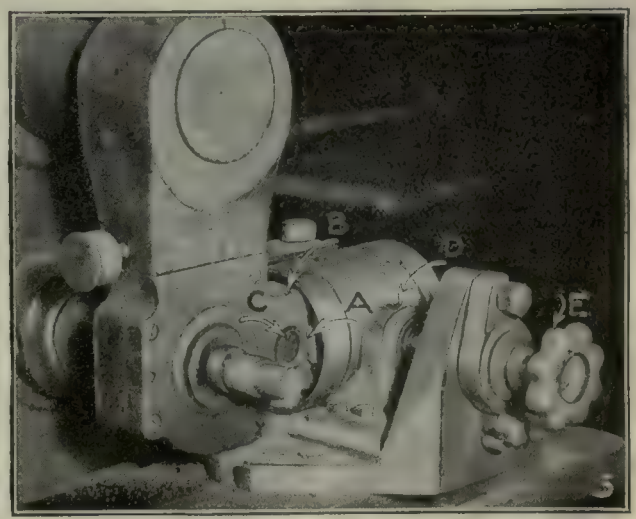


FIG. 5. MILLING PISTON-PIN BOSSES

AUTOMOTIVE CONSTRUCTION

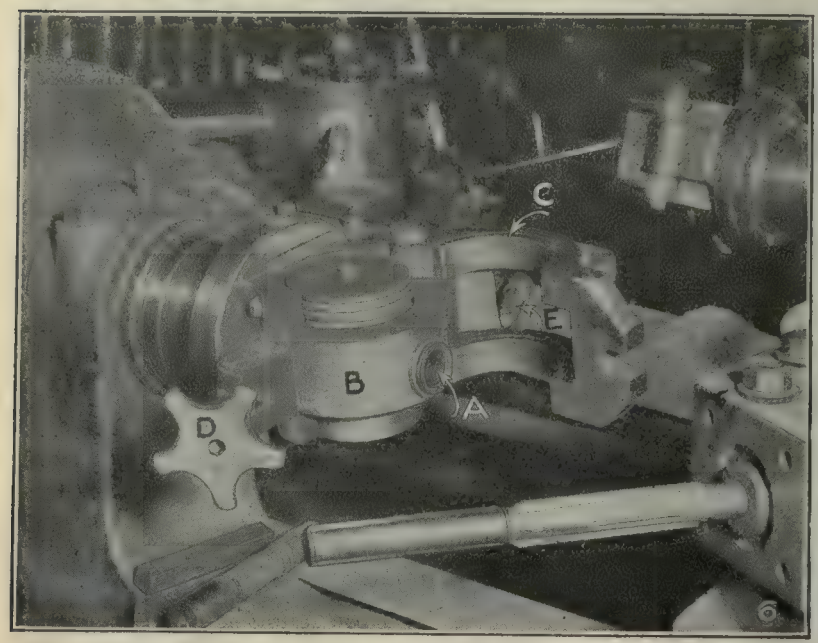


FIG. 6. REAMING THE CROSSHOLE

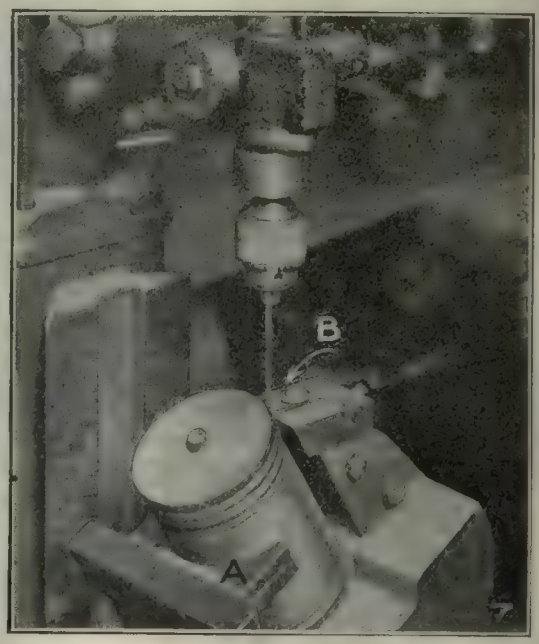


FIG. 7. DRILLING THE OIL HOLES

boss is cut off and the end of the piston faced. The head is then polished, the edges burred and the bushings are again reamed.

Burnishing the Bushings

The finish, however, is secured by roll burnishing in much the same way as some cylinders are finished. A roller tool *A*, Fig. 9, is driven in a special head while the piston is mounted on a sliding carriage *B* having a raised center, which fits the bore of the skirt of the piston. The bar *C* simply prevents the piston from raising off the plate *B*. The carriage carrying the piston is then fed by hand, using the handle shown, and the piston fed over the rollers. The carriage is counterbalanced, as can be seen, so that very little pressure is necessary and the coil spring *D* prevents sudden collision with the headstock.

The manufacture of pistons in a factory having a large output of cars, offers an excellent opportunity for ingenious and economical methods of handling as well as machining. For, when the number of pieces which must be handled per day runs up to the thousands, a few seconds on each count in the total output. Then, too, the suggestion of fatigue plays an important part, and this is beginning to be realized more fully than in the past. The piston, on account of its shape and size, makes it possible to use gravity conveyors or chutes in which the pieces simply roll themselves to the next operation. The light weight of the pistons permits these to be made of light sections of metal.



FIG. 8. PRESSING IN THE BUSHINGS

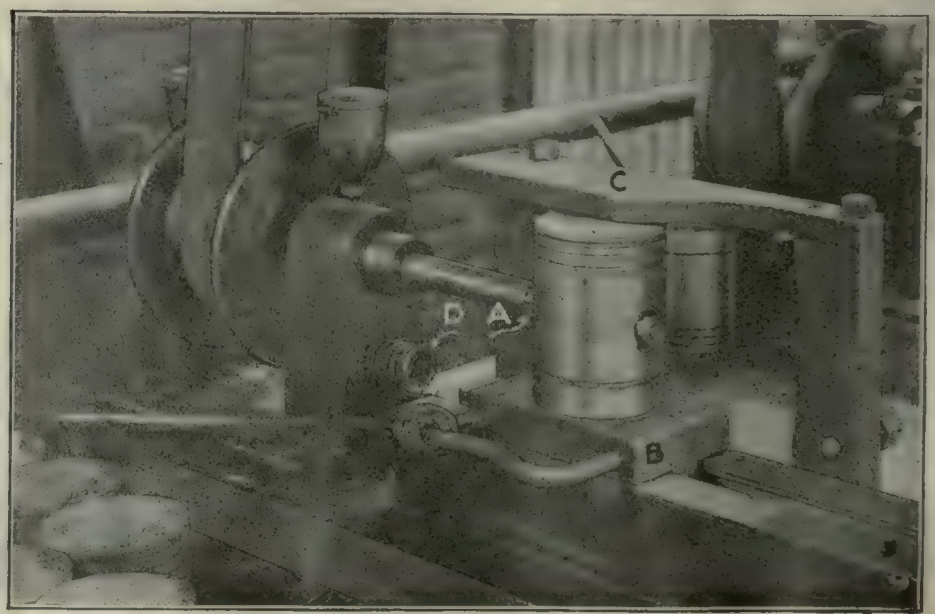


FIG. 9. THE FINAL FINISH BY ROLLING

AUTOMOTIVE CONSTRUCTION

The Oakland Piston

The Oakland motor has small aluminum pistons made from die-castings and their manufacture presents a number of interesting features.

THE five principal operations are shown in the transformation sheet, Fig. 1. The pistons are made of aluminum die-castings, the first operation being to bore and face the open end of the skirt as a locating point. Then comes the rough-turning on a Cleveland automatic, as shown in Fig. 2, after which the cross hole is drilled, and then reamed in the fixture shown in Fig. 3. It will be noted that this fixture clamps the piston by a combination of the screw *A* and latch *B*, making a very quick and yet positive locking action. It will also be noted that a gravity conveyor is fastened to the face of a drilling machine. The upper part *C* brings the work to the machine, while the lower portion *D* is so inclined as to roll the reamed piston to another machine. Gravity conveyors of this type are used quite extensively in the Oakland shop. The finish turning of the piston is done in the small lathe shown in Fig. 4. The piston is held by drawing it back against the skirt face, using the pin *A*, as is fairly common practice. An unusual feature, however, is the use of a diamond turning tool, suitably supported in the toolholder shown. Diamond tools are used because there are two breaks in the circumference of the piston which would prevent a satisfactory job by grinding. The pistons are turned at a cutting speed of 1,084 ft. per minute and a feed of 0.016 in. per revolution. A good grade of hard black diamond is used for the tool and its life before recutting is about 7,500 pistons, on which the length of cut is $3\frac{1}{2}$ in. and the diameter $2\frac{1}{16}$ in. Each diamond will stand, on an average, about two recuttings.

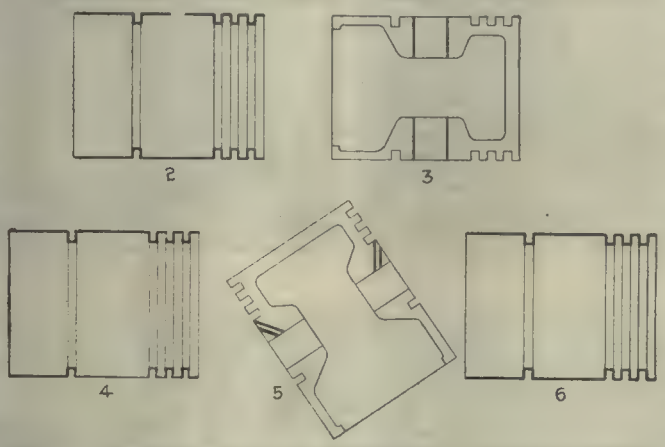


FIG. 1. TRANSFORMATION SHEET OF OAKLAND PISTON

While this method is used in finishing Oakland pistons, Olds pistons (which are made in the same plant) are finished by grinding, as there are no breaks in the circumference. Where cylindrical surfaces have no indentations or breaks, finishing by grinding gives the best results.

The pistons are drilled in two places, as can be seen from the drilling fixture shown in Fig. 5. This fixture

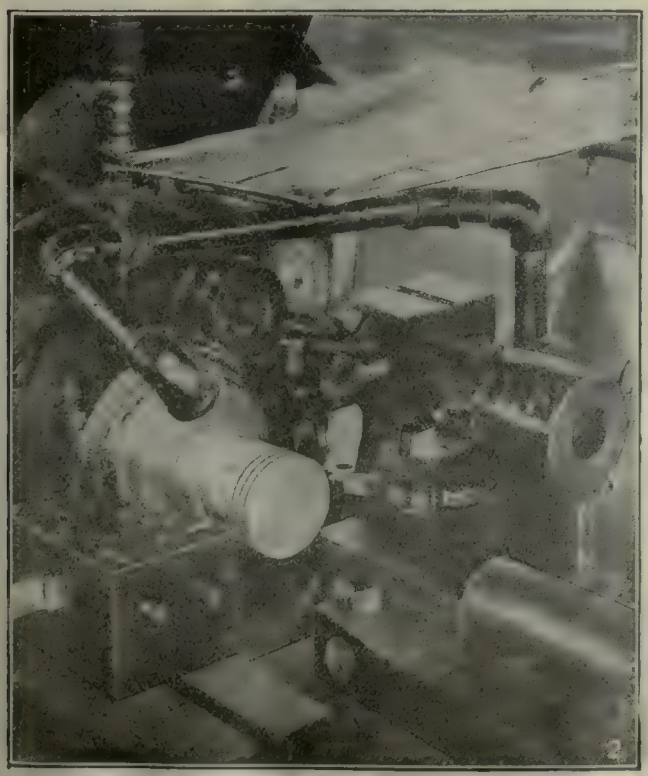


FIG. 2. ROUGH-TURNING AND FACING PISTONS

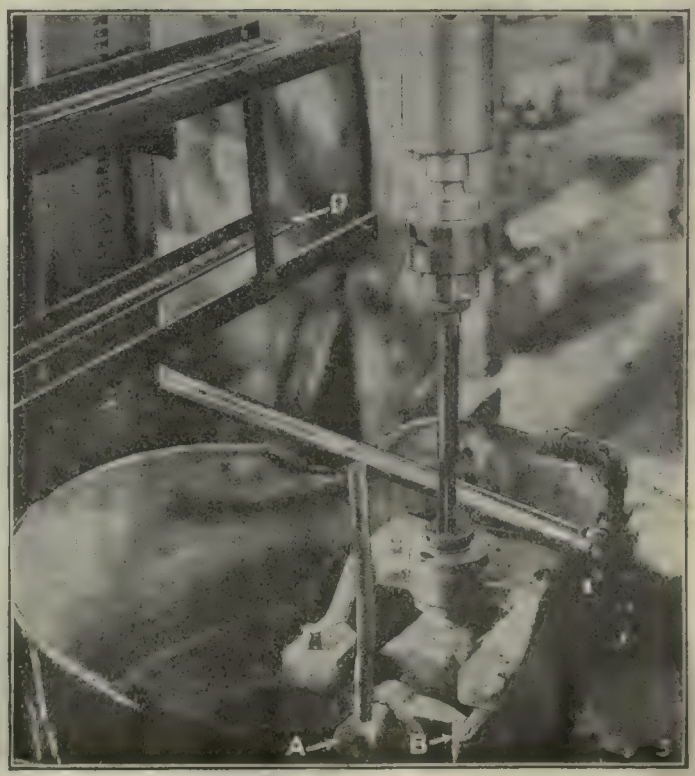


FIG. 3. REAMING THE PISTON-PIN HOLES

AUTOMOTIVE CONSTRUCTION

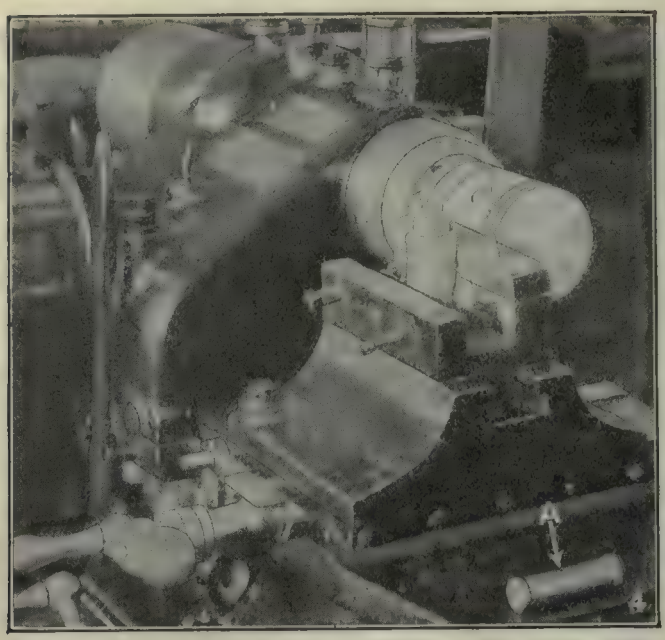


FIG. 4. TURNING THE PISTON WITH A DIAMOND TOOL

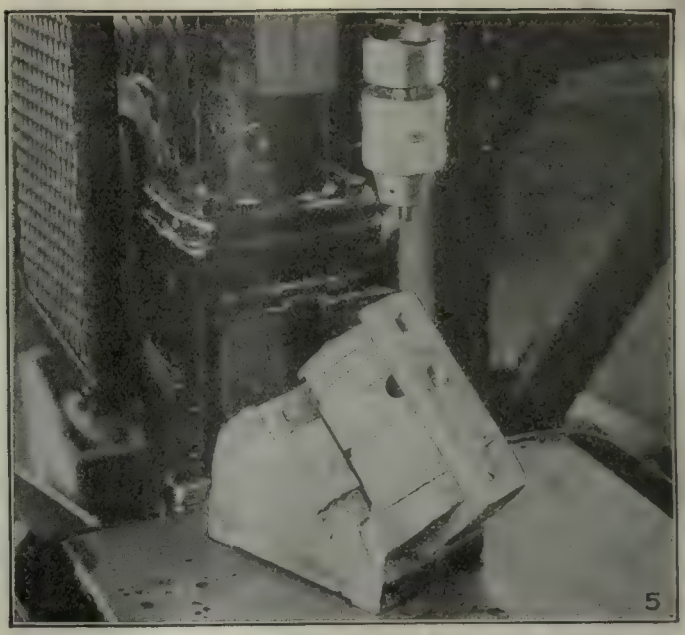


FIG. 5. DRILLING THE OIL HOLES

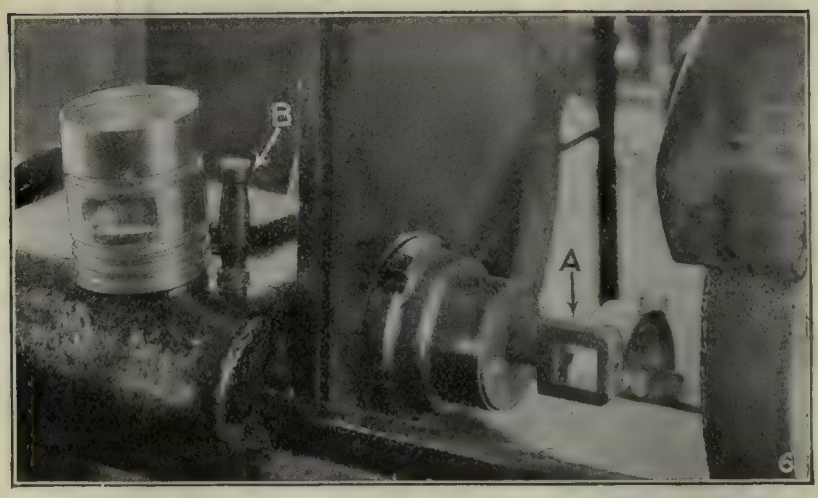


FIG. 6. HOLDING THE PISTON FOR GRINDING

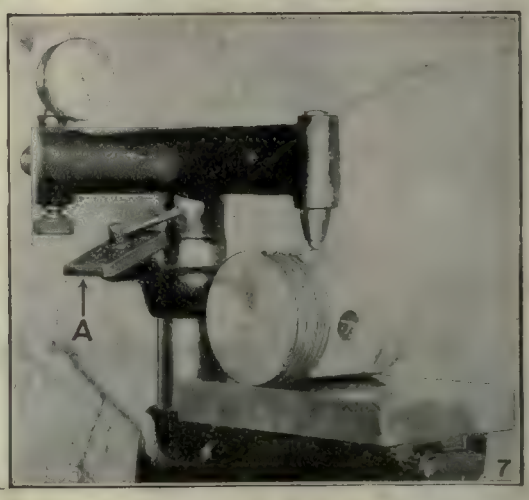


FIG. 7. DIAL GAGE FOR INSPECTION

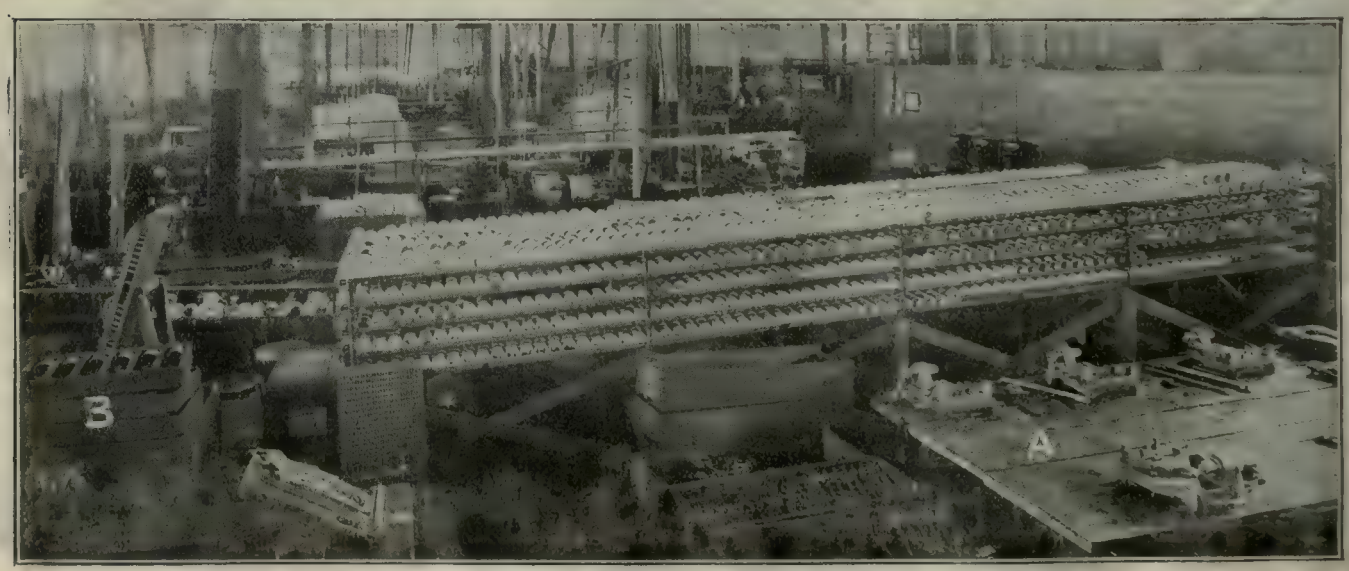


FIG. 8. CONVEYOR AND SORTING RACK FOR PISTONS

AUTOMOTIVE CONSTRUCTION

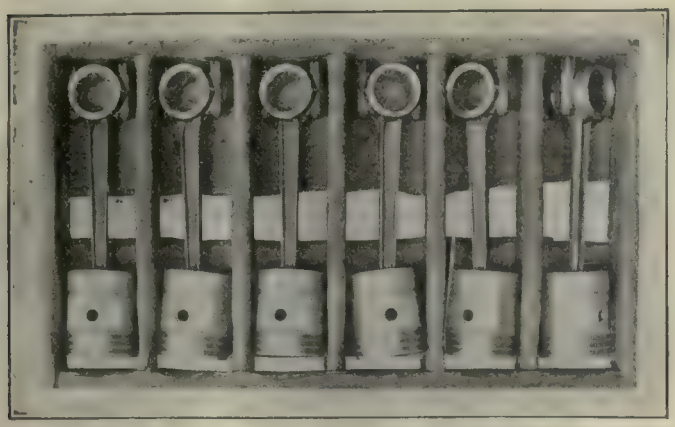


FIG 9. BOX FOR HOLDING PISTONS AND RODS IN SETS

is a very simple device, carrying the two drill bushings at the proper angle, both sets of holes being drilled at the same operation.

The pistons are finished by grinding on the machine shown in Fig. 6. This illustration also shows full details of the draw-back mechanism, both the drawbolt *A* and the pin *B* being shown.

The pistons are gaged in the machine shown in Fig. 7, which has a dial indicator with multiplying levers. It also has a gaging point *A* which can be adjusted to suit.

The inspecting is done at the upper end of the inclined conveyor shown in Fig. 8, and pistons of various sizes (all of course coming within predetermined limits) are placed in different compartments so that the inspectors who are stationed at the lower end know exactly which size piston is in each conveyor or rack. This enables them to pick any desired size for assembling to the connecting rods.

This view also shows fixtures for testing connecting rods on the bench in the right-hand corner at *A*, and the boxes *B*, in which pistons are placed in sets of six for assembly. A closer view of one of these boxes is shown in Fig. 9, which shows a set of pistons and rods all ready to go to the assembling department. As shown in Fig. 8, these boxes are so made that they can be stacked as high as desired and at the same time protect their contents against contact with other work. After the contents are used by the assemblers, the box is returned to the piston and connecting-rod departments.

Teaching Machine Shop Mathematics

By George Heald

Perhaps no other branch of work affords a greater opportunity for making mathematical calculations than does machine shop practice. Here the boy discovers that in order to perform the various operations of the trade, he must not only have a knowledge of the fundamental processes of arithemetic, but must also be able to figure the problems related to the trade.

During the past few years various schemes have been tried out with a view to correlating the mathematics with the shop work. One plan, when practicable, required the boys to take their work to the mathematics class: there it was analyzed and the problems worked out. Another plan tried was to have the boys take their time cards to the class room, i.e., cards that listed the title of the work and the operations to be performed. These were gone over with a view to bringing out the points that should be known in order to do the work intelligently. Still another plan was to furnish the mathematics instructor with blueprints of work being done in the shop, which permitted the boy to become familiar with the work and the problems connected with it before taking up the work in the shop. In addition to the plans mentioned, a new feature has been added and is now being used in conjunction with the other plans in the Seneca Vocational School. The new feature that is here described makes the work more interesting and aids in producing better and quicker results.

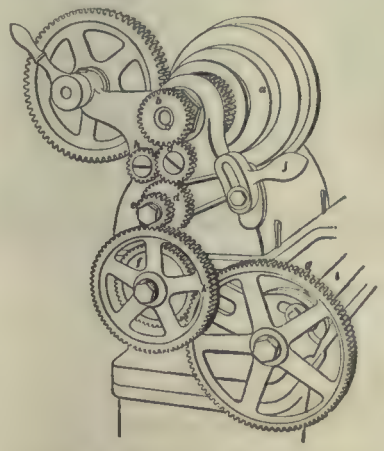


FIG. 1. CHART ON COMPOUND GEARING

Several charts about four feet square were made up showing machine parts and types of work which serve to illustrate the phases of the trade that require a knowledge of mathematics. These charts can be plainly seen from any part of the room and serve the purpose better than grouping the boys around the machine itself.

Fig. 1 shows a chart on compound gearing. Anyone familiar with thread cutting knows that a knowledge of fractions is necessary in order to work out the problems involved in change gearing. The chart shown in Fig. 2 illustrates some of the problems on tapers that come up in practice. Other charts have been made up on simple gearing, speeds, threads, and the micrometer.

The charts can be made up in a very short time and in a very simple way. A negative is made of the cut which it is desired to represent on the chart. The negative is put into a stereopticon and reflected at the size desired, onto a piece of drawing paper. It is then traced with pencil. If more than one copy is required a tracing can be made and copies blueprinted. If only one copy is required the sketch can be inked in on the drawing paper.

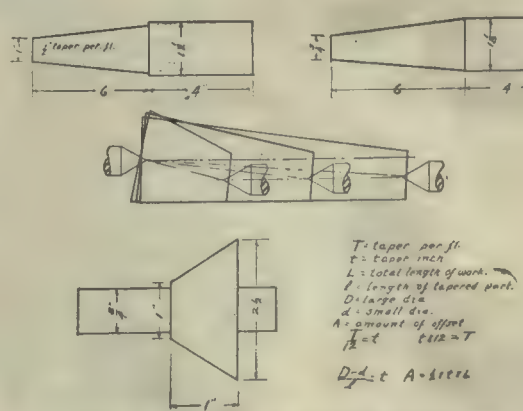
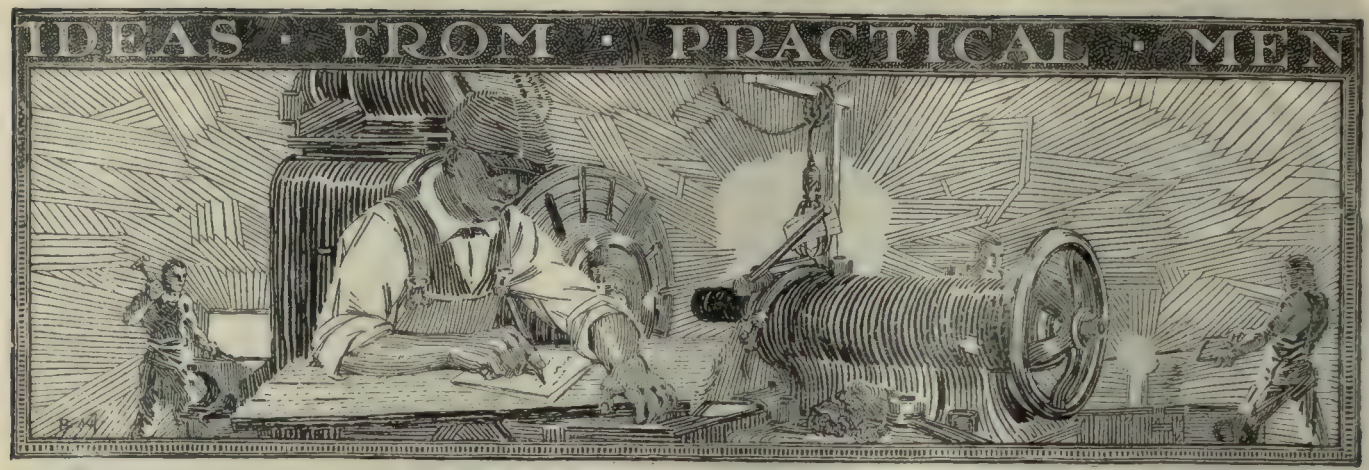


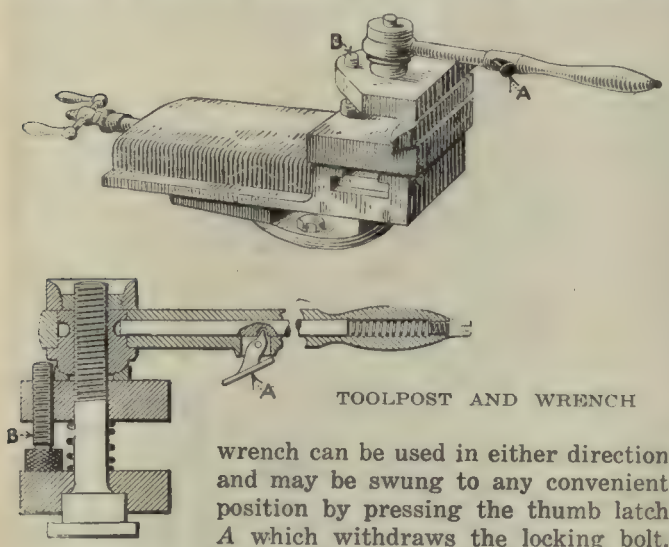
FIG. 2. CHART ON TAPER PROBLEM



Toolpost and Wrench for Lathe

By Fransisco Mussi
Montevideo, Uruguay

The illustration shows a form of toolpost and wrench which I have designed for use in a lathe where the tools have to be changed frequently. As will be noted, the



TOOLPOST AND WRENCH

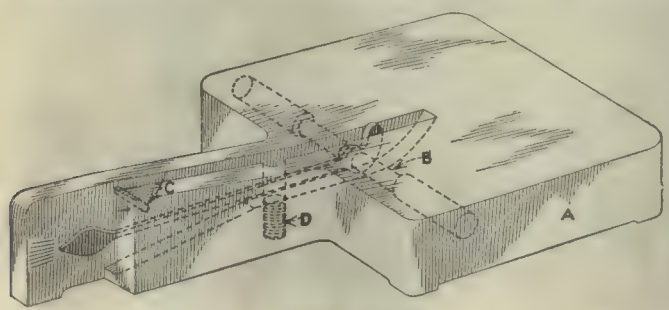
wrench can be used in either direction and may be swung to any convenient position by pressing the thumb latch *A* which withdraws the locking bolt. Adjustment for varying heights of tool shanks is made by means of the jackscrew *B* in connection with the toolpost screw.

A Simple Recess Gage

By E. Wilmont La Rue

The illustration shows a simple form of recess gage for small work. It is used for indicating the variation in the depth of the recess.

The machine-steel block *A* is drilled and reamed for a dowel pin *B* and is finished on the bottoms of its five legs in order to allow it to set level. The flat surface of the top of *A* on which the work rests must also be finished. Dowel pin *B* is made of drill rod and hardened, as is pin *C*. Screw *D* is for adjusting purposes. Indicator *E* is made of tool steel and hardened. The hole in the indicator through which the dowel pin passes should be lapped out, and the graduations should be made after the tool is assembled.



RECESS GAGE

A Relieving Tool for Broach Teeth

By Josef Rask

A broach for cutting a number of tongues or keys in a sprocket or similar piece of work is shown at *A* in Fig. 1.

To produce a good job the broach must be backed off, as shown at *B*, for if the teeth are left straight at this

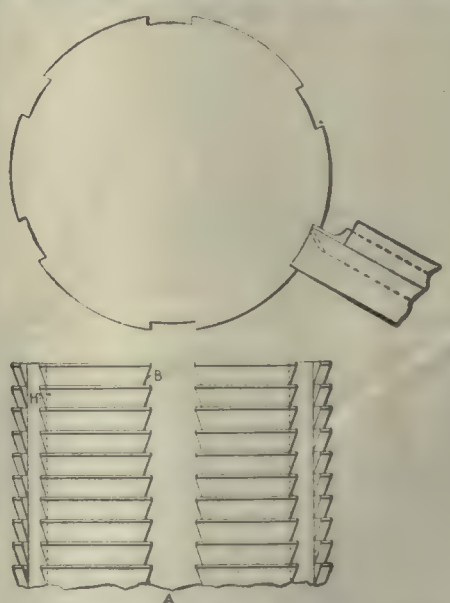


FIG. 1. THE BROACH TO BE BACKED OFF

point they will drag and, after the broach has been used a short time, will tear the work instead of giving a clean cut. To back off a broach of this kind is a rather delicate job and care must be taken that every tooth is given the same amount of clearance.

This operation is usually done by filing, a process which is slow and uncertain. A simple tool for doing the work is shown in Fig. 2.

The tool is made in three parts—the base *A*, the cap *B*, and the chisel *C*, *B* being attached to *A* with fillister-

or flat-head screws and dowels, and the chisel being let equally into each piece so that its center line coincides with the junction of *A* and *B*. The thickness of the base at *D* is made a nice fit for the groove in the broach.

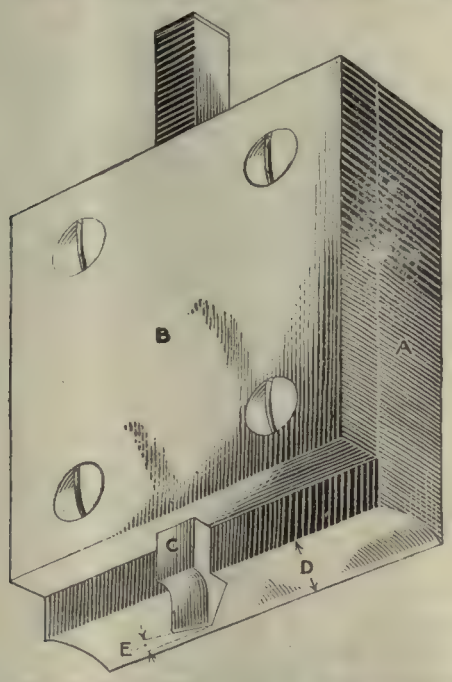


FIG. 2. TOOL FOR BACKING OFF BROACH TEETH

The angle *E* is made to conform to the clearance angle wanted on the sides of the broach teeth.

The tool is placed in position with the chisel on the top of the tooth and a light tap with a small hammer causes the chisel to make a straight clean cut over the end of the broach tooth.

A broach can be backed off uniformly in a much shorter time than is required if a file is used.

Bulging With a Rubber Punch

By L. J. Voorhees
Industrial Engineer, New York, N. Y.

In making an investigation to determine the advisability and method of manufacturing a certain article, I arrived at the conclusion that one of it's component parts could best be made by the bulging process. As this process is novel, interesting, and where applicable I believe a time and money saver, and as this article was not manufactured or the result of my investigation made use of, I therefore feel at liberty to pass it on and believe it will be of interest.

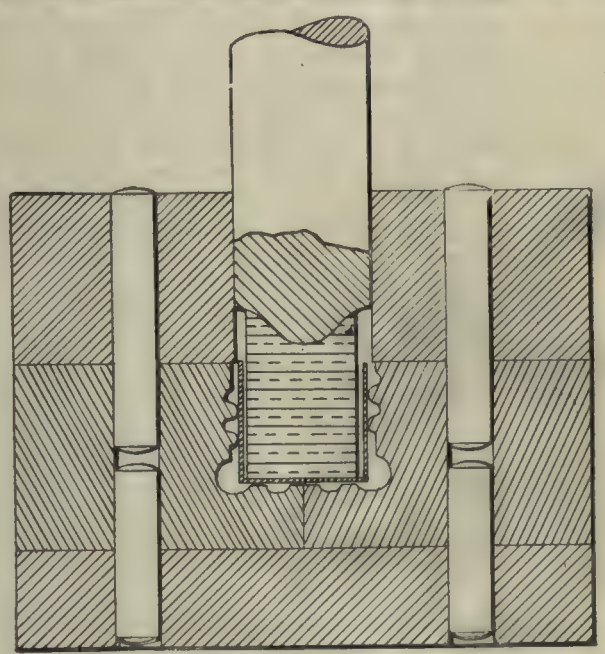
The form or contour of this part was very similar to the screw-top of a salt shaker, with the exception that instead of having holes in the bottom of the cup-shaped part, as the screw-top of the salt shaker has, it has a design embossed in the bottom. The sides of this cup-shaped part, between the bottom and the threaded portion, had an outward projecting half-round bead that was knurled so that the fingers would not slip when turning it.

The usual method of making pieces of this kind is to blank and cup them in one operation. The cups are then trimmed in a machine where they are inserted and removed by hand, the knurled bead is then put on in a similar machine, and the thread rolled in another. The parts are then hand-fed into a press where the bottoms are embossed. It was my intention to do the knurling, beading, threading, and embossing all in the one bulging operation to which the parts might be automatically conveyed, or stepped along, from the trimming operation.

The bulging operation consists essentially in forming parts in an irregular shaped die by the use of a flexible punch. In this case the punch was rubber, such as is usually found in toolrooms for use on punches with spring stripper plates. The experimental die was made in two pieces so it could be opened to remove the cups. The recess in the die was as deep as the height of the cup. A combination cover and guide for the ram was placed over the die. The hole in the cover, through which the ram operated, was the diameter of the inside of the cup at the top *after bulging*. The ram was made of steel and of suitable diameter to allow it to slide easily in its guide. The punch was a piece of rubber fastened on the end of the ram. The diameter of this rubber punch was about $\frac{1}{16}$ in. smaller than the cup before it was bulged, and its length about one and one-half times the depth of the cup. The cups themselves were made of brass about 0.018 in. thick.

The Operation

In trying this process the experimental die was clamped on the bed of a power press and the bulging punch was placed in the ram of the press. The stroke was then adjusted until the cup was fully bulged, in other words, until the cup after being pressed by the flexible punch entirely filled the die. No means were available by which the power exerted on the punch could be determined. This could be done with a hydraulic press, and the results should be of interest, especially in view of the facts this experiment disclosed.



BULGING DIE AND RUBBER PUNCH

Within the range used there appeared to be no point beyond which the rubber could not be further compressed. The amount of pressure transmitted by the rubber appeared to increase in direct proportion to the amount applied, and with no destructive effect upon it. It did not appear possible to increase the pressure until the rubber was torn apart, or its texture in any way changed, *and the pressure was increased un-*

til the sides of the brass cup were shredded. This appeared to be caused by the relative movement between the rubber punch and the die, *when the punch was under high compression.*

From the above results it was concluded that the action while bulging a cup was as follows. As the ram descends it first compresses the rubber punch until it fills the cup; then it bulges the cup until it fills the die. As the rubber becomes more compressed and is flowing as it compresses, it is evident that there is some movement between the rubber and the sides of the cup, and this relative movement continues as long as the pressure on the punch is increased. It is apparently possible to increase this pressure and compress the punch to a point where the friction between the rubber and the cup is greater than the cohesion of the brass, or its strength, and consequently the brass is torn apart or shredded. Before reaching a point where the brass was torn apart the punch would press the cup into every recess in the die with sufficient force to cause even the tool marks and scratches to show.

From the amount of friction evidenced between the cup and punch it would appear desirable in practice to use some form of lubricant on the punch. Evidently oil could not be used on account of its action on rubber, but graphite would not effect rubber and a light coating might prove satisfactory. If it was found desirable to use a liquid lubricant, graphite mixed with glycerine might be tried. No lubricant was used on the experimental punch, and it was not found necessary in getting out the few samples desired.

Possibilities of a Rubber Punch

From the results obtained with the experimental die it appears as though the process could be used in a large number of places and that it should effect a saving in the cost of manufacture. It should also permit the use of ornamental designs that are precluded by the present methods of manufacture. Many of the screw-tops or screw-caps that are used on salt and pepper shakers, bottles, cans, jars, etc., could apparently be made by this process. Threads and other shapes could be bulged on the ends of tubes and even at some distance from the ends under certain conditions. In embossing designs in flat sections of sheet metal this process would eliminate the necessity of making a metal punch that accurately fitted the die, a the rubber punch would form itself and would always fit.

Rubber might also be used as a flexible die, and by applying pressure to the outside, metal could be forced into recesses in the punch, such for instance as straight or spiral grooves in the side of a tubular-shaped part. In experimental work where a few odd shaped parts are wanted this process could also be used to advantage.

While it is evident that the rubber punch would wear out in time, it was conjectured that it would produce several thousand parts, and many steel punches do no more and they are much more difficult to make. From the number of places where this process is applicable it ought, in the near future, to be found in a large majority of the metal-working factories.

A Short Proof for Long Division

By E. S. Mummert

Upon seeing the method of proving long division by Walter R. Meyer on page 157 and again on page 350 of the *American Machinist*, and after familiarizing himself with it, the writer thought he would spring it on some of the others in the office. However, the joke soon came back, as one of the versatile stenographers soon proved that the method would not prove, but that it detected mistakes made in subtraction only and not in multiplication. No matter what figures be put down in the multiplications, if the subtractions be correct, the figures, shown in plain type and disregarding the italics, must add up to give the dividend.

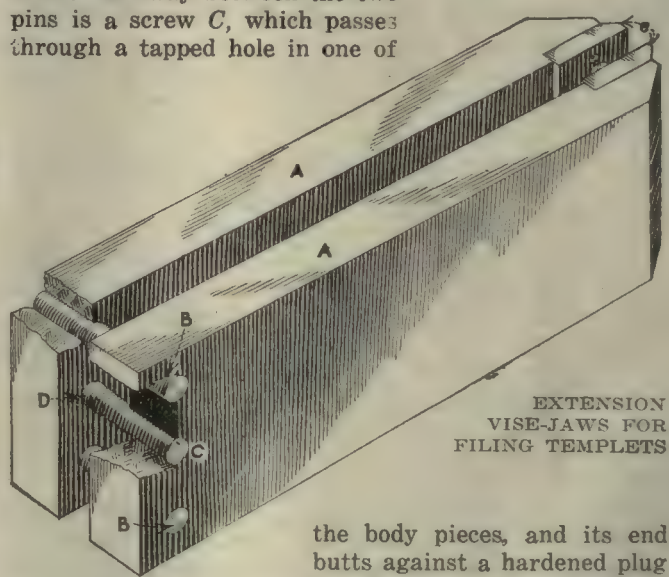
Just try a few examples for yourself. Here is one. The first is correct; the second has a mistake in multiplication in the line marked by the asterisk; both prove according to Mr. Meyer's method:

760)584218(768		*760)584218(795*	
*5320		*5120	
5221		*7221*	
4560		6840	
6618		*3818*	
6080		3800	
538		18	
Proof:	584218	Proof:	584218

Filing Jaws

S. H. Drake

This style of filing jaws was devised to handle some rather large templet work. They are to be placed in an ordinary bench vise, the jaws of the vise clamping against the body pieces *AA*. Two pins *BB* are located near the bottom of the body pieces, the pins being a press fit in one of the body pieces and a slide fit in the other. Midway between the two pins is a screw *C*, which passes through a tapped hole in one of the body pieces, and its end butts against a hardened plug *D* in the other body piece. In using the jaws the adjusting screw is turned until the opening between the hardened jaws is slightly greater than the thickness of stock to be filed. When the vise is released the jaws will return to their original position, making it easy to remove the stock. The jaws *E* are doweled to the body piece, making it easy to remove and replace them in case they need grinding. The body pieces were made of cast iron and were left 1½ in. thick to avoid springing. This set of jaws is 9 in. high by 3½ in. wide and has proved a valuable asset on templet work, but no doubt could be applied to other work of a similar character.



EXTENSION VISE-JAWS FOR FILING TEMPLETS

WHAT to READ
—for the man in a hurry



Suggested by the Managing Editor

H. H. MANCHESTER, in the leading article, tells of economic conditions following the Civil War. Mr. Manchester's current story may be called a sequel to his "Evolution of Wage and Price Levels" published in the *American Machinist*, issue of May 27.

What to read was not a difficult matter to decide two hundred years ago when books were few and magazines unheard of. It is far different now when so much reading matter is offered to pass the time pleasantly or profitably as the reader chooses. We are doing our utmost to make the "American Machinist" not only profitable but indispensable as a clearing house of ideas and news of the machinery world. This page is the editors' advertisement of their section of the paper. It gives the high spots.

The second half of the report on "Experimental Investigation of Steel Belting" begins on page 393. The first part was published August 12.

There is a great deal of truth in the statement that safety guards should be applied to machines for the purpose of aiding production as well as to prevent maiming of operators. A. L. Kaems, a safety engineer, in his paper "Increasing Production by Safeguarding Power Press Operation" gives some convincing statements relative to this. Page 400.

An automatic Electric Arc Welding Machine is described by H. L. Unland of the General Electric Co., page 403. Mr. Unland says, "It is possible, with this device, to weld at a speed of from two to six times the rate possible by skilled operators welding by hand."

A short article by Entropy appears on page 406. It is chiefly directed toward recent engineering graduates and those responsible for them.

If there could be found the right job for each man a truly efficient condition would be reached. The science of psycho-technics is being applied to this work in the United States and abroad. A two-page article on "Psycho-Technics in Germany" by Dr. Alfred Gradenwitz begins on page 407.



JOHN S. WATTS

John S. Watts has contributed frequently to *American Machinist*. This issue contains one of his articles, "Section Moduli of Rectangles"— page 410. The many readers familiar with Mr. Watt's writings will be glad to see his likeness presented on this page. We find that John S. Watts was born in South Shields, England, in 1881. He served an apprenticeship with H. S. Edwards & sons of South Shields; was educated in mechanical engineering at the Durham College of Science, New-Castle-on-Tyne, England; came to Canada in 1902, where he worked as designing draftsman with several companies; from 1906 to 1917 was superintendent for I. Matheson & Co., New Glasgow, N. S.; during 1917 and in 1918 was mechanical superintendent at the Eastern Car Co. of Glasgow; in 1918 and during 1919 was mechanical engineer for the Ore Mines and Quarries Department of the Nova Scotia Steel and Coal Co. and since 1919 has been a consulting mechanical engineer, principally on designing and specifying equipment for collieries. There will be more of the interesting Watts articles in future issues of *American Machinist*. We are devoting almost three pages, beginning with 413, to the F. A. E. S. The purposes of the organization are explained. Among the other valuable features is a recounting of the accomplishments of Engineering Council whose work will be carried on by the F. A. E. S.

The automotive section this week deals with the manufacture of automobile pistons. The article is by Fred Colvin, who continues the policy of presenting in one issue the methods of manufacture in more than one plant. Studebaker and Oakland pistons are followed through their respective shops.

Other worthy articles are "Judicial Construction of Machinery of Every Description," by Leslie Childs, page 409; "Increasing Production in Johnson's Shop," by John R. Godfrey, page 411, and "Machine for Drilling Gear-Shift Bodies," by J. V. Hunter, page 412.

Piston Ring Work in a Railroad Shop

By FRANK A. STANLEY

The author of this article describes the methods of making packing rings for locomotive pistons and piston valves as practised in a railroad shop on the Pacific Coast. The description and illustrations show methods nearer to manufacturing than will be found in the average railroad shop.

THE engravings illustrate some methods employed in machining piston valve rings and piston rings in a railroad shop in the West.

The line drawing, Fig. 1, shows a piston valve complete and also illustrates the bushing or liner in which the valve operates. The rings, as will be seen, are here shown in double offset form, though for some classes of piston valves the rings are made with single offset. The halftone engravings which follow represent some of the

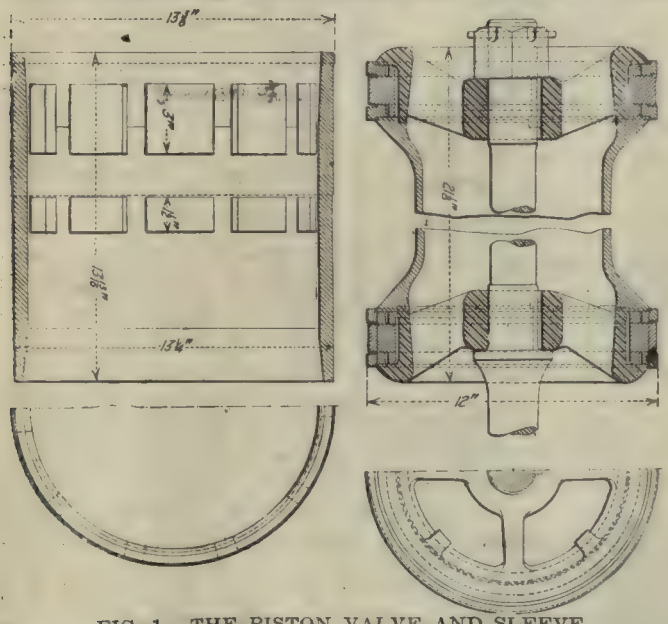


FIG. 1. THE PISTON VALVE AND SLEEVE

tool equipment for machining both single and double offset rings.

The turning and cutting off of the rings is accomplished in a Libby turret lathe, the turning being done as shown in Fig. 2. Here a casting, long enough for twelve rings, is gripped in the chuck jaws and a roughing cut taken with a tool held in the turret block on the cross slide of the machine. This turret also carries the set of twelve cutting-off tools seen in the illustration. The barrel or sleeve casting from which the rings are to be cut is turned to $\frac{1}{16}$ in. over size in the roughing cut, the metal removed on a side being about $\frac{1}{4}$ in. The feed for turning is $\frac{1}{32}$ in. per revolution. This $\frac{1}{16}$ in. is the amount left for finishing and compression and spring in the ring when finished. That is, after the rings are cut off in the turret lathe as described later in this article, they are put into a form or jig which is bored $\frac{1}{32}$ in. above size and here an arbor is put in with plates for clamping the rings for finish turning after they have been slipped out of the form. As the

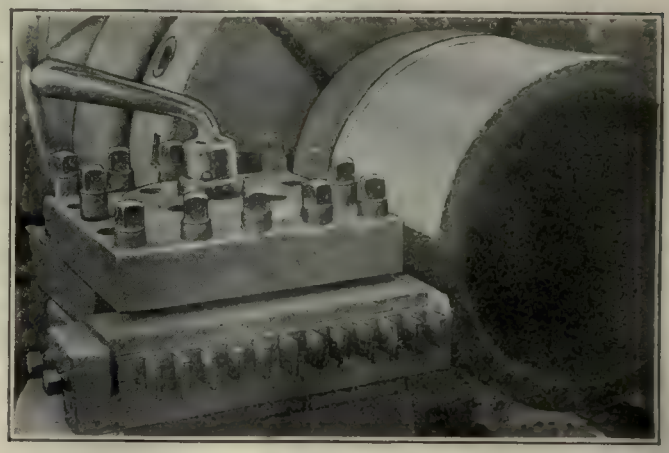


FIG. 2. TURNING THE BARREL FROM WHICH THE RINGS ARE CUT

form is $\frac{1}{32}$ in. above size and as the rings are placed therein when they are themselves $\frac{1}{16}$ in. above size there is a compression of $\frac{1}{32}$ in. required to put them into the form or jig. Consequently when the rings are finish turned they still have $\frac{1}{32}$ in. spring for actual operation.

Now, to return to the ring cutting off operation: In Fig. 3 the cross-slide turret is shown with the twelve tools withdrawn from the ring casting and a special turret toolhead carrying cutters for operating upon the face and interior of the outer ring. The process is first to feed the cutting-off tools part way through the casting wall, then withdraw the tools, reset $\frac{1}{16}$ in. to the side by adjusting the cross-slide carriage, then feed the multiple cut-off tools in again, thus forming the offset at one side of the rings. The metal at the inside of the ring casting still holds the whole sleeve casting intact and the outer face of the ring is machined before it is cut off from the casting.

In Fig. 3 the facing and boring tools in the head on the main turret are shown. The facing tool acts as a recessing device to bore out the face of the ring to the depth required for the offset on that face of the

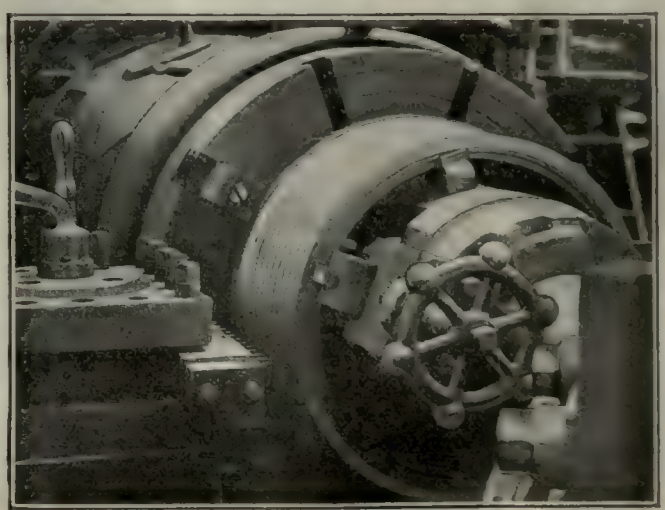


FIG. 3. GANG AND TURRET TOOLS IN POSITION

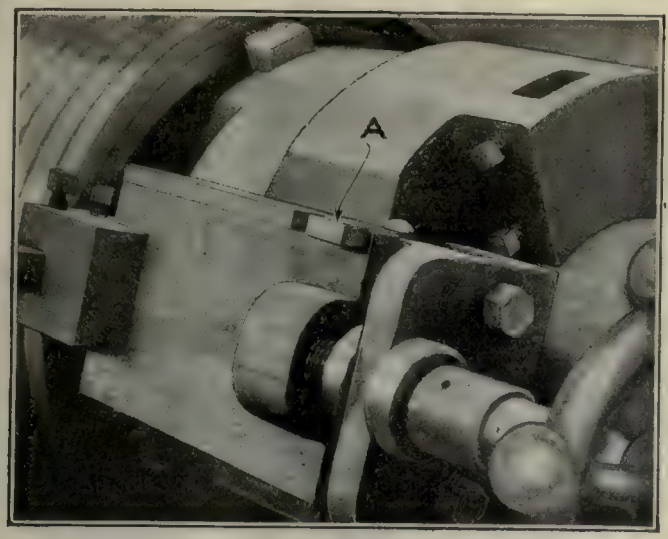


FIG. 4. AUXILIARY FACING TOOL IN TURRET

ring. This tool is carried by an auxiliary slide and toolholder seen at the front of the special toolhead of the main turret. A better view of this auxiliary device is obtained from Fig. 4. It consists of a body attached to the main toolhead and in this a slide is operated by a handwheel and screw to feed the tool parallel to the axis of the work. There is a stop block or thickness gage block at *A* which allows the tool to be fed into the ring to face out the recess to exact depth. The tool is then withdrawn and the boring tool on the main head of the turret is then fed in to bore out the interior of the ring and thus sever it from the sleeve casting. The operations of facing each successive ring and boring it to size the interior and cutting off the ring from the inside is thus continued until the twelve rings in the casting are finished. The thickness of the rings, as determined by the operation of the multiple cutting-off tools in the carriage block, is held accurately to dimension by snap gages giving a limit of 0.001 in.

The boring out of the rings requires the removal of about ½ in. of metal on each side, this being done in one cut. The speed of the work while the cutting-off tools are operating is eight revolutions per minute, or a surface speed of about 26 ft. per minute. This enables the series of tools to operate without chatter and leaves a smooth surface where the tools are run in the second time for facing down to the shouldered offset. The original casting for the twelve rings is 13 in. long and only 1 in. of metal is lost in the grip for the chuck jaws.

The facing of large piston rings in a vertical boring mill is represented by Fig. 5. Here a quick acting chuck is used on the table of the machine for holding the work securely while a facing tool is fed across the surface. The chuck consists of a set of four jaws which

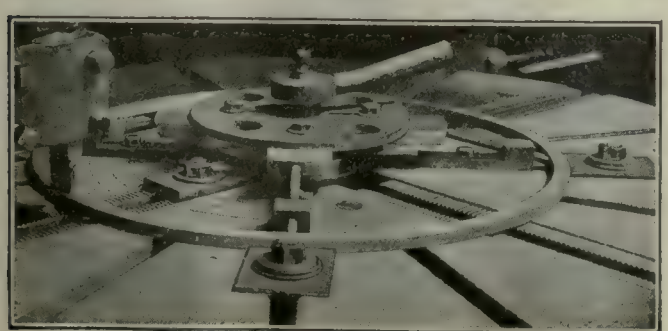


FIG. 5. FACING PISTON RINGS IN A BORING MILL

serve to hold the ring from the interior and force it against four properly located stops secured in the slots of the table. The interior jaws are really similar to the planer "toes" commonly used when thin work is to be held to the planer table. They are in the form of short pointed rods placed at a slight angle to the horizontal and when set up against the inside of the work they tend to hold the latter down securely to the table.

The four "toes" are actuated by four straight jaws which are forced outwardly by a flat disk with a beveled edge. This disk is drawn down to set out the jaws by the binder handle operating on a screw at the top. The outer ends of the flat jaws are also bevelled slightly inwardly so that they always hold the rear ends of the "toes" from lifting.

The facing tool is forged and ground to present a slightly angular edge to the work surface and thus produces a smooth even cut when fed across the ring face.

The methods shown are in use at the Southern Pacific shops at Sacramento, California.

The Fat Pay Envelope

By W. Burr Bennett

Fred W. Taylor's contention that high wages and low labor cost can go hand in hand, had been well demonstrated before the great war, and with the greatly changed conditions following the war, it is still more of a truism that labor is always seeking for higher wages and manufacturers a lower labor cost. Admittedly, the factory management that succeedes in bringing nearest together these two apparent opposites has gained an achievement of no mean value.

We have unlimited evidence of the manufacturers' efforts at low labor cost. Methods, fixtures and machines are being daily evolved and put into use for greater production without change of labor rate, and intelligent capital is not adverse to financing such equipment if assured of a reasonable return.

But what about high wages? The gentle reader will smile, perhaps, when he compares today's rate for the machinist with the rate of a few years ago. But that is hardly to the point—wages are merely a relative value in the last analysis. Explicitly, Mr. Taylor meant high wages as compared with a competitive shop and it is this kind of high wages that is worth careful thought.

During the past few years our company has studied and tried out about every theory and fad that has been suggested for the reduction of labor turnover, with the result of very little lowering of this costly expense. Some few months ago we decided to put the money formerly expended in the various welfare schemes into the pay envelopes in the form of higher rates. To say the least, the results have been marked. We have been able to secure the best of local labor with consequent improvement in workmanship. The men are glad to comply with all shop rulings and hate to loose their jobs. It is becoming a privilege to get a job in our shop. Being able to get high-grade men we have once and for all eliminated the problems that go along with irresponsible labor.

The results are such as to make the writer believe that: Given a clean, light shop, with good sanitary conditions and a practical working day, high wages for the particular shop, in the community in question, will produce lower labor costs than all the hosts of paternalistic schemes; and last, but not least, the results can be made permanent by the liberal use of the old fashioned "golden rule."

Repairing Locomotives in Our Oldest City

By FRED H. COLVIN
Editor, *American Machinist*

Keeping locomotives in running order is a different problem in divers sections of the country. On the Florida East Coast Ry., one of the main difficulties is that the roadbed is built upon the Sands of the Florida Peninsula, and these sands are almost constantly blown around the locomotives and bearings of the whole equipment. One compensation is that they are spared the rigors of a Northern winter and that they can work comfortably out of doors all the year around.

THE St. Augustine shops of the Florida East Coast Ry. are particularly attractive to one who has left the North in the grip of snow and ice and finds himself in a place where machine work can be done in open buildings and where one can get home without wading knee deep through snow.

Accidents happen occasionally as can be seen from the locomotive in Fig. 1, which is, however, not as badly damaged as it looks. The open-work effect, which can be found in shops in this part of the country, is shown in Fig. 2, which is the babbitting shed where all the car brasses are lined with babbitt. Babbitt is used in this part of the country in place of bronze for car axle bearings and for locomotive trucks, as it has been found better under the conditions which exist here.

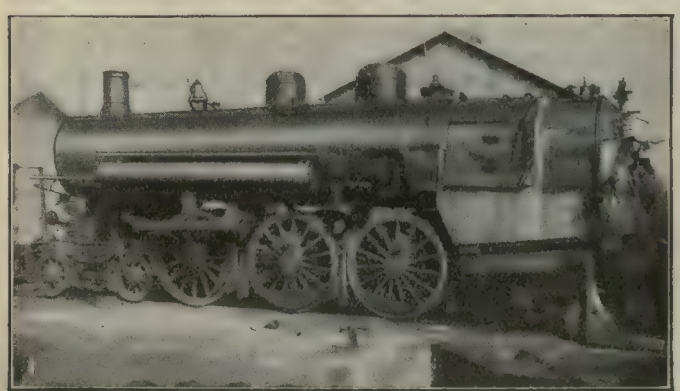
The babbitt melting furnaces are at the right, the fixtures for holding the brasses in position against a suitable form or mold being on the bench in the center. The bench at the left, equipped with vises, is where the surplus metal is chipped off in the usual manner.

The machine shop itself is an inclosed building, but ample provision is made for ventilation. The work hours are from seven to eleven, and from twelve to four, which accomplishes the daylight saving results whether it is a government measure or not. Figs. 3 and 4 were taken in the main shop, the first being the machine used for turning the main driver while setting the valves. This is a fairly common device consisting of a frame carrying two pairs of rollers so spaced as to come under both the driving wheels as at *A*, *B* and *C*. The rolls are drawn together until the wheels are raised clear of the track so that the drivers can be revolved by means of ratchet actuated by the long handle *D*.

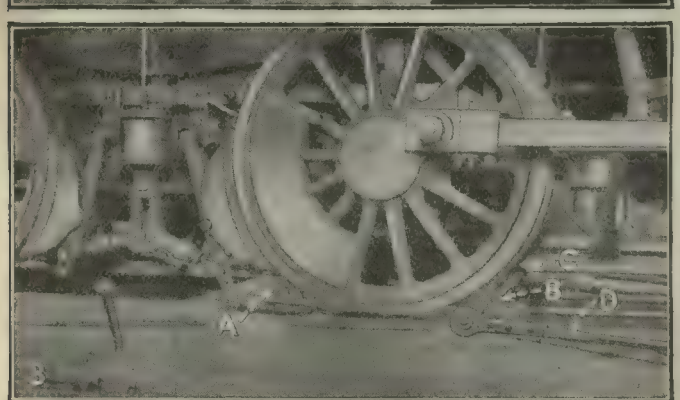
Turning Driving Wheels

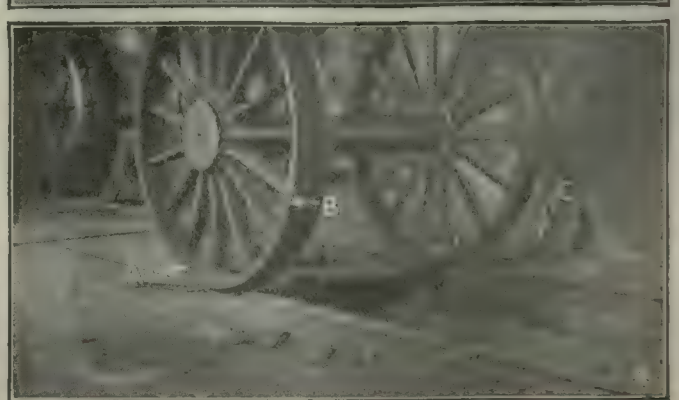
Fig. 4 is in the same shop and shows a pair of driving wheel centers which are used as mandrels on which to turn tires. The rims are split at several places as at *A* and *B*, and, after the tire has been slipped over the wheel center, plugs are driven into the holes so that they expand the rim inside the tire and hold it firmly for turning. The large hook *C* is then used in hoisting the mandrel with the tires in place into position in the wheel lathe.

One of the outdoor shops is shown in Figs. 5 and 6, this being where the boiler tubes are cut off and safe ends welded in place. The machinery in this shop is practically all home-made, the power to operate it in most cases being derived from compressed air cylinders.



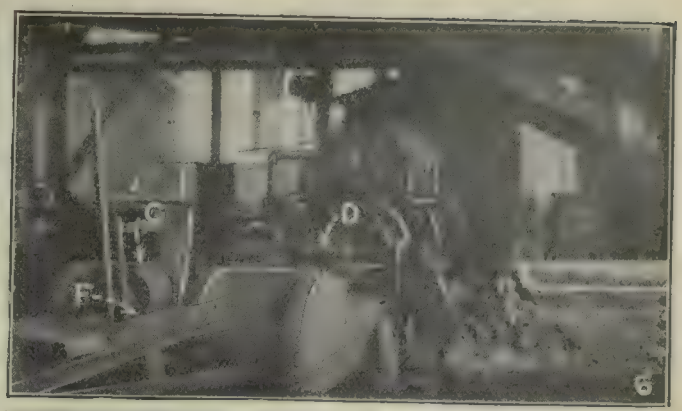






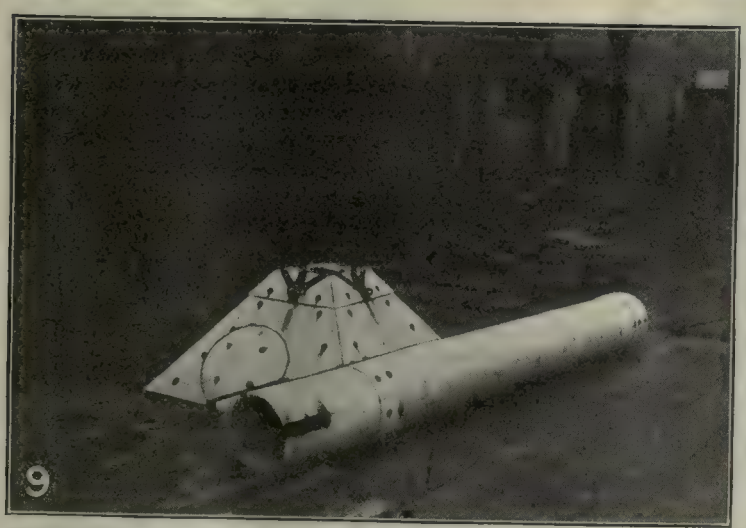
FIGS. 1 TO 4. SHOP DEVICES
Fig. 1—In for repairs. Fig. 2—Babbitting shed. Fig. 3—The valve setter. Fig. 4—Mandrel for turning driving wheel tires.

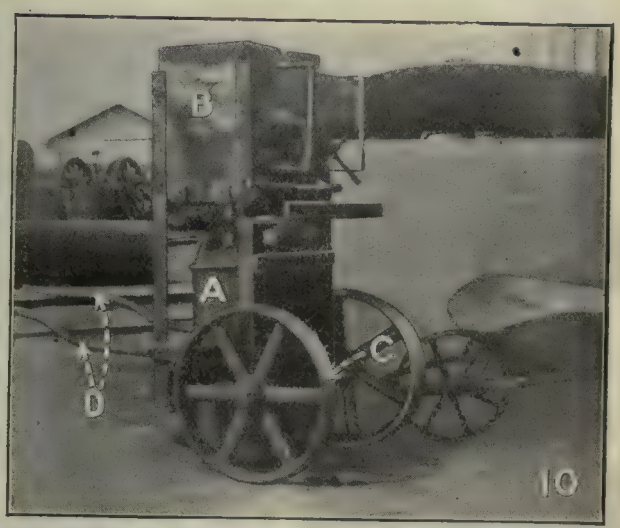


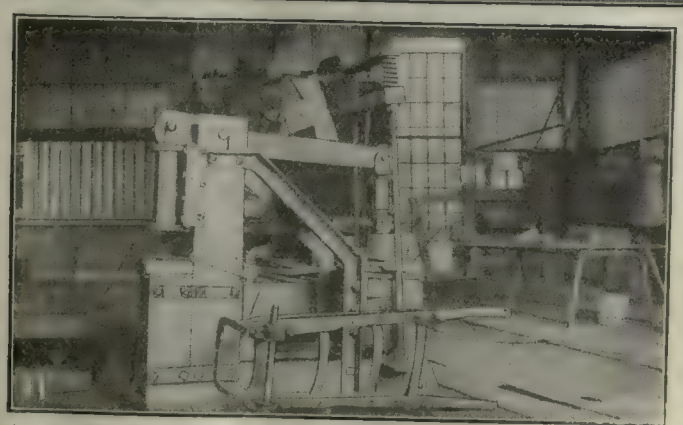














FIGS. 5 TO 12. WORK IN THE BOILER AND SMITH SHOP AND SOME OF THE APPLIANCES

Fig. 5—Boiler tube swaging press. Fig. 6—The other end of the swaging press. Fig. 7—Blacksmith spring dies. Fig. 8—Form for fitting bumper-block rails. Fig. 9—Asbestos pipe and hood for a forge fire. Fig. 10—Portable oil furnaces. Fig. 11—Pneumatic press. Fig. 12—Springbanding press.

In Fig. 5 the heating furnace is shown at *A*, while the holders *B* and *C* support the tube during the operations which are performed by the jaws *D* at the head end of the machine. Another view of this is shown in Fig. 6, which gives more of an idea of its construction. The tube support *C* is the same as is shown in the other view, as is the head *D*. The cylinders and the operating mechanism are shown very plainly in the center of the fixture. The way in which the head or operating portion of the machine is tied to the back end is shown by the angle iron *F*.

Part of the blacksmith's equipment of spring forging dies is shown in Fig. 7. These, it will be noted, are hung on a convenient rack, also out of doors, and, although the markings cannot be distinguished in the illustration, every pair of dies has its proper label so as to be readily found when wanted.

Fitting Bumper Blocks

Not far from this, and also out of doors, is a circular rack at *A*, Fig. 8, and also the form or rail-fitting block *B*. This block is for fitting rails used in connection with bumper blocks at the ends of blind tracks. The rails are bent until they fit the block *B*, when resting in their proper position on the tie *C*. The bent rails can then be sent to any part of the system and be spiked and bolted into place without further fitting.

One of the effects of this climate is a tendency to corrode metal work, especially when coupled with gases from blacksmiths' fires. On this account, the use of asbestos has been found very desirable, a hood and pipe of that material being shown in Fig. 9. A portable heating furnace for rivets or other purposes is shown in Fig. 10. This requires very little explanation; the angle iron framework carrying the oil tank beneath is shown at *A* and the furnace at *B*. The whole thing is mounted on a pair of good sized wheels *C*, so that by means of the handles *D* it is easy to move it to any part of the yard where it may be needed.

Another home-made, air-operated press is shown in Fig. 11. This is used for holding work of various kinds while being bent or for any purpose where a substantial holding press is desired.

Fig. 12 is a spring-banding press, also air-operated and home-made. This has the usual plungers *A* and *B* operated by the toggle levers shown. This press is large and heavy and can handle the largest driver springs.

Clamping Device With Automatically Locked Spring Plunger Support

By Francis W. Shaw

The Editor expresses doubt as to the practicability of the device illustrated under the above title which appeared on page 722, Vol. 52, of the *American Machinist* and reproduced in principle here. An object *A* must have support besides that afforded by clamps at other points, to prevent deflection under a cut. It is, therefore, supported by a spring plunger *B* which must be firmly locked. The aim of the "inventor" is to lock the plunger through the medium of the bolt *E*, thus saving an independent locking device.

The action of the clamp is not easy to analyze. Perhaps, first of all, it is best to imagine that, by tightening the nut, locking *has* been effected; that the plunger *B* *is* firmly held by the bar *F* and that, consequently, *A* *is* tightly grasped between *B* and the clamp *C*. An imagination after this fashion is not difficult, for it is plain to see that if a wedge were inserted between the jaws instead of the piece *A* and this wedge were pressed in, the farther it went the greater it would stress the bolt *E*. We may assume, therefore, that by tightening the nut the effect would be the same, and the tighter the nut were screwed up the greater would be the pressure at all points in contact, hence at the point of contact between the plunger *B* and the bar *F*. Analyzed in this way, the device would appear perfection itself, for there appears no good reason why the plunger *B* and clamp *C* should occupy any position vertically other than that it is compelled to occupy by the location of *A*.

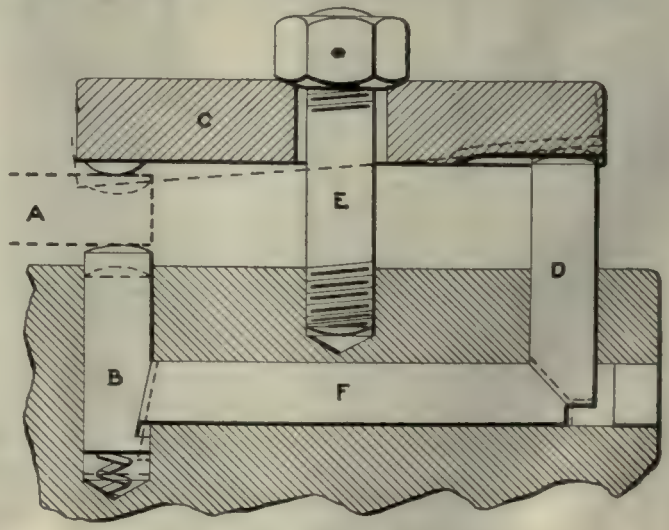
But—though at a glance one would place the device as positive in nature, it really is not. The plunger *B* is not locked any more firmly by the bar *F* than if the latter had a flat end, *if as firmly*—the action is still entirely frictionable, unless the piece *A* were quite unyielding, then no necessity would exist for the device.

There being a necessity for the device, for we must admit that *A* may yield under the cutting stresses. Assume first that the tendency is to an upward movement. In this case, *C* would tend to spring upward at the gripping end. The additional pressure it received would react on *D* and through *F* on *B*, which would be held more securely. Secondly, assume that *A*'s tendency was to a downward movement. Then *B* would receive additional pressure which, however, would have no effect, provided the locking is sufficiently good. If, however, the nut has been but lightly locked, *B* may yield. If it yields it may push the bar *F* to the right. The plunger *D*, however, will rise less than the plunger *B* falls and therefore *the clamping plate will no longer be in action*, and the whole device will be inoperative.

The success of the device, therefore, depends upon the intensity of the initial locking, which must be sufficient to induce the friction necessary to prevent movement in the plunger *B*.

Up to the point at which friction begins to have effect, the floating action at the jaws will be perfect. Afterward float is not wanted. The dotted lines on the sketch indicate how yielding in the object will free the clamping plate if the initial tightening is insufficient to prevent *B* falling with *A*.

In a nutshell, the work is held in a floating vise or pair of pincers, which, however, is prevented more and more from floating the more we increase the grip.



THE CLAMPING DEVICE IN QUESTION

SHOP EQUIPMENT NEWS

-Edited By-
S. A. HAND

SHOP EQUIPMENT • NEWS •
A weekly review of modern designs and equipment

Descriptions of shop equipment in this section constitute editorial service for which there is no charge. To be eligible for presentation, the article must not have been on the market more than six months and must not have been advertised in this or any previous issue. Owing to the news character of these descriptions it will be impossible to submit them to the manufacturer for approval.

• CONDENSED • CLIPPING INDEX
A continuous record of modern designs and equipment

Changes in Cincinnati Planer

A number of changes have lately been incorporated in the line of planers built by the Cincinnati Planer Co., Cincinnati, Ohio. A noticeable change is found in the use of the box form of construction for both the arch and the cross-rail.

The arch is cast as shown in Fig. 1, the tops of the housings having been widened to accommodate it. The box form of cross-rail adopted is shown in Fig. 2, and it is claimed that this construction adds rigidity and firmness to the cutting tools. The rail is well ribbed to add stiffness.

Another feature is the automatic stop which has been provided for the rail elevating and lowering device, this being shown in the phantom drawing, Fig. 3. The vertical stop-rod extending up the side of the left-hand column is equipped with set-collars that at the limits of travel of the rail come in contact with a bracket bolted to its back. When this occurs, the clutch in the elevating mechanism is released by means of suitable connections. The upper collar on the stop-rod remains fixed in position, but the lower one may be adjusted to stop the downward movement of the rail at any point within its travel.

The style of harp or swivel now used on the clapper-box is also shown in Fig. 3. Provision is made for clamping the upper part of the box securely against the face of the saddle, without using the long slotted opening in the harp formerly employed for this purpose. It is claimed that the construction insures against breakage that formerly was apt to occur in this part.



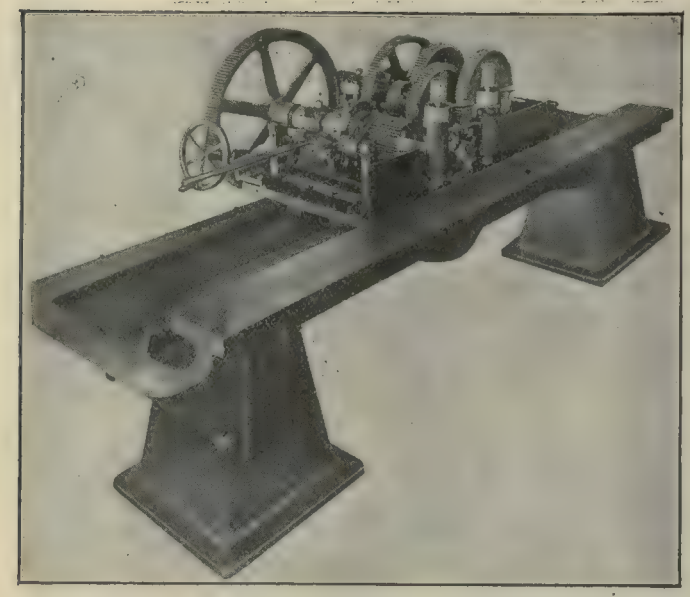
FIG. 1. BOX FORM OF ARCH FOR THE CINCINNATI PLANER. FIG. 2. SECTION THROUGH BOX-FORM CROSS-RAIL OF CINCINNATI PLANER.



FIG. 3. CINCINNATI AUTOMATIC CROSS-RAIL STOPS AND CLAPPER-BOX CLAMP

Marshalltown Plate Milling Machine

The illustration shows a plate milling machine built by the Marshalltown Manufacturing Co., Marshalltown, Iowa. It is intended for beveling and squaring the edges of boiler plates up to 1-in. thickness, the full length of the sheet. Curves can also be milled. The machine consists of a bed mounted on pedestals and carrying a sliding head containing all the operating mechanism. A 5-hp. motor on the head is geared to the spindle, driving the feed as well as the spindle. Both a friction slip and a quick return are provided in the feed mechanism. An inserted-tooth cutter 8½ x 2½ in. is used, the end thrust on the spindle being taken by ball bearings. A traverse of 2 in. is provided for the spindle, so that offset edges may be machined. Rollers are provided on both sides of the cutter for holding down the work. The cutting lubricant is circulated by means of a motor-driven pump located in a case at the

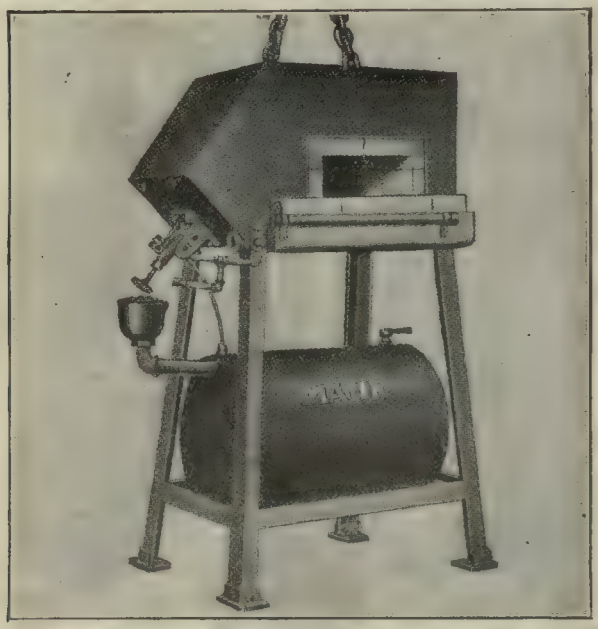


MARSHALLTOWN PLATE MILLING MACHINE

end of the bed. The machine is built in four sizes to mill lengths up to 8, 12, 16 or 24 ft. The weights range from 8,600 to 14,765 lb.

Mahr No. 16 Oil-Fuel Rivet Forge

The Mahr Manufacturing Co., Minneapolis, Minn., builds the No. 16 oil-fuel rivet forge shown in the illustration. The forge is designed for stationary use, but it is furnished with a chain by which it may be lifted and moved by a crane. It is claimed that the shape of the heating and combustion chambers is such that the fuel is completely burned before the gases reach the rivets, but that excess space has been eliminated. A tile lining is used. Either fuel oil or kerosene may be burned. Compressed air is employed at any pressure from 30 to 120 lb. per square inch. The forge is equipped with the Mahr V-1 type burner, which operates on the vacuum principle, thus avoiding the necessity of maintaining pressure in the fuel tank and eliminating considerable fire hazard. It is claimed for this burner that it will not clog with even the dirtiest oil, and that when once adjusted for the character of fuel being used it requires no attention for starting or stopping the furnace other than the control of the air valve.

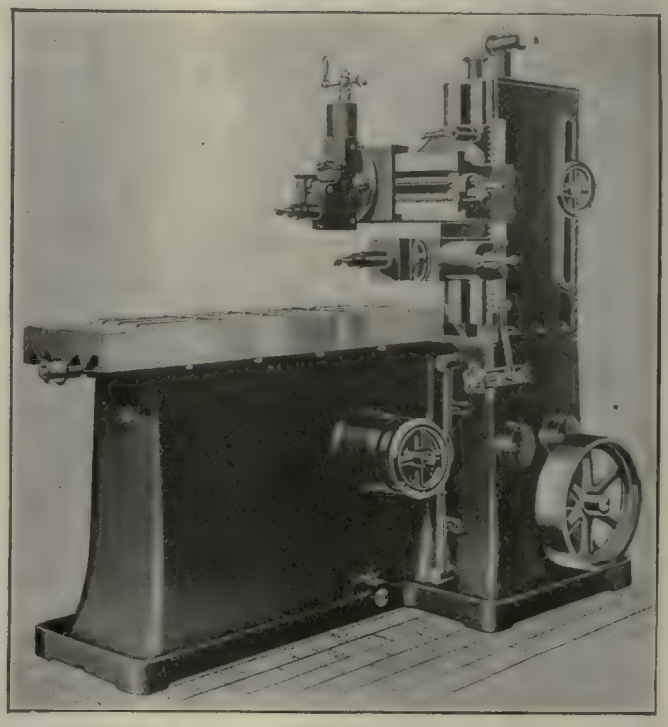


MAHR NO. 16 OIL-FUEL RIVET FORGE
Specifications: Normal capacity, 400, ⅝ x 3 in. rivets per hr. Fuel tank capacity, 18 gal. Air consumption, 8 cu.ft. per min. Size opening, 10 x 3¾ in. Height over all, 52 in. Floor space, 27 x 28 in. Weight; net, 520 lb.; boxed, 700 lb.

Universal 24-In. Open-Side Planer

The illustration shows a 24-in. open-side planer which has been put on the market by the Universal Machine and Tool Co., Canton, Ohio. The machine combines the characteristics of the shaper and the planer. One side is open, thus allowing large work to overhang the table. The single column is on the right-hand side, all controls being centralized, so that the operator need not shift position to operate the machine.

The table is driven by means of a variable-stroke crank mechanism. Constant-speed belt drive is employed, and the table speed is varied by means of shift gears, four speeds being available. The feed of the tool head is by power.



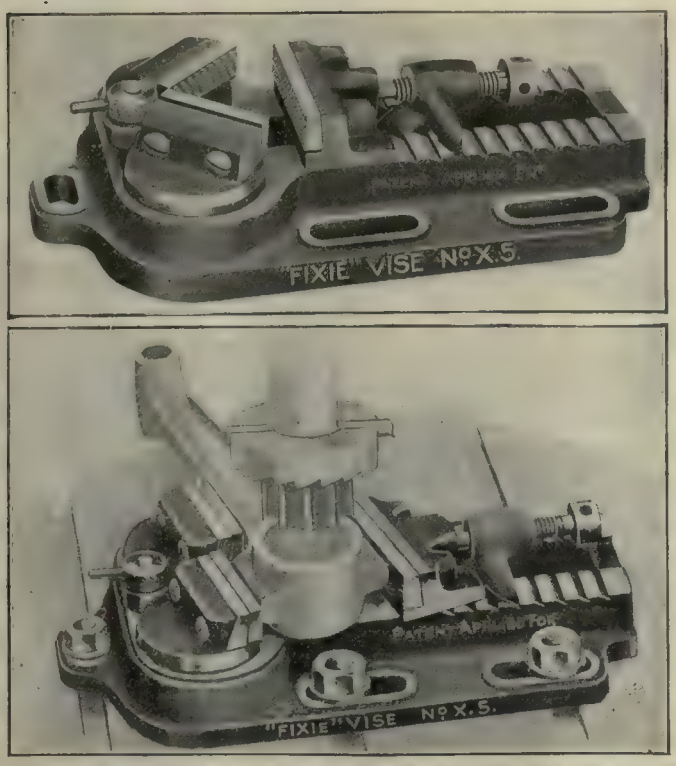
UNIVERSAL 24-IN. OPEN-SIDE PLANER, TYPE B
Specifications: Table size, 17½ x 46¾ in. Table height, 36 in. Maximum stroke, 27 in. Strokes per minute, 7, 20, 30 or 40. Speed of drive pulley, 125 r.p.m. Floor space, 36 x 63½ in. (neglecting over-travel of table). Weight, about 4,500 lb.

The type A machine has only one head, while type B has a second head mounted on the column below the cross-rail, as shown.

Fixie 3-Jaw Machine Vise

The vise shown in the accompanying illustrations has been placed on the market by Manning, Maxwell & Moore, Inc., 119 West 40th St., New York, N. Y. It is intended for holding pieces of irregular shapes while machining, being adapted to both toolroom and quantity production work. Many pieces ordinarily requiring jigs may be held for drilling or milling.

All three jaws can be swiveled, each independently of the others, and can be fixed in the positions required. The sliding jaw is held down by means of a T-head bolt and is not secured to its screw, which can be shifted



TWO VIEWS OF THE FIXIE 3-JAW MACHINE VISE

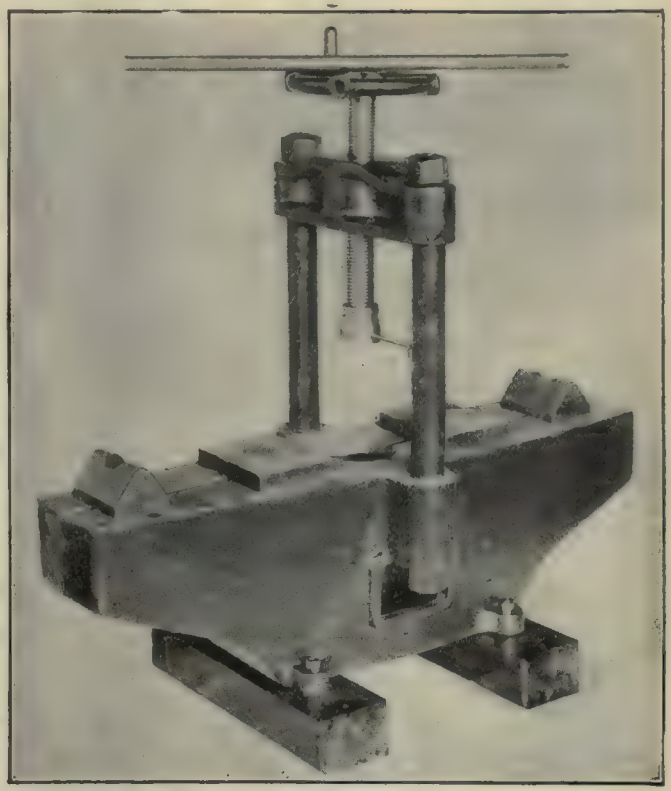
along the body and readily engaged. In place of the usual stationary jaw there are two swiveling jaws, which can be swung to form a V-block having an angle of 90 deg. or more for holding cams or circular work. For holding irregularly shaped pieces, such as a connecting rod, as shown in the lower view, the jaws may be swung to accommodate themselves to the form of the work. They can be locked in position by the nut between them, the turning of which tightens a cone against the flanges of the circular bases of the jaws. The jaws are fitted with loose grip-plates, which tend to draw the work down on the body of the vise when pressure is applied by means of the screw. Smooth, soft plates can be furnished if desired.

The body of the vise is made of steel alloy and the remaining parts of mild steel, casehardened where necessary. The bearing surfaces are hand-scraped. The vise is made in sizes, having maximum openings between the jaws of 4, 6, 9, 12 and 18 in. For the smallest and the largest sizes the depths of the jaws are, respectively, 1¼ and 2½ in.; the widths of the sliding jaws, 3 and 8 in.; the widths of the swiveling jaws, 2½ and 5 in.; and the over-all sizes 12 x 6½ in. and 34½ x 13 inches.

Pletz Utility Screw Presses

The illustration shows the Utility hand screw press made by Carl Pletz & Sons, 717 Sycamore St., Cincinnati, Ohio. It is intended for general use, being adapted to such work as straightening shafts, pressing in bushings and bending metal. It is made in two sizes, the No. 3½ machine accommodating work of greater height and width than the No. 3.

The bed is heavily ribbed, with a hole cored under the screw to permit work to drop through or shafts to be handled. The lower end of the steel screw is fitted with a steel pad which is prevented from turning, the thrust being taken on a bronze washer running in oil. The handwheel is fitted with a handle so that the screw



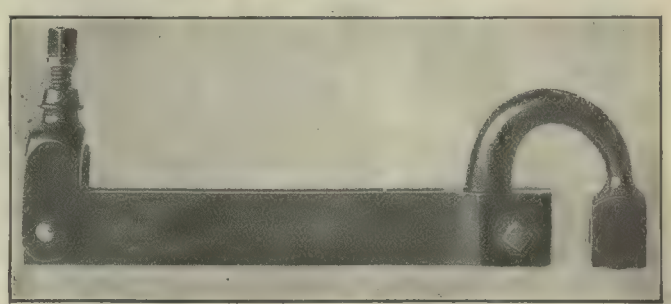
PLETZ UTILITY HAND-SCREW PRESS

Specifications. Screw; diameter, 2 in.; pitch, ¼ in. Length, 4 ft. Height with screw down, 42 in. Distance between posts, 12¾ in. for No. 3, 17¼ in. for No. 3½. Distance under screw pad, 14 in. and 20 in., respectively. Weight, 500 and 600 lb., respectively.

may be returned quickly. It is claimed that by using a 4-ft. bar a pressure of about 20 tons can be secured under the screw.

Derringer Combination Toolholder

The toolholder shown in the illustration has recently been placed on the market by Maurice H. Derringer, 3133 N. Eight St., Philadelphia, Pa. It is intended for medium-sized work on lathes from 12- to 20-in. swing. On the end shown at the left is a yoke which can swung to either side of the bar. One side of the bar is adapted for holding square stock up to ⅝ in. and the other side, formed as a V-block, will hold round stock from ⅛ to ⅝ in. in diameter. This groove is useful for holding indicator stems as well as boring or internal-threading tools. When the holder is placed in position in a lathe, the screw in the lathe toolpost can be tightened on the end of the tool, thus holding it rigidly. The yoke may be easily removed by taking out the taper pin which holds it. The other end of the holder is provided with a gooseneck which can be locked in position at any angle. This neck will hold ⅝-in. tool stock, being especially adapted to thread cutting.



DERRINGER COMBINATION TOOLHOLDER

SPARKS FROM THE WOR

Valentine Francis

Why Westinghouse Does Not Use the Metric System

One of the reasons most commonly urged for the adoption of metric units was that it would greatly aid foreign trade. That would appear to be inviting the mountain to go to Mahomet, for the greater number of manufacturing plants are located in English-speaking countries, where naturally the people use only the English system of weights and measures. Factories located in the United States, for instance, sell all but a small percentage of their goods in this country. It would appear then, that to sell a few articles to metric countries, a certain class would make one hundred million people climb out of their accustomed channels to learn a puzzling unfamiliar language. Nor is this necessary, for Westinghouse Electric and Manufacturing Co. does a great deal of business with countries using the metric system without difficutly or embarrassment.

From stories sent out it would seem that all foreign countries with the exception of Great Britain were metric. That this is not true is evident from the fact that even those which are out and out metric, like France, Belgium, Denmark, etc., are more familiar with the English system than we are with the metric. In Latin-America some countries use a system of English extraction but with Spanish terms. Some use metric and Spanish. Others use metric alone, but all are familiar with the English.

No one doubts for a moment the tremendous difficulties that would be involved in making this country over into a metric speaking and thinking people. These difficulties would multiply daily until nothing less than chaos would result. First, the greatest number of people in the country would have to learn the metric tables. Then they would have to translate metric terms into English before a ratio of values could be obtained. This in daily life where thousands of small transactions are carried on would be ludicrous.

This is a period when production is needed, throughout the country there being shortage of manufactured materials. Is there any reason for urging the adoption of the metric system at this time when it is certain that were it suddenly introduced in the factory, production undoubtedly would be held up and more than likely would be stopped entirely, until the workmen familiarized themselves with the new units? The very fact that English measurements can be halved and quartered without introducing complicating fractions makes it more advantageous in shop work than the metric measurements. The Westinghouse Co. has no desire to install a metric translation department pending the adoption of the French system in America. It is a complex organization, highly detailed and a delay in any point of production, is felt in every department. Thousands of delicate, high-priced instruments are in daily use which the company has no desire to scrap for metric tools. There are also many tables computed in the English system which would have to be made over and in addition have a table of equivalents, practically tripling the labor used in making up tables as well as doubling their size. This paves the way for errors.

Westinghouse, too, has little desire to install a school to teach its thousands of workmen the metric system. The work entailed in this one item alone would be enormous, even if it were certain that employes could pick up the system rapidly. Others have not found this the case.

These are, briefly, some of the reasons why the Westinghouse Electric and Manufacturing Co. is opposing the introduction of the Metric system in America. Its advantages have yet to be proved in every way except theoretically and its practicability in the Unitetd States is uncertain.

Market for American Agricultural Machinery in Java

American Trade Commissioner John A. Fowler states that, in his opinion, there are good prospects for the sale of large numbers of American tractors to the plantation owners of Java, the opening of which market would be hastened by the co-operation of American manufacturers, and suggests that tractor and implement manufacturers send experienced men to Java to demonstrate their machines to the people and let them know what co-operation they may expect from the manufacturers. At present there are plows, rollers, cultivators, and other implements to work with in Java, but the people are not educated up to their use. There is also a market for ditchers, which should be of a plow type of implement that will cut the soil so it can easily be squared up, and it is thought that it should be attachable to the tractor to get the advantage of the tractor's weight.

An announcement from London states that. with 38,954 flights and a total of 70,000 passengers carried during the first year of civil flying in England, there was but one fatal accident. The number of miles flown was 734,200 and goods carried totaled 116,498 pounds.

National Safety Council Will Soon Hold Its Ninth Meeting

The best methods of saving fingers, hands, arms, legs, and lives and of conserving labor and increasing production through accident prevention and industrial medicine, will be discussed at the ninth annual safety congress of the National Safety Council at Milwaukee, Sept. 27 to Oct. 1, the program for which will soon be completed.

During these five days, four thousand men and women—safety engineers, industrial relations managers, municipal traffic officers, educators and plant executives—will gather at the Milwaukee Auditorium to throw into the common pot all the information on accident prevention that has developed during the past year.

The 1920 safety congress will be the most important in the history of the safety movement. One hundred and eighty speakers, each an expert in some particular line of safety work, are on the program. Accident prevention will be discussed not as a humanitarian proposition alone, but with reference to the most important industrial problems of the day—underproduction and labor unrest. Safety is no longer a haphazard proposition; it has been developed through the expenditure of millions of dollars by the industries of America and through years of research and experimentation into a science with fundamentals as definite as those of chemistry, biology or physics.

A special session of the congress has been arranged where beginners in the field of organized accident prevention will be instructed in these fundamentals. This "A B C" session will be addressed by experts in the organization and operation of industrial safety departments. The congress program includes a debate on the bonus system in safety work between J. Claude Smith, safety director of the Inland Steel Co., and Philip Stremmel, superintendent of the Hot Mills, National Enameling and Stamping Company.

Baltimore Has New $2,500,000 Concern

The Maryland Steel Products Co., with $2,500,000 capital stock, has been incorporated at Baltimore, Md., and has taken over the plant of the Maryland Pressed Steel Co., Hagerstown, Md., which has been a subsidiary company of the Poole Engineering and Machine Co., Woodberry, Baltimore. The incorporators of the new company are Richard B. and Melville P. Rodermond, New York; Henry Huss and Oscar Eurich, Hagerstown, and B. R. Youngman, Baltimore.

LD'S INDUSTRIAL FORGE
News Editor

Steel Treaters To Meet at Philadelphia Next Month

Emphasizing that "the product produced is only as good as its heat-treatment," the American Steel Treaters' Society and Steel Treating Research Society are sending out advance information concerning their second annual convention which will be held at the Commercial Museum, Philadelphia, Pa., on Sept. 14 to 18. The societies invite nonmembers to attend the convention and join in the discussions.

Over seventy-five papers are listed. These will cover all branches of heat-treatment and are by men prominent in the industry. An outline of the program follows:

TUESDAY, SEPT. 14.

Exhibition open 9 a.m. to 10:30 p.m.
Program will be run strictly on scheduled time. Please be prompt.
All sessions of the convention will be held in the Assembly Hall at the Commercial Museum, Thirty-fourth at Spruce Street.

MORNING SESSION—10 TO 12 A.M.

Address of Welcome—His Honor, Mayor Moore of Philadelphia.
Address of Welcome—Colonel A. E. White, Chairman of the Amalgamation Committee.
Appointment of Tellers of Election.
Papers.

NOONDAY LUNCHEON

The Delegates from all the Chapters will have business meeting and luncheon at the Commercial Museum.

AFTERNOON SESSION—2 TO 4:30 P.M.

Report of Tellers of Election.
Address of President-elect.
Papers.

TUESDAY EVENING—8 TO 10 P.M.

Papers.

WEDNESDAY, SEPT. 15.

Exhibition open from 9 a.m. to 10:30 p.m.

MORNING SESSION—10 TO 12 A.M.
NOONDAY LUNCHEON

The Delegates and National Officers will have business meeting and luncheon at the Commercial Museum.
AFTERNOON SESSION—2 TO 4:30 P.M.
EVENING SESSION—8 TO 10:30 P.M.

THURSDAY, SEPT. 16.
"New York Day."

Exhibition open from 9 a.m. to 5 p.m.
Morning session—10 to 12 a.m.
Noonday luncheon.
The Delegates and National Officers will have noonday luncheon at the Commercial Museum.
Afternoon session—2 to 4:30 p.m.

THURSDAY EVENING, SEPT. 16.

6:30 p.m. sharp.
Informal banquet and entertainment, Grand Ball Room of the Bellevue-Stratford Hotel. Tickets $5. Visitors and guests are invited and will be welcome. Tickets on sale at Secretary's office just inside the main entrance to exhibition hall. Secure your tickets early—seating capacity limited to 800. The banqueters will be addressed by speakers of national prominence.

FRIDAY, SEPT. 17.

Exhibition open from 9 a.m. to 5 p.m.
The various plant in Philadelphia will be visited.

FRIDAY EVENING, SEPT. 17, 8 P.M.

Informal dance and reception by the Philadelphia Chapter in the Clover Room at the Bellevue-Stratford Hotel.

SATURDAY, SEPT. 18.
"Philadelphia Day."

Exhibition open from 9 a.m. to 6 p.m.
Over 80,000 sq.ft. of floor space will be used to display heat-treating appliances and heat-treated products, and more than 125 nationally known firms will be represented. This is a good chance to have your difficulties solved in heat-treating.

Exports of Machinery Treble in Six Years

According to *The World Markets*, the R. G. Dun & Co. magazine, in six years' time the exports of American machinery have trebled in value. In 1913 the total exports of machinery were valued at $127,980,000, while in 1919 they reached a total value of $378,425,000. That the total in the latter year was not greater was due to the urgent home demands for machinery of almost every description, which limited the amount available for export. One large manufacturer declared recently that his foreign orders for the first six months of the present year were more than 60 per cent greater than during the same period last year.

Flywheel Does Much Damage

Thousands of dollars damage resulted when a flywheel broke recently at the plant of the Scott Paper Co., Chester, Pa., putting out of commission the largest individual paper machine in the country. The flywheel broke suddenly and flying fragments played havoc with the machinery, intricate parts being badly smashed. An electrician was probably fatally injured when struck by parts of the wheel.

Employers Warned To Carry Compensation Insurance

"Employers who come under the Workman's Compensation Law are warned to carry Compensation insurance to cover their employees. The failure to do so," said Bernard L. Shientag, Chief Counsel to the New York State Industrial Commission, "is a misdemeanor punishable by a fine up to one thousand dollars, by imprisonment up to one year, or by both such fine and imprisonment." The Industrial Commission through its counsel will proceed vigorously against any employer who continues to disregard this important law.

"A large number of awards to injured workmen and to widows and orphans cannot be collected," said Mr. Shientag, "because employers have neglected to carry compensation insurance and in many cases are financially unable themselves to make payment. These widows and orphans are condemned to a life of want and compelled to seek the aid of charity because employers have violated this law."

"It is not only a great injustice and social wrong, but it arouses a spirit of resentment and discontent in the hearts of these unfortunate victims of industrial accidents, who cannot understand why the humane workmen's Compensation Law, which they counted on for protection, has completely failed them."

Any employer who is in doubt as to his duties under the Workmen's Compensation Law should apply promptly to his State Industrial Commission.

A $12,000,000 Car Building Program

The Southern Pacific Railroad has decided upon a $12,000,000 car-building program and wiii spend a large sum of money in enlarging and improving its car shops in Sacramento. New buildings will be provided for the iron and steel foundries, rolling mills and general shops.

Commerce Chamber To Trace Slack in Business

Acting on indications of a slack in business from some sections, the National Chamber of Commerce has started a survey of every industry in all lines and in all parts of the country.

"Complaints came in that wholesalers and retailers were cancelling contracts to such an extent that some were compelled to shut down," said E. W. McCullough, head of the Industrial

Production Department, of that body here today, "so we have sent out a questionnaire."

"It is not certain that this situation is prevalent but we want to determine whether decreased buying is responsible for the reticence of wholesalers and retailers to maintain orders ahead booked, or, if not, what the cause really is."

Tests of Bearing Metals for S. A. E.

The tests at elevated temperatures of babbitt bearing metals, four of which were investigated in connection with the S. A. E. specifications for such material, have been completed. As was expected, the yield point and ultimate strength decreased rapidly with increasing temperature. It would appear that babbitts containing lead lose their strength more rapidly than those with a tin base. Brinell hardness measurements have also been made on these four samples, and will be repeated later on larger specimens. In order to study the effect of small quantities of lead on the physical properties of a high-grade tin-base babbitt, varying percentages of lead have been added to metal made in accordance with specification No. 2 of the American Society for Testing Materials, and the physical properties of the various combinations thus secured will be studied at ordinary and at elevated temperatures. A thermostatically controlled oil bath has been constructed for annealing specimens over long periods of time in order to determine its effect on the mechanical properties of the babbitts.

Black & Decker To Sell Stock to Its Employees

A plan to enable the employees of the Black & Decker Manufacturing Co., machinery makers, Baltimore, Md., to share in the profits of the company and to become holders of the company stock, has been announced by the concern. All the workers will be permitted to purchase the stock and the length of time given them to pay for it will depend upon the length of time they have been with the company. With each four shares of the preferred stock, par $25, will be given one share of common stock upon which a dividend will be paid if the earnings warrant it. The first sale is to represent a block of $250,000 of 8 per cent cumulative preferred stock. Blocks of the same amount will be sold at various times until the total reaches $1,000,000. The company recently increased its authorized capital stock.

The National City Bank, New York, states that automobile manufacturers of United States made, in the fiscal year just ended, their highest record in supplying foreign markets. The total value of automobiles and accessories exported aggregates $275,000,000, against $138,000,000 two years ago, and $30,000,000 in year preceding war.

A Good "Safety" Record

The case of a night shift of 160 men in an extra-hazardous department who went for four years without a single lost-time accident recently came to the attention of the National Safety Council in the plant of one of its members, the American Steel and Wire Company.

This record was made at the Electric Cable Works, a department of the South Works of the company at Worcester, Mass. On Dec. 31, 1919, the night shift of this department completed its fourth year, operating hazardous processes such as coating cables with molten lead, slitting rubber with series of revolving knives, and rolling heavy cable reels from place to place, without a single lost-time accident. These hazards peculiar to this company, are in addition to the ordinary perils of gears temporarily left unguarded, electric switches, and grinding tools. The fact that this work is all done at night, when workmen are naturally less fit, makes the record truly remarkable.

This safety achievement is attributed by Stephen W. Tener, director of safety for the plants of the American Steel and Wire Co., to three things; first, the special efforts that have been made to educate the workmen in safety; second, the company spared no expense in providing safeguards for dangerous machines or revising dangerous processes; third, the foreman of the department was himself thoroughly converted to the safety idea.

Safety posters are placed regularly on the bulletin boards of this plant and interesting safety meetings are held frequently. George E. Harbour, foreman of the department, has grasped the importance of accident prevention and made the record possible by constantly impressing the importance of care upon the workmen and setting an example by faithfully employing safety methods himself.

Acme Die Casting Corporation Opens Philadelphia Office

The Acme Die-Casting Corporation, Brooklyn, N. Y., has recently opened a branch office in the Machinery Exhibition Sales Department of the Philadelphia Bourse.

This branch office is in charge of Edward McK. Hunt, and will handle the company's rapidly growing business in New Jersey, Eastern Pennsylvania, Maryland, Delaware and the District of Columbia.

The corporation maintains offices at the present time in Detroit, Cleveland, Chicago, Pittsburgh, Rochester, Boston, and Philadelphia, and contemplates opening another office in the near future in Newark, N. J.

It specializes in the production of high grade zinc, aluminum, tin, and lead alloy die-castings.

A. Buol Honored

Abram Buol of the New Britain Machine Co., New Britain, Conn., was the guest of 100 officers, department heads and foremen of the company at a dinner given in his honor recently at Le Bal Tabarin in East Hartford. Mr. Buol celebrated his 25th anniversary with the local firm and the dinner was a tribute from his associates to his long and successful business career.

New York-San Francisco Mail via Airplane

The recent carrying of mail from New York to San Francisco by airplane marks a new step in the development of aërial navigation from a commercial standpoint. The fact that this was accomplished in an all-metal plane equipped with a motor of only 185 hp. is further indication of the progress being made.

A photograph of one of these planes is shown in these columns, the wing covering being aluminum alloy instead of fabric. There are no outside struts or guy wires and the absence of the resistance of these is largely responsible for increased efficiency of the machine.

This is known as the Larsen plane, or the J. L. 6. Arrangements are being made to build these planes in this country.



A. S. M. E. To Hold Meeting in December

The 1920 annual meeting of the American Society of Mechanical Engineers will be held in the Engineering Societies Building, 29 West 39th St., New York City, Dec. 7 to 10.

Sessions will be held on the subjects of Appraisal and Valuation and the Application of Engineering to Woodworking. The newly founded professional sections on Management, Power, Fuels, Machine Shop, Railroads and Textiles will also conduct sessions to consider the vital problems in their fields. In addition a number of valuable papers will be presented at General Sessions.

A memorial session for Dr. Brashear is planned, as a fitting tribute to his life and work.

New York City Establishes Pension System

Through an enabling act of the 1920 legislature a pension system was created, the support of which is to be shared equally between New York City and its employees. In the case of the administrative and technical forces, it provides for optional retirement at the age of sixty and mandatory retirement at seventy, with a pension allowance at the rate of one-seventieth of the average salary for the last ten years of service, for each year of service. It is thus made practicable for an employee to retire on a substantial annuity at a period in his life when he can really enjoy it.

The contributions to this fund are graded according to class of service, age, and time of entrance into the city service, and range from about 4 upward to a little over 7 per cent of the employee's salary. In case of withdrawal from the service for any cause, all contributions to this fund on the part of the employee are repaid, together with interest at the rate of 4 per cent. Incidental features of the plan include pensions for disability, life insurance to the extent of one-half a year's salary, and pension to dependents in case of the employee being killed while in the performance of duty. These latter benefits are paid for wholly by the city, which also assumes the burden of financing the operation of the fund for those now in the service up to Oct. 1, 1921, or such previous date as they may elect to avail themselves of it. Acceptance of the plan is optional on the part of present employees but is mandatory upon those who join the service after Oct. 1, 1920, when the system goes into effect.

Pittsburgh Has A. W. S. Branch

A local branch of the American Welding Society was recently organized this week at Pittsburgh in the Chamber of Commerce auditorium. O. I. D. Conway was elected chairman; Dr. R. C. Brownlee, first vice president; F. W. Maxfield, second vice president; F. W. Tupper, temporary secretary, and F. O. Gardner, treasurer.

Business Items

Carl G. Barth & Son, consulting engineers, announce that they have opened an office in the Fuller Bldg., 10 South 18th St., Philadelphia, Pa. They will continue their specialization in production and costing methods based on the Taylor system of management.

The National Twist Drill and Tool Co. announces that after Aug. 1 it will occupy new quarters at 73 Warren St., New York. A complete stock of twist drills, reamers and milling cutters will be carried.

Nemirovsky & Son, machinery dealers, who have been located at North Third St., Philadelphia, for the past twenty-six years, will occupy new sales rooms at 137 North Third St., a short distance from the old stand. Extensive alterations have been made and everything has been done to make this an attractive showroom.

Plans for the enlargement of its plant are being prepared by the Indestructible Wheel Co., Lebanon, Ind., which recently increased its capital to $300,000. There are approximately $500,000 of contracts for the pressed steel wheels on hand. Extension plans call for the equipment of a new hub shop, and a number of machine tools will be added to the machine shop equipment. The toolmaking department will be doubled in capacity and the company will equip an electric power plant.

The business of Charles L. Talbott & Co., 309 Scott St., Baltimore, Md., which has been doing contract machine work in Maryland and Virginia, has been incorporated with $50,000 capital stock by Charles L. Talbott, Ida Talbott and Howard M. Lynch to manufacture and deal in machinery and supplies and also to repair and install machinery.

The Northern Manufacturing Co., of New Haven, Conn., has recently been organized to deal in machinery, etc., with a capital of $50,000. The organizers are: John Hugo, J. J. Hines and C. O. Beck.

The Waterbury Farrel Foundry and Machine Co., of Waterbury, Conn., has increased its capital stock from $440,000 to $2,500,000.

Obituary

WILBUR S. GATES, for over thirty years travelling representative of the Hartford Machine Screw Co., died at his home in Woody-Crest, Conn., Aug. 13, after a brief illness. During the last few years he has travelled principally in New York, Pennsylvania and Maryland, although previously he covered the New England states as well. Few men have won such a wide circle of friends in the hardware, automobile and general manufacturing trades, who will feel his loss very keenly.

Personals

RAYMOND HAWLEY, formerly of the Keystone Motor Truck Corporation, has been elected vice president of the Technical Advertising Service, Inc., of 1133 Broadway, New York.

F. C. HERMANN has resigned his position with the Stocker-Rumely-Wachs Co., Chicago, and will be associated with the combined interests of the Reed-Prentice Co., Becker Milling Machine Co., and Whitcomb-Blaisdell Machine Tool Co. at their new Chicago office.

WALTER DEAN has been selected as superintendent of the supply department of the Graton & Knight Manufacturing Co., of Worcester, Mass., maker of factory leather belting.

J. A. FORSITHE, formerly in charge of the Western sales division, with headquarters at San Francisco, for the Gilbert & Barker Manufacturing Co., of Springfield, Mass., has been selected as general sales manager at the home plant in Springfield. Mr. Forsithe joined the Gilbert & Barker organization about four years ago in the sales department.

E. D. MITCHELL has been appointed manager of the New York branch of Alfred Herbert, Ltd., New York, in place of W. J. Fuller who recently resigned. Mr. Mitchell joined the company in January, 1906. He has an intimate knowledge of the Alfred Herbert organization and its development and has had a great deal of experience in connection with the export business of this company, having visited the Far East, India and Continental Europe. He is also a director in the Societe Anonyme Alfred Herbert, Paris.

ARTHUR JACKSON, formerly of the Gould-Shapley & Muir Co., Brantford, Ont., Can., the Jones & Lamson Co., Springfield, Vt., and for the past five years selling and demonstrating agent of the Gridley automatics in Great Britain, has recently resigned from the latter company. Mr. Jackson has been appointed as a Potter & Johnson representative with the Yamatake Co., of Tokyo, Japanese agent for the Potter & Johnson Machine Co., Pawtucket, R. I.

JAMES T. LEE has been recently added to the sales engineering staff of the Southwark Foundry and Machine Co., of Philadelphia. Mr. Lee for several years past was vice president in charge of sales of the Hanna Engineering Works, of Chicago.

HARRY W. AULT has been appointed factory manager of the Quick Change Chuck Co., of Cleveland, Ohio. Mr. Ault was formerly with the Heald Machine Co., of Worcester, Mass.

THOMAS CONROY, general works manager of Harper-Bean, Ltd., London, is spending ten days in New York on business.

R. B. HUBBELL has resigned as assistant sales manager of the Heald Machine Co. to accept an appointment as sales manager with Churchill-Morgan-Crittsinger, Inc., of Worcester, Mass.

DONALD S. MICHELSEN, formerly general manager of the Worcester Pressed Steel Co., Worcester, Mass., assumed the office of general manager of the Globe Machine and Stamping Co., Cleveland, on Aug. 1. A. F. Schroeder, who has been general manager for almost twenty years, will continue to hold the office of president.

H. E. PAINE is now with the Vermont Tap and Die Corporation as vice president. He was formerly with Butterfield & Co.—Division of the Union Twist Drill—having held various positions from draftsman to general manager, retiring from the latter position to take up the organization of the new corporation.

PAUL HOFFMAN has been made district manager of Philadelphia, for the Norton Co., of Worcester, Mass. He was formerly in the Worcester office of the company. His offices will be located at No. 324 Bulletin Building, Philadelphia.

New Publications

Screw-Thread Production to Close Limits. By Howard D. Adt, the Geometric Tool Company, New Haven, Conn. One hundred ninety-two pages, 6 x 9 in., illustrated.

The first sixty odd pages of the book are devoted to a study of the question of thread production, beginning with the evolution of the screw thread and including screw-thread standards, screw-thread accuracy, charts and tables for limits and tolerances, formulas for medium-fit screws, nuts and taps suited for general use, gaging devices, testing thread for accuracy, testing thread gages and methods of threading.

Much of this data is from the report of the screw-thread committee of the American Society of Mechanical Engineers, and represents the result of several years of work on the part of this committee. It also includes data from the Bureau of Standards and other sources.

The remainder of the book deals with thread-cutting tools and shows a great variety of die heads used for various purposes and including both straight and taper dies. Collapsing taps are treated in the same manner and there is much information regarding the grinding of chasers and the use of both taps and dies in practical work. The author has made accurate threading a study for many years, and the book is especially valuable on that account.

The Making, Shaping and Treating of Steel. By J. M. Camp and C. B. Francis. Six hundred fourteen 5 x 7½-in. pages, 122 illustrations and 71 tables. Second edition. Bound in flexible black imitation leather. Published by the Carnegie Steel Co., Bureau of Instruction, Pittsburgh, Pa.

This is an unusual book. It was compiled especially for the non-technical employees of the Carnegie Steel Co., and others seeking means of self-instruction. It gives, in condensed form, an enormous amount of accurate information regarding the metallurgy of iron and steel. The book is the outcome of a number of years' experience in attempting to teach steel salesmen and other non-technical employees of this company something of the metallurgy of steel. From the first the method pursued has been to take the students into the mills where they could obtain, first hand and individually, such information as they desired and were able to collect. Such knowledge as was gained from this was supplemented by talks and explanations delivered in a classroom. These talks were put into writing and a copy given to each student. As the demand for these lectures increased it was decided to put them into print. Accordingly they were revised and are assembled into this book. Probably nowhere else can such recent information regarding actual rolling mill practice be found anywhere. That it represents the practice of the Carnegie Steel Co. only adds to its definite value. The ordinary book on steel usually gives average practice only, and the author seems afraid to pin his information down to any named plants, for fear of being charged with "advertising." This is a huge mistake, and the sooner authors learn to properly credit sources of information in an open manner the better for all concerned.

Beginning with the elementary subjects of physics and chemistry the text leads up logically and easily to the pertinent problems of metallurgy as applied to iron and steel. One beauty of the whole work is that it mainly represents actual working practice, and not mere theory.

Chapter 1 of Part 1 starts off with a brief introduction and a few definitions, then takes up the physical properties of matter, energy, heat and temperature and the ether, changes in matter, the atomic and electron theories, chemical formulas and reactions, chemical nomenclature, chemical calculations, description of elements important in iron and steel making. Chapter II deals with refractories: acid, basic and neutral. Chapter III takes up ores and iron-bearing minerals, valuation of ores, the Birmingham district, the Lake Superior district, mining lake ores. Following these are chapters on fuels, fluxes and slags, the manufacture of pig iron, the Bessemer process, the basic open hearth process, the manufacture of steel in electric furnaces, the duplex and triplex processes.

Part II is headed "The Shaping of Steel." The individual chapters describe the mechanical properties of steel, the mechanical treatment of steel, essentials of rolling mill construction and operation, preparation of steel for rolling, the rolling of blooms and slabs, the rolling of billets and other semi-finished products, the rolling of plates, the rolling of large sections, the rolling of strip and merchant mill products, circular shapes, forging of axles, shafts and other round shapes.

Part III, headed "The Constitution, Heat Treatment and Composition of Steel," covers the constitution and structure of plain steel, heat-treating theory and practice, constituent elements of commercial carbon steel and their influence upon its mechanical properties, alloy steels.

Tin, Sheet Iron, and Copper Worker. Leroy J. Blinn. 32 pages. Henry Carey Baird & Co., Inc., New York.

This book is a comprehensive manual for the sheet-metal worker. It consists of many tables and formulas as well as workshop recipes that will prove helpful, especially to younger and less advanced workers. The book is well illustrated, with diagrams for laying out and cutting patterns for all kinds of sheet-metal work.

The Business Man and His Bank. By William H. Kniffin. Two hundred and seventy-eight 5½ x 8-in. pages; 24 illustrations. Bound in black cloth boards. Published by the McGraw-Hill Book Co., 239 West 39th St., New York. Price $3.

This book tells the business man who does not pretend to have any special knowledge of banking what he should know about banking practice in order to make full use of his bank in the promotion of his business. It gives helpful advice on choosing a bank, on how to prepare a financial statement, on how to read a bank statement, on the use of trade acceptances and on the making of warehouse loans. A large number of other pertinent subjects are handled in a masterly way. It is based on the author's many years' experience in mutual savings banks, national banks and state banks. The various chapters deal with the bank and the business man, types of banking institutions, choosing a bank, the point of contact, the receiving teller, how to indorse a check, bank checks and their collection, protection of bank checks, the paying teller, collecting out-of-town checks, exchange, profitable and unprofitable accounts, collection of checks through the clearing house, overdrafts, protest, credit and banking, the science of credit, how to prepare a statement, bank loans, collections, how to read a bank statement, acceptances and their uses, savings banks, bank examinations, the Federal Reserve Bank and its relation to business and foreign exchange.

Trade Catalogs

Flexible Shafting. Stow Manufacturing Co., Inc., Binghamton, N. Y. Catalog, pp. 15, 6 x 9 in. A list of the latest additions to the Stow Co.'s line of flexible shafting, clamp spindles, chucks, radial flexible boring and grinding machines, automatic screw-feed drill press with improved supports and the Stow general utility tool.

Machine for Setting Adjustable Snap Gages. Societe Genevoise D'instruments De Physique, Geneva (Switzerland). Catalog, pp. 4, 6 x 9 in. A small pamphlet giving a description (with illustrations) of the new "Machine A Pointer No. 2," for setting snap gages.

General Tools. Mound Tool Co., St. Louis, Mo. Catalog No. 7, pp. 57, 6 x 9 in. A complete list of the small machinist's tools produced by this company. It includes full specifications, price lists and illustrations of these products.

Portable Floor Cranes and Hoists. Canton Foundry and Machine Co., Canton, Ohio. Catalog, pp. 34, 4 x 7½ in. An illustrated and descriptive catalog of the several types of Canton cranes and hoists, including a few new types of "handy tool" lifting and conveying machines.

Rock Drills. Chicago Pneumatic Tool Co., 6 East 44th St., New York. Bulletin No. 504, pp. 22, 9 x 7½ in. This is an illustrated and descriptive bulletin of its slogger drills. It also gives specifications, multipliers for altitude and number of drills and a descriptive table for slogger rock drills.

Locomotive Headlight Equipment. Electric Service Supplies Co., 50 Church St., New York. Bulletin No. 166, pp. 48, 6 x 9 in. An illustrated and descriptive bulletin covering a variety of Keystone products, among which are turbo-generators, "Golden Glow" locomotive headlights, headlight switches, tender lights, locomotive wiring devices, gage light fixtures, lamps, and many smaller articles of electrical equipment.

Drilling Machines. The Avey Drilling Machine Co., Cincinnati, Ohio. Catalog, 9½ x 11⅛ in. This catalog is printed on coated stock and illustrates and describes various drilling machines.

Forthcoming Meetings

The American Railway Tool Foremen's Association will hold its annual meeting at the Hotel Sherman, Chicago, on Sept. 1 to 3.

The National Gas Engine Association, Monadnock Bldg., Chicago, Ill., will hold its thirteenth annual convention at the Congress Hotel, Chicago, on Sept. 1, 2 and 3.

The American Steel Treaters' Society and the Steel Treating Research Society will hold their second annual convention and exhibition at the Commercial Museum, Philadelphia, Pa., on Sept. 14 to 18, inclusive. J. A. Pollack, of the Pollak Steel Co., Cincinnati, Ohio, is secretary of the former society.

The National Safety Council, 168 North Michigan Ave., Chicago, Ill., will hold its ninth annual safety congress in Milwaukee on Sept. 27 to Oct. 1.

The American Foundrymen's Association will hold its annual convention and exhibit at Columbus, Ohio, on Oct. 4 to 9. C. E. Hoyt, 1401 Harris Trust Building, Chicago, Ill., is secretary.

An exposition of U. S. manufacturers at Buenos Aires, Argentine Republic, S. A., has been arranged for the month beginning Nov. 15. Information can be obtained from the American National Exhibition, Inc., Bush Terminal Sales Building, 132 West 42nd St., New York.

The National Machine Tool Builders' Association will hold its 19th annual fall convention at the Hotel Astor, New York City, on Thursday and Friday, Dec. 2 and 3, 1920. C. Wood Walter, care of the association at Worcester, Mass., is secretary.

The 1920 annual meeting of the American Society of Mechanical Engineers will be held in the Engineering Societies Building, 29 West 39th Street, New York City, from Dec. 7 to Dec. 10.

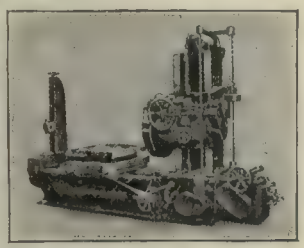
Condensed-Clipping Index of Equipment

Patented Aug. 20, 1918

Boring and Facing Machine, Horizontal, "Harvey"

G. & A. Harvey, Ltd. Govan, England.

"American Machinist" (European Edition), July 24, 1920

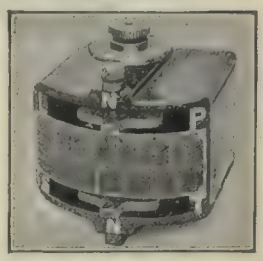


This machine can be used for facing diameters up to 36 in. The bed is of double I-section, the work table having a traverse along it of 5½ ft. The main table has a cross traverse of 3 ft., while the top table can be revolved and clamped in any position. The saddle has a vertical adjustment of 2 ft. 7 in. The spindle is driven through gears, having two sets of speeds, namely, 5 to 78 r.p.m. and 12 to 180 r.p.m. Boring and facing feeds of 8, 16 and 24 per in. and milling traverse feeds of 8, 16, 24 and 32 per in. are provided, while arrangements for cutting from 4 to 16 threads per in. are available. A 7½-hp. constant-speed motor is used. Floor space, 14 x 9 ft. Weight, about 11,000 lb.

Indicator, Screw-Cutting, Lathe, "Entwistle"

W. L. & F. Entwistle, 471 Tonge Moor Road, Bolton, England

"American Machinist" (European Edition), July 24, 1920

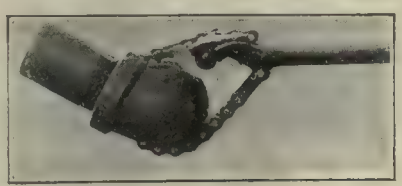


This indicator is intended for use on screw-cutting lathe so as to enable the engaging of the nut at the proper time. It consists of a small gear box which is attached to the saddle. A wormwheel engages the leadscrew of the lathe and four different speeds of rotation of the dial are provided. During the first cut taken on a job a mark of the dial is made to register with the fixed point. On succeeding cuts, whenever a mark registers with the fixed point, the cutting tool will engage with the thread being cut. The lathe can be kept running, and it is not necessary to return the saddle to a definite position before the feed is engaged, since any mark on the dial can be used. The attachment is suited to work on a large range of single and multiple threads.

Wrench, Pipe and Fitting, "Falcon"

J. H. Williams & Co., Brooklyn, N. Y.

"American Machinist," August 12, 1920

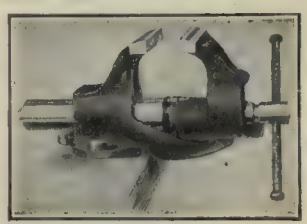


The wrench is particularly adapted for work on pipe fittings. The jaw is solid across the center but has open ends, the face resembling somewhat the letter H. The curved face of the jaw allows an effective grip with three shifts of the chain links and also permits work in close quarters. The wrench is designed for one-way operation. When the jaw becomes dull its position may be reversed by driving out the holding pin. The jaw is made from tool steel and the lever from 0.45 per cent carbon steel. The wrench is made in six sizes, covering all sizes of pipe from ⅛ to 12 inches.

Vise, Bench, All-Steel, "Soderfors"

V. Lowener, 114 Liberty Street, New York, N. Y.

"American Machinist," August 12, 1920



The main parts are made of Dannemora special alloy steel. The stationary jaw is an integral part of the body. The movable-jaw body is round and fits closely in a hole in the main body. The screw and nut are said to be made of a special long-wearing alloy steel. The vises are made in eight sizes and can be furnished with either plain or swivel bases. The jaw widths of the various sizes range from 3¼ to 8⅝ in. and the weights with plain base from 11 to 200 lb. and with swivel base from 13¼ to 250 lb.

Press, Bench, Horn, "Emco," Type V

Enterprise Machinery Co., 30 South Clinton St., Chicago, Ill.

"American Machinist," August 12, 1920



This press, known as type V, is intended for rapid production in the assembling of small parts and for operations such as seaming and riveting on hollow work. The machine has a single-stop stroke, and is made with strokes of ¾, 1¼ and 1⅞ in. The ram is 1⅜ in. square and has an adjustment of ¼ in. The horn hole is 1⅞ in. in diameter. The press is 26 in. high, runs at 300 r.p.m. and weighs 130 lb.

Milling Machine, Multiple-Spindle, Continuous, Vertical, "Betts"

Betts Machine Co., Rochester, N. Y.

"American Machinist," August 12, 1920



The machine is intended for heavy production milling on duplicate parts, and is of simple and rigid construction. It is provided with three forged spindles driven through long splines and spur gears, and capable of being adjusted vertically by hand. The machine may be driven either from a pulley or by a motor at the top of the machine. The work-holding fixtures are carried on the continuously revolving table, and the pieces are changed while the fixtures are passing from one cutter to the next. The table is driven through a large internal gear, and four rates of continuous feed are obtained through sliding steel gears. It is claimed that the machine will take care of as much work as can be conveniently handled by two men.

Key-Seating Machine, Horizontal-Bar, "Hercules"

Hercules Manufacturing Co., Portland, Ore.

"American Machinist," August 12, 1920

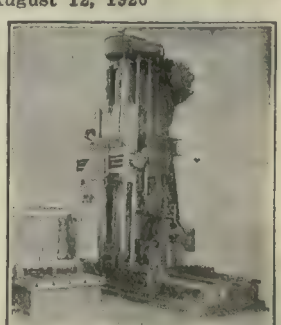


The cutter bar reciprocates horizontally, the work being fastened to the vertical face-plate, which can be tilted if it is desired to cut a taper keyway. The machine is light enough to be moved up to very heavy work rather than to move the work. The machine cuts on the forward stroke and the cutter is relieved on the backward stroke. The bar is provided with power feed in a vertical plane. The motion of the cutter bar is controlled by means of a lever, the reversal of motion being obtained by means of a wood-covered friction disk alternately engaging the two driving pulleys, which run in opposite directions. Maximum length of stroke, 12½ in. Strokes per min., 15. Horsepower required, 2. Net weight, 800 lb.

Slotting Machine, Portable, "Newton"

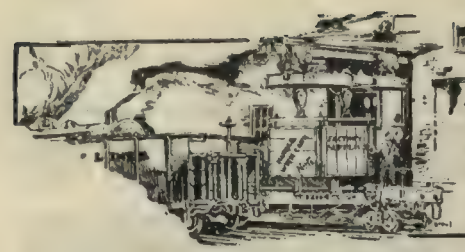
Newton Machine Tool Works, Inc., 23d and Vine Sts., Phila., Pa.

"American Machinist," August 12, 1920



The machine is intended for slotting work on very heavy machine parts, and it consists of an upright mounted on a sub-base and carrying a tool suitably mounted on a saddle that reciprocates vertically. The saddle has a maximum stroke of 76 in. The toolslide has a crossfeed of 40 in. and an in-and-out feed of 6 in., both actuated by power. The toolslide has, also, a vertical adjustment on the saddle of 24 inches. The toolholder is hinged and the tool apron can be swiveled through a full circle for angular cutting. The crossfeed of the upright on the sub-base is 84 in., being driven by a separate 7½-hp. motor. The traverse of the saddle is operated by a coarse-pitch screw running in a one-piece bronze nut and driven by a 15-hp. reversing motor at the top of the upright.

Clip, paste on 3 x 5-in. cards and file as desired



THE WEEKLY PRICE GUIDE

IRON AND STEEL

PIG IRON—Quotations compiled by The Matthew Addy Co.:

	Current	One Year Ago
CINCINNATI		
No. 2 Southern	$45.60	$29.80
Northern Basic	44.80	27.55
Southern Ohio No. 2	46.80	28.55
NEW YORK—TIDEWATER DELIVERY		
2X Virginia (Silicon 2.25 to 2.75)	52.60	31.90
Southern No. 2 (Silicon 2.25 to 2.75)	50.70	33.95
BIRMINGHAM		
No. 2 Foundry	42.00@44.00	25.75
PHILADELPHIA		
Eastern Pa., No. 2x, 2.25-2.75 sil.	47.00@49.50*	30.65
Virginia No. 2	47.00*	30.85
Basic	44.50†	29.90
Grey Forge	43.50*	29.90
CHICAGO		
No. 2 Foundry local	46.00	27.25
No. 2 Foundry, Southern	48.70	31.75
PITTSBURGH, INCLUDING FREIGHT CHARGE FROM VALLEY		
No. 2 Foundry	45.65	28.15
Basic	46.00	27.15
Bessemer	46.00@47.00	29.35
MONTREAL		
Silicon 2.25 to 2.75%	43.25	

* F.o.b. furnace. † Delivered.

STEEL SHAPES—The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses at the cities named:

	New York Current	New York One Month Ago	New York One Year Ago	Cleveland Current	Cleveland One Year Ago	Chicago Current	Chicago One Year Ago
Structural shapes	$4.47	$3.97	$3.47	$5.00	$3.37	$3.97	$3.47
Soft steel bars	4.62	4.12	3.37	4.50	3.27	3.87	3.37
Soft steel bar shapes	4.62	4.12	3.37	....	3.27	3.87	3.37
Soft steel bands	6.32	5.32	4.07	6.25	....	....	....
Plates, ¼ to 1 in. thick	4.67	4.17	3.67	4.50	3.57	4.17	3.67

BAR IRON—Prices per 100 lb. at the places named are as follows:

	Current	One Year Ago
Mill, Pittsburgh	$4.25	$2.62
Warehouse, New York	4.57	3.37
Warehouse, Cleveland	3.52	3.22
Warehouse, Chicago	3.75	3.37

SHEETS—Quotations are in cents per pound in various cities from warehouse; also the base quotations from mill:

Blue Annealed	Large Mill Lots Pittsburgh	New York Current	New York One Year Ago	Cleveland	Chicago
No. 10	3.55-7.00	7.12@8.00	4.57	8.10	7.02
No. 12	3.60-7.05	7.17@8.05	4.57	8.15	7.07
No. 14	3.65-7.10	7.22@8.10	4.67	8.20	7.12
No. 16	3.75-7.20	7.32@8.20	4.77	8.30	7.22
Black					
Nos. 18 and 20	4.20-6.20	8.30@9.80	5.30	8.70	7.80
Nos. 22 and 24	4.25-6.25	8.35@9.85	5.35	8.75	7.85
No. 26	4.30-6.30	8.40@9.90	5.40	8.80	7.90
No. 28	4.35-6.35	8.50@10.00	5.50	8.90	8.00
Galvanized					
No. 10	4.70 8.00	8.80@11.50	6.20	9.00	8.15
No. 12	4.80 8.10	8.90@11.50	6.25	9.10	8.20
No. 14	4.80-8.10	8.90@11.60	6.30	9.10	8.35
Nos. 18 and 20	5.10-8.40	9.15@11.90	6.60	9.40	8.65
Nos. 22 and 24	5.25 8.55	9.30@12.05	6.75	9.55	9.05
No. 26	5.40 8.70	9.45@12.20	6.90	9.70	9.20
No. 28	5.70-9.00	9.75@12.50	7.20	10.00	9.50

Acute scarcity in sheets, particularly black, galvanized and No. 16 blue enameled.

Automobile sheets are unavailable except in fugitive instances, when prices are 9.45c per lb. for No. 16; 9.50 for Nos. 18 and 20, and 9.55c for Nos. 22 and 24.

COLD FINISHED STEEL—Warehouse prices are as follows:

	New York	Chicago	Cleveland
Round shafting or screw stock, per 100 lb. base	$6.25	$5.80	$6.00
Flats, square and hexagons, per 100 lb. base	6.75	6.30	6.50

DRILL ROD—Discounts from list price are as follows at the places named:

	Per Cent.
New York	50
Cleveland	50
Chicago	50

NICKEL AND MONEL METAL — Base prices in cents per pound F. O. B. Bayonne, N. J.

Nickel	
Ingot and shot	43
Electrolytic	45

Monel Metal			
Shot and blocks	35	Hot rolled rods (base)	40
Ingots	38	Cold rolled rods (base)	56
Sheet bars	40	Hot rolled sheets (base)	55

Special Nickel and Alloys	
Malleable nickel ingots	45
Malleable nickel sheet bars	47
Hot rolled rods, Grades "A" and "C" (base)	60
Cold drawn rods, grades "A" and "C" (base)	72
Copper nickel ingots	42
Hot rolled copper nickel rods (base)	52
Manganese nickel hot rolled (base) rods "D" — low manganese	64
Manganese nickel hot rolled (base) rods "D"— high manganese	67

Domestic Welding Material (Swedish Analysis)— Welding wire in 100-lb lots sells as follows, f. o. b. New York: 5/32, 8½c. per lb.; ¼, 8c.; 5/16 to ½, 7½c. Domestic iron sells at 12c. per lb.

MISCELLANEOUS STEEL—The following quotations in cents per poundare from warehouse at the places named:

	New York Current	Cleveland Current	Chicago Current
Openhearth spring steel (heavy)	7.00	8.00	9.00
Spring steel (light)	10.00	11.00	12.25
Coppered bessemer rods	9.00	8.00	6.75
Hoop steel	6.57	6.50	5.32
Cold-rolled strip steel	12.50	8.25	10.75
Floor plates	6.80	6.00	6.77

PIPE—The following discounts are to jobbers for carload lots on the Pittsburgh basing card, discounts on steel pipe, applying as from January 14, 1920, and on iron pipe from January 7, 1920.

Steel Inches	Steel Black	Steel Galvanized	Iron Inches	Iron Black	Iron Galvanized
BUTT WELD					
⅜ to 3	54–57½%	41½–44%	⅜ to 1¼	24½–34½%	8 –18½%
LAP WELD					
2	47 –50½%	34½–38%	1¼	....	....
2½ to 6	50 –53½%	37½–41%	1½	....	....
7 to 12	47 –50½%	33½–37%	2	20½–28½%	6½–14½%
13 to 14	37½–41 %	....	2½ to 3	22½–30½%	9½–17½%
15	35 –38½%	....	3½ to 4	22½–30½%	9½–17½%
			4½ to 6	22½–30½%	9½–17½%
			7 to 12	19½–27½%	6½–14½%
BUTT WELD, EXTRA STRONG PLAIN ENDS					
⅜ to 1¼	52 –55½%	39½–43%	⅜ to 1¼	24½–34½%	9½–19½%
2 to 3	53 –56½%	40½–44%			
LAP WELD, EXTRA STRONG PLAIN ENDS					
2	45 –48½%	33½–37%	1¼	....	....
2½ to 4	48 –51½%	36½–40%	1½	....	....
4½ to 6	47 –50½%	35½–39%	2	21½–29½%	8½–16½%
7 to 8	43 –46½%	29½–33%	2½ to 4	23½–31½%	11½–19½%
9 to 12	38 –41½%	24½–28%	4½ to 6	22½–30½%	10½–18½%
			7 to 8	14½–22½%	2½–10½%
			9 to 12	9½–17½%	5½–+2½%

	New York Black	New York Galv.	Cleveland Black	Cleveland Galv.	Chicago Black	Chicago Galv.
⅜ to 3 in. steel butt welded	40%	24%	40%	31%	54%40%	40½@30 %
2½ to 6 in. steel lap welded	35%	20%	42%	27%	50@40%	37½@27½%

Malleable fittings. Classes B and C, banded, from New York stock sell at plus 32%. Cast iron, standard sizes, net.

METALS

MISCELLANEOUS METALS—Present and past New York quotations in cents per pound, in carload lots:

	Current	Month Ago	Year Ago
Copper, electrolytic	19.00	19.25	21.75
Tin in 5-ton lots	49.00	61.50	70.00
Lead	9.50	9.00	5.50
Zinc	8.35	8.70	8.00
ST. LOUIS			
Lead	8.90	8.87½	5.25
Zinc	7.70@8.40	8.37½	7.65

At the places named, the following prices in cents per pound prevail, for 1 ton or more:

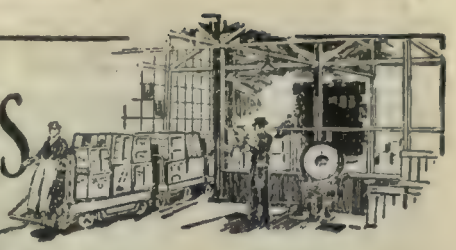
	New York Current	New York Month Ago	New York Year Ago	Cleveland Current	Cleveland Year Ago	Chicago Current	Chicago Year Ago
Copper sheets, base	33.50	33.50	29.50	34.00	33.50	36.00	36.50
Copper wire (carload lots)	31.25	31.25	26.50	31.50	29.50	27.00	25.00
Brass sheets	28.50	28.50	23.00	36.00	29.00	27.00	28.00
Brass pipe	33.00	33.00	34.00	31.00	36.00	35.00	37.00
Solder (half and half) (case lots)	38.00	33.00	45.00	40.50	41.00	38.00	41.00

Copper sheets quoted above hot rolled 16 oz., cold rolled 14 oz. and heavier, add 2c.; polished takes 5c. per sq.ft. extra for 20-in. widths and under; over 20 in., 7½c.

BRASS RODS—The following quotations are for large lots, mill. 100 lb. and over, warehouse; net extra:

	Current	One Year Ago
Mill	25.00	19.00
New York	27.00	21.50
Cleveland	27.00	30.00
Chicago	29.00	30.00

SHOP MATERIALS AND SUPPLIES



ZINC SHEETS—The following prices in cents per pound prevail:

Carload lots f.o.b. mill 12.50

	Warehouse			
	—In Casks—		— Broken Lots —	
	Current	One Year Ago	Current	One Year Ago
Cleveland	15.00	12.50	15.50	13.00
New York	14.00	11.50	14.50	12.50
Chicago	15.00	16.50	15.00	16.00

ANTIMONY—Chinese and Japanese brands in cents per pound, in ton lots for spot delivery, duty paid:

	Current	One Year Ago
New York	7.50	9.50
Chicago	7.75	10.25

OLD METALS—The following are the dealers' purchasing prices in cents per pound:

	— New York —			
	Current	One Year Ago	Cleveland	Chicago
Copper, heavy, and crucible	16.25	19.00	15.00	15.50
Copper, heavy, and wire	15.25–15.75	18.00	14.50	15.00
Copper, light, and bottoms	13.00	15.50	13.00	14.00
Lead, heavy	7.25	5.00	7.00	7.50
Lead, tea	5.00	3.75	4.50	6.00
Brass, heavy	10.25	12.50	11.00	15.50
Brass, light	7.75– 8.00	8.50	8.00	9.50
No. 1 yellow brass turnings	9.00– 9.50	10.00	8.50	9.50
Zinc	5.25	4.50	4.50	5.50

ALUMINUM—The following prices are from warehouse at places named:

	New York	Cleveland	Chicago
No. 1 aluminum, 98 to 99% pure, in ingots for remelting (1-15 ton lots), per lb	$33.00	$33.00	$33.50

COPPER BARS—From warehouse sell as follows in cents per pound, for ton lots and over:

	Current	One Year Ago
New York (round)	38.00	33.00
Chicago	29.00	31.00
Cleveland	34.00	35.50

BABBITT METAL—Warehouse price per pound:

	—New York—		—Cleveland—		— Chicago —	
	Current	One Year Ago	Current	One Year Ago	Current	One Year Ago
Best grade	90.00	90.00	60.50	80.00	60.00	75.00
Commercial	50.00	50.50	21.00	18.50	15.00	15.00

SHOP SUPPLIES

NUTS—From warehouse at the places named, on fair-sized orders, the following amount is deducted from list:

	— New York —		— Cleveland —		— Chicago —	
	Current	One Year Ago	Current	One Year Ago	Current	One Year Ago
Hot pressed square	+ $6.00	$1.50	$ .50	$2.25	List	2.00
Hot pressed hexagon	+ 6.00	1.50	.50	2.25	List	2.00
Cold punched hexagon	+ 6.00	1.50	.50	2.25	List	1.30
Cold punched square	+ 6.00	1.50	.50	2.25	List	1.30

Semi-finished nuts, ⅞ and smaller, sell at the following discounts from list price:

	Current	One Year Ago
New York	30%	50–10%
Chicago	50%	50%
Cleveland	50%	60-10-10%

MACHINE BOLTS—Warehouse discounts in the following cities:

	New York	Cleveland	Chicago
½ by 4 in. and smaller	+ 20%	20%	20%
Larger and longer up to 1½ in. by 30 in.	+ 20%	20%	10%

WASHERS—From warehouses at the places named the following amount is deducted from list price:

For wrought-iron washers:

New York..... list Cleveland..... $2.50 Chicago..... $3.00

For cast-iron washers, ⅜ and larger, the base price per 100 lb. is as follows:

New York..... $7.00 Cleveland..... $4.50 Chicago..... $4.75

CARRIAGE BOLTS—From warehouses at the places named the following discounts from list are in effect:

	New York	Cleveland	Chicago
½ by 6 in. and smaller	+ 20%	35%	10%
Larger and longer up to 1 in. by 30 in.	+ 20%	20%	5%

COPPER RIVETS AND BURS sell at the following rate from warehouse:

	Rivets		Burs	
	Current	One Year Ago	Current	One Year Ago
Cleveland	20%	20%	10%	20%
Chicago	net	20%	net	20%
New York	25%	40%	net	40%

RIVETS—The following quotations are allowed for fair-sized orders from warehouse:

	New York	Cleveland	Chicago
Steel ⅞ and smaller	List Net	40%	30%
Tinned	List Net	40%	30%

Boiler, ½, ⅝, 1 in. diameter by 2 to 5 in. sell as follows per 100 lb.:

New York..... $6.00 Chicago..... $5.62 Pittsburgh..... $4.5

Structural, same sizes:

New York..... $7.10 Chicago..... $5.72 Pittsburgh..... $4.60

MISCELLANEOUS

SEAMLESS DRAWN TUBING—The base price in cents per pound from warehouse in 100-lb. lots is as follows:

	New York	Cleveland	Chicago
Copper	$34.00	$36.00	$35.00
Brass	33.00	36.00	34.00

The prices, of course, vary with the quantity purchased. For lots of less than 100 lb., but not less than 75 lb., the advance is 1 c.; for lots of less than 75 lb., but not less than 50 lb., 2½c. over base (100-lb. lots); less than 50 lb., but not less than 25 lb., 5c. should be added to base price; quantities from 10-25 lb., extra is 10c.; less than 10 lb., add 15–20c.

Double above extras will be charged for angles, channels and sheet metal mouldings if ordered in above quantities. Above extras also apply to brass rod other than standard stock sizes—stock sizes being considered as ⅛-2 in. inclusive in rounds, and ¼-1½ in., inclusive, in square and hexagon—all varying by thirty seconds up to 1 in. by sixteenths over 1 in. On shipments aggregating less than 100 lb., there is usually a boxing charge of $1.50.

LONG TERNE PLATE—In Chicago No. 28 primes from stock sell, nominally, for $12.50 per 100 lbs.

In Cleveland—$10 per 100 lbs.

COTTON WASTE—The following prices are in cents per pound:

	— New York —			
	Current	One Year Ago	Cleveland	Chicago
White	15.00@17.00	13.00	16.00	11.00 to 14.00
Colored mixed	9.00@14.00	9.00–12.00	12.00	9.50 to 12.00

WIPING CLOTHS—Jobbers' price per 1000 is as follows:

	13½x13½	13½x20½
Cleveland	55.00	65.00
Chicago	41.00	43.50

SAL SODA sells as follows per 100 lb.:

	Current	One Month Ago	One Year Ago
New York	$2.00	$3.00	$1.75
Philadelphia	2.75	2.75	1.75
Cleveland	3.00	2.50	2.75
Chicago	2.75	2.50	2.00

ROLL SULPHUR in 360-lb. bbl. sells as follows per 100 lb.:

	Current	One Month Ago	One Year Ago
New York	$3.90	$3.90	$3.65
Philadelphia	3.65	3.65	3.62
Chicago	4.10	5.00	4.12½

COKE—The following are prices per net ton at ovens, Connellsville:

	July 8	July 1	June 24
Prompt furnace	$17.50@$18.50	$17.50@$18.50	$15.00@$16.00
Prompt foundry	18.00@ 19.00	18.00@ 19.00	16.00@ 17.00

FIRE CLAY—The following prices prevail:

		Current
Ottawa, bulk in carloads	Per Ton	$8.00
Cleveland	100-lb. bag	1.00

LINSEED OIL—These prices are per gallon:

	—New York—		—Cleveland—		—Chicago—	
	Current	One Year Ago	Current	One Year Ago	Current	One Year Ago
Raw in barrels, (5 bbl. lots	$1.48	$2.25	$1.86	$2.15	$1.67	$2.48
5-gal cans, (without cans)	1.51*	2.40	2.15	2.40	1.92	2.68

*To this *oil* price must be added the cost of the cans (returnable), which is $2.25 for a case of six.

WHITE AND RED LEAD—Base price per pound:

	— Red —				— White —	
	Current		One Year Ago		One Year Ago	
	Dry	In Oil	Dry	In Oil	Current Dry and In Oil	Dry and In Oil
100 lb. keg	15.50	17.00	13.00	14.50	15.50	13.00
25 and 50-lb. kegs	15.75	17.25	13.25	14.75	15.75	13.25
12½-lb. keg	16.00	17.50	13.50	15.00	16.00	13.50
5-lb. cans	18.50	20.00	15.00	16.50	18.50	15.00
1-lb. cans	20.50	22.00	16 00	17.50	20.50	16.00

500 lb. lots less 10% discount. 2000 lb. lots less 10–2½% discount.

NEW and ENLARGED



Edited by
L·V·FLETCHER

Machine Tools Wanted

If in need of machine tools send us a list for publication in this column

Conn., Bridgeport—The Hatheway Mfg. Co., Bostwick Ave.—one Manville or Baird 4-slide wire-forming machine.

Mass., Boston—City, Schoolhouse Dept., Schoolhouse Com., Purch. Agt.—
One 4-in. No. 6 Chicago steel cornice brake.
One 36-in. Dreis & Krump squaring shears.
One 20-in. Dreis & Krump "Niagara" tin folder.
One champion sheet iron folder.
One improved adjustable bar folder.
One continuous rolling cutter shears.
One wire ring former.
One 2 x 30 in. "Niagara" stove pipe former.
One 30-in. "Wrights" tin pipe former.
One Miller's oval handle former.
One 6-in. throat beading former, with offset standard.
One beading machine.
One large and two small turning machines with offset standard.
One large and two small burring machines.
Two wiring machines with offset standard.
One Van Bramer's patent wire cutter.
One No. 1 "Little Blacksmith" combined punch, shear and bender.
Two machinists' vises, 4-in. jaws.
Three bench plates, "Niagara" No. 2.
One double seaming stake, "Niagara" No. 1.
One conductor stake, "Niagara" No. 00.
One beakhorn stake, "Niagara" No. 2.
Two hollow mandrel stakes, "Niagara" No. 0.
Two No. 189 blowhorn stakes.
One 14½-in. plain creasing stake, one bevel edge square, one coppersmith square, one common square, one hatchet, one bottom, one candlemould, one needlecase and one 3¾ diam. round-head stakes.
One square pan swedge.
One type BHA "Cincinnati" bench grinder.

Md., Baltimore—The Talbott Machine & Supply Co., 1411 West Baltimore St., C. L. Talbott, Purch. Agt.—prices on all machine tools, machinery, etc.

N. Y., New York (Borough of Brooklyn)—The Schaap Automobile Co., 344 Cumberland St.—cylindrical, rotary surface and internal grinders and single purpose lathes, all for piston ring manufactory.

N. Y., New York (Borough of Manhattan)—Erie R.R., 50 Church St.—one 6-ft. radial drill.

N. Y., New York (Borough of Manhattan)—Scott & Williams, 366 Bway.—equipment for new experimental shop at Jamaica, L. I.

N. Y., New York (Borough of Manhattan)—J. Stolz & Son, 841 East 136th St.—power punch and shear for 1-in. plate.

N. Y., New York (Borough of Manhattan)—Wonham, Bates, Goode Trading Co., 17 Battery Pl.—one No. 3 and one No. 17 combination and one 42-in. vertical turret lathes, Bullard type.

N. Y., Buffalo—The Pierce-Arrow Motor Car Co., 1695 Elmwood Ave.—several grinding machines and drills of various sizes.

N. Y., Syracuse—The Jones Oil Engine Co., 227 Walton St.—24 upright high-duty drills, 4 crankshaft lathes, 4 cylindrical and internal grinders and 4 horizontal boring machines.

Pa., Norristown—The Hutchinson Mfg. Co.—machine and carpenter shop equipment.

Pa., Philadelphia — The Colonial Ice Cream Co., 4th and Poplar Sts.—machine tools for garage work.

Pa., Tacony (Philadelphia P. O.)—The Dodge Electric Steel Co., State Rd.—heavy-duty grinders.

Ala., Mobile—The Kelly Dry Dock Shipbuilding Co., Commerce St.—lathes, drills, shapers, grinders, power pipe threading machines, etc., also woodworking machinery.

La., New Orleans—The Little Grand Garage, 1548 Canal St.—12-in. swing lathe and hand power press, 3 or 4 tons.

La., New Orleans—The Motor Car Co., 1423 Canal St., T. A. North, Prop.—16-in. lathe.

La. New Orleans — The New Orleans Motor Co., 1801 Canal St., I Levy, Mgr.—drills, taps, speed wrenches and reamers.

La., New Orleans—Rex Automobile Co., 202-208 Saratoga St.—drill presses.

La., New Orleans—E. J. Serpas Auto Repair Shop, 1611 Gravier St.—electric drills up to ¾ in. and milling machines, medium sizes.

Va., Richmond—The Virginia Machine Wks., 2310-12 East Main St., W. W. Tennant, Purch. Agt.—radial lathe.

Ill., Chicago—The Atchison, Topeka & Santa Fe Ry., Ry. Exch. Bldg., M. J. Collins, Purch. Agt.—51-in. vertical boring machine with two heads on cross rail.

Mich., Benton Harbor—The Crary Machine Wks., H. Vissering, Pres.—miscellaneous machine tool equipment for plant expansion.

Mich., Detroit—The Crescent Tool Co., 11 Woodbridge St.—general machine tool equipment.

Mich., Detroit—The Hayes Mch. Co., East Larned St., A. Sprague, Secy.—large and medium presses of standard make.

Mich, Detroit—The Hess Motor Co., 112 Sherman St.—miscellaneous machine shop equipment.

Mich., Detroit—A. Stein, 1375 12th St.—one spinning lathe (used preferred).

Mich., Kalamazoo—The Kalamazoo Co. Rd. Comm.—garage equipment.

O., Columbus—The Atcheson Die Tool Co., 609 North 4th St., H. S. Atcheson, Purch. Agt.—one lathe, one press and one shaper.

O., Columbus—The Columbus Auto Parts Co., 215 East Russell St.—one grinder and one shaper.

O., Columbus—The J. Immel & Sons Co., 1675 South High St.—punches, cutters and boring machines.

O., Columbus—The Lawwell-McLeish Co., 97-101 North 4th St., T. H. Lawwell, Purch. Agt.—one lathe with 16-in. swing and 8-ft. base.

O., Columbus—The Monitor Motor Car Co., 373 East 5th Ave., C. C. Cummins, Purch. Agt.—grinders, presses, lathes, shapers, etc.

O., Columbus—The Ohio Auto Sales Co., 772 North High St., M. F. Millikin, Purch. Agt.—grinders and drill presses.

O., Newark—The Holliday Motor Car Co., G. W. Shartee, Purch. Agt., 359 Dublin Ave., Columbus—
Five planes 24 to 48 in.
Twelve to 15 lathes running from 15 to 36 in.
Six drill presses from 14 to 32 in.
One slotter.
Three boring machines.
Two topping machines.
Two threading machines, etc.

O., Toledo—The Maumee Finishing Co., the DeVore Co., Nicholas Bldg., Purch. Agts.—lathe having 18 ft. between the centers, swing over the carriage of 26 in., with the necessary collars; double emery stand, 20-24-in. drill press, rip saw with table, 14 or 16-in. saw, 14 or 16-in. cross cut with table, necessary collars and clutches, also high-grade set of dial scales, automatic, platform 48 x 60 (Howe scales preferred).

Wis., Two Rivers—The Two Rivers Plating & Mfg. Co.—one No. 5 Bliss spinning lathe complete with all attachments (or equivalent) and one 4-jawed independent 26-in. chuck for 30-in. lathe.

Minn., Minneapolis—The Minneapolis Elevator Repair and Supply Co., 19 High St., F. A. Pigeon, Purch. Agt.—one good disk grinder, lathe and shaper.

Tex., Fort Worth—The Standard Battery Mfg. Co., 1103 North Main St., J. J. King, Secy.-Treas.—4 power punch presses, sizes up to 1 in.; lathe and metal shapers.

Machinery Wanted

Mass., Boston—L. W. Allentuck, 6 Fordham Rd.—garage repair shop equipment.

Mass., Boston—The Nat. Co., 338 Congress St.—Polishing nickel plating and light woodworking machinery, also woodturning production lathe.

Mass., Lynn—M. J. Bratt, 14 Central Ave.—garage equipment.

N. H., North Stratford—New Hampshire Stave & Heading Mill—woodworking equipment.

N. J., Newark—The Williams Baking Co., 711 South 10th St.—baking machinery.

N. Y., New York (Borough of Manhattan)—The Amer. Can Co., 120 Bway—can-making machinery for new plant at Portland, Ore.

N. Y., New York (Borough of Manhattan)—E. F. Callan, 17 Battery Pl.—one locomotive crane, caterpillar type.

Pa., Allentown—The Lehigh Portland Cement Co.—one 15-ton crane with 42 ft. 6 in. span, for new building at New Castle.

Pa., Frankford (Philadelphia P. O.—W. & H. Rowland Co.—one 6 in. and one 4½ in. cutting-off machine.

Pa., Philadelphia—G. H. Evans, 2539 North 26th St.—power pipe cutting machine.

Pa., Philadelphia—C. S. Jarvis, 1217 Vine St.—garage equipment.

La., New Orleans—The Louisiana Marble Works, 703 Carondelet St., G. A. Shane, Mgr.—pneumatic hammer, 1⅛ in. x ⅜ in., one cut off machine for cutting marble made like a buzz-saw, ¼ in. thick wheel, and one air compressor.

Va., Richmond—A. Reeves, West Broad St.—emery wheels.

Va., Richmond—The J. H. Rose Co., Inc., 12th and Main Sts., A. Hazlewood, Purch. Agt.—machinery for cutting, forming and making tin boxes.

Va., Richmond—The Standard Paper Co., Hull and Canal Sts.—paper mill machinery.

Ill., Chicago—A. M. Stoehr, 844 North Wells St.—miscellaneous metal working machinery.

Mich., Detroit—The Penberthy Injector Co., 346 Holden Ave.—metal working equipment for plant expansion.

Mich., Detroit—The Pere Marquette Railway Co., Union Depot—2½ in. bolt cutting machine with triple head.

O., Findlay—The Differential Car Co., Inc.—equipment for the manufacture of steel cars.

O., Toledo—The O'Neil Machine Co., Factories Bldg.—one 36 x 36 in. x 8 ft. planing machines, 2 heads (used).

Wis., Grafton—The Jungers Stove Range Co.—additional machinery for manufacture of stoves.

Wis., Merton—The Merton Dairy Products Co.—creamery equipment.

Wis., Sheboygan—The Phoenix Chair Co., South 12th and Virginia Sts.—machinery for the manufacture of chairs, etc.

Tex., Dallas—The Texas Hosiery Mills, 1407-09 South Ervay St., J. C. Dobson, Mgr.—electrically driven knitting machinery

Ont., Carp—The Review Printing Co.—new equipment.

Ont., Grand River—The Beatty Bros., Fergus, Ont.—machinery equipment for woodworking plant.

Ont., St. Thomas—The Elgin Milk Products Co.—modern machinery and equipment for special milk products.

Ont., St. Thomas—The Canada Iron Foundries, Ltd., S. Gilbert, Mgr.—foundry equipment. Noted Aug. 12.

P. E. Q.—Charlottetown—Bruce Stewart & Co.—machinery equipment for the manufacture of gasoline engines.

Metal Working

NEW ENGLAND STATES

Conn., Bridgeport—The Bridgeport Gas Light Co., 793 Main St., has awarded the contract for the construction of a 1 story, 60 x 160 ft. garage on Housatonic Ave. Estimated cost, $25,000.

Conn., New Britain—The Landers, Frary & Clark Co., Commercial St., will build a 3 story 60 x 210 ft. addition to factory on Ellis St. for the manufacture of electrical specialties. Estimated cost, $115,000. Noted April 29.

Conn., New Britain—Swift & Upson Lumber Co., 153 Elm St., will soon award the contract for the construction of a 1 story, 30 x 50 ft. garage on Elm St. Estimated cost, $10,000.

Conn., New Haven—The Tuttle Color Printing Co., 30 Crown St., will soon award the contract for the construction of a 2 story, 50 x 70 ft. factory on Olive St. Estimated cost, $20,000. Della, Valle & Vece, Exch. Bldg., archts.

Conn., West Haven—F. Dainesi, 74 Lamson St., will build a 1 story, 40 x 105 ft. garage on Elm St. and 1st Ave. Estimated cost, $20,000.

Mass., Boston—J. H. Dunn, 101 Tremont St., has awarded the contract for the construction of a 1 story, 70 x 90 ft. garage on Dorchester St. Estimated cost $25,000.

Mass., Brighton (Boston P. O.)—C. F. Vallender, 175 Tremont St., Boston, has awarded the contract for the construction of a 1 story garage on Colonial Rd. Estimated cost, $20,000.

Mass., Cambridge—The Mack Motor Truck Co., 185 Massachusetts Ave., has awarded the contract for the construction of a 1 story, 25 x 110 ft. addition to its garage. Estimated cost, $22,000. Noted July 29.

Mass., Cambridge—The Standard Oil Co. of New York, 50 Congress St., Boston, has awarded the contract for the construction of a 5 story, 120 x 140 ft. garage and repair shop on Munroe St., here. Estimated cost, $275,000.

Mass., Cambridge—The Suffolk Engraving & Electrotyping Co., 394 Atlantic Ave., Boston, has awarded the contract for the construction of a 6 story, 100 x 100 ft. factory on Main St., here. Estimated cost, $225,000. Noted July 22.

Mass., Chelsea—M. Rosenthal, 64 Hawthorn St., will soon award the contract for the construction of a 2 story garage on Ellsworth St. Estimated cost, $75,000. S. Eisenberg, Exch. Bldg., Archt.

Mass., East Boston (Boston P. O.)—The Simpson Dry Goods Co., 249 Marginal St., has awarded the contract for the construction of a 1 story addition to its machine shop. Estimated cost, $20,000.

Mass., Lynn—M. J. Bratt, 14 Central Ave., will soon award the contract for the construction of a 1 story, 90 x 120 ft. garage on Washington St. Estimated cost, $35,000. G. A. Coronet, Washington St., Archt.

Mass., Willimansett (Holyoke P. O.)—Rauch & Lang, Inc., has awarded the contract for the construction of a 1 story, 300 x 325 ft. factory, on Meadow St., for the manufacture of electric automobiles. Estimated cost, $300,000. Noted June 17.

Mass., Worcester—The Boston & Maine R.R., North Station, Boston, has awarded the contract for alterations to the 1 story machine shop on Bridge St. Estimated cost, $10,000.

N. H., Dover—The Natl. Woodworking Mchy. Co., Bway., has awarded the contract for the construction of a 50 x 100 ft. foundry, 35 x 200 ft. machine shop and a 40 x 100 ft. pattern shop, all 1 story, on Locust St. Estimated cost, $125,000.

R. I., Cumberland—The Standard Nut & Bolt Co., c/o A. H. Humes, Archt., 229 Main St., Pawtucket, will soon award the contract for the construction of a 1 story, 60 x 80 ft. factory on Abbott St., here. Estimated cost, $25,000.

MIDDLE ATLANTIC STATES

D. C., Washington—The Vasil Steam Systems Co., 314-318 Washington Loan & Trust Bldg., plans to construct a foundry and machine shop.

N. J., Newark—The Amer. Can Co., 120 Bway., New York City, is having plans prepared for the construction of a factory, here. Estimated cost, $500,000. Private plans.

N. J., Newark—Z. Raskin, 182 Harvard St., will build a 1 story, 69 x 100 ft. garage. Estimated cost, $25,000.

N. J., Newark—I. Rekoor, 61 Monmouth St., is having plans prepared by M. B. Silberstein, Archt., 119 Springfield Ave., for the construction of a 1 story, 60 x 100 ft. garage. Estimated cost, $25,000.

N. J., Orange—The Monroe Calculating Machine Co., 49 Mitchell St., has awarded the contract for the construction of a 4 story, 67 x 175 ft. factory.

N. J., Trenton—O. Agabiti, 636 Roebling Ave., has awarded the contract for the construction of a 1 story, 25 x 90 ft. garage on Division St. Estimated cost, $18,000.

N. Y., New York (Borough of Bronx)—The Welrich Constr. Co., c/o P. Steigman, Archt., 690 Bway., will build a 2 story, 100 x 100 ft. garage on Barretto St. Estimated cost $65,000.

N. Y., New York (Borough of Brooklyn)—W. M. Good, 880 St. Marks Ave., will build a 1 story, 90 x 100 ft. garage on Herkimer St. Estimated cost, $40,000.

N. Y., New York (Borough of Brooklyn)—The Kalman Constr. Co., 1779 Pitkin Ave., will build a 1 story, 100 x 150 ft. garage on Ave. J. Estimated cost, $300,000.

N. Y., New York (Borough of Brooklyn)—P. E. Meyer, 54 Rochester Ave., will build a 3 story, 25 x 75 ft. garage on Atlantic Ave. near Rochester Ave. Estimated cost, $60,000.

N. Y., New York (Borough of Manhattan)—C. Schuckin, 1601 University Ave., will build a 2 story, 100 x 100 ft. garage on 176th St. Estimated cost, $125,000.

N. Y., New York (Borough of Manhattan)—J. Schumacher, 176 East 111th St., will build a 1 story, 100 x 100 ft. garage on Jerome Ave. and 167th St. Estimated cost, $25,000.

N. Y., Jamaica—Scott & Williams, 366 Bway., New York City, has had plans prepared by C. M. Hart, Engr. and Archt., 12 East 44th St., New York City, for the construction of a 2 story machine shop on Arche and Middletown Sts., here. Estimated cost, $50,000.

N. Y., Syracuse—The Jones Oil Engine Co., 227 Walton St., has awarded the contract for the construction of a 1 story, 90 x 260 ft. factory and two 2 story, 50 x 108 ft. warehouses, etc., on Free St. Estimated cost, $125,000.

N. Y., Syracuse—The Latta Electric Station, 562 East Genesee St., plans to build a 1 story, 66 x 125 ft. electric garage. Estimated cost, $40,000. J. M. Scrafford, Syracuse, Engr. and Archt.

Pa., Beaver Falls—The Keystone Driller Co. is building an 80 x 110 ft. factory for the manufacture of steam shovels. Estimated cost $100,000.

Pa., New Castle—The Johnson Bronze Co., South Mill St., has awarded the contract for the construction of a core building, foundry and machine shop. Estimated cost, $125,000. Noted Aug. 12.

Pa., Philadelphia—The Frankford Arsenal, Bridge and Tacony Sts., has awarded the contract for the construction of a 3 story, 82 x 200 ft. small arms shop on Dearborn and Tacony Sts. Estimated cost, $246,000.

Pa., Philadelphia—C. S. Jarvis, 1217 Vine St., has awarded the contract for the construction of a 1 story, 14 x 84 and 45 x 105 ft. auto shop on 12th and Pearl Sts. Estimated cost, $25,000.

Pa., Philadelphia—G. E. Noll, 2352 North 13th St., will build a 1 story, 48 x 100 ft. garage at 2453 North Park Side. Estimated cost, $10,000.

Pa., Philadelphia—The Taylor Wharton Iron & Steel Co., 25th and Wahington Sts., has awarded the contract for the construction of a 1 story, 90 x 100 ft. machine shop on 51st and Grays Sts.

Pa., Pittsburgh—The Natl. Casket Co., Reedsdale St., soon awards the contract for the construction of a 2 story, 30 x 87 ft. addition to factory. Estimated cost, $30,000. R. M. Trimble, Ferguson Bldg., Archt.

SOUTHERN STATES

Ala., Mobile—The Kelly Dry Dock Shipbuilding Co., Commerce St., plans to build a 1 story, 75 x 150 ft. machine shop at Blakely Island. Estimated cost, $150,000.

Fla., Tampa—O. Daniels will build a 3 story, 100 x 105 ft. garage on Franklin St.

Ill., East St. Louis—Darling & Co., 4201 South Ashland Ave., Chicago, has awarded the contract for the construction of the following: 134 x 300 ft. main and 60 x 93 ft. storage buildings, 50 x 80 ft. acidulation plant, 30 x 40 ft. garage, etc., all 1 story. Estimated cost, $500,000.

Ill., East St. Louis—The Excelsior Tool & Machine Co., 32nd St. and Ridge Ave., has awarded the contract for the construction of a 1 story addition to foundry. Estimated cost, $35,000.

Ill., Melrose Park—The Heppes-Nelson Roofing Co., 4500 Filmore St., has awarded the contract for the construction of a plant to include a 100 x 320 ft. finish and an 80

x 140 ft. still and gas bldg., a 60 x 100 ft. garage, etc., all to be 1 story. Estimated cost, $400,000.

Ind., Indianapolis—E. W. Steinhart Co., 11th and Meridian Sts., has awarded the contract for the construction of a 5 story, 110 x 130 ft. service station. Estimated cost, $400,000.

Ind., South Bend—The G. Cutter Wks. of the Westinghouse Electric & Mfg. Co. is building a 64 x 112 ft. extension to foundry, also a 2nd floor, 66 x 250 ft. assembling and storage room.

Mich., Jackson—The Union Truck & Storage Co. has awarded the contract for the construction of a 1 story, 70 x 150 ft. garage and warehouse. Estimated cost, $45,000.

Mich., Kalamazoo—The Kalamazoo Co. Rd. Comn. will soon award the contract for the construction of a 1 story, 60 x 80 ft. garage. Estimated cost, $20,000.

O., Cincinnati—Hill & Griffith, 1262 State Ave., plan to build a 1 and 4 story, 150 x 300 ft. addition to its factory for the manufacture of foundry supplies. Estimated cost, $100,000. B. Baldwin, 2nd Natl. Bank, Engr.

Wis., Grafton—The Jungers Stove Range Co. has awarded the contract for the construction of a 3 story, 61 x 105 ft. factory on Main St. Estimated cost, $50,000.

Wis., Sheboygan—The Ebenreita Lumber Co., 1215 Erie Ave., has awarded the contract for the construction of a 2 story, 42 x 157 ft. garage.

WEST OF THE MISSISSIPPI

Mo., St. Louis—The G. J. Fritz Fdry. and Machine Co., 2018 South 3rd St., has awarded the contract for the construction of a 1 story addition to its foundry. Estimated cost, $40,000.

WESTERN STATES

Cal., San Francisco—The Amer. Can Co., 120 Bway., New York City, is having plans prepared for the construction of a factory, here. Estimated cost, $500,000. Private plans.

Ore., Portland—The Amer. Can Co., 120 Bway., New York City, has awarded the contract for the construction of a factory, here. Estimated cost, $750,000.

CANADA

Ont., Kingston—The Canada Cutlery Co., Ltd., will soon erect a plant here.

P. E. I., Charlottetown—Bruce Stewart & Co. will soon award the contract for the construction of a 60 x 120 ft. plant, for the manufacture of gasoline engines.

Que., Upper Bedford—The Torrington Co., manufacturers of knitting needles, will soon erect a plant for the manufacture of screws, rivets and electric vacuum cleaners, etc.—machinery required.

General Manufacturing

NEW ENGLAND STATES

Conn., Montville—R. Gair & Co., 50 Washington St., Brooklyn, N. Y., has awarded the contract for the construction of a 2 story, 200 x 500 ft. manufacturing and a 1 story, 50 x 50 ft. power plant, here. Estimated cost, $600,000.

Conn., Stafford Springs—Fabyan Woolen Co., East Main St., has awarded the contract for the construction of a 1-story, 50 x 70 ft. addition to plant. Estimated cost, $18,000.

Mass., Cambridge — The Atwood & McManus Box Co., Vale St., Chelsea, has awarded the contract for the construction of a 1 story, 90 x 105 ft. dry kiln building on Aberdeen Ave., here. Estimated cost, $35,000. Noted July 22.

Mass., Fall River—The Amer. Printing Co., Water St., will soon award the contract for the construction of a 1 story, 100 x 119 ft. factory and 1 story, 44 x 133 ft. power plant for the manufacture of textiles. Estimated cost, $165,000.

Mass., Springfield—The Pabco Flour Mills, Inc., has awarded the contract for the construction of a 3 story mill on Margaret St. Estimated cost, $50,000.

Vt., Woodstock—The Maplewood Lumber Corp. has awarded the contract for the construction of a 1 story sawmill.

MIDDLE ATLANTIC STATES

Md., Annapolis—The Public Utilities Co. plans to build additions to gas plant. Estimated cost, $200,000.

Md., Hagerstown—The Howard Hosiery Mill, South Jonathan St., plans to build a 2 story, 40 x 104 ft. mill. H. E. Stamm, Prop. F. C. Mack, Negley Bldg., Archt.

N. J., Newark—The Clark Thread Co., Clark and Ogden Sts., has awarded the contract for the construction of a 4 and 5 story, 60 x 200 and 82 x 300 ft. factory.

N. J., Newark—The Williams Baking Co., 711 South 10th St., soon awards the contract for the construction of a 2 story, 50 x 125 ft. addition to its bakery. Estimated cost, $100,000. J. T. Simpson, Essex Bldg., Archt.

N. J., Passaic—The Smith Tire Co. has awarded the contract for the construction of a 60 x 200 ft. factory. Estimated cost, $150,000.

N. J., Union Hill (Weehawken P. O.)—The Consumers Hygienic Ice Co., 320 Fulton St., has awarded the contract for the construction of an addition to its plant. Estimated cost, $29,000.

Pa., Wilkes-Barre—J. J. Becker, Market St. plans to build a 1 story, 60 x 100 ft. ice cream factory on the corner of Market and Gates Sts. Estimated cost, $100,000.

SOUTHERN STATES

Fla., Dade City—The Dade City Citrus Growers Assn. will build packing house for oranges and grapefruit. G. B. Massey, Pres.

La., New Orleans—The Union Paper Products Co., 109 Tchoupitoulas St., has awarded the contract for the construction of a 1 story factory. Estimated cost, $112,-743. Noted Aug. 5.

N. C., Lexington—The Erlanger Cotton Mills plan to build a new 50 x 100 ft. cloth room building. J. E. Sirrine & Co., Greenville, S. C., Engrs.

N. C., Salisbury—The Yadkin Finishing Co, plans to build a 50 x 100 ft. extension to its plant, also making additions and changes in its equipment. J. E. Sirrine & Co., Greenville, S. C., Engrs.

W. Va., Shinnston—The Paquet Glass Co. is building an 80 x 120 ft. illuminating glassware plant. Estimated cost, $25,000.

MIDDLE WEST

Ill., Chicago—A. H. Weber, c/o D. H. Hannan, Engr., 155 North Clark St., will soon award the contract for the construction of a 2 story, 50 x 100 ft. factory on Root and State Sts., for the manufacture of groceries and sundries. Estimated cost, $57,000.

Wis., Campbellsport—The White House Milk Products Co., West Bend, has had plans prepared by M. Tullgren & Sons, Archts., 425 East Water St., Milwaukee, for 2 story, 50 x 100 ft. plant on Main St. Estimated cost, $75,000. Noted Aug. 12.

Wis., Sheboygan—The Phoenix Chair Co. will soon award the contract for the construction of a 4 story, 200 x 400 ft. factory on South 12th and Virginia Sts. Estimated cost, $200,000. A. C. Hohn, Supt.; E. Juul, 805 North 8th St., Engr.; Juul Smith, Imig. Bldg., Archts.

WEST OF THE MISSISSIPPI

Kan., Pittsburg—The Pittsburg Builders & Pavers Brick Co. is having plans prepared for the construction of a factory. Estimated cost, $60,000. Private plans.

Neb., Minatare—The Great Western Sugar Co., Scotts Bluff, plans to build a 1,200 ton capacity factory, here.

Tex., Dallas—The Texas Hosiery Mills, 1407-09 South Ervay St., plan to build a factory with annual capacity of 204,000 doz. pairs. J. C. Dobson, Mgr.

Tex., San Antonio—H. D. Kellar, Coldwater, Mich., plans to build a cannery and syrup mill, to include electric light plant and ice factory, here.

Tex., Amarillo—The Amarillo Cooperative Union Laundry has awarded the contract for the construction of a 60 x 120 ft. laundry. Will install laundry machinery to cost $15,000.

Tex., El Paso—The Atlas Brick Co., Dallas and Cotton Sts., plans to build a lime hydrating plant. Estimated cost, $100,000. C. L. North, Pres.

Tex., Sherman—The Sherman Mfg. Co. plans to build a 2 story, 30 x 80 ft. plant to be used in storing and working up waste. J. E. Sirrine & Co., Greenville, S. C., Engrs.

Tex., Zavilla—The Zavilla Lumber Co. has awarded the contract for the construction of a 36 x 160 ft. saw mill. Estimated cost, $50,000.

CANADA

Man., Winnipeg—The Dominion Oxygen Co. soon receives bids for the construction of a plant for the manufacture of oxygen for welding purposes. Estimated cost, $100,000.

Ont., Grand River—The Beatty Bros., Fergus, Ont., will build a plant here.

Ont., Kapukasing—The Spruce Falls Co., Toronto, Ont., will soon receive bids building a pulp and paper mill, here. Estimated cost, $800,000.

Ont., St. Thomas—The Elgin Milk Products Co. will build a 2 story, 55 x 200 ft. condensed milk factory on Talbot St. Estimated cost, $100,000.

Que., Quebec—The Standard Pulp and Paper Co., Ltd., plans to build a factory. Estimated cost, $1,250,000.

Sask., Regina—W. R. Phillips, former mayor of Trenton, Ont., states that a $1,000,000 paper mill will be erected here soon.

"Live" Business Propositions—

Many excellent opportunities to sell, rent or buy equipment, engage experienced men, acquire agencies, etc., can be found in the

"SEARCHLIGHT" Section

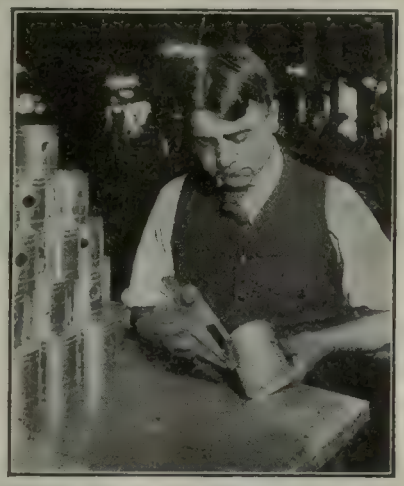
See Pages 276 to 305

For every business want
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See Pages 276 to 305

September 2, 1920 American Machinist Vol. 53, No. 10

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Automobile Engine Pistons as a Stock Proposition

By ELLSWORTH SHELDON
Associate Editor, *American Machinist*

The making of pistons and other small parts for automobile engines, as a business entirely aside from the manufacture of the engines themselves, has grown to very large proportions within the last decade. In this article some of the tools, fixtures and machines, used by one large manufacturer of engine parts, are illustrated, and many of the operations described.

WHEN the cylinders of an internal combustion engine become worn to the extent that a machining operation is necessary to restore them to their original degree of efficiency, it also becomes a practical necessity to refit the enlarged cylinders with new pistons; else most of the benefits to be derived from the repair will be lost, and conditions will be introduced that tend to loss of energy and rapid wear.

While there are repair shops, garages, etc., that will undertake to rebore or regrind a block of cylinders, the making of new pistons involves patterns, a foundry, and much special machinery ordinarily beyond the financial compass of the average small business, therefore the garage and service station willingly leave the production of these parts to larger concerns that by specializing upon the detail are able to put their operations on a manufacturing basis, and, producing the parts by thousands, reduce the individual cost to a fraction of what would be possible in the smaller shop, as well as to maintain a higher standard of quality.

Standard "oversizes" to which cylinders are reground are established by most manufacturers of automobile engines; these standards usually conforming to the scale adopted by the Society of Automotive Engineers,—0.010, 0.020, 0.030, 0.040 in., etc.,—over the normal sizes. This means that in grinding a worn cylinder, the grinder will stop at the nearest standard oversize after the cylinder has been made true and smooth.

The Houpert Machine Co., Long Island City, with the exception of a separate department for regrinding cylinders and crankshafts, devotes its attention to the manufacture of three small parts,—pistons, piston-rings, and wristpins. This company manufactures pistons for all standard automobile engines and, because of the established oversizes, is able to carry in stock, pistons to fit all motors, finished in practically every respect but the final grinding so that any order can be filled almost immediately upon its receipt.

Some of the machines, fixtures, and tools used by the company are described in this article, and also the progress of the work is followed from the receipt of the castings to the issuance upon order of finished pistons. The sequence of operations is somewhat dependent upon the design of the piston being operated upon.

The castings are received at the raw stockroom which is so situated that an automobile truck may back up to the receiving window. The shutter of this window turns down and inward so that when let down upon



FIG. 1. RECEIVING ROOM FOR CASTINGS

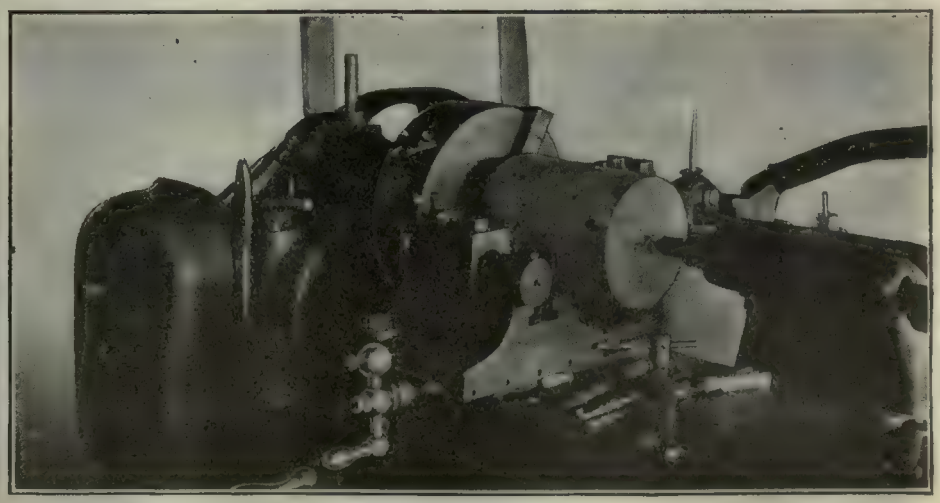


FIG. 2. CENTERING CLOSED END ON PORTER-CABLE LATHE

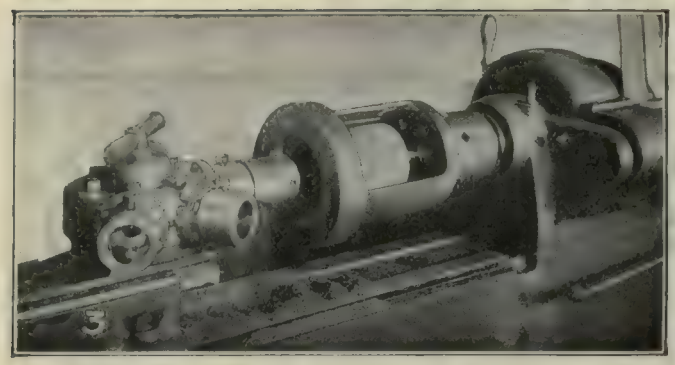


FIG. 3. BORING THE SKIRT



FIG. 4. DRILLING WRISTPIN HOLE

its hinges it becomes an apron or chute upon which the load of castings is discharged. Fig. 1 shows this shutter open, ready for unloading the castings.

The first manufacturing operation on practically all pistons is the centering of the closed end. There is upon this end of all castings a small boss for the reception of the center and the boss is made high enough so that upon its removal in the final operation no trace of the center is left.

Fig. 2 shows a piston casting in a Porter-Cable lathe where the centering is done. After setting a casting in the chuck, the jaws of which true up the inner end, the outer end is made to run as true as possible by rapping it with a mallet while the operator turns the lathe by hand. The center is then drilled and reamed by means of a combination drill and countersink held in a slip chuck used on the tail center.

Operation two is the boring of the inside of the piston. While this operation is not absolutely essential to the running of an engine, it amply justifies itself by simplifying succeeding operations; besides it produces a better balanced piston, and also reduces somewhat the weight of the casting. This is an important consideration in the design of gas engine pistons for the reasons that excess weight in the rapidly reciprocating parts entails unnecessary loss of energy, and a light body radiates heat more rapidly than a heavy one. The operation is shown in Fig. 3.

The third operation in regular progression is the drilling of the wristpin hole. This is ordinarily done upon the special machine shown in Fig. 4, in a fixture that locates the work from the bored and faced skirt. A round steel plate at the base of the fixture has a narrow shoulder fitting the bore of the skirt, while a center-pointed screw in the swinging yoke at the top of the fixture bears in the center at the closed end of the piston, causing it to seat firmly upon the plate resting upon the faced end. A stud of suitable shape projects from the center of the bearing plate a sufficient distance to enter between the wristpin bosses of the casting and thus locate the pin hole at right angles to them.

A movement of the capstan wheel on the front of the machine now brings up a drill spindle from each side. The drills run at high speed and work under a flood of lubricant so that the cutting time is reduced to a minimum. The piston-pin holes are finished by boring with a single pointed tool at a much later stage when they can be located from the finished outside surfaces. The rough drilling is done at this time for two reasons: one being that the pin hole furnishes an important link of the holding devices used in subsequent operations, and the other because it is desired to remove as much superfluous metal as possible before the heat treating.

Not all pistons go to this operation at this stage. The machine shown in Fig. 5 has been recently installed, and is intended to drill, bore and ream the wristpin hole in successive steps at one setting. A four-position turret mounted upon a horizontal axis at the center of the machine has holding fixtures similar to those just described. As there are four positions and but three operations there is always an idle position from which the operator can be removing the finished work and setting in pieces to be operated upon. Aside from this unloading and reloading the action is automatic and the machine runs continuously.

The fourth operation in the regular sequence is the rough turning, performed on Gridley automatics. In these machines the tail center is not available as a locating and supporting medium, and it is at this stage that the rough drilled wristpin hole becomes essential.

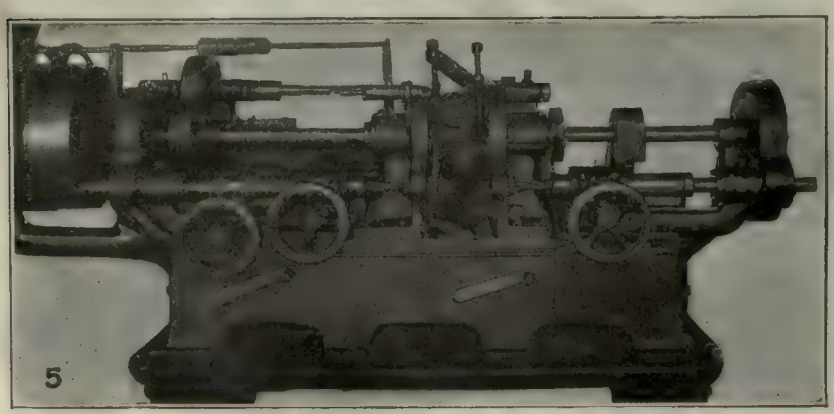


FIG. 5. THE HOEFER MACHINE FOR DRILLING, BORING AND REAMING THE WRISTPIN HOLE

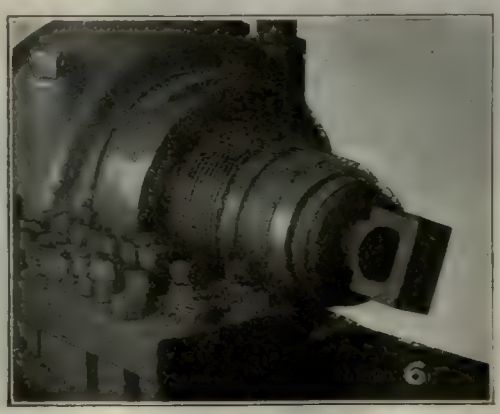


FIG. 6. DETAIL OF CHUCK ON GRIDLEY AUTOMATIC

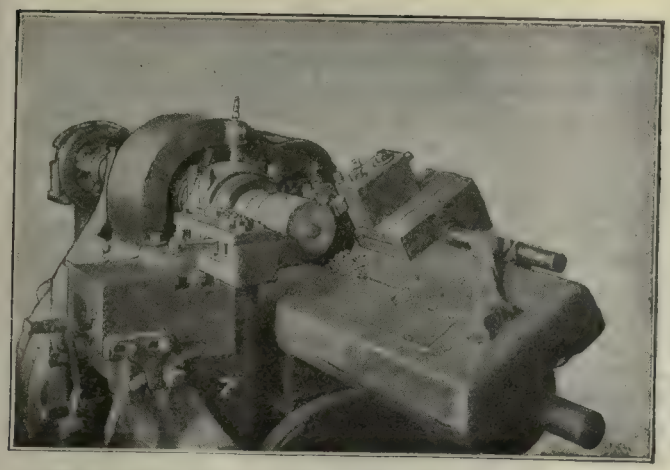


FIG. 7. THE SET-UP IN THE GRIDLEY MACHINE

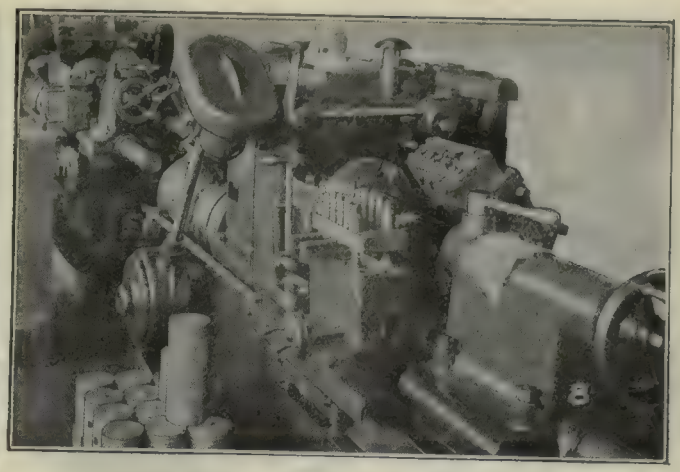


FIG. 8. THE FAY LATHES

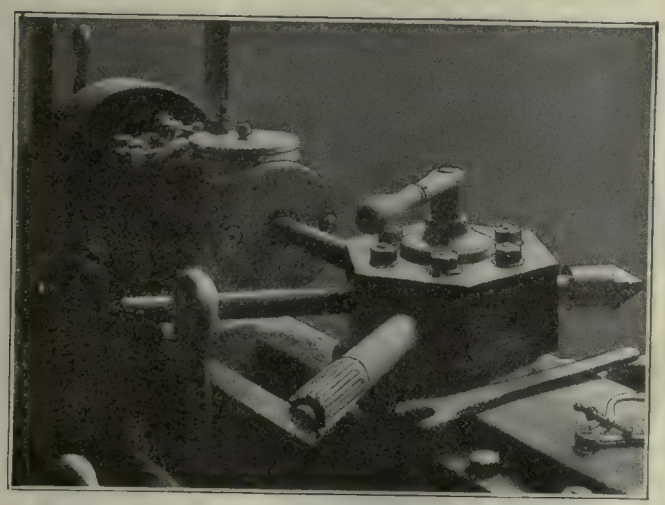


FIG. 9. BORING WRISTPIN HOLES IN TURRET MACHINES

The driver, or chuck in this operation, shown in Fig. 6, is a round block somewhat smaller in diameter than the rough-turned size of the piston it is to hold, with a narrow shoulder fitting the bore of the work. A draw rod of rectangular section projects from the center of the chuck far enough to enter between the pin bosses; a cross hole in the end of the bar lining up approximately with the rough-drilled hole in the piston.

A plug is pushed through the holes in piston and draw rod and the latter drawn back by means of the handwheel at the outer end of the spindle. This provides a rigid hold on the work and at the same time leaves the outer or closed end free for facing. Fig. 7 shows the set-up on the Gridley machine. In this operation the diameter is turned to within $\frac{1}{16}$ in. of finished size, the closed end is faced and the ring grooves roughed out, leaving stock enough to finish in the final operation.

New castings of iron when subjected to high temperatures have a tendency to swell, or become permanently enlarged, and if an engine piston is placed in service without a proper seasoning, it is quite likely to stick and cause all kinds of trouble. For this reason manufacturers of such parts subject them to an annealing process which in the present case is done in a gas furnace. This annealing is the fifth operation and follows the rough turning.

Following the annealing is the finish-turning; operation six. For this a battery of Fay lathes, one of which is shown in Fig. 8, is provided. These machines bring the pistons to their finished size plus grinding allowance. The holding and driving device is much the same as on the Gridley machines, except that the central driving stud is fixed instead of being a part of the draw rod and no pin is necessary. This is because the Fay lathes are provided with tail spindles and the work is held between the driver and the tail center.



FIG. 10. RIG FOR FACING INSIDE OF PIN BOSSES

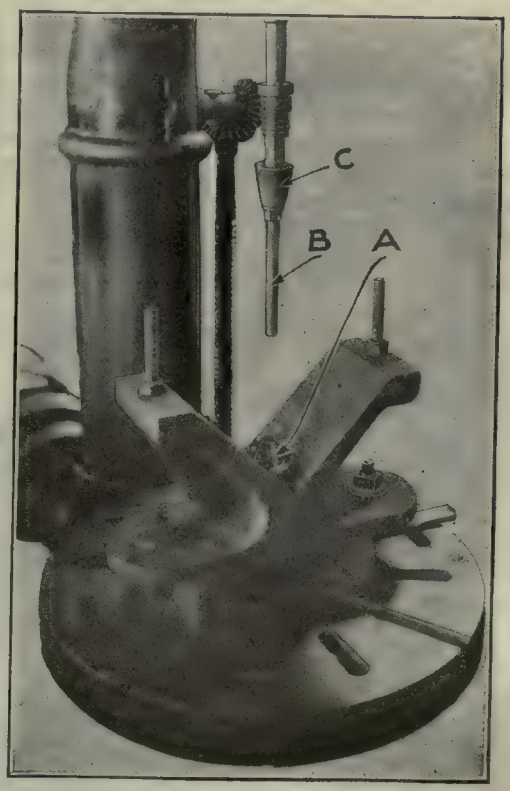


FIG. 11. FACING INSIDE OF PIN BOSSES

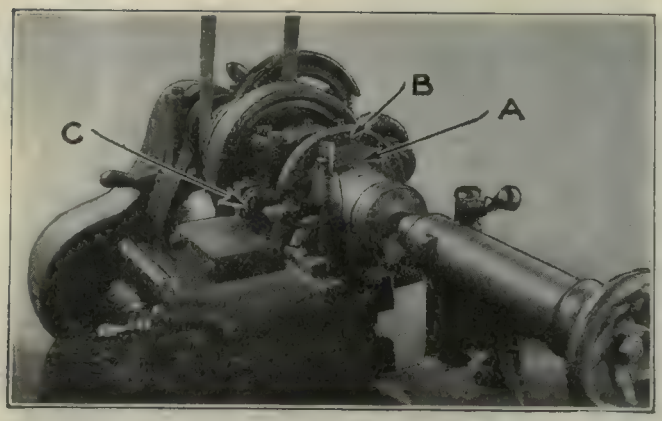


FIG. 12. THE RELIEVING DEVICE

From the finishing lathes the work goes to a turret machine shown in Fig. 9 on which the wristpin hole is bored with a single-point tool to insure that it is absolutely square with the axis, and exactly in the center of the piston.

The inside faces of the pin boss are finished on the drill press, the fixture being shown in Figs. 10 and 11. A piston is laid in the V with the cone shaped spring plunger A, Fig. 10, entering the hole in the lower side. The plunger is hollow, being accurately ground both outside and in, and forms a bearing for the boring bar *B*. A spring-supported, cone shaped bushing *C* on this bar enters the hole in the upper side of the piston and together with the lower cone centers the bar in the hole. A loose face-mill *D*, Fig. 11, is slipped on the lower end of the bar as the latter is passed through the piston and, being held to the bar by a feather and backed up by a shoulder on the bar, it mills off the surface of the boss to an amount determined by a stop on the drill-press spindle. The bar is withdrawn and the piston turned over to mill the other boss.

There is a pronounced tendency of pistons to "swell" around the wristpin hole and become oval, causing undue wear upon the cylinder walls at this point. To overcome this, it is customary to relieve them over this area by cutting away the surface to a depth of perhaps $\frac{1}{32}$ in. The relieving device is shown in Fig. 12 and is applied to an ordinary engine lathe.

The driver *A*, which screws upon the spindle nose of the lathe, carries a cam *B* upon its periphery which contacts with the roller *C* mounted upon a bracket which is attached to the cross-slide of the lathe. The cross-screw has been removed and the slide is drawn in (toward the cut) by a weighted cord passing over a sheave at the back of the carriage; its movement in this direction being limited by the roller *C* stopping against the cam.

The driver, like those on the turning lathes, has a short shoulder fitting the bored "skirt" of the piston and a central stud with flatted end projecting far enough to pass between the wristpin bosses. Thus the act of putting the piston in the lathe trues it up, locates it to bring the relief at the right place and furnishes the means of driving it without the necessity for a dog or other positive means of holding. The outer end is supported by the tail center.

The cam *B* which appears in the picture to be round is not so in fact, but has two depressions not more than $\frac{1}{8}$ in. deep which correspond to the positions of the piston that brings the ends of the piston-pin hole toward the tool. The roller *C* runs on a long stud upon which it is free to travel lengthwise, thus permitting, within limits, the usual traverse for the carriage. The tool is under positive control of the operator by means of the compound slide. The relieving of a piston is therefore quite a simple matter as the rough turning would be; the cam allows the tool to cut where metal is to be removed and pushes it out of the way where the surface is to remain untouched. Fig. 13 shows a piston after the relieving operation.



FIG. 13. A RELIEVED PISTON

Several minor operations follow. The bosses are drilled and tapped for the setscrews that hold in the piston pins, and drain or "weep" holes are drilled around the circumference of the piston, starting from

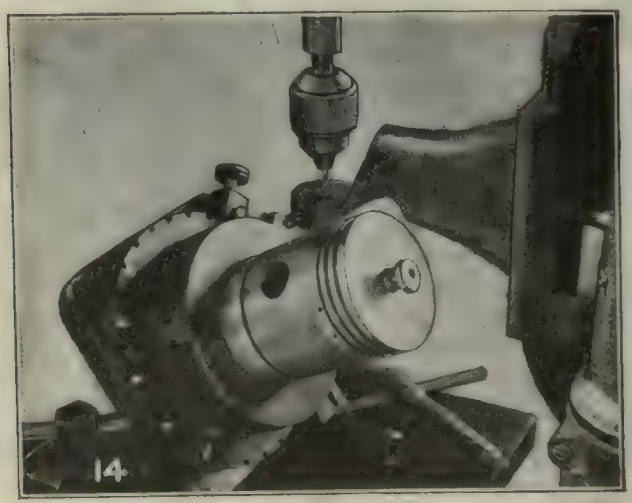


FIG. 14. DRILLING THE WEEP HOLES

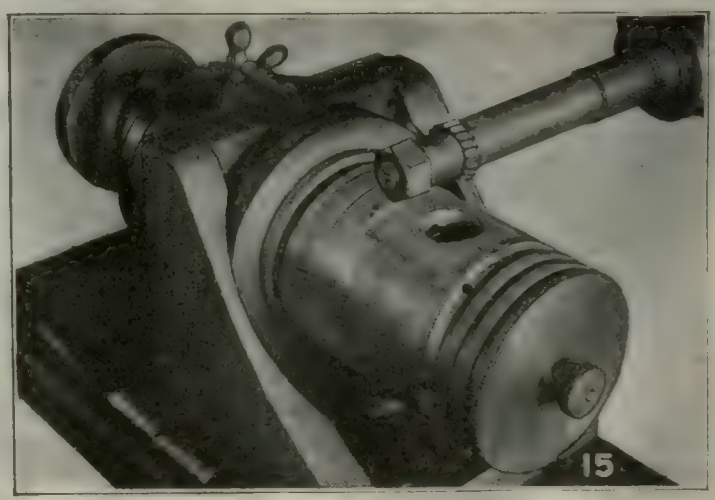


FIG. 15. MILLING OIL GROOVES

the angular side of a groove which was cut there for that purpose just below the ring grooves. The holes allow any surplus of oil on the cylinder walls to drain back through the interior of the piston and help to prevent an accumulation of carbon by keeping superfluous oil out of the upper part of the cylinder.

In the fixture shown in Fig. 14 a universal chuck is mounted on the upper end of a spindle which is supported by the base casting at an angle of approximately 40 deg. Below the chuck, and keyed to the spindle, is a dial plate having its outer edge notched to receive a locking-slide by means of which any desired number of holes are equally distributed around the circumference of the work. The fixture when photographed was not in drilling position.

Besides these holes there is a shallow but wide groove leading from the angular groove down to the end of the wristpin, for the purpose of conducting oil to, and through, the hollow pin to the wrist bearing. The set-up for this job is shown in Fig. 15 the work being done on a hand milling machine.

Operations in a New Orleans Foundry

By Frank A. Stanley

The photographs herewith illustrate some of the operations of a New Orleans foundry engaged in the production of sugar machinery.

The greater part of the work of this firm is of a very heavy character and much of it is loam molding in which the cores and molds are swept up by striking boards or sweeps. The sweeps are made of rigid metal striking bars or spindles held vertically in heavy brackets with suitable bearings and carrying adjustable arms to which the boards are bolted for various sweeping operations. A view of such work is shown in Fig. 1. Most of these molds are made up of brick and loam with a certain amount of clay in spots. The



FIG. 1. THE SWEEP IN POSITION



FIG. 2. A COMPLETED LOAM MOLD AND ITS CORE

sand or loam inside the brick mold is usually ¾ to 1 in. thick, and commonly loam is used as a binder for holding the bricks together. The building up of the mold by the sweeping process is followed by baking over night in big core ovens, the whole brick mold being picked up bodily by overhead cranes and transferred to cars which are run into the ovens.

In molding big rings, drums, cylinders and the like the brick and loam work is built up and swept to any desired height and diameter and both molds and cores are handled advantageously in this manner. Fig. 2 illustrates a completed loam mold and the core, which has been swept to proper dimensions.

An Interesting Molding Job

A job of special interest is represented by Figs. 3 and 4. This is the molding of a cone-shaped casting which is part of a calandria vacuum pan. The casting is of brass and its diameter is 13 ft. or more, depending upon the size of vacuum pan manufactured. In the conical face of this casting there are cored over four hundred 3½-in. holes, which are afterward machined to receive the ends of short copper tubes connecting two of these cone castings together in the assembled vacuum pan in much the same manner as tubes are placed in a boiler. The cone casting in the 12- or 13-ft. size is about 6 ft. high. The thickness of the metal in the wall is about ½ inch.

The lower half of the mold, Fig. 3, is built up first, loam and sand being used over a brick center and the cone swept to dimensions ready for baking in the oven. This cone is used as a core or center for

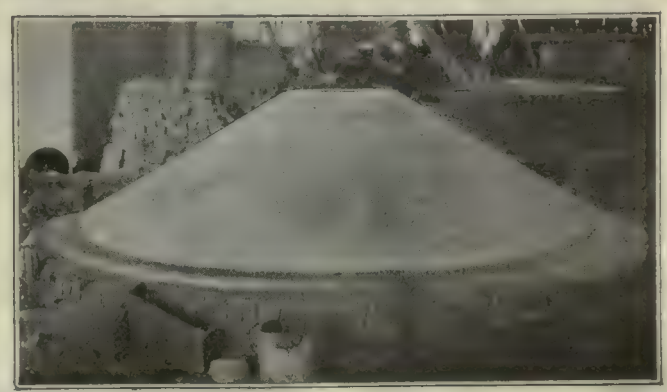


FIG. 3. PART OF A MOLD FOR A VACUUM PAN

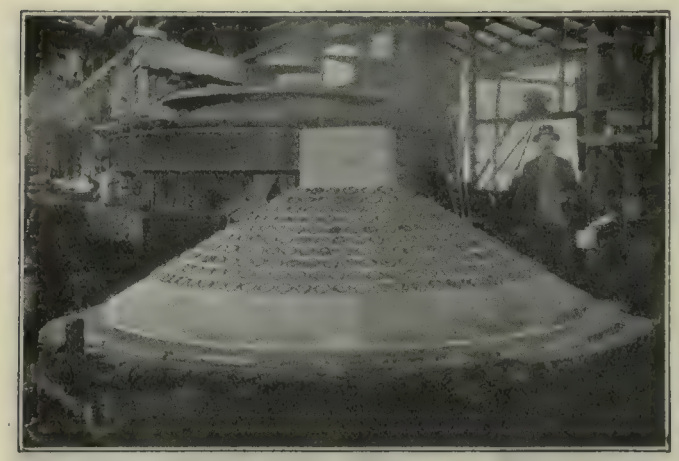


FIG. 4. OVER 400 CORES IN PLACE

the molding of the upper half of the mold, and for this purpose a half-inch thickness of sand is left all the way round on the lower cone to represent the thickness of metal to be run. The top half of the mold is placed in position and molded to the lower cone.

Afterwards the half-inch of extra sand thickness is swept off the lower cone and the latter is scribed with a series of lines around its surface for the accurate placing of the 3½-in. cores to form the openings through th walls. These small cores are dry sand, baked as usual, and are positioned as shown by Fig. 4, where they may be seen in ten circles around the cone.

When the top of the mold is placed in position the metal is poured through the neck and flows down over the sloping cone. About 3,700 lbs. of metal is run in this job.

The operations illustrated are from the plant of Dibert, Bancroft & Ross, New Orleans, La.

Cost Keeping in the Small Shop

By Fred H. Colvin
Editor, *American Machinist*

The reason many systems fail is because people expect them to run themselves. This is particularly true of the small shop. While the perfect automatic system is yet to be invented, the one shown herewith has worked out well in a small shop and is worth looking over.

While cost keeping may be said to be one of the great problems in all industries it is particularly true of the small shop, where clerks are a luxury and most of the time-keeping devolves on the boss and the men. Direct costs are of course based on labor and material, and while these are not always as simple as they seem it is the indirect expense that gets the small shop into difficulty.

Then, too, the question of how a bill shall be rendered is well worth careful consideration as the psychology of the one who is expected to pay it must be taken into account. Many demand an itemized bill, and this extends up to one of the wealthiest men in the world, who requires an itemized account from his physicians and specialists.

There are two sides to this question, however, and some are opposed to it for various reasons. You have a certain job to be done—it costs you so much money, using necessary material and labor. Why, say some,

Overhead

Billed

Entered

Folio

Contract Price

JOB ORDER

WALSTAD MACHINE CO.

*Job No.*_____

*Tacoma,*_____

*CHARGE TO*_____ *Address*_____

*Req. No.*_____ *Promised*_____ *Finished*_____ *By*_____

INSTRUCTIONS:

PIONEER B'DY. & P'TR. CO., TACOMA—96567

LABOR							MATERIAL					
DATE							QUANTITY	DESCRIPTION	REQ.	COST	SELL	AMOUNT
TOTALS											TOTAL	

*Hours @*_____
*Hours @*_____
*Hours @*_____
*Hours @*_____
*Total Labor*_____
*Total Material*_____
*Sundries*_____
*Total*_____
*Charge*_____

FIG. 1. JOB ORDER BLANK

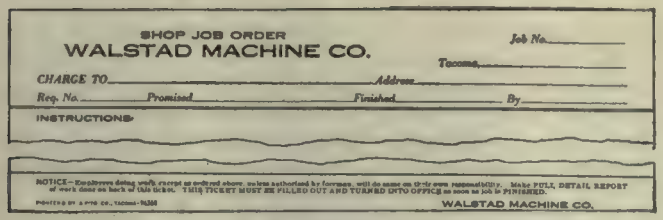

SHOP JOB ORDER
WALSTAD MACHINE CO.
Job No.
Tacoma,
CHARGE TO
Address
Req. No. Promised Finished By
INSTRUCTIONS
NOTICE—Employees doing work except as ordered above, unless authorized by foreman, will do same on O'time unless reasonable[illegible]. Make FULL DETAIL REPORT of work done on back of this ticket. THIS TICKET MUST BE FILLED OUT AND TURNED INTO OFFICE as soon as job is FINISHED.
WALSTAD MACHINE CO.

FIG. 2. SHOP JOB ORDER CARD

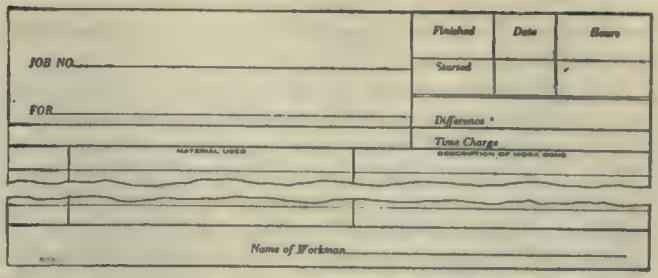

JOB NO.
FOR
Finished
Started
Date
Hours
Difference
Time Charge
MATERIAL USED
DESCRIPTION OF WORK DONE
Name of Workman

FIG. 4. INDIVIDUAL TIME AND MATERIAL SLIP

itemize every bolt and screw? If there is to be complaint as to cost it might just as well be as to whether a new bolt was needed as to question its cost.

It often happens that a job needs a single bolt which ought not to cost over five cents at any hardware store. And yet that bolt may have cost the small shop man fifty cents or more, because he had to send a man or boy down town, or elsewhere, to get it. Yet if anyone sees a charge of fifty cents for a five cent bolt the wail against the profiteer will be loud and deep. Of course the extra forty-five cents might go in as labor, but it really belongs in overhead, which few small shop men know how to figure.

Some shops have come to believe that the most satisfactory method is to bill something like this: To reboring cylinders, replacing four piston rings and two piston pins; grinding valves, cleaning carbon, assembling and turning motor—$43.65, or whatever the charge may be.

But whatever the method of charging or billing the small shop needs a cost-keeping system, and the one used by A. N. Walstad of Tacoma, Wash., seems to fill the bill.

First comes the "Job Order Sheet," Fig. 1, which is 11¼ x 10¾ in. and fits into a loose leaf binder. This is the office record, on which is noted each day the time and material which have been charged against this particular job. These items come from the individual time slips which are shown in Fig. 4.

The "Shop Job Order," Fig. 2, goes into the shop. This gives the number of the job for the time slips, tells them briefly the conditions as to delivery and contains any special instructions which may be necessary. The workman makes a full report on the back of this slip for the information of the office. This order slip is 5 x 8 in. for card files.

The "Daily Time Card," Fig. 3, is a 3 x 5 card size and covers the time spent each day in the shop. It is stamped on time clock, "in" and "out" in the usual way, with allowance for overtime in case more than eight hours are worked in the shop.

The last form is a 5 x 8-in. card and is the "Individual Time and Material Slip." It is stamped in at the same time the man starts to work in the morning and is only used for one period of work on one job. If the workman works an hour on the first job he stamps his time in and out, and makes out a new card for the second job. If he works on the same job four times in one day he has a card for each time, four cards in all. When he stamps "out" on a card he is through with that card and it goes into the office.

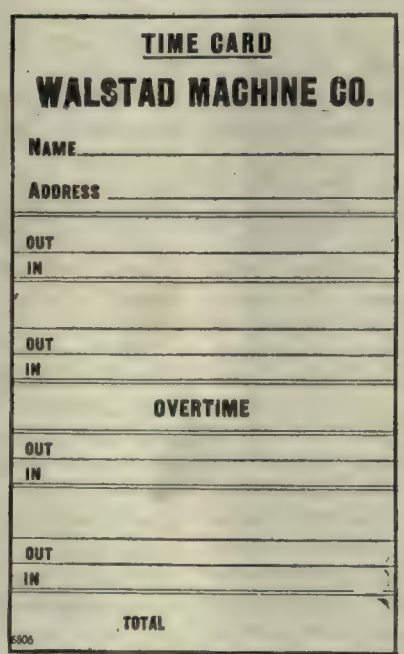

TIME CARD
WALSTAD MACHINE CO.
NAME
ADDRESS
OUT
IN
OUT
IN
OVERTIME
OUT
IN
OUT
IN
TOTAL
5906

FIG. 3. DAILY TIME CARD

If he worked on one job all day he would have two cards, one for each time he stamped in and out. In any case the sum total of his various time and material slips must equal the time charged on his daily time slip, Fig. 3.

One of the leaks in a small shop is in overlooking to charge for material used, especially small stuff such as screws, solder, etc. When these individual time and material slips come to the office they are looked over to see that all material has been charged. If it is a job of soldering there should be a charge for solder and acid or paste, and so on. These small items count up in many cases.

When a job is completed all the individual time and material slips, Fig. 4, are taken from the card index file and filed away with the shop job order, Fig. 2. The large job order is also removed from the daily job book and filed away in a loose leaf binder for future reference.

The daily time card for each man is filed away every day after the time has been entered in the time book from which the pay roll is made up. This system, with only four different blanks, has worked out very well in practice under varying and trying conditions. It is so much better than anything used before that Mr. Walstad wishes others to benefit by it, should it seem to fit into their business needs. Of course, different kinds of business will require different forms or routine, but the principle remains unchanged.

Combining Quantity Production with the Making of Special Parts

By Peter F. O'Shea

There are many machine shops in the United States which have developed their business from individual jobs made to suit each customer's needs rather than from a large and steady output of a standardized product. After such a shop becomes established as a factory for its special kind of product, the trade is apt to continue wanting that product, but with changes and variations. Provision is therefore made in such a factory for putting through orders for one or a small lot of the products with variations to suit the customer's needs. This is especially true of builders of machine tools. In fact, machine tools to meet special needs are really "built," rather than manufactured, speaking in the quantity sense. Efficient shops doing this sort of

work generally devise ways of combining manufacturing and building methods.

An excellent example of this is in a certain shop which makes machine tools adapted to the customers' special needs on a semi-manufacturing, semi-building basis. The hybrid character of the work affects every department. It starts in the drafting room, for in a business of this nature, it is there that the layout of special parts must be made. The drafting force has, therefore, analyzed the component parts of all the machine tools made in the plant and divided the parts into two classes—like parts, which are the same for all machines of a given catalog number or style, and unlike parts, which must be changed for each job to get the different features wanted. By far the greater majority of parts are like parts, and these are drawn up into standard lists, one list being made for each style of machine tool. Spaces are provided for quantity, part number and a brief description, as shown by the accompanying extract from a parts list.

The "like parts" and "unlike parts" lists for each style of machine are typed on tracing cloth. Blueprints are taken of the tracing, and whenever an order comes in for a variation of that style of machine, one blueprint of like parts is issued with the order, and serves as a requisition. If from time to time changes are made in the specifications of parts for that style of machine, corrections are made on the tracing itself. The blueprint requisitions are issued from the drafting room, which is also the office of the chief engineer. He knows at all times just what work is to be done, and prescribes the necessary parts. He fits special layout of parts in with the standardized methods of suspension, drive, etc.

Method of Manufacture

The like parts are either made on large orders for stock, or purchased and held in stock. Separate orders are issued by the production department for the manufacture of sufficient quantities of each part for stock, the making of the parts most in demand being a real manufacturing proposition. The production department, in conjunction with stores, is responsible for always having a stock of them on hand.

Some of the like parts, however, are alike for only one style of machine, not for several. The number of orders coming through for that style of machine may vary from month to month, and it is difficult to make a large supply of some of the heavier part without tying up a good deal of money on the stock shelves. Therefore, the orders for these parts are put through only when the demand for them for the coming month is approximately known. Although they are "like" parts and do not have to be specialy designed, the scheduling of orders for making them is closely tied up with the delivery date for the special parts. They are to meet the special parts on the day the latter are completed, and when both are ready, then the ordinary "like" parts are drawn out of stock and all three kinds assembled into machine tools.

The superintendent controls the starting of manufacture of each part by means of a cabinet beside his desk. In the cabinet are placed envelopes holding the orders for special parts, or orders for the making of like parts, or a list of stock parts needed for the order, that is, a copy of the blueprint list of stock parts to complete the machine order. All the envelopes pertaining to one order of machines are put in the same pocket of the cabinet, or "board." To start the making of one of the components of an order, the envelope for it is given to the foreman concerned. Thus, as soon as a part is started, its envelope disappears from the pocket, and envelopes still remaining in the pockets denote that parts have yet to be started. If one pocket has become empty except for one envelope, it means that the assembling of that order of machines may be held up by the lack of one part. The superintendent, of course, gets after that order.

The Scheduling Board

In scheduling the work, a month is used as the unit of time required. This does not mean that it needs to take a month to build an order of machines, by any means. It simply means that the superintendent aims to clean up his work once a month. Several days before the end of the month, therefore, he takes a look over his board to see what envelopes are still remaining in the pockets.

The board is a visible index of the condition of the factory with regard to preparedness to meet new orders. The material can easily be followed through the shop by the superintendent and is not allowed to lie idle or accumulate, but must keep on moving. At the end of the month the board is empty and is refilled with orders for parts scheduled for completion during the new month. Each month envelopes accumulate in a large separate pocket for "orders due next month," until it comes their time to be distributed. Many of them are issued to the shops and are being made ahead of schedule.

The manner of recording drawings also fits in with the method of manufacture of a semi-special, semi-standardized product. In a machine design room or machine shop it is a habit of mind to speak of an article somewhat as follows: "Don't you remember that part we made specially for So and So? It was so good that we afterward used it regularly." Therefore, in the shop being considered, the title-legend in the corner of each drawing bears a notation of the firm for whom that design was first made. All the original correspondence and data, with possibly the reasons for the design in preference to another, will be available under the correspondence with that firm.

TYPE OF PARTS LIST USED FOR SCHEDULING PARTS

Description	Part No.	PC	PCS In	PCS Wanted	Purchase Order No.	Purchase Order Date	Purch se From
Unlike Parts—Iron Castings							
End plates for brg	B1213P	4					
Cone sh. lower brg	B1277P	1					
Loose pulley 19¼ dia	B1458P	1					
Tight pulley 20 dia	B1458A	1					
Pump pulley	B1593P	1					
Additional C'weights	B1749P						
Shipper fork	B1344P	1					
Shipper rod link	B1345P	1					
Cone sh. standard	C379P	1					
Shipper rod lever	C432P	1					
Belt fingers	C473P	2					
K. O. hand lever	C581P	1					
Add'l C'weights (bottom)	C636P						
Shipper rod bracket	C461P	1					

Production Records at the Hart-Parr Factory

BY A. W. SAWYER

The matter of keeping all hands busy and a constant flow of material moving in the right direction, toward the finished product, has always been a big problem in the factory, especially where the number of distinct parts entering into the completed machine or article approximate several hundred and possibly a thousand or more.

THE factory management of today, if it is conducted along successful modern lines, determines upon a certain amount of production for a given period, say one year, then sets the various wheels turning and the functions operating within the works to perform that allotted task. The amount of production is determined by the apparent future demand for the machine, the orders on hand and the company's ability to finance and produce. This is strictly a managerial problem and must be settled before production matters are undertaken in the works. In a big industrial establishment where the number of employees exceeds 500 and the work has been thoroughly divided into departments, the important matter left to be arranged for is synchronizing these departments in their respective functions so that each one is assisting all the others.



FIG. 1. THE PRODUCTION BOARD

To this end the Hart-Parr Company, tractor manufacturers of Charles City Ia., has established a thoroughly organized production department and, by a system of reports and printed blanks sent in each day from all producing centers of the works, the eye is able to discern at a glance just what progress is being made with the year's plan and in just what relation each necessary part stands to every other part, or in other words, is able to forecast and issue such orders as will cause the skirmish line of parts to form a solid straight line advancing in uniform order to the erecting floor or side bays where the parts become incorporated into the finished machine, which, by the way, should be moving toward the shipping floor during all stages of its building.

In the production office are four large boards, each about 2 x 9 ft. in size, hung on the walls by counterweights so that each board may be raised or lowered at will for convenience sake. As these boards are duplicated, in so far as their mission is concerned, but one will be described in this article.

Board No. 1 is designed to carry certain parts, arranged in units of assembly, for the production of 1,000 tractors. Boards Nos. 2, 3 and 4 are similarly marked. Tacks with various colored heads are used on all four boards to trace production through from one end to the other.

Let us now describe one board as to its markings, as it answers for all. Fig. 1 shows the entire board while Fig. 2 shows a small section enlarged so as to plainly show the markings. Parallel, horizontal lines, each line representing a tractor part, are laid out from one end of the board to the other. Each of these horizontal lines is divided by 1,000 equidistanced prick marks, each mark representing a tractor. Across these horizontal lines 10 perpendicular lines are drawn, 100 prick marks apart, thus assisting in the ready calculation by the supervisor of the boards. Assuming that tractor production has progressed to the number of 85 for that particular series of thousand lots, the right colored tack would be pushed into the prick mark midway between the eighth and ninth perpendicular lines and on the horizontal line standing for the finished products, either shipped or ready to ship. Of course if a 10,000 production is planned for, and later accomplished, these boards will be used ten times over.

In order to show the number of completed machines, let us proceed to set forth how, by the same methods, each individual piece in the tractor is, at all times, under the watchful eye of the production manager, who, by the glance to the right or left, in front or behind, may discern what part or parts are lagging on the skirmish line, thus allowing him to issue orders from time to time which will provide a steady stream of parts to the erecting floor. The working of these boards covers the entire time from the day when the material is checked into stores until the finished product is loaded on cars. By this method also the purchasing department is easily kept appraised of quantities of material on hand and is governed accordingly in purchasing more.

Different Colored Tacks

In order to trace this material from the raw stage through all departments until it reaches the shipping room, tacks of seven different colors are employed. These are used the same as the tack showing the number of the finished machines, except of course that the various colors are used on their respective lines describing the individual parts. Thus the yellow tack represents all purchased stock delivered to stores; black, all stock for the various parts which have been ordered by the purchasing department; white, all stock that does not require machining or previous attention; green, all castings, gray iron or steel, delivered to store house from the foundries. Brown represents all stock, either raw or in castings, delivered by the managers of the storehouse to the machine shop. Orange stands for all finished parts delivered from machine shop to manufactured stores which, in the case of the Hart-Parr Works, are bays located conveniently adjacent to the line of progressive production on the erecting floor. Any or

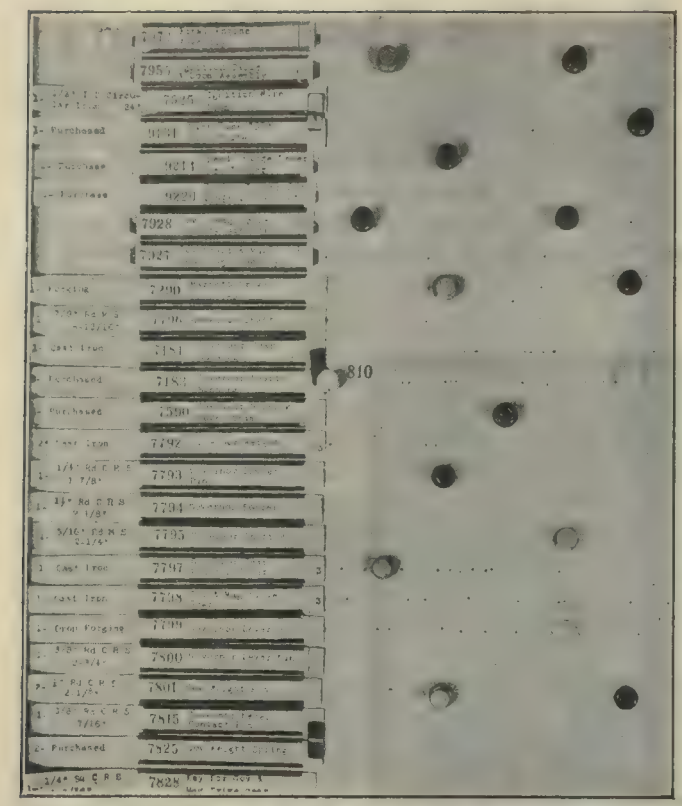


FIG. 2. ENLARGED SECTION OF THE PRODUCTION BOARD

all of these colored tacks may be found on the same horizontal line according as the reports sent in on any given part or assembly indicates.

To illustrate the practical workings of the boards, let us take a concrete example. For instance, the main cast-steel frame of the tractor. The boards, we will assume, are all being used for the first series of one thousand tractors. Then the green-headed tack may be set at the extreme right or end of the line carrying the name "Main Frame"—indicating that a sufficient number of them has been delivered from the steel foundry to build the series. If the number in stores is but a few ahead as reported by the storekeeper the foundry is notified of that fact and the tack placed at the correct number as a constant reminder of the situation. Then by the use of the brown, orange and blue tacks set on the "Main Frame" line accordingly as the daily reports indicate, this particular piece is carefully watched in its progress through the machine floor to manufactured stores and finally out on the erecting floor. Every other part of the tractor is watched with equal closeness, the result being that no sudden discovery is made that a certain part or parts have been thoughtlessly overlooked and the entire assembly floor paralyzed until the missing parts can be rushed to it.

This system for governing production may appear intricate at first but in reality it is very simple and worth each day many times over expense of installation. It must be religiously attended to, however, for the arrangement falls to pieces of its own weight unless carefully supervised and kept up to the minute from the reports sent in.

The management regards its production system as one of its best safeguards and could not be persuaded to discontinue it in the light of present knowledge applied to industrial management.

The system is also elastic and may easily be applied in whole or in part to any industrial enterprise. The color of tacks used is not arbitrary, only each office force must designate a special color for each specific purpose. No other system has been devised which so thoroughly visualizes the progress of parts through a factory.

To the machine shop foreman the production board shows all parts made ahead and permits him to work with the purchasing department in regulating the flow of material through the machine shop and it informs the foreman just what relation the machine shop bears to the schedule of tractors yet to be assembled on the erecting floor. It also discloses the quantity of material on hand going through the different operations in the machine shop. The system also takes care of all spoiled or defective parts both on the machine and erecting floors.

The production board, at a glance, shows the head of the experimental department the number of parts already finished and tells him when a new or changed part or device may go into effect without discarding material already manufactured.

The head of the repair department also seeks the production board for it tells him how many parts have been used for repair work by subtracting from the total number made and the total number of tractors built, the remainder being the number of parts or pieces used exclusively for the repair trade, and the same process shows the head of the repair department when the demand for any particular part is abnormally large, suggesting a weakness in it of some sort. This is reported to the experimental department and a remedy is immediately sought for.

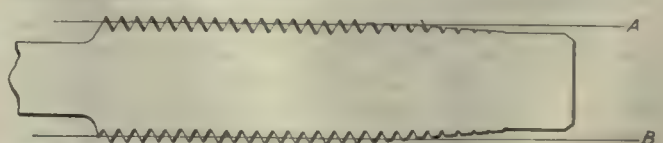
The production board system has become very popular with all departments and although the boards are centrally located and easily accessible yet a number of the department heads keep boards of their own for their particular needs, thus avoiding loss of time and needless steps. This also provides a check between the central boards, hence error is readily detected.

In a word, the production board system visualizes the condition of affairs, at a glance, an end that is both difficult and tiresome to obtain by turning the pages of the old fashioned records.

Using Worn Taps

By S. E. Frew

When the teeth of taps become worn by use, the wear is mostly on the points. By grinding a tap, as in the illustration, along the line *AB* the original shape is preserved and it may be used for taking out the first cut in tapping new holes, and thus relieve a new tap of a lot of work, preserving the new tap for a much longer time than would be the case if the old one were to be thrown away and all the work put on the new one. The teeth should be ground with a slight clearance along the entire length of the threaded part, making the tap cut with unusual ease. If a grinding machine is at hand the tops of the teeth can be ground uniformly on the machine, afterward grinding the clearance by hand.



OLD TAP WITH TOPS OF TEETH GROUND OFF



THE layout and equipment of a welding shop will, of course, vary with the class and amount of work handled, the capital available and the personal opinions of the owner. One should, however, have enough equipment of a mechanical nature to insure the finishing of work in a reasonable time without too great an expense for labor.

A first class workman can, when necessary, turn out a good job of difficult work with a single welding and cutting outfit; means for preheating which may consist of a few firebrick, asbestos and charcoal; a chisel or two; a good hammer and a few files. These are insufficient, however, where any amount or variety of work is to be handled economically and to the satisfaction of the ordinary run of patrons. A minimum amount of mechanical equipment should include a number of hand and handled chisels, several hammers and sledges of different weights, a portable electric grinder or at least a grinding stand, and a portable electric or a stationary drilling machine, or both. To this, for more extensive work should be added a pneumatic or an electric chipping hammer, a lathe, cranes, and possibly a portable or a stationary motor-cylinder grinding machine. Oil- or gas-burning preheaters are also almost a necessity in any case, while a gas-burning preheater of the table type, will save an enormous amount of time and trouble on the general run of gasoline motor work. Special grated iron welding tables, heavy surface plates and grids, iron blocks and straps and numerous other articles will need to be added as local requirements dictate.

The shop layout for equipment will have to conform to the building unless the shop is built purposely for the work. In this connection very few suggestions of any value can be made, except that the shop manager should endeavor to so place his equipment as to cause the least running back and forth possible.

We will, for the benefit of our readers give the layout of a large shop doing nothing but welding work. This is the shop of the Oxweld Acetylene Co., Newark, N. J., and it was built expressly for this work. Allowance in position had to be made for the set directions of the railroad and street lines. Fig. 294 shows the end of the building next to the railroad. The overhead track for the chain blocks is so placed as to be readily used for loading or unloading either cars or trucks. This is good but a still better arrangement would be to extend the runway on into the shop itself and so save considerable rehandling in order to get the work to or from the welding floor. Fig. 295 is a floor plan showing the location of the various benches, lockers, machines, etc.

In Fig. 296 is shown a view of the shop just inside the northern end. The doors shown at the right are the ones that open out under the crane shown in Fig. 294. This interior view in Fig. 296 gives a good idea

XXIV. Welding Shop Layout, Equipment and Work Costs*

No set rules can be given for welding-shop equipment as conditions vary so greatly. There are a few things, nevertheless, that every shop should have. The general layout of a shop is as difficult to suggest as the equipment, and each owner must plan for himself to meet his special problems. However, regardless of equipment or shop layout, the owner of a welding shop must keep track of his costs, and two standard forms are given to aid him in this.

(*Part XXIII appeared in the July 8 issue.*)

*For the author's forthcoming book, Welding and Cutting. All rights reserved.



FIG. 294. EXTERIOR VIEW OF OXWELD SHOP, SHOWING CRANE HOISTS

of the lighting and the ventilators at the top for carrying away the fumes. The air and acetylene pipe lines are shown, and in the left foreground is illustrated the way cylinders are chained. In the central foreground one of the workmen is chipping a casting with a pneumatic chisel.

The opposite end of the shop is shown in Fig. 297. Here a portable crane is shown in the middle foreground. Suspended from it is a portable electric grinding machine. Just back of this is an electric grinding stand. At the right, in the background, is a Wiederwax preheater and just in front of this is an iron preheating and welding stand with an operator at work at it.

At the left in Fig. 298 is shown a number of welding tables with grated cast-iron tops and welded angle- and strap-iron legs. Both the daylight and artificial lighting are excellent throughout the shop. Probably no other shop would be built exactly like this, as conditions differ so radically, but a careful study will reveal to the prospective shop man some of the things that will, or will not apply to his particular case.

Keeping Track of Costs

No shop can succeed financially without keeping a close watch on cost of material, gas, labor, overhead, etc. The way this is done in the Oxweld shop will be seen by referring to the form shown in Fig. 299. This is so made as to cover both inside and outside jobs. These forms are made in duplicate on white and pink paper, so that a carbon of the original is made. These forms are for shop and office use only, and from them the customer's bill is easily made out. With forms of this kind, the entire data relating to any job may be had at any time by reference to the files.

Another form of cost card, suggested by the Imperial Brass Manufacturing Co., is shown in Fig. 300. This is not so complicated as the form just given, and will answer in many cases. The manager should not forget, however, to add to this the cost of overhead, which it is wise to make fairly high to allow for contingencies—say from 100 to 150 per cent.

Carbon Burning

While carbon burning has nothing to do with welding, the ordinary welding shop is often called upon to do such work on account of having a supply of oxygen at hand.

Carbon in a motor cylinder is caused by imperfect combustion. It may be that the carburetor was not adjusted so as to give sufficient air, or it may be too

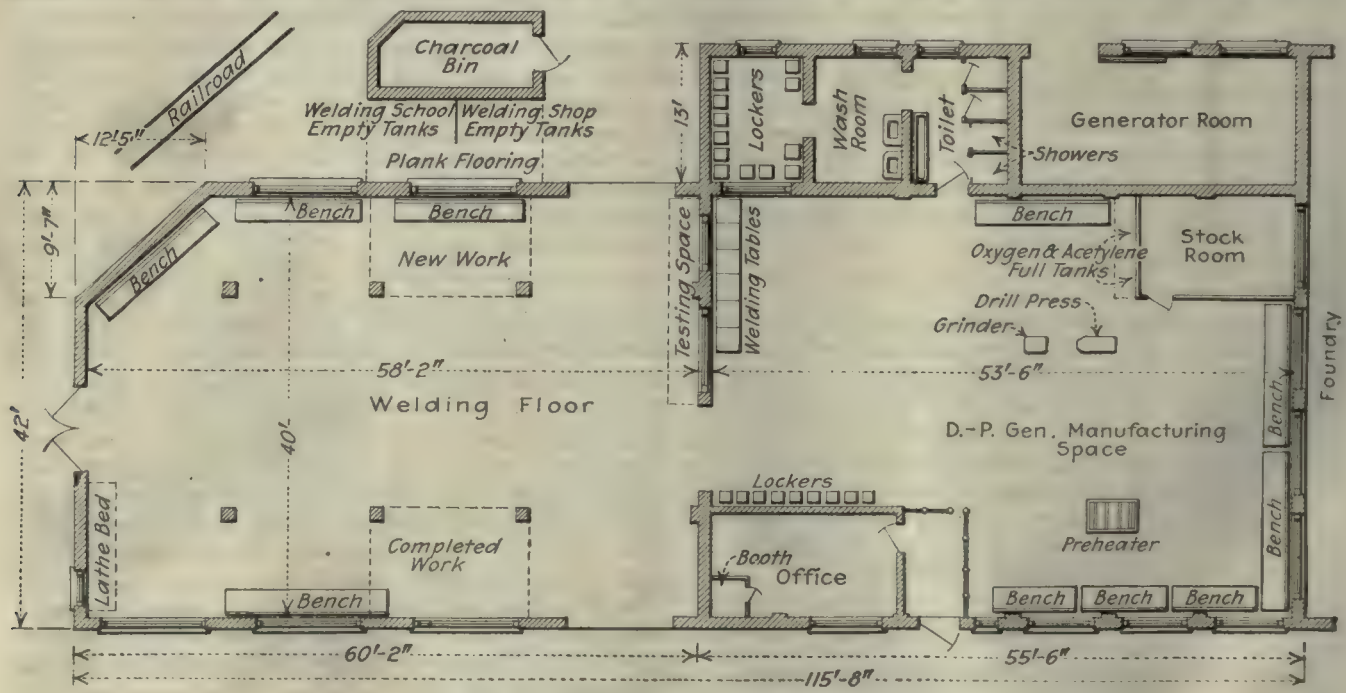


FIG. 295. FLOOR PLAN OF OXWELD SHOP



FIG. 296. INTERIOR VIEW OF SHOP

much oil was used. The use of oxygen is the most practical and thorough way to remove this deposit.

A Decarbonizing Outfit

A decarbonizing outfit is shown in Fig. 301. Here *A* is the oxygen tank valve, *B* the tank coupling, *C* the pressure gage showing the pressure at which the oxygen is delivered to the "torch," *D* the regulating screw, *E* hose connection, *F* trigger valve, *G* hose connection and *H* the flexible copper tip.

To use this outfit, connect it up as shown, then with the motor running shut off the gasoline and let the motor run down. If the engine is particularly dirty, it may be advisable to protect the carburetor and pan by placing some asbestos paper at points to prevent fires from flying sparks.

Remove spark plugs from cylinders—not the valve caps. Crank the motor until the cylinder to be started upon has the piston at the top, with both valves closed.

Set the pressure on the regulator at about fifteen

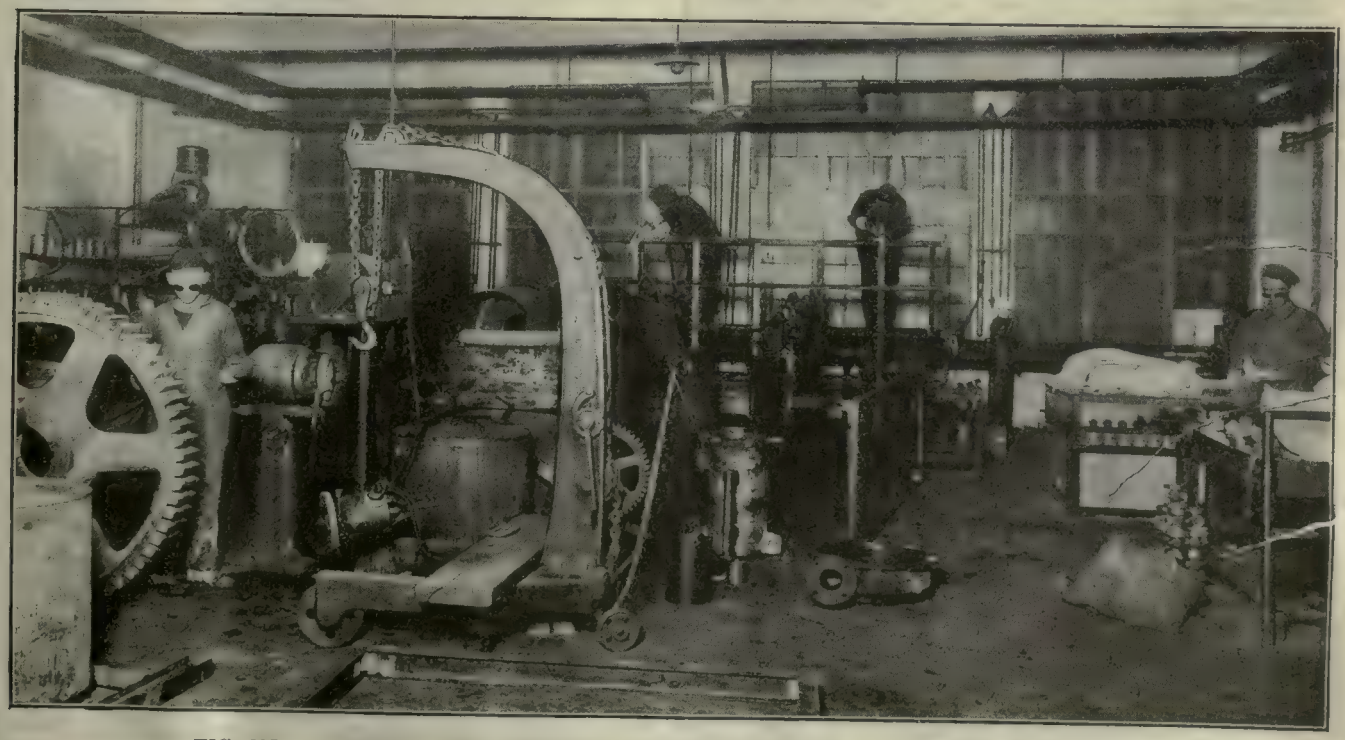


FIG. 297. INTERIOR VIEW SHOWING PORTABLE CRANE AND OTHER EQUIPMENT



FIG. 298. VIEW SHOWING WELDING TABLES

pounds and *partially* depress the lever on the handle of the carbon burner.

Use a wax taper or drop a lighted match into the spark plug opening of cylinder, at the same time directing the copper tube of the carbon burner at that point. This ignites the carbon, and if it is not too dry, the oxygen should thereafter be sufficient to completely consume it without again lighting it. At the start, particularly if the cylinder is oily, there will be some flame as well as considerable sparks. Hold the pressure down until the flame has practically disappeared, then press down the lever all the way and move the nozzle back and forth around the walls until sparks stop.

Sometimes the cylinder is very dry and the carbon is rather difficult to burn. This can be more or less determined by the appearance of the spark plug. If it is dry, squirt about a teaspoonful of kerosene into the cylinder, spreading it over as large a surface as possible, to aid the burning.

The copper tube is flexible and may be bent as desired to reach any portion of the cylinder. Actual contact with the carbon by the tube is not necessary to consume it—carbon burns in an atmosphere of oxygen after it is ignited.

The only possible danger to the cylinder, valves or piston is a too high pressure of oxygen on an extremely

Oxygen gauge, start	1800 lbs.	=	100 cu. ft.
Oxygen gauge, finish	900 lbs.	=	50 cu. ft.
Oxygen used	900 lbs.	=	50 cu. ft.
Acetylene used—			
50 cubic feet @	2½		$1.25
Oxygen used—			
50 cubic feet @	2		1.00
PREHEATING COST			
Charcoal			
Gas, ½ hour, 2 burners @	60		.30
Kerosene			
LABOR (Preparing)—			
1 hour 30 min. @	60		.90
LABOR (Welding)—			
1 hour 30 min. @	60		.90
LABOR (Finishing and testing)—			
1 hour min. @	30		.30
RODS—			
Lbs. Steel @			
15 Lbs. Cast Iron @	10		1.50
Lbs. Bronze @			
Lbs. Copper @			
Lbs. Aluminum @			
FLUX—			
½ Cans Cast Iron @	50		.25
"			
"			
"			
"			
Total			$6.40
REMARKS			

FIG. 300. SUGGESTION FOR COST CARD

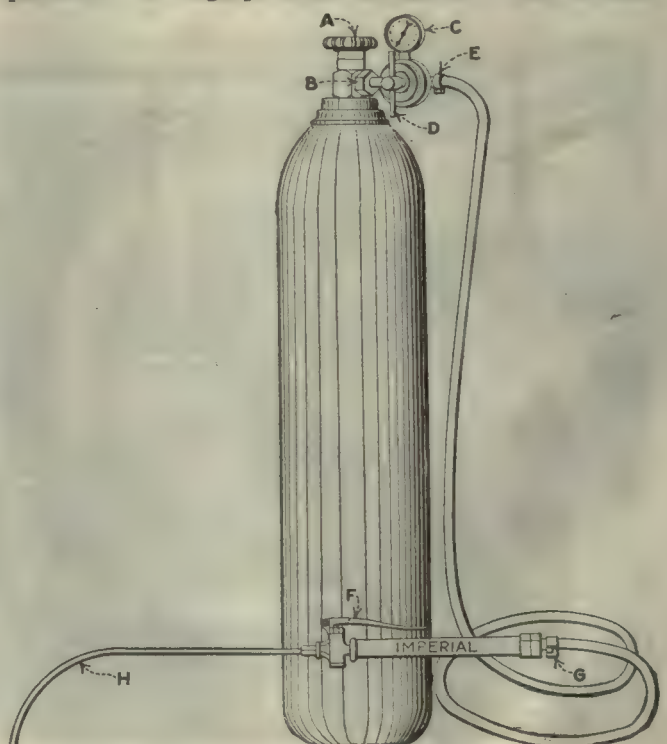


FIG. 301. IMPERIAL DECARBONIZING OUTFIT

WORKING ORDER—WELDING SHOP

JOB No. ..... DATE ..... 191....

NAME .....

ADDRESS .....

DESCRIPTION OF WORK REQUIRED .....

TIME JOB RATE $ ..... PER HOUR. GAS, MATERIAL AND EXPENSES EXTRA. INVOICE $ .....

CONTRACT PRICE $ ..... SALESMAN .....

PAY COMMISSION OF ..... % ON $ ..... AMT. OF COMMISSION $ .....

DATE COM. REPORTED ..... 191....

SHOP TRANSIT							GAS		LABOR					
ARTICLE	AMOUNTS USED				TOTAL AMOUNT USED	PRICE	TOTAL COST	OXYGEN CU. FT.	ACETYLENE CU. FT.	DATE	WELDER'S NO	HOURS	RATE	TOTAL
CHARCOAL														
OIL PENETATING														
CAST IRON RODS														
OXWELD IRON WIRE														
ALUM. ROD WIRE														
BRONZE														
BRASS														
FLUX KIND														
STEEL ROD KIND										TOTALS				
ASBESTOS														
GLOVES														
CARBON, ROD BLOCK														
GOGGLES														
MISCELLANEOUS														
BOARD AND LODGING														
R. R. FARES														
FREIGHT OR EXPRESS														
CARTAGE														
TOTAL COST—SHOP TRANSIT $														

REMARKS:

INDIRECT CHARGE A/C FOREMAN ..... $ .....

TOTAL LABOR ..... $ .....

OVER HEAD ..... $ .....

GAS	AMT.	PRICE	TOTAL	
OXYGEN				$
ACETYLENE				$

SHOP TRANSIT ..... $ .....

BASE COST ..... $ .....

COM. TO SALESMAN ..... $ .....

PROFIT FOR COMPANY ..... $ .....

CHARGE CUSTOMER ..... $ .....

FIG. 299. COST KEEPING FORM

oily cylinder—there would be considerable heat generated in this instance. Hold the pressure down, then, until the flames have gone and sparks only are being thrown out before fully opening the lever on the handle.

When through cleaning, it is desirable to remove the valve cap and blow out any solid particles there may be present; these solid particles cannot be carbon, but may be pieces of iron, etc. The appearance of the cylinder will be considerably improved by swabbing off the top of the piston and valves with an oily rag.

Carbon burning is a very practical solution of carbon deposits—but care and horse sense must be used, though the process calls for no particular degree of skill.

Shall We Make Essentials Or Non-Essentials?

By John S. Watts

I have read, pondered upon, and written sundry articles bearing on the underlying causes and have suggested remedies for the present unrest in the whole world, and have yet to see in any part of the world an intelligent effort by "those set in authority over U. S." to lead us out of the turmoil.

Those who take time to spend a few moments thought on the subject usually give as the reason for it the reaction from the war and the shortage of essentials due to the destruction incidental to the war. If asked for an explanation of what is meant by the reaction from the war the answer is that the war increased the wages of almost all manual workers, and they acquired more extravagant tastes, which have raised the so-called standard of living without increasing the production of the goods required to satisfy this higher standard.

If this were the whole truth, which I shall endeavor further on to prove it is not, we could expect that time would cure the evil; but on the contrary, notwithstanding periodical prophecies that the world will soon be back to normal, conditions are going steadily from bad to worse. Even as it is there seems to be no concerted effort to arrive at the just solution for the cause of the manual workers' continual demand for more and ever more.

If we had competent leadership in our communal affairs it should not be impossible to convince a set of dissatisfied workers that they are in actual fact receiving the full value of their production; or, on the other hand, to prove to a recalcitrant employer that he is not paying his employees the full value of their production.

The main, in fact the only, practical argument advanced by labor in demanding increased wages is that it must be paid a living wage, apparently regardless entirely of whether it produces an equivalent in value or not. With the requirements considered essential to a living becoming more and more extravagant daily the time is fast approaching, if it is not indeed already here, when it will be impossible to draw upon the reserves built up in the more frugal past to pay out to labor more in value than it is producing.

In my opinion, not the shortage of essentials but the wrong distribution of labor is the root of our labor unrest and the high cost of living. With the present distribution of labor we have an actual shortage for the production of essentials and an overplus for the production of non-essentials. This, which is really the crucial point, seems to be almost entirely overlooked, or neglected, and for intelligent human beings we have displayed a distinct and shameful absence of leadership in the direction of our affairs as an interdependent community. We have allowed it to come to pass that the producers of actual necessities have been coaxed away to produce non-essentials to the point where actual want is a not improbable expectation.

The very ones whom we have in our ignorance attracted to the factory from their proper work of producing food are able, because of their organization, to demand and to get from the community more than their fair share of the depleted production. This is true even to an extent where the others are unable to

get the real value of their work because there is insufficient production to supply all and the stronger take the lion's share.

This shortage of essentials due to the wrong distribution of the available labor will undoubtedly become worse as time goes on unless those in authority can be made to take some action in the matter and not leave it to chance. The point I wish to emphasize is that unless a redistribution of the available manual power is made the whole population will soon be engaged in some form or other of factory work, and agriculture, the most essential occupation of all, in fact the only one that is absolutely necessary to life, will be entirely stopped because there will be none left to undertake it. The prophecy that at the beginning of the millenium men will beat their swords into plowshares needs revision, as it would seem to be more to the purpose to beat our automobiles into plowshares.

Factories Attracting Men from Farms

For some four or five generations now factories of all kinds have been attracting by every means in their power the young men from the farms. Very, very few of them or of their children ever returned to the country. This has produced the situation we now have on our hands, when there is plenty of everything but the necessities. Doubtless Henry Ford's ideal of an automobile for every working man will be realized, but will there be at that time also a barrel of flour for every family? Or, to put it another way, can we find men enough to operate the factories necessary to supply an auto for every one, to say nothing of a gramophone, gold watch, diamonds, etc., and still leave enough men on the farms to feed and clothe us?

Supply and Demand

Probably the reply of a government to the suggestion to take up the distribution of labor would be that such matters are best left to the law of supply and demand, which will right things in time. While possibly true, the time will be, I fear, too long and conditions are likely to become disastrous before this law takes effect. In fact, I believe the only remedy we shall have if we trust to the law of supply and demand, will be that sufficient numbers will starve to death, or be killed in food riots, to improve conditions for the remainder. In any case, being supposedly intelligent creatures, it ill becomes us to leave our future at the mercy of a law which is at best an offshoot of the brutal law known as the survival of the fittest.

Obviously, if we are to continue to exist, a certain percentage of the people must do agricultural work, and it is as necessary for us as a people to see that each department of our communal activities is supplied with its proper percentage of the total population as it is for a factory manager to allot the available labor proportionately among the various departments of his plant.

The ever recurring periods of overproduction in factory work are results of the working of the law of supply and demand. Factory workers are thrown out of employment and with rare exceptions they simply loaf until the demand for their product increases again. Meanwhile they have to be supplied with food and other necessities from the available supply without returning anything for it. If the unemployed answered to the law of supply and demand by reverting to agricultural work when factory work was not in demand this law would be of some benefit, but under the present conditions it simply makes matters worse.

Moreover, the owners of factories do their best to render the aforesaid law inoperative by creating an artificial demand for their products by skillful and alluring advertising and so really selling more of their output than the people are in a position to purchase. Then in order to satisfy the stimulated demand it is necessary for them to draw still further on the already depleted ranks of country workers.

Seductive Advertising of Luxuries Helps Boost H. C. L.

This seductive advertising has a double effect on the cost of living inasmuch as it creates a desire for its products in a class whose productiveness does not create a sufficient value to enable it to afford them. When we consider the insistence and cleverness of the advertising methods used it is small wonder that they are followed by a demand for higher wages to enable the worker to purchase the luxuries advertised. These higher wages are not, as a rule, accompanied by any greater production and this gives the cost of living still another boost.

High wages offered as inducement to labor and increased demand for luxuries, due to both higher wages and clever advertising, lead to a still further increase in the quantity of labor employed in producing those luxuries, and this additional labor must be largely drawn from those previously engaged in producing necessary articles. The more people working for high wages the more the demand for luxuries and the fewer people left to produce necessities. The few will continue to become fewer until a break occurs in the vicious chain.

Women Responsible for Strikes

I am firmly impressed with the idea that if we could trace strikes back to their beginning we should find that the women were responsible for the greater part of them. If Mrs. Carpenter finds that her next door neighbor, Mrs. Bricklayer, has a better gramophone you may be sure that Mr. Carpenter will have no rest until he gets his wife one that is still one grade better, and therein lies the reason why we have the sudden and apparently unreasonable demands put forward upon which no compromise is possible. We all know that when the fair sex is determined to have a thing there is nothing to be done about it, but just get out and get it, honestly if possible, but we must get it.

Our schools do not teach the subjects which would tend to attract our children to take up the truly independent life of a farmer. The whole curriculum seems to be laid out for the benefit of the city worker. Nor is the most useful science of political economy taught. If it were we would not have the people basing their demands on the belief that money in itself has value and that there will always be an amount of commodities to be purchased equivalent in value to the money in circulation. The simple fact that the value of money depends entirely upon the available supply of goods and the relation that this supply bears to the demand seem to be almost unknown.

To sum up, unless we are to starve we must take stock of our resources in manpower and see that a sufficient proportion of this power is applied to the production of necessities before any is used for the manufacture and sale of non-essentials.

Making Some Ball-Ended Plugs

By E. A. DIXIE

The production of accurate spherical surfaces is something that is not often undertaken in the ordinary machine shop. In this article the author tells how he accomplished such work and gives in detail the how and why of the necessary tools.

A RATHER interesting job came up in connection with some work I am doing, and as no one in the shop had ever done anything of this sort before, I decided to do it myself so as to gain the experience. The results were entirely satisfactory and as the method of doing the job may be new to some, as it was to me, it may be of interest:

Six plugs $1\frac{1}{8}$ in. in diameter and 7 in. long were required to have a section of an accurate sphere 34 in. in diameter formed on one end. The body of each plug for $4\frac{1}{2}$ in. from the spherical end was ground and lapped $1\frac{1}{8}$ in. in diameter. The balance of the plug was reduced to 1 in. and knurled with a coarse knurl for a grip.

A center was permissible in the knurled end, but no center was to be left in the spherical end after finishing.

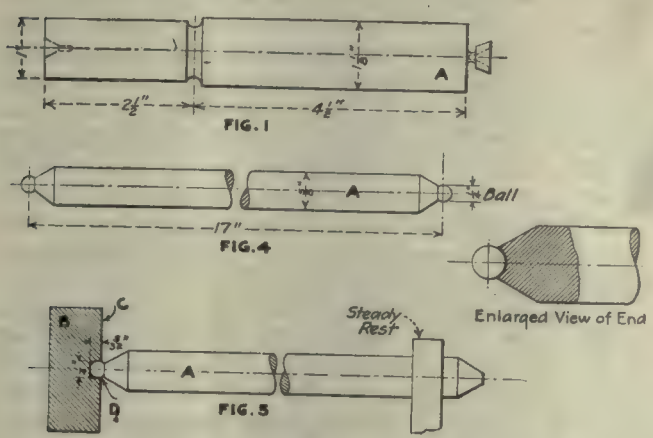


FIG. 1. THE BLANKS FOR THE SPHERICAL ENDED PLUGS
FIG. 4. CONSTRUCTION OF THE RADIUS ROD
FIG. 5. SET-UP FOR FINISHING THE RADIUS ROD TO LENGTH

For this reason the blanks were turned as shown in Fig. 1, with the end *A*, which was to be finished to the sphere, necked down so that it could be broken off after the body was ground and lapped.

Cylindrical grinding and lapping were done in the usual way, and the process is so well known that it requires no explanation. The reduced centers were then broken off and the ends roughly ground flat on a water tool grinder.

It was found that the most suitable lathe for roughing the spherical ends was a 14-in. Willard, shown in Figs. 2 and 3. The opening *B* in the steadyrest was ample for swinging the 17-in. radius rod *A* and the rest would take the Dumore grinding attachment *C* without much extra rigging.

Before starting to set up on the lathe, the radius rod *A*, Figs. 2, 3 and 4, was made. A piece of $\frac{5}{8}$-in. drill rod was cut off and the ends turned conical about 60 deg. A spherical seat was then turned in one end,

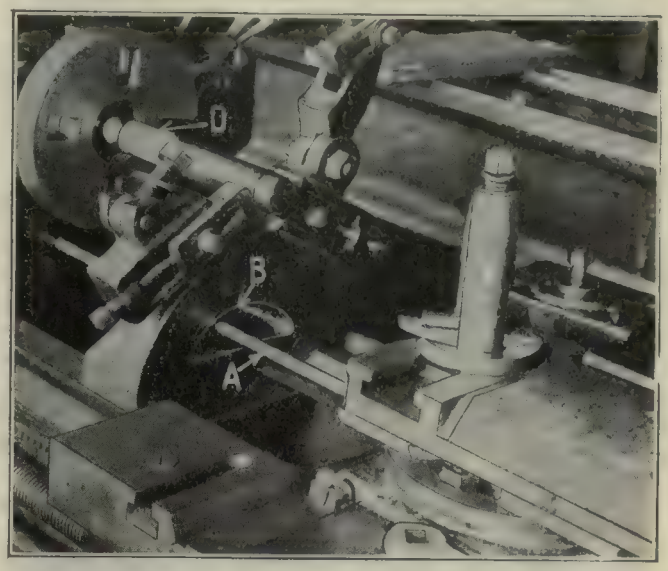


FIG. 2. THE SET-UP FOR GRINDING WITH GRINDING ATTACHMENT REMOVED

and to assure a smooth seat for the ball which was to occupy it, a $\frac{1}{4}$-in. ball was placed in it and given a sharp blow with a light hammer. A selected $\frac{1}{4}$-in. ball was then taken and tinned as was also its seat in the end of the drill rod. It was then placed in the tinned seat and clamped by pressure while sufficient heat was applied to cause the solder to flow. Care was taken that the temperature was kept below that which would draw the temper of the ball. After the rod and soldered ball were cool, a piece of steel, *B*, Fig. 5, was gripped in the chuck of the lathe and a recess turned in it $\frac{1}{4}$ in. in diameter and $\frac{5}{32}$ in. deep with a flat bottom, the front *C* was then faced true, to afford a locating surface for measuring the length of the rod. A dog was then secured near the finished end of the rod and a belt lace used to strap the job back so that the ball *D* was firmly seated in the recess in *B* which was firmly held in the chuck.

The front end of the rod was run in a steadyrest and the second ball seat, carefully worked out. Length measuring was easily carried out without removing the work from the lathe. The surface *C*, a known distance from the bottom of the recess for the ball *D*, afforded

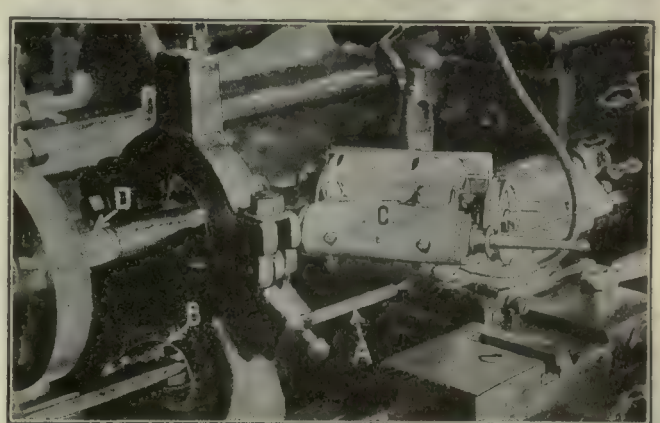


FIG. 3. SET-UP FOR GRINDING WITH GRINDING ATTACHMENT IN POSITION

a support for the base of a height gage which was improvised from a 12-in. height gage with a 12-in. vernier clamped to it. The sliding jaw of the vernier having been turned around so that the fixed jaw would not interfere with the rod *A* while measurements were being made.

The clamping on of the vernier was necessary because the radius rod was 5 in. longer than the height gage would measure. When the seat for the second ball was finished, checked up and found correct, a ball was soldered on in the same manner as the first one.

With the radius rod finished the lathe was prepared in the following manner:

Points were laid off on the headstock and the cross-slide of the lathe in such position that a line connecting them would be parallel both vertically and horizontally to the axis of the lathe spindle.

The vertical distance above the Vs was such that the rod *A* would swing clear in the opening in the steadyrest and allow sufficient lateral movement of the rod in the steadyrest opening while grinding the spherical surfaces on the ends of the plugs.

Two ¼-in. holes ⅜ in. deep were then drilled in the

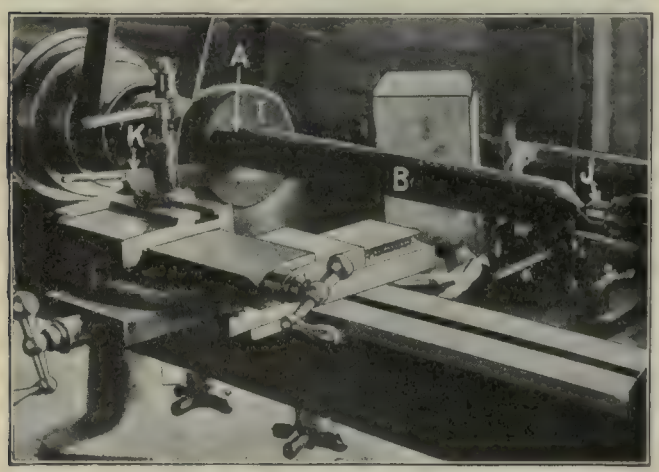


FIG. 7. THE SET-UP FOR LAPPING

headstock and cross-slide to accommodate the ball ends of the radius rod. When setting up for the grinding job, the compound rest was turned parallel with the bed, as shown in Figs. 2 and 3.

The plug *D* was driven by a dog and strapped back with a belt lace. The set-up is shown in Fig. 2, but the lathe dog and belt lace are not shown here, and the grinding attachment has not yet been placed, as with it in place it was not possible to take a good photograph from this position and show the work.

In Fig. 3 the set-up is shown in operating position with the grinding attachment in place.

While grinding the spherical faces the left hand was kept on the longitudinal feed handwheel so as to keep the carriage in contact with the ball-ended radius rod *A*. A weight was first tried but was not sufficiently sensitive. The cross-slide was fed backward and forward to move the grinding wheel across the face of the work. A diagram of the operation is given in Fig. 6. Feed to depth was obtained with the tool slide. The total time for rough grinding the 6 plugs was about 3 hours. The work came too rough from the rough-grinding operation to go direct to the lapping operation, but we have a polishing department, and by using an old 180-emery felt wheel with care the ends of the plugs were ground free-hand till the marks of the rough grinding were barely visible. The plugs were then ready for the lapping operation, and were subjected to three lappings, two roughing and one finishing. But as the methods employed in all three were the same a single description will cover them all.

A ball-ended holder *B*, Figs. 7 and 8, was prepared.

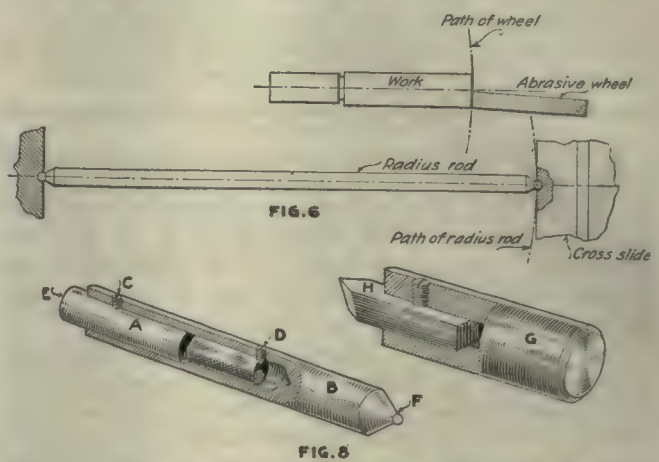


FIG. 6. PLAN VIEW DIAGRAM OF THE GRINDING OPERATION. FIG. 8. HOLDER FOR PLUGS DURING LAPPING AND TOOL USED FOR FORMING THE LAPS

In these two illustrations similar reference letters refer to similar parts. At one end the holder *B* was turned conical and a ball *F* was inserted in the same manner as those in the radius rod. The other end was bored and ground a fit for the bodies of the plugs *A*. Two setscrews were located in *B*, one at *C* to clamp the plug in place, and the conical-pointed one at *D* to aid in adjusting *A* so that the face *E* would be the required distance from the ball *F* to give the 17-in. radius so that the work could be swung on the lap and thus take advantage of all the lapping surface.

At first glance one would imagine if the lap were formed to the correct 17-in. radius, the length of the work holder would not matter, but on accurate work of this character finished in this way the work must be swung to the arc of the lap to get the desired results. Obviously, if the work and holder were shorter than

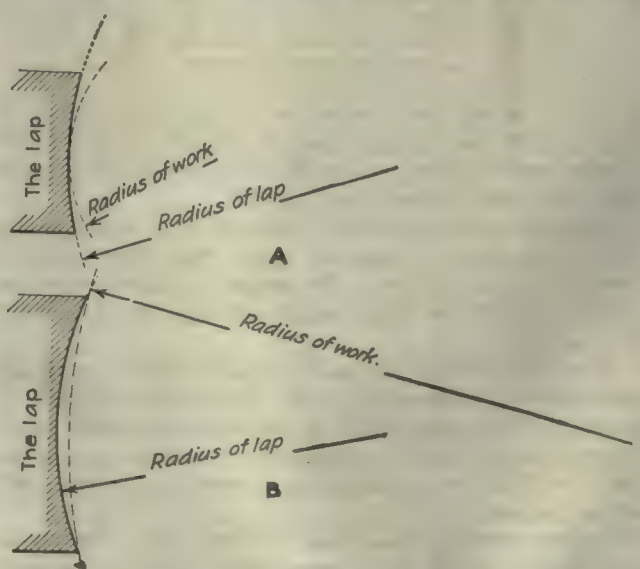


FIG. 9. DIAGRAM SHOWING EFFECT WHEN WORK AND LAP ARE TO DIFFERENT RADII

the radius to which the lap is finished, the end of the work would bear hard in the center of the lap and not at all when swung to the perimeter. If, on the other hand, the work and holder were longer than the lap radius, it would bear hard at the perimeter and not at all when at the center. Both these conditions are shown in the diagrams *A* and *B* in Fig. 9.

A toolholder *G*, Fig. 8, was also made to fit in the hole in *B*. It was held and adjusted to length by the two screws *C* and *D* in the same manner as were the plugs. At the front it carried a tool *H* made of high-speed steel. High-speed steel was used because the lapping was done on the Pratt & Whitney bench lathe shown in Fig. 7, and its speed was too high to use carbon steel for turning the cast-iron laps.

A piece of cast iron *I* was screwed to the faceplate and faced off with the slide rest.

The toolholder *G*, Fig. 8, was then set and adjusted to 17 in. in length in the holder *B*, and a special female center *J*, Fig. 7, put in the tail spindle of the lathe. A tool *K* was put in the toolpost to act as a rest as shown.

The holder *B* was placed with the ball *F* in the female center *J*. The tail spindle screw was advanced till the tool *H* cut the face of the lap *I* at the center. The cutting tool was then pulled by hand toward the front, removing the metal as it advanced; it was again moved to the center and the tail spindle again advanced and another cut taken. This was repeated till the piece *I* was concaved to nearly its perimeter. The toolholder *G* was then removed, and a plug located in the holder *B*. The lap was charged with 220 carborundum and with the plug resting on the tool *K*, the lathe was started up. The adjusting screw *D* was then screwed in, forcing the plug *A* forward against the face of the lap.

Advantages of the Method

This method of doing the work has several advantages: If the tail center is concentric with the lathe spindle axis a true hollow spherical lap may be formed as described. At the center of such a lap the speed is *theoretically* zero, and practically very slow, and, therefore lapping action is very slow at this point; however with this method I did not use the slow-moving center of the lap, but got as far as possible from it so as to take advantage of the increased speed.

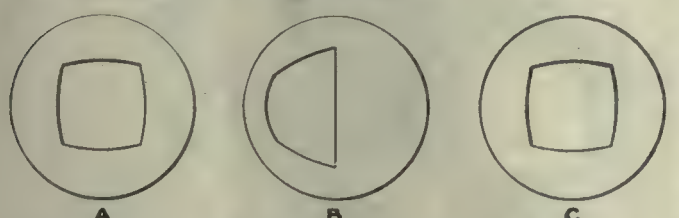


FIG. 10. REFLECTIONS OF SQUARE THROWN AT DIFFERENT ANGLES ON SPHERICAL ENDS OF PLUGS

When setting the plug the tail spindle was kept in the same position it occupied when the final cut was taken on the lap *I*. The adjusting screw *D*, Fig. 8, was slackened back so that the plug *A* could be set in *B* to such depth that it would clear the face of the lap *I* when the ball was in the female center *J*.

When working the center of a spherical lap the "scratches," if I may use such a term, are concentric on the work face and great care is required to get a high finish together with accuracy. But when working, as shown, the axis of the plug is radial from the focal point of the female sphere (of whose surface the lap surface is a part) and the position of the rest *K* whether above or below the axis of the lathe can have no influence on the accuracy of the work, its only function being to take the resistance of the lapping. Further the scratches are all approximately in one direction, *i.e.* parallel to each other, and therefore it is very little trouble to get a high finish with accuracy of shape. As the surface being lapped and the surface of the lap wear, the plug is fed forward by the screw *D*, Fig. 8, care being exercised not to apply too much pressure. When all the plugs had been lapped with 220 carborundum another lap was prepared but charged with 15-min. carborundum. The final finish lapping was done on a third lap with 60-min. carborundum which gave a very high finish.

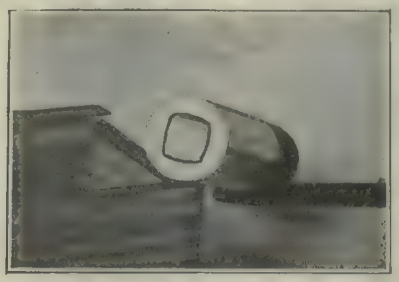


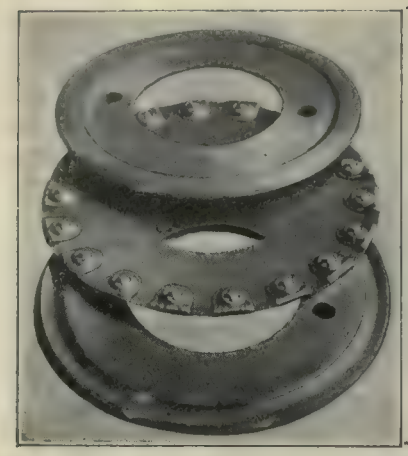
FIG. 11. REFLECTION OF SQUARE ON SPHERICAL END OF PLUG

It is a well known fact that the reflection of a taut wire is a very good test either for the straightness of a hole or for the flatness of a plain surface, so a variation of this test was applied to the spherical ends of these plugs. Four strips of black paper were gummed in a square on a pane of glass. After the gum was dry an accurate square was laid out, and with square, straight edge, and knife, the superfluous paper was cut away leaving an accurate square with sides about 18 in. long by $\frac{3}{8}$ in. wide. The glass with the square on it was then secured in one of the windows, so its reflection could be observed on the ends of the plugs and noted.

When the plug was so inclined that the reflection from the square was centered round the center of the plug, the reflection appeared as shown in Fig. 10 at *A*. It will be noted that the sides of the square bulge all around the center.

The Time Taken Was Twenty Hours

If the plug is so located with relation to the square that the reflection of one of the sides of the square passes through the center of the plug then it will appear as a straight line while the other sides are curved as shown at *B*. By rotating the plug slowly while noting the reflection, any slight variation from accuracy of the spherical end is readily detected, and the position of the error located. I had no means of *measuring* the errors thus noted but one of the plugs which was apparently corrected was taken and passed lightly *one stroke* over a flat lap, care being taken that the new lapping scratches (to avoid refraction) ran as nearly as possible in the same direction as the original ones on the spherical surface. The reflection was then observed and the flat made by the *single passage across the flat lap* was readily detected, a distinct irregularity appearing in the reflection at this point as shown at *C*, Fig. 10. Fig. 11 shows how the reflection looked when viewed at the proper angle. The entire time making the necessary tools and fixtures, and lapping the plugs, was less than twenty hours, the lapping time alone being less than half an hour for each plug.



Press Work on the Bailey Ball Thrust Bearing

By J. V. HUNTER
Western Editor, *American Machinist*

A punch-press job on light work is the subject of this article, which gives the sequence of operations on the sheet-metal retainer used in a ball bearing. Although the operations are not new, the tools used are worthy of examination.

SOME of the light automobiles are equipped with bronze washers for thrust bearings in the differentials, and after these washers have become somewhat worn the teeth of the differential gears are no longer held properly in mesh. To take the place of this washer the George D. Bailey Co., of Chicago, Ill., is manufacturing a special ball-thrust bearing. The manufacturing operations on the bearing are done almost entirely on a punch press, the method of manufacture being described in the following paragraphs. The illustration of the thrust bearing in the headpiece shows that it consists of two side bearing plates and a center retainer which carries the balls. The bearing plates are produced by simple punch-press operations, and their manufacture offers no unusual features. They are blanked and then formed with the groove or race and given a thor-

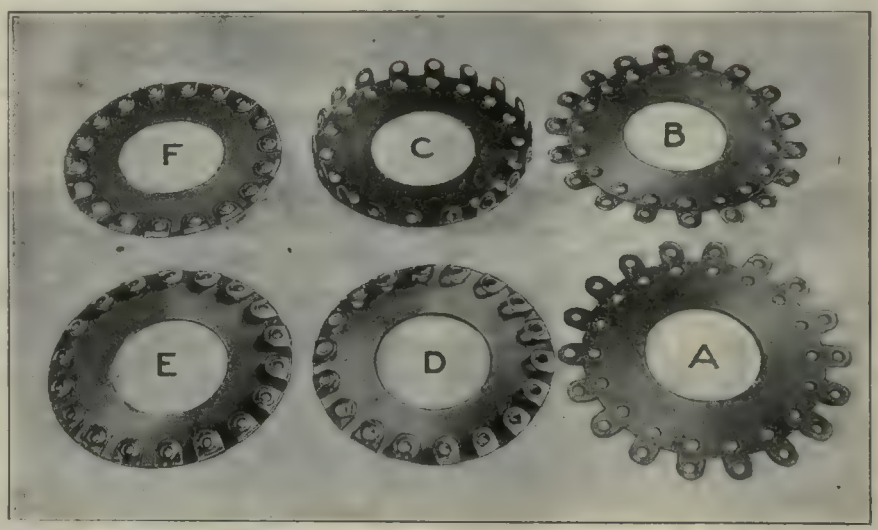


FIG. 1. STAGES OF OPERATION ON THE BALL RETAINER

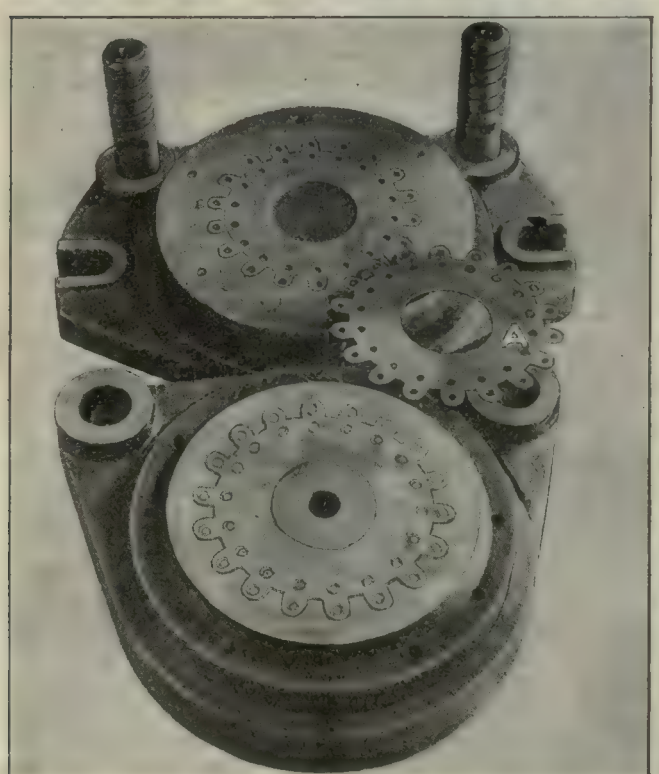


FIG. 2. COMPOUND DIES FOR BLANKING OPERATION

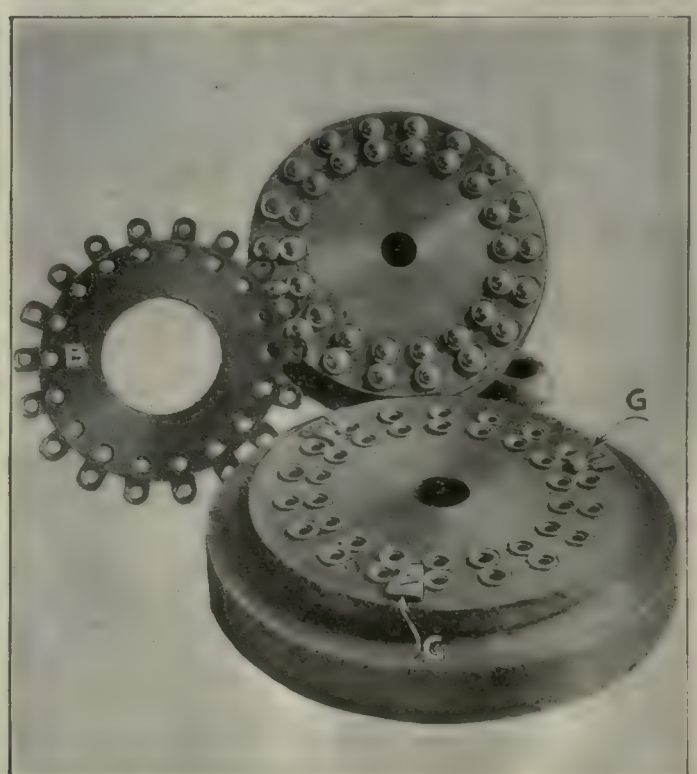


FIG. 3. PUNCH AND DIE FOR FORMING THE BALL POCKETS

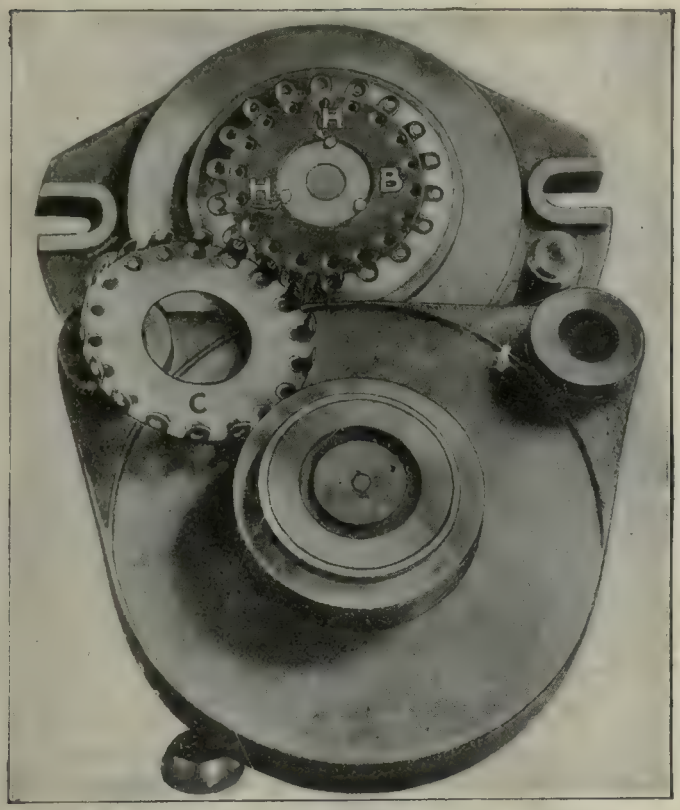


FIG. 4. TOOLS USED IN THE FIRST OPERATION OF BENDING EARS

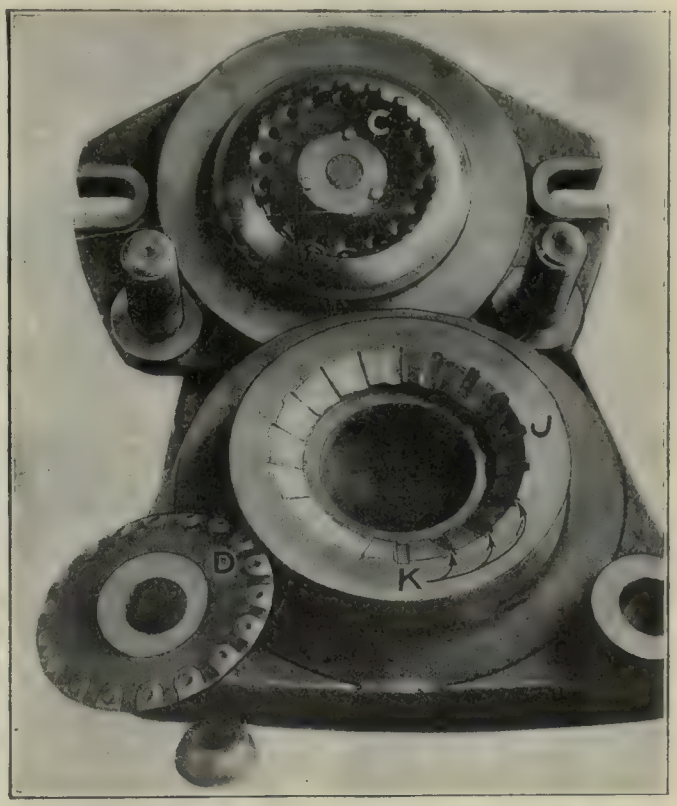


FIG. 5. TOOLS USED IN BENDING EARS DOWN READY FOR INSERTION OF BALLS

ough case-hardening and heat treatment. Then they are ground to finish the inside of the race and the back face, care being taken to grind to the proper thickness between these two surfaces.

Stamping the Ball Retainer

The blank *A*, Fig. 1, is stamped from the sheet as the first operation in the manufacture of the ball retainer; and this is followed by the drawing or countersinking operation, thus forming the concave impressions shown at *B* that are afterwards closed about the balls. The third operation stands the ears up in a vertical position, as shown at *C*, and next they are bent down as at *D* so that they stand at an angle of 30 deg. with the main body. The ears are now in a position so that the balls can be pushed under each one, as at *E*. The ears spring back into place and hold the balls until the retainer is placed under the last die and they are bent down tight, as shown at *F*.

The compound die for the blanking operation, Fig. 2, is simple in general construction and is provided with a rubber pressure pad under the stripper in the center. A punched blank is shown at *A*.

The punch and die for forming the ball impressions are shown in Fig. 3, together with a formed blank *B*. The blank is positioned relative to the forming impressions by means of the three lugs *G*, which fit between pairs of ears and both center it and hold it in the correct position over the impressions. The punch and die bodies are constructed of cast iron with steel insertions for the forming surfaces.

The punch and die, Fig. 4, serve to turn the ears up at right angles as shown at *C*. An unbent blank *B* may be seen resting on the face of the die in the position it occupies before bending, it being held in place by three round dowels *H*. A pressure plate beneath the blank retreats into the die as the punch enters, and as the punch rises again the pressure plate discharges the formed blank.

The die used for the fourth operation, Fig. 5, is the same as that used in the preceding operation, but a different punch plate *J* is employed. This plate is beveled with the requisite angle, so that its pressure

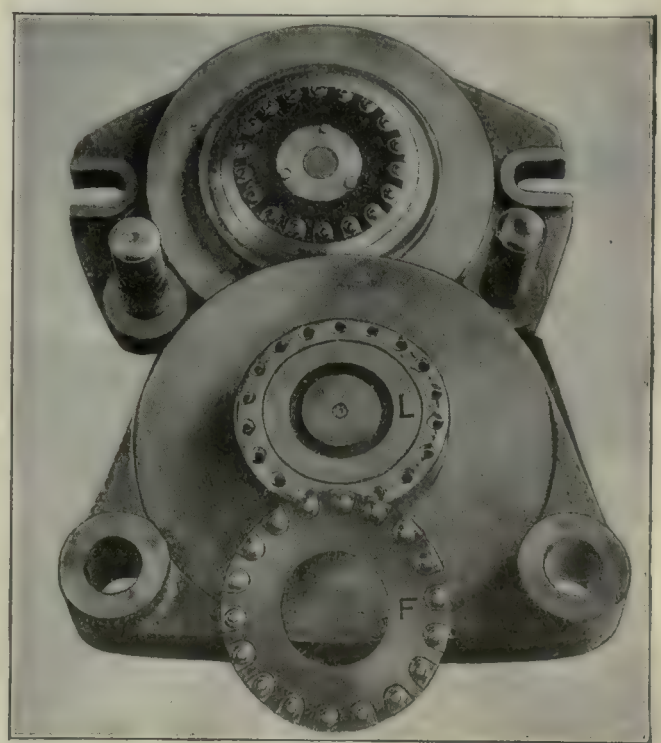


FIG. 6. TOOLS FOR COMPLETING RETAINER BY CLOSING DOWN EARS

on the blank *C* bends the ears into the position shown at *D*, see also Fig. 1. The grooves *K* in the beveled face of the punch prevent the flattening of the pockets which were formed for the balls in the second operation, and it may be mentioned here that the pressure plate likewise has recesses so that the impressions for the balls in the ring itself will not be crushed.

The final operation, Fig. 6, again uses the same die with a different punch plate *L*, which presses the ears down to the final form *F*, thus holding the balls in the retainer ring. All operations are performed on a No. 20 power press built by the E. W. Bliss Co.

Some Thoughts on Early Machine Design

By W. D. Forbes

The article on page 1 of the *American Machinist*, entitled "Examples of Early Machine Design," is more than interesting as it takes up a subject which is well worthy of consideration at this or any other time.

The first comment I would make, is upon the speculative part of the article as to the forces which influenced the early designers of machine tools. Mr. Sheldon suggests that the influence was that of Nature and the design of the drill press was possibly suggested by the trunk of a tree. Now to my mind the early designers of machine tools show very clearly what influenced them in their most creditable work. History shows beyond all doubt that the first Art that resorted to the compass, pen and drawing board was the builders trade. Kings wanted palaces to live in and monuments raised to their great deeds. Religious sentiment was also closely coupled with the kingly desires, and temples were raised. All of these demanded something grand and ornate to satisfy the vanity of man and propitiate his God.

The Gothic style of building, no doubt, was suggested by the trees of the forests, while the strong influence of the religious sects, in themselves powerful and rich, gave a most vigorous push to the Art of building. In the early days of machine-tool design when draftsmen were wanted for the work, the only place where they could be found was in an architect's office and it is little wonder, therefore, that the ecclesiastic architectural inclination is so clearly shown in all their work.

It was to be expected that when the housings of the first planers were designed the panels should show Gothic pointed terminals and that the long lathe bed should show paneling and molding that broke the surfaces so that, pleasing to the draftsman's eye, he thought that they would please others.

I saw in Providence, R. I. many years ago, a planer where the ecclesiastic idea was carried to the extreme. The back members of the housings were in the form of scaly monsters, their tails forming the feet of the machine and their eyes the bearings for the shaft that raised the cross rail. Here was the church gargoyle exactly reproduced.

Not very long ago I saw a milling machine made by the Brainard Co. and, while the general design was most modern and pleasing, the hinges of the door in the base were of the most ornate Gothic form; which showed that the old ornamental desire would crop out at times even in modern design. Again we see the Gothic idea, even today, in the lagging of steam engines.

I have often wondered if Philadelphia, the Quaker City with its plain and severe buildings, did not influence the Sellers people when they designed their first machine tools. They were the first, to my knowledge, to break away from the ornate design and the "green paint," to adopt the dignified plain form and flat gray color.

All the above refers to the speculative part of Mr. Sheldon's article concerning original machine-tool design. The real practical suggestion is that concerning the value of the old machine tools. Ornamented though they may be, the evidence is plain that their days of usefulness are not over.

The maximum capacity of a machine tool is rarely, if ever, reached. I can remember but few instances where a lathe or planer had a job which demanded its maximum. The first I can clearly remember, was a 28-in. swing lathe, taking 6 ft. between centers, used to turn a cylinder of practically these dimensions; the second, was when a planer 72 in. square in its housings with a 14-ft. bed had to finish a casting that required every inch of its capacity. Both of these jobs evoked much talk among the men of the shop and in the town where the work was done, thus showing its rarity.

The old tools could not quickly remove the maximum amount of metal on work which taxed their capacity, but they could remove quickly the metal on the pieces given them to do just as well as if the power for the larger work was there.

I know that the idea of power and rigidity of machine tools has been much talked about by builders of late machine tools, but I take the view that if excess power is never to be used it is of no value. If the excess power is to be used very rarely, it is of a little value, but as this large power must add to the first cost, and constantly to the cost of driving the machine, then it is not a good engineering job.

The early tool designers failed in bearing surfaces more than anywhere else and this made the lasting qualities of their tools less; yet it may be that the early designers did not expect the heavy work later put on the machines or they would have made greater allowances. At any rate the bearing, even though too small, seems to have stood up pretty well, particularly in the case of the lathe. In a shop under the old skating rink in Providence, R. I., I once saw an old man turning up small pulleys to be used on the grinding machines made by the Diamond Tool Co., using three old chain feed lathes. He was also turning cone pulleys such as are used on lathes and milling machines for the feed drive, and doing this latter work with a gang of three tools at a rate of speed that more modern tools could hardly have bettered. Such work does not require heavy cuts but the pulleys had to be true cylinders, and they were.

Using the old men right as well as the old tools, as illustrated in Mr. Sheldon's article, shows wisdom indeed. I know of one shop where for years the few older men who had passed the working age, were given a room in the shop where they could meet every day and read the trade papers, smoke their pipes and tell of past doings. The manager told me that the knowledge possessed by these men concerning the past products of the shop, and gained by their long service, was of the greatest value.

To recapitulate: Don't scrap your old tools or your old men too hastily. It is worthy of careful thought in designing machine tools for the future whether or not we have gone too far in providing power which is rarely required and which constitutes an extra and continuous expense.



The Evolution of the Workshop—XIV

By H. H. MANCHESTER

What the great World War did for our present-day industries was only a repetition of what occurred during the Civil War. American metal-working industries developed greatly from 1860 to 1870, and the foundations of many of our present enterprises were laid at that time. This article, the last of the series, gives data upon the American metal-working industries during the Civil War.

(Part XIII appeared in the Aug. 19 issue.)

THE necessities of the Civil War gave a great impetus to the machine shop. Many new shops sprang up, and various improved and more rapid methods were devised.

One very important machine developed for this work was the universal milling machine designed by Joseph R. Brown, and employed by Brown & Sharpe at the end of 1861, Fig. 90 showing an old print of it. This machine had a cutter which could be sharpened by emery wheels without having the temper drawn, and while still retaining its shape. The new method of sharpening made the milling machine far more practical, and led to its more general adoption.

A few years later the Journal of the Franklin Institute wrote: "This machine is adapted to the making of many tools required by gun makers and machinists, such as twist drills, mills of all shapes with straight or spiral teeth, and cutters for gears and other work. It will, moreover, cut a tapering or conical mill with right- or left-hand spiral teeth, and will take the place of the common index milling machine."

The illustrated weeklies of 1861 contained several interesting pictures with brief notes upon them which delineated the work at the different arsenals.

At the Watervliet Arsenal, West Troy, N. Y., according to Frank Leslie's, a pressure hammer was in use, superseding the old trip hammer. It was described as sending the striker down with irresistible momentum. There were also shears of "monstrous" caliber having the upper blade on a pivot, and easily cutting iron an inch in diameter. The arsenal made principally iron for gun carriages, shells, and rough tools. It depended regularly upon water power, but had a steam engine in reserve if this failed. A view of the hand-forging shop is shown in Fig. 91. An illustration, reproduced in Fig. 92, of filling canister shot at this armory shows a woman employed at the work, and one of filling cartridges, shown in Fig. 93, proves that this was done chiefly by women. The old method of casting bullets was still in use, but a new one had just been invented.

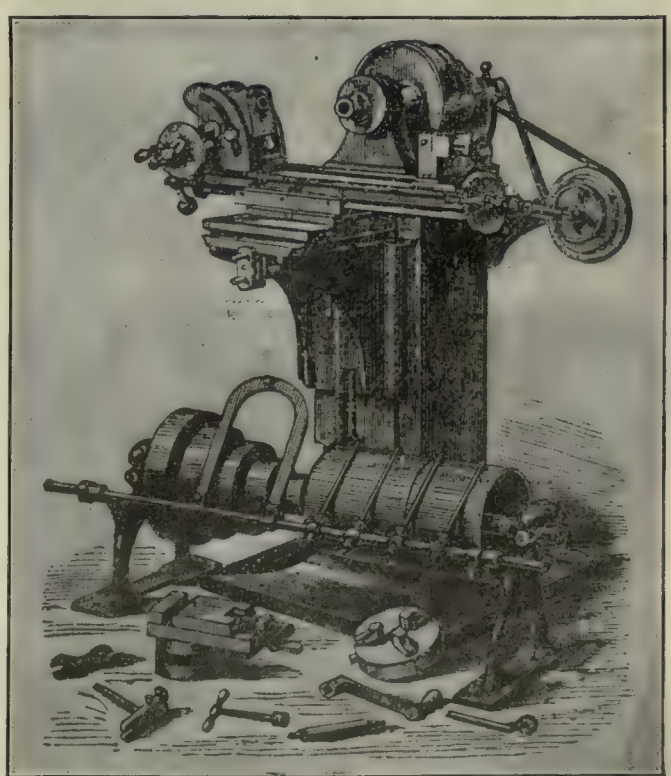


FIG. 90. THE BROWN & SHARPE UNIVERSAL MILLING MACHINE IN THE EARLY SIXTIES



FIG. 91. THE HAND-FORGING SHOP, WATERVLIET ARSENAL, 1861

The Springfield Armory, according to Harper's Weekly, 1861, was chiefly engaged in the manufacture of the famous Springfield rifle which was used by the great majority of the volunteers. This rifle was assembled from forty-seven pieces which were put together with screws and springs. Its manufacture required 396 distinct operations by different workmen. The workmen were held strictly accountable for the quality of their work. An average of one out of sixty barrels burst while being proved, but the rent usually disclosed where the weakness lay, and the barrel was charged back to the workman whose fault it was. The bayonets, which were also made in the armory, were milled and not ground as formerly, and the change was said to have been of great advantage to the health of the workmen.

Harper's Weekly gave a page of a dozen cuts illustrating the principal operations in making the barrel and bayonet; this page is shown in Fig. 94. It is noticeable that the barrel was rolled, shaped, bored, rifled, and polished by machines. The straightening, however, was still done by eye and hand.

Illustrations of the West Point Foundry which appeared in Harper's Weekly in 1861, and which are shown in Fig. 95, show the boring and rifling of the guns, and the turning of the trunnions. This foundry had been established as early as 1817 at Cold Spring, Putnam Co., N. Y. In peace times the demand for cannon had often been so slack that the foundry had been used for making steam engines and other heavy machinery. During the Civil War, Parrott guns were made there, which re-introduced the old 15th-Century method of strengthening cannon with metal hoops.



FIG. 93. WOMEN FILLING CARTRIDGE, WATERVLIET ARSENAL, 1861

In the United States arsenal at Watertown there were seventy women among the three hundred operatives. The powder was inserted in the cartridges and shells by the men, while the bullets were put in by the women.

Some of the difficulties involved in heavy iron work at the time are illustrated by the efforts required to build the Monitor. This famous ironclad was contracted for by Winslowe & Griswold, the iron masters, at their own risk if it proved a failure. The hull was built by Thomas F. Rolant, agent of the Continental Iron Works, at Greenpoint, Long Island; the engines by the Delamater Iron Works of New York; the turret



FIG. 92. FILLING CANISTER SHOT, WATERVLIET ARSENAL, 1861

by the Novelty Iron Works of the same city, while some of the plates were made by H. Abbott & Son of Baltimore.

Harper's said that at the time there was no rolling mill able to roll the plates, and that they had to be forged with a great deal of effort. It gave pictures of the forging of a bloom, Fig. 96, and of a plate, Fig. 97, for the new style of craft. There is, however, a statement that Abbott & Son rolled part of the plates which they produced. Some of the guns for the later monitors were made at the Fort Pitt Works in Pittsburgh. There the guns were cooled by water from the inside, which was thought to be a protection against flaws. Fig. 98 is of interest because it shows the methods in use at that time.

Manufactures Other Than Guns

One industry which was not entirely overshadowed by munition making was the manufacture of sewing machines. These machines were still novel, and permitted a saving of labor which was greatly to be desired at the time.

A description of the Wheeler & Wilson factory in 1863 includes several interesting details. The work was still let out on a curious contract system, although it was done in the shop. All the materials and tools were furnished by the company to so-called jobbers who produced the separate parts. What was then considered the utmost accuracy was required. To secure this there was a set of gages or duplicates provided for every

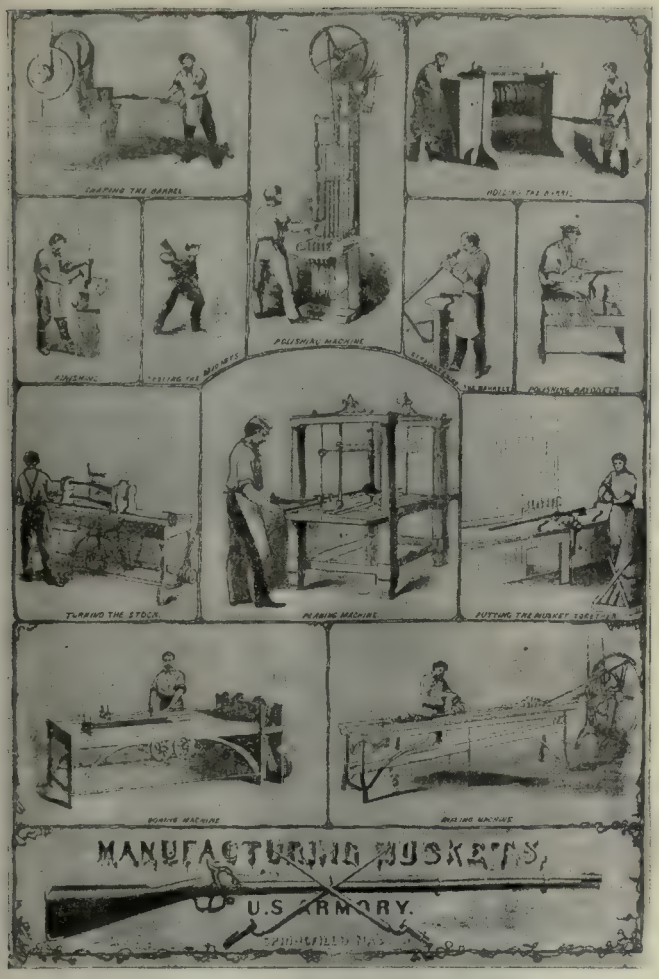


FIG. 94. MAKING THE SPRINGFIELD RIFLE, 1861

screw, spring, joint, and bar. These standards were supplied to the contractors, while originals of them were accessible only to the superintendent.

The most novel process employed seems to have been in making the rotating hook. This was first cut off about seven inches long, then heated in a furnace and placed under a draw press which had dies in either face corresponding to the shape desired. There were four separate dies required to bring it to the rough form, after which it was again softened and taken to the machinist.

At the end of the war we find the edges of armor being planed, and the plates themselves multiple drilled. There were also planing machines using a number of tools at once, as well as a machine making nuts, and another one heading bolts at a single operation. In 1866 William Sellers & Co., of Philadelphia, were employing the formed-tool system of gear cutting. J. R. Brown's micrometer caliper dates from 1867.

In 1867, according to the Journal of the Franklin Institute, "Numerous shops supplied with every facility for the construction of arms were left unemployed. Many of them very judiciously turned their attention to the production of a class of small tools for which their peculiar facilities especially fitted them, and . . . we have thus introduced into the market a new class of articles."

In various brief articles at the time, the Journal mentioned an improved toolholder by Cooper, a boiler-maker's drifting tool, cutters for the teeth of gear wheels, a vertical boring and turning machine weighing seventy tons, a die bolt-cutter, and improved screw-cutting and screw-slotting machines.

A dictionary of machinery, published at Philadelphia in 1869, gave as the principal machine tools then in use the self-acting lathe, steam hammer, and machines for planing, slotting, vertical and radial drilling, shaping, and shearing.

Data on the Metal-Working Industries in 1870

Probably the most exact information concerning conditions in the machine-shop industries at this period is to be found among the details of the census of 1870. As this was just half a century ago, it is interesting to recall what the situation was then, as a basis for realizing the tremendous contrast between that date and today.

The production of forged and rolled iron had been multiplied about four times since 1860, though the total output was still only about $128,000,000. This was produced in about four hundred plants, which gives an average of only $320,000 to a plant. These mills employed about 48,000 men, and paid wages of approximately $27,000,000, which suggests average earnings during the year of about $562 per man. There was more than five times as much steel produced as in 1860, though the total product was as yet only about $9,600,000. The manufacture of bessemer steel had already begun, and there were three plants running which produced about $1,800,000 worth.

The steam engine and the waterwheel were running neck and neck in a race for popularity. In the 250,000

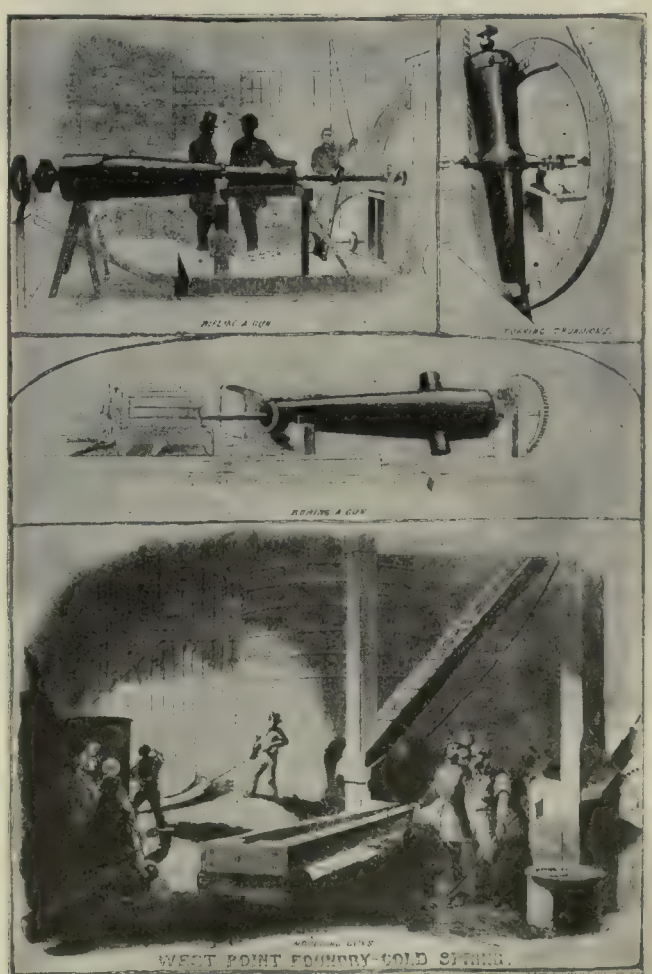


FIG. 95. A PAGE FROM HARPER'S WEEKLY, ON GUN MAKING, 1861

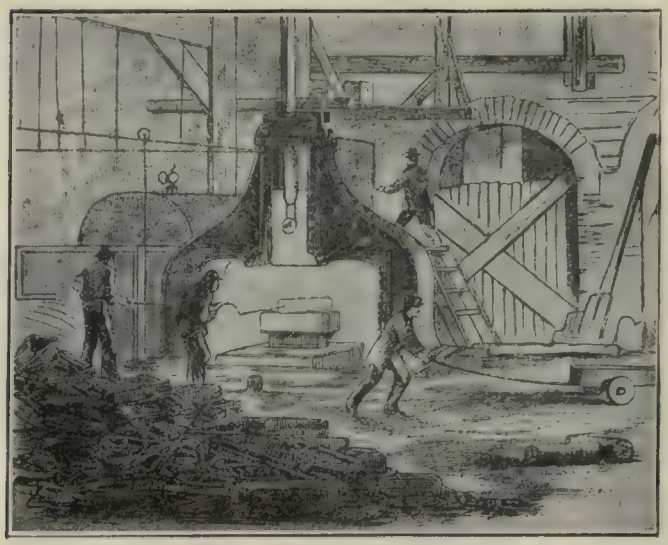


FIG. 96. FORGING A BLOOM FOR THE MONITOR, 1862

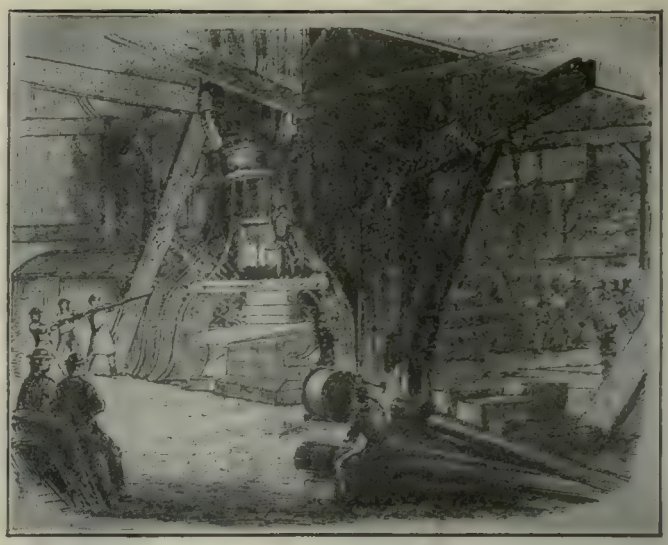


FIG. 97. FORGING A PLATE FOR THE MONITOR, 1862

plants in the country, there were about 40,000 steam engines employed, and about 51,000 waterwheels. In horsepower, however, the steam engines had already passed the waterwheel, supplying 1,215,000 hp. as against 1,130,000 from the waterwheels.

The total production of machinery in 1870 was not quite $140,000,000, as against something over $50,000,000 ten years before. In fact, a comparison of the statistics of 1870 and 1860 of both the North and the South, suggests that the machinery of the North was a decisive factor in winning the war—in that it permitted the North to send half her men to the battle field, and still produce as much or more than she ever did before.

The statistics on some of the industries which were just rising at that time are worthy of note. There were, for example, over 2,000 establishments making agricultural implements, which included the new mowers, reapers, binders, and threshing machines. There were forty-nine plants making sewing machines with a total product valued at $14,000,000.

Steam engines and boilers were made in 663 plants which had a total production of $41,576,000. There were 170 plants making cars, and doing car repairing, with an output of about $31,000,000. Other railroad repairing was done in 150 shops. The industries of the next magnitude were those making wrought-iron pipe, safes and vaults, scales, steel springs, and wire. It is noticeable in connection with the statistics of these comparatively new industries that the number of plants was surprisingly large, but that the average output was only a small percentage of that today.

The census of 1870 also includes the actual number of the machines of certain types which were produced. In some cases these are of great interest. There were 1,137 locomotives built during the year, 10,226 portable steam engines and 7,667 stationary steam engines. There were 90 caloric engines and 101 steam fire engines built during the same year. There were 6,981 lathes manufactured in the country and 178 planing machines for iron. Only one plant in the country was designated as being engaged chiefly in iron shipbuilding. In this connection it is worth noticing that only eighteen riveting machines were manufactured during the year in the whole United States.

The tendency toward consolidation was already being shown in the sewing-machine industry. In 1860 there had been 75 factories making machines to the value of $4,000,000. In 1870 the number of plants was reduced to 49, but the output was increased to $14,000,000.

Of the industries not already mentioned dealing largely with metals, that of general hardware and that of nails and spikes each had a production of over $20,000,000. In the five-to-ten-million class were edge tools

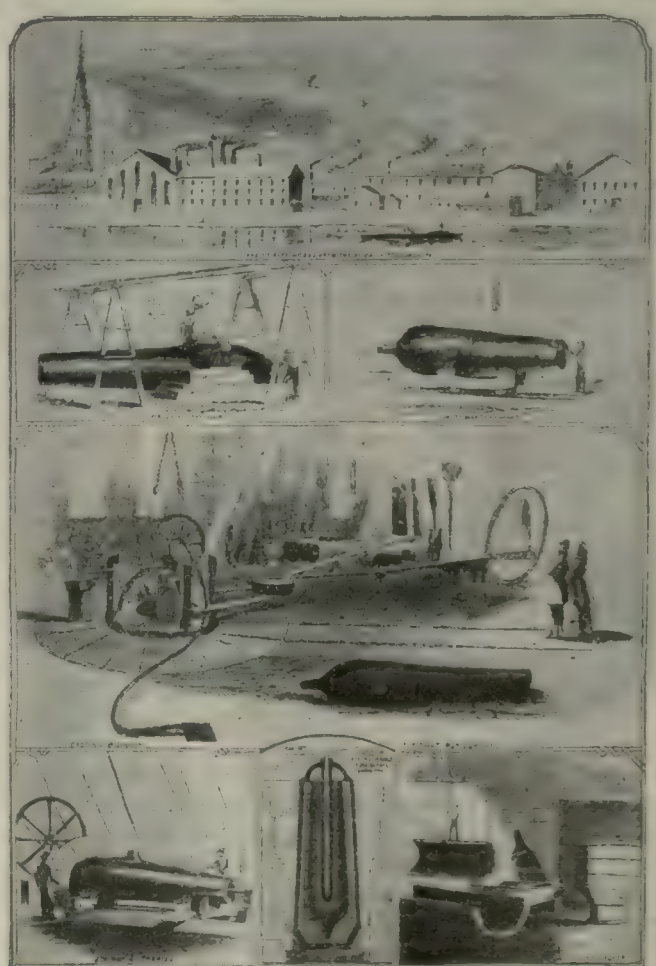


FIG. 98. MAKING A CANNON FOR THE LATER MONITORS, PITTSBURGH, 1862

and axes, firearms, bolts and nuts, cast steel, and wheel wrighting. Industries with a production of from one to five million were cutlery, files, heating apparatus, lightning rods, percussion caps, saws, shovels and spades, and steel springs. The metal industries with a production of less than a million were gunsmithing, hinges, anchors and cable chains, and needles and pins.

It will be noted that by this time a beginning had been made with most of the machines upon interchangeable manufacture and quantity production, which were to be the great features of American manufacture. The nail-cutting machines of the early Republic, Blanchard's shaping lathe for irregular forms, the milling machine, the profiling and edging machine, the turret lathe, and certain of the die-stamping machines for metals were all first developed in America, and were all directly applicable to the rapid reproduction of duplicate parts.

This brings our story up not only to a half century ago, but, what is of more importance than any mere date, to the era of the *American Machinist*, in the files of which it is possible to follow the evolution of the machine shop throughout all its subsequent phases.

"Wanted—Young Man, Fully Experienced"

By Entropy

Pick up any Sunday paper, scan the "Help Wanted" columns and it seems as though the larger part of the "ads" begin by specifying a young man, and most of them demand experience. The terms are so contradictory that it seems worth while to inquire a bit into the motives which place them so prominently in these "ads."

First of all, the requirement that the man shall be young is based on one truth and one misconception. The truth is that young men are more easily adaptable to the way business is done by the advertiser. A man who has worked for years for one or many firms acquires a ripeness of experience that is really not wanted in many establishments. The man who is always ready with a line of talk about "How we used to do it in ———" is about as welcome in some places as the measles. To be sure the same firm will go outside and hire an expert to tell them the same thing, but that is different; then they pay for it and it is worth money.

The misconception that affects advertisements for young men is that they, once trained in the way of the company, will have a longer life ahead of them and will therefore return greater dividends on the investment in training. Facts happen to lean the other way. It is the young man who rises and sees visions beyond the company with whom he learns the business, and reaches out, usually successfully, and grasps opportunities where his employer cannot see any.

What is meant by "fully experienced"? It cannot be taken literally, as no man is fully experienced in anything and never can be. Some have more experience than others, and some have much more intensive experience than others.

What is usually meant by fully experienced, is a degree of experience that has taken off the raw edges and has put a man where he can go ahead without continual instruction and bolstering up. Recently an advertisement for a young man "experienced in traffic management" was answered by a lad just out of college, who had worked in a railroad office and in the freight house two or three summer vacations. He got the job, simply because he was the only one of those responding who had had any experience at all and who was willing to work for the meager salary offered, which, by the way, was considerably less than he could have obtained by going into the freight house again and juggling freight. In this case the word "experienced" in the advertisement expressed a hope rather than a requirement, or, better yet, it was a figure of speech.

There is a perfectly sound theory that each firm should get all its raw material soon after graduation from college and train it in its own way. This has been carried farther by the transportation and transmission lines than any others. In railroad work and in the telegraph and telephone lines, seniority has a real and visible value. The one most notable result is that they have a low labor turnover, so far as individual quits are concerned, but they have a high strike average; that is, the men feel that if they hold together they can make their point without losing seniority rights. Their experience is in the formative stage. They are experienced in certain parts of the work, and in due time will naturally have more experience. This plan is certainly much better than that of so many shops which simply let promotion go by chance, with the chances against the most capable men, whose foremen are bound to block their promotion because they do not want to break in other men to do the work, and where no one really knows whether he is being promoted or demoted when he is shifted from one job to another.

There is a better plan, however, and that is to provide a plainly visible line of promotion and then to promote those who deserve it without reference to seniority. This is not the easy way because it makes it necessary to tell unpleasant truths to men whose friendship is likely to be valuable to the firm at some later time. It is wise to have this proviso because it makes the heads of departments do some serious thinking into the future when they promote or demote a man. It is not so easy to push Cousin Tom ahead over some other man's shoulders when one must explain to the man over whom he is put just what the merits of the case are. Under the seniority rule it is easy to tell Tom that he will have to wait his turn, but it is equally easy for Tom to take it very easy while he is waiting for someone else to die. Moreover, the seniority system does prevent men reaching responsible jobs before they lose their elasticity and ability to adapt themselves to new conditions.

There is an old saying, "Young men for war, old men for counsel," which pretty well fits the question of age in the employment office. There are always jobs that require physical strength and quickness. There are jobs that require quick mental action, but there are also many jobs that will get on the nerves of a quick thinker, or a strong, quick-motioned man. These are the jobs for men who have lost elasticity, whether physical or mental. Some of these jobs are easy and some are difficult and important. Judicial jobs are never easily filled. The man under forty who can efface himself and his own likes and dislikes from the consideration of a problem is rare. It is only when a man can see that there is a possibility that he will not live to see the world complete its term of existence, and realizes that very possibly it may go on after he leaves it, that he is able to take a calm view of many vexing problems.

Report of the Classification and Compensation Committee to Engineering Council

IN ITS progress report to Engineering Council, presented at the meeting of June 17, 1920, by Chairman Arthur S. Tuttle, the Committee on Classification and Compensation of Engineers makes the following statements regarding the report of the Congressional Joint Commission on the Reclassification of Salaries.

"The classification of engineers proposed by the Congressional Joint Committee on Reclassification of Salaries shows that the work of this commission has been guided largely by the work of your committee, and a comparison of its recommendations with those of your committee will be shortly released for publication. It is the belief of the Committee that, to say the least, the Federal Commission's classification where it differs from that of your committee has no advantage. The compensations for the various positions proposed in the Federal report are disappointing as they do not provide anything like the increases which are believed by your committee to be essential to the end that the engineering profession may attract and retain men of proper calibre to assume responsibilities successfully.

"From the analysis it would appear that in the lower grades of Federal service in sixteen bureaus the compensations proposed by the Congressional Commission would be from 2 to 19 per cent less than those which have heretofore prevailed, while in the higher grades the increases range from 8 to 17 per cent. The proposed salaries other than those for the grade "Junior Assistant Engineer" range from 20 to 30 per cent less than those suggested by your committee."

Discussing work to be undertaken, the report states: "It is proposed to undertake a vigorous campaign for the purpose of securing recognition of the classification of various positions as recommended by the committee last year and as adopted by council on Dec. 18, 1919, and at the same time to secure a general expression of opinion on the part of engineers and heads of services as to the compensation schedule tentatively suggested by the committee."

In addition to addressing communications to the secretary of each of 123 engineering societies in the United States and Canada, "arrangements are being made to secure co-operation on the part of the lay as well as the engineering heads of all services employing engineers and of all Civil Service Commissions.

"The committee is hopeful that the plans which it has laid for continuing its work will bring to its assistance the earnest backing of engineers throughout the country in making the classification effective, and that information as to the value of engineering service and as to a wise employment policy will be obtained from such a wide variety of sources that it will be practicable to formulate definite recommendations along these lines and to set up standards which will insure respect."

Comparison of Report of the Congressional Joint Commission on Reclassification of Salaries With the December, 1919, Report of Engineering Council's Committee

The Congressional Joint Commission's report on Reclassification of Salaries was presented to Congress March 12, 1920. Its main features are as follows:

Findings

NOTE: The numbers of the paragraphs correspond to those in the report of the Congressional Joint Commission.

"As to lack of uniformity and equity in present rates:

"1. That the salary and wage rates for positions involving like duties and responsibilities and calling for the same qualifications (that is, for positions of the same class) show wide variations and marked inequalities.

"2. That the salary and wage rates for positions of the same class are different in different departments and independent establishments, the scale of pay in some departments being markedly higher than the scale for the same class of work in other departments.

"3. That these inequalities in salary and wage scales as between departments are most striking when the rates of pay in the war-expanded establishments are contrasted with those in the organizations that were not largely increased during the war.

"As the causes that have led, and unless remedied will continue to lead, to this lack of uniformity and equity:

"7. That the Government has no standard to guide it in fixing the pay of its employees and no working plan for relating the salaries appropriated to the character and importance of the work for which such salaries are to be paid.

"11. That the absence of any uniform plan or system for regulating increases in pay of employees who have gained in experience and usefulness in a given class of work and the even more serious lack of any equitable system governing promotions from lower to higher classes of positions have been very large factors in causing the disproportion in pay and work.

"As to the effect of the lack of uniformity and equity in rates of compensation of Government employees:

"12. That there is serious discontent accompanied by an excessive turnover and loss among the best trained and most efficient employees, that the morale of the personnel has been impaired, that the national service has become unattractive to a desirable type of technical employee, and that the Government has put itself in the position of wasting funds on the one hand and doing serious injustice to individuals on the other, and of failing to get that degree of efficiency in administration that a more equitable and uniform wage policy would bring about.

"As to certain conditions of employment having bearing on compensation:

"13. That seven hours constitute a normal day's work for the clerical and professional groups of employees and eight hours for the manual; and that there is no uniformity of practice in the compensation for overtime and night work.

"16. That opportunities for advancement, either in salary or rank, for those of marked efficiency do not compare favorably with the opportunities offered to persons of the same ability in the commercial world. In the opportunity for development of professional or scientific careers, the Government service has in many ways a distinct advantage, which is, however, offset to some extent by certain personal restrictions generally unknown in the academic and business world.

"18. That the Government is paying heavily in the form of employees' compensation, as well as in loss of time and efficiency, for its failure to adopt a thorough going safety program. In safe construction, safety inspection, and safety education the Government falls far short of meeting the standards set by the more progressive States, municipalities, and private employers.

"As to those policies and measures that control the Government's return in efficient personal service:

"21. That there is no systematic policy of introducing new appointees to their work nor of training them for new duties, although certain progressive governmental organizations are proving the feasibility and value of such training.

"22. That in spite of the necessity of some satisfactory method of testing efficiency as a basis for salary increases and promotions, efficiency rating systems are not in general use, and where they have been adopted are commonly regarded as of questionable value.

"23. That no uniform practice exists in the advancement of efficient employees in either salary or rank, both of which are commonly referred to as 'promotion'; that salary advancements proper are controlled by administrative officers, while true promotions are usually made as the result of non-competitive examinations; and that lack of assurance that efficient work will receive suitable reward injures the morale and reduces the efficiency of the entire service.

"24. That the Government's failure to adopt a retirement system for civilian employees has proved costly, inefficient, and destructive to the morale of the force.

"26. That there is a striking lack of any comprehensive personnel policy administrated by a central personnel agency and having in view increased efficiency through standardizing and supervising the various conditions of employment and through enlisting the co-operation of the employees."

RECOMMENDATIONS

"For immediate attainment of uniformity and equity in pay for the same character of employment:

"1. That the Congress adopt the classification of positions set forth.

"2. That the Congress adopt the schedules of compensation set forth for the respective classes of positions.

"3. That the Congress authorize the Civil Service Commission to take over the Reclassification Commission's records and keep them current, pending action on the above recommendations.

"4. That the Congress direct an existing agency (hereinafter referred to as the "Classification Agency"), logically and preferably the Civil Service Commission, to make a final allocation of individual positions to the classes set forth in the recommended plan of classification.

"For the future maintenance of uniformity and equity in pay:

"6. That permanent administration of the classification and schedules of compensation be delegated by law to an existing independent agency of the Government (to be termed hereinafter the "Classification Agency"), logically and preferably the Civil Service Commission.

"10. That estimates, appropriations, and payments for personal services be made under the title of the class and in accordance with the schedule of pay applying to the class which the Classification Agency certifies as applicable to the position in which such services are to be or have been rendered.

"11. That the pay of individual employees be regulated on a basis of efficiency and length of service in the class in which their respective positions are classified, according to the schedule of compensation applying to the class.

"For attainment of uniformity in the regulation of all factors having an indirect bearing on rates of pay and for the improvement and standardization of working conditions:

"13. That the Congress prescribe standard minimum working hours for each group of employees, together with uniform rules for the compensation of overtime work for those employees for whom the compensation schedules provide for pay at an hourly rate, and for additional compensation for all night work.

"For securing the maximum return in efficient personal service for the Government's pay-roll expenditures:

"15. That the Congress undertake a systematic examination of the functions now being exercised, the organization now in effect, and the methods of procedure in use in the several departments and independent establishments making up the Washington service, in order that unnecessary work, duplicated work, improperly allocated work, instances of poor organization, and expensive or inefficient methods of conducting business may be discovered and eliminated.

"16. That the Congress provide for a comprehensive and uniform employment policy to be administered by a central personnel agency, logically and preferably the Civil Service Commission, and to include the standardization of rates of compensation and working conditions and the selection, development, and retention of an efficient personnel; and an advisory council be established to advise the Civil Service Commission on matters coming under the jurisdiction of the latter, and to arrange for the formation of personnel committees in the various departments."

Note: Advisory Council is to be composed of twelve members, six to be appointed by the President from among employees of the administrative staff, and two each to be elected by and from employees in the manual, clerical and professional groups.

"17. (a) That all positions hereafter be filled by the appointment of those best fitted to perform the duties as determined by the central personnel agency through the most effective methods of test and investigation; and (b) that no permanent appointment to the service be made except on certificate by the central personnel agency that the employee has satisfactorily passed his probationary period.

"18. That the central personnel agency be empowered to undertake, in co-operation with the departments, measures for the training of employees for increased usefulness in the service.

"19. That the central personnel agency be authorized and directed, after consultation with the heads of departments, to arrange for the installation of efficiency rating systems in the various Government establishments; and that the appropriate administrative officers be required to rate all employees under their direction in accordance with these systems and under such rules and regulations as the central personnel agency may prescribe.

"20. That hereafter employees be increased in pay not oftener than once a year and only within the limits of the range set for their class of positions and on the basis of ascertained efficiency of the required standard, to be set by the central personnel agency; and that failure to maintain such standard after advancement to a given rate shall subject the employee to reduction to a lower salary rate in the same class.

"21. That when vacancies in the higher classes are not filled by transfer or reinstatement they be filled by promotion of properly qualified employees as determined by competitive civil-service examination; and that open competitive examinations for the filling of such vacancies be held only when three such eligibles can not be secured from those already in the service.

"22. That employees who fail to attain a fair standard of efficiency as prescribed by the central personnel agency be removed from the service, after suitable opportunity for appeal to the personnel agency.

"23. That employees who, by reason of their age or disability resulting from their service, are unable to render service of a fair standard of efficiency be retired under an actuarially sound pension plan."

GENERAL CLASSIFICATION

Regarding the Engineering Service, the commission makes provision for twenty-three branches with an average of seven grades in each branch. The branches are as follows:

Aeronautical Engineering	Landscape Architecture
Automotive Engineering	Marine Engineering
Cadastral Engineering	Materials Engineering
Cartographic Engineering	Mechanical Engineering
Ceramic Engineering	Mining Engineering
Civil Engineering	Nautical Engineering
Electrical Engineering	Naval Architecture
Forestry	Ordnance Engineering
Highway Engineering	Petroleum Engineering
Hydraulic Engineering	Radio Engineering
Hydrographic and Geodetic Engineering	Structural Engineering
	Topographic Engineering

There is a close parallel between the classification recommended by this commission and that recommended by Engineering Council. The difference in title is shown in the following table:

Grade	Engineering Council	Congressional Joint Commission
1	Chief Engineer	Senior Engineer Commissioner Director Chief Engineer Chief, Superintendent, etc.
2	Engineer	Engineer
3	Senior Assistant Engineer	Associate Engineer
4	Assistant Engineer	Assistant Engineer
5	Junior Assistant Engineer	Junior Engineer
6	Senior Aid, Office Senior Aid, Field	
7	Aid, Office Aid, Field	Draftsman Aid
8	Junior Aid, Office Junior Aid, Field	Copyist Draftsman Junior Engineering Aid

Requirements in Parallel

Using the Civil Engineering branch as typical, requirements for each grade in the two classifications line up as follows:

PROFESSIONAL SERVICE
GRADE 1

Engineering Council
Chief Engineer

Duties.—To act in chief administrative charge of a technical organization, or of a main division thereof; to determine the general policies of the organization under the limitations imposed by law, regulation, or other fixed requirement: to have final responsibility for the preparation of reports, cost estimates, designs, and specifications and for the construction, maintenance, or operation of engineering works or projects; to have full charge of the collection and presentation of data for the conduct of valuation proceedings; to conduct or direct the most comprehensive lines of engineering research.

Qualifications. — Training and experience of a character to give substantial evidence of engineering knowledge and ability or of executive capacity of highest order along lines of work similar to those involved in the position to be occupied and of at least twelve years' duration, of which at least four years shall have been spent in duties of Engineer, or their equivalent, and at least five years in responsible charge of important work or projects. Fundamental training equivalent to that represented by professional degree granted upon the completion of a standard course of engineering instruction in an educational institution of recognized standing or, in absence of such degree, at least four years of additional experience. The completion of each full year of such standard course shall be considered the equivalent of one year of such additional experience.

Congressional Joint Commission

A. Senior Civil Engineer

Duties.—To perform one or more of the following functions: (1) to have administrative charge of a civil engineering organization or of a main division thereof, and to determine or execute general policies under the limitations imposed by law, regulations or other fixed requirements; (2) to be responsible for reports, estimates, designs, specifications, and data or for the construction, maintenance, and operation of large civil engineering works or projects; (3) to have full charge of the collection and presentation of data for, and the conduct of valuation proceedings; (4) to direct or to perform the most comprehensive research in civil engineering; (5) to act as consulting specialist on important civil engineering projects, policies, or valuation; and to perform other related work.

Qualifications. — Training equivalent to that represented by graduation with a degree from an institution of recognized standing, with major work in engineering, preferably in civil engineering; and not less than 12 years' general engineering experience, of which at least 8 years shall have been in the direction or performance of important projects in civil engineering work of a character to give substantial evidence of engineering knowledge and ability, or executive capacity of the highest order.

B. Commissioner of Lighthouses

Duties.—Under general direction of the Secretary of Commerce, to serve as the executive head of the Lighthouse Service; to oversee the construction, maintenance, repair, illumination, inspection and superintendence, of lighthouse depots, lighthouses, light vessels, lighthouse tenders, fog signals, submarine signals, beacons, buoys, daymarks, and other aids to navigation on the sea and lake coasts of the U. S. and on the rivers of the U. S. so far as specifically authorized by law, and on the coasts of all other territory under the jurisdiction of the U. S. with the exception of the Philippine Islands and the Canal Zone; and to perform other related work.

Qualifications. — Training equivalent to that represented by graduation, with a degree, from an institution of recognized standing with major work in civil engineering or other technical course; extended professional experience in handling lighthouse problems, of which at least eight years shall have been of a character to give substantial evidence of knowledge and ability and of executive capacity of the highest order.

GRADE 2

Engineer

Duties.—Under general administrative direction and within the limits of the general policies of the organization, to have responsible charge of and to initiate and determine policies for a major subdivision of an organization; to prepare for final executive action reports, cost estimates, designs, specifications, and valuation studies and data, to have immediate charge of the construction, maintenance, or operation of engineering works or projects of major importance; to conduct or direct major lines of engineering research; or to fur-

Civil Engineer

Duties.—To perform one or more of the following functions under general direction: (1) to have responsible charge of, and to initiate and determine policies for a major sub-division of a civil engineering organization; (2) to prepare for final executive action, reports, estimates, designs, specifications, and valuation studies and data; (3) to have charge of the construction, inspection, maintenance, and operation of municipal or other civil engineering works of major importance; (4) to conduct or to direct major lines of civil engineering research;

nish for executive action expert or critical advice on engineering works, projects or policies.

Qualifications.—Active professional practice or executive charge of work for at least eight years, of a character to demonstrate a high degree of initiative and of ability in the administration, design, or construction of engineering work or projects of major importance, of which at least three years shall have been spent in duties of Senior Assistant Engineer or their equivalent, and at least three years in responsible charge of work. Fundamental training equivalent to that represented by professional degree granted upon the completion of a standard course of engineering instruction in an educational institution of recognized standing or, in absence of such degree, at least four years of additional experience. The completion of each full year of such standard course shall be considered the equivalent of one year of such additional experience.

GRADE 3

Senior Assistant Engineer

Duties.—Under general administrative and technical direction, to be in responsible charge of an intermediate division of an organization; to exercise independent engineering judgment and assume responsibility in studies and computations necessary for the preparation of reports, cost estimates, designs, specifications, or valuations; to have immediate charge of the construction, maintenance or operation of important engineering works or projects; to conduct or direct important lines of engineering research.

Qualifications.—Active professional practice or executive charge of work for at least five years, of which at least three years shall have been spent in duties of Assistant Engineer, or their equivalent, with at least one year in responsible charge of work. Fundamental training equivalent to that represented by professional degree granted upon the completion of a standard course of engineering instruction in an educational institution of recognized standing or, in absense of such degree, at least four years of additional experience. The completion of each full year of such standard course shall be considered the equivalent of one year of such additional experience.

Associate Civil Engineer

Duties.—To perform one or more of the following functions under general administrative and technical direction: (1) to be in responsible charge of an intermediate subdivision of a civil engineering organization; (2) to exercise independent engineering judgment and assume responsibilities in studies and computations necessary for the preparation of reports, estimates, designs, or valuations; (3) to have immediate charge of the construction, maintenance, or operation of important civil engineering works or projects; (4) to conduct or direct important lines of civil engineering research; and to perform other related work. Examples: Having immediate charge of the construction of water mains, sewers, streets, and other municipal work; testing engineering materials; making cost studies; supervising surveys of areas and acquisitioning of lands; laying out of railroad terminals, yards and storage bases; estimating and expediting construction work and design.

Qualifications. — Training equivalent to that represented by graduation with a degree from an institution of recognized standing, with major work in engineering, preferably civil engineering; not less than 5 years' general engineering experience of which at least one year shall have been in the direction or performance of important civil engineering work; and supervisory or administrative ability, or a high degree of technical skill.

GRADE 4

Assistant Engineer

Duties.—Under specific administrative and technical direction, to be responsible for the conduct of the work of a minor subdivision of an organization; to collect and compile data for specific items of engineering studies; to take immediate charge of field survey projects and of the design and construction of minor engineering work; to lay out and develop work from specifications and to supervise the work of a drafting or computing force; or to conduct specific tests or investigations of apparatus, material or processes.

Qualifications.—Experience for at least two years in duties of Junior Assistant Engineer or their equivalent. Fundamental training equivalent to that represented by professional degree granted upon the completion of a standard course of engineering instruction in an educational institution of recognized standing, or, in absence of such degree, at least four years of additional experience. The completion of each full year of such standard course shall be considered the equivalent of one year of such additional experience.

Assistant Civil Engineer

Duties.—Under specific administrative and technical direction, to be responsible for the conduct of the work of a minor subdivision of civil engineering organization; to collect and compile data for specific items of civil engineering studies; to take immediate charge of field survey projects in, or of the design, inspection and construction of minor civil engineering work; to lay out and develop work from specifications and to supervise the work of a drafting or computing force; to conduct specific tects or investigations of apparatus, material, or processes; and to perform related work as required.

Example: Directing field parties on construction, valuation, or surveys; superintending and inspecting construction work; performing the work of an office engineer; assisting the superintendent of an aqueduct or important water-supply structure; testing materials, as steel or cement; preparing technical material for publication; investigating waterproofing of structures; compiling statistical data; compiling and analyzing costs of railroad materials and construction.

Qualifications. — Training equivalent to that represented by graduation with a degree from an institution of recognized standing, with major work in engineering, preferably in civil engineering; not less than two years' experience in civil engineering work in field or office; proven technical knowledge and proficiency.

GRADE 5

Junior Assistant Engineer

Duties.—Under immediate supervision, to perform work involving the use of surveying, measuring, and drafting instruments; to take charge of parties on survey or construction work; to design details from sketches or specifications; to compute and compile data for reports or records; to inspect or investi-

Junior Civil Engineer

Duties.—Under immediate supervision, to perform routine surveying, computing drafting, and inspecting, on survey, construction, or valuation work; and to perform related work as required.

Example: Surveying with transit or level; using measuring devices for stream-gauging; inspecting struc-

gate minor details of engineering work; or to perform routine tests of apparatus, material or processes.

Qualifications.—No experience required other than that involved in securing a professional degree upon the completion of a standard course of engineering instruction in an educational institution of recognized standing; but in absence of such degree, a high school education or its equivalent is required and at least four years' experience in the use of surveying, measuring or drafting instruments, or the computation and compilation of engineering data, together with evidence of a knowledge of the fundamentals of engineering science sufficient, with further experience, to qualify for the higher professional grades. The completion of each full year of such standard course of engineering instruction shall be considered as the equivalent of one year of experience.

SUB PROFESSIONAL SERVICE

GRADE 6

Senior Aid, Office

Duties.—To supervise the plotting of notes and maps, and to direct the work of a drafting or computing squad.

Qualifications.—Experience for at least five years in tracing, lettering, drafting and computing, of which at least three years shall have been spent in the duties of draftsman. Education equivalent to graduation from high school. The completion of each full year of a standard course of engineering instruction in an educational institution of recognized standing shall be considered as the equivalent of the experience otherwise required, with the provision, however, that at least one year shall have been spent in the duties of draftsman.

Senior Aid, Field

Duties.—To direct work of field party on surveys or construction; to keep survey notes and engineering records; to supervise construction or repair work; to direct the work of computing surveys and estimates; to direct the work of making minor engineering computations.

Qualifications.—Experience for at least five years in the use and care of surveying instruments, of which at least three years shall have been spent in the duties of instrument man. Education equivalent to graduation from high school. The completion of each full year of a standard course of engineering instruction in an educational institution of recognized standing shall be considered as the equivalent of the experience otherwise required, with the provision, however, that at least one year shall have been spent in the duties of instrumentman.

No corresponding grade.

GRADE 7

Aid, Office

Duties.—To prepare general working drawings where design is furnished; to plot notes and prepare maps; to design simple structures; to make computations and compile data for reports and records; to check plans, surveys, and other engineering data.

Qualifications.— Experience for at least two years in tracing, lettering, drafting, and computing. Education equivalent to graduation from high school and familiarity with the use of the slide rule, and of logarithmic and other simple mathematical tables. The completion of each full year of a standard course of engineering instruction in an educational institution of recognized standing shall be considered as the equivalent of the experience otherwise required.

Aid, Field

Duties.—To run surveying instruments and to adjust and care for same; to compute surveys and estimates; to make minor engineering computations; to inspect incidentally construction or repair work.

Qualifications.— Experience for at least two years in the duties of rodman. Education equivalent to graduation from high school and familiarity with the construction, operation, and care of surveying instruments. The completion of each full year of a standard course of engineering instruction in an educational institution of recognized standing shall be considered as the equivalent of the experience otherwise required.

Civil Engineering Draftsman

Duties.—To perform, under immediate supervision routine drafting work in connection with the preparation of plans for civil engineering projects; and to perform related work as required.

Examples: Making tracings from original drawings; making drawings of minor importance; filing and indexing drawings, lettering, computing and revising.

Qualifications. — Training equivalent to that represented by graduation from high school; not less than two years' experience in engineering drafting work; and ability to letter and to make simple calculations.

Civil Engineering Aid

Duties.—To perform, under immediate supervision minor technical work in any branch of civil engineering; and to perform related work as required.

Example: Making measurements and estimates in the field; acting as recorder or computer in laboratory, field, or office; operating and caring for surveying instruments; computing data for reports of records; plotting notes and maps; preparing working drawings where design is furnished.

Qualifications. — Training equivalent to that represented by graduation from high school; not less than two years' experience in engineering work; familiarity with the use of the slide rule; and ability to do lettering and drafting, and to make simple engineering computations.

GRADE 8

Junior Aid, Office

Duties.—To trace and letter maps and plans; to make simple drawings from sketches and data; to make minor calculations.

Qualifications. — Education equivalent to graduation from high school.

Copyist Draftsman

Duties.—Under immediate supervision, to make tracings from original drawings, prepared by others; and to perform miscellaneous routine work in a drafting room.

Example: Making simple tracings, copying data; filing

and indexing under supervision; lettering; making simple drawings and diagrams; making hand corrections on printed chart.

Qualifications. — Training equivalent to that represented by graduation from high school; knowledge of the use of drawing instruments, and ability to use them neatly.

Junior Aid, Field

Duties. — To run tape or leveling rod; to perform other miscellaneous subordinate duties in survey party in field or office, as directed.

Qualifications. — Education equivalent to graduation from high school.

Junior Engineering Aid

Duties.—Under immediate supervision, to perform miscellaneous subordinate work in the laboratory, office or field, in any branch of engineering.

Examples: Setting up apparatus; making simple engineering computations compiling field data or laboratory notes; filing and indexing maps, plans, and notebooks; preparing samples, caring for instruments in the field or laboratory; working as rodman, chainman, or tracer, making blueprints.

Qualifications.—Common school education; good health.

Exceptions to General Classification

One glaring inconsistency in titles is found in the Automotive Engineering branch. Instead of the standard titles as proposed for the other branches, the titles proposed in this branch for grades 7, 5, 4, 3, 2, and 1 are respectively "Automotive Tracer," "Automotive Draftsman," "Automotive Designer," "Senior Automotive Designer," "Automotive Engineer," and "Senior Automotive Engineer."

In fifteen of the twenty-three branches, senior engineer is the only title in grade 1. The exceptions in the other branches are as follows:

Cartographic Engineering	No title of "Senior Engineer" provided. Promotion is from "Cartographic Engineer" to "International Canadian Boundary Commissioner."
Civil Engineering	Promotion is from "Senior C. E." to "Commissioner of Lighthouses;" "Chief Valuation Engineer," I. C. C.; "Director and Chief Engineer Reclamation Service;" or "Supervisor of Land Appraisals," I. C. C.
Forestry Service	Promotion from "Senior Forester" to "Chief, Forest Service."
Highway Engineering	Promotion from "Senior Highway Engineer" to "Chief, Bureau of Public Roads."
Hydographic and Geodetic Survey	Promotion from "Senior Hydrographic and Geodetic Engineer," to "Supt., Coast and Geodetic Survey."
Marine Engineering	Promotion from "Senior Marine Engineer" to "Supervising Inspector General, Steamboat Inspection Service," or "Commissioner of Lighthouses."
Mining Engineer	Promotion from "Senior Mining Engineer," to "Director, Bureau of Mines."
Nautical Engineering	Highest grade, "Nautical Engineer."

PROMOTION

The Congressional Commission's Report indicates that the principle line of promotion to the special positions listed above, is from the "Senior Engineer" class. The qualifications for these positions, however, are not of such high standard as those of "Senior Engineer" because all that is

COMPARISON OF CLASSIFICATION AND COMPENSATION OF ENGINEERS AS SUGGESTED BY ENGINEERING COUNCIL COMMITTEE AND BY CONGRESSIONAL JOINT COMMISSION; AND OF AVERAGE SALARY PER ANNUM AS SUGGESTED BY CONGRESSIONAL JOINT COMMISSION AND PRESENT AVERAGE SALARY OF EMPLOYEES IN SIXTEEN ENGINEERING BUREAUS IN CIVIL ESTABLISHMENTS OF THE FEDERAL SERVICE.

Engineering Council							Congressional Joint Commission							
Grade	Title	Educational Equivalent	Minimum Experience in Years	Minimum Annual Salary	Maximum Annual Salary	Estimated Average Range	Title	Educational Equivalent	Minimum Experience in Years	Minimum Annual Salary	Maximum Annual Salary	Estimated Average Range	Present Average Yearly Salary (Note)	Average per cent Increase or Decrease (Note)
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
8	*a.* Junior aid, office *b.* Junior, aid, field	High school	0	1,080	1,560	1,240	*a.* Copyist draftsman *b.* Junior engineering aid	High school Common school	0	840	1,260	980	1,215	—19
7	*a.* Aid, office *b.* Aid, field	High school	2	1,680	2,400	1,920	*a.* Draftsman *b.* Aid	High school	2	1,200	1,800	1,400	1,533	— 9
6	*a.* Senior aid, office *b.* Senior aid, field	High school	5	2,520	3,240	2,760	No corresponding grade	.....	.....	.....	.....	.....	.....	.....
5	Junior assistant engineer	Degree	0	1,620	2,580	1,940	Junior engineer	Degree	0	1,800	2,160	1,920	1,959	— 2
4	Assistant engineer	Degree	2	2,700	4,140	3,180	Assistant engineer	Degree	2	2,400	3,000	2,600	2,402	+ 8
3	Senior assistant engineer	Degree	5/1*	4,320	5,760	4,800	Associate engineer	Degree	5/1*	3,240	3,840	3,440	3,128	+10
2	Engineer	Degree	8/3*	5,940	.....	.....	Engineer	Degree	8/4*	4,140	5,040	4,440	3,801	+17
1	Chief engineer	Degree	12/5*	8,100	.....	.....	*a.* Senior engineer *b.* Commissioner, director chief engineer, chief, superintendent, etc.	.....	12/8* 8/—*	.....	.....	.....	5,867	...

NOTES—Columns 4 and 10. * Years in responsible charge of work.

Columns 7 and 13. Estimated average salary is the minimum, plus ½ the difference between the minimum and the maximum. This relation was found to hold approximately for positions in the Federal Service and was assumed in the studies conducted in connection with the salary schedules of the Reclassification Commission.

Column 14. Present average yearly salary, including bonus, of employees in 16 bureaus in civil establishments of the Federal Government. The bonus is $240 for salaries of $2,500 and under; for salaries above $2,500, it is the amount, if any, necessary to make a total of $2,740.

Column 15. Average percentage increase (+) or decrease (—) in pay per employee under schedule proposed by Congressional Joint Commission over present schedule, if distribution of employees within each grade remains unchanged. The estimated increase in the salary roll, which would be caused by putting the Commission's recommendations for all branches of the Civil Service into effect is, as estimated by the Commission, 8 to 10%, probably 8.5%.

required, in addition to educational qualifications is "extended professional experience" in the special branch of work, "of which at least 8 years shall have been of a character to give substantial evidence of knowledge and ability and of executive capacity of the highest order." For a "Senior Engineer," the corresponding qualifications are "not less than 12 years general engineering experience, of which at least 8 years shall have been in the direction or performance of important projects in—engineering work of a character to give substantial evidence of engineering knowledge and ability, or executive capacity of the highest order." In making this subdivision of grade 1, it is quite possible that the Joint Commission was influenced by political considerations.

The essential features of the Joint Commission's report are incorporated in the attached table which shows the salary range for the various grades of service as compared with that suggested by Engineering Council. The table also shows how the average salary as proposed by the Joint Commission, compares with the average salary received by employees in sixteen engineering bureaus in civil establishments of the Federal Government on July 1, 1919.

The research staff of the commission made estimates of the average salaries in the different classes for the engineering service which are somewhat different than the figures of column 14. They are slightly higher in the lower grades and slightly lower in the higher grades. These differences are brought about as follows: The commission's averages are for the Washington service only. The averages in column 14 include both the Washington and the field services. The commission's figures included salaries paid in civilian positions in the War and Navy Departments. The Navy Department schedule is considerably higher than that of the civil bureaus and therefore the commission's averages would be somewhat higher on this account alone. Finally, the averages will vary according to the classification of positions. It is believed that the commission classified positions more liberally than Engineering Council's committee. The commission probably included more positions in the higher grades than did council's committee, with the result that the averages for these grades are lower in the commission's than in council's calculations.

Since the commission in any comparison of proposed with existing salary scales will use somewhat different data, it is evident that the averages will not be identical. There appears no doubt, however, that in the lower two grades the averages proposed are less than the averages now paid with the bonus, but how much less will depend upon what positions are classed within these grades and what date is taken for determining the averages.

In the Professional Group, the Joint Commission recommends the same educational and experience standards for grades 5, 4 and 3 as Engineering Council, but it recommends 4 years "in the direction or performance of important engineering work" for grade 2, and 8 years for grade 1, against Engineering Council's recommendation of 3 years, and 5 years, respectively. The Joint Commission provides for a minimum increase in salary from $1,800 for grade 5 to $4,140 for grade 2; ie., $2,340, or 130 per cent in a minimum of 8 years. Engineering Council provides for a minimum increase for the same grades and number of years from $1,620 to $5,940; i.e., $4,320 or 267 per cent; more than double the rate recommended by the Joint Commission.

The increments of increase proposed for the various grades are as follows:

Grade 8 $60—7 steps to maximum
Grade 7 $120—5 steps to maximum
Grade 5 $120—3 steps to maximum
Grade 4 $120—5 steps to maximum
Grade 3 $120—5 steps to maximum
Grade 2 $180—5 steps to maximum
Grade 1 ——

"The guiding factor as to the number of steps was the consideration as to whether the position was a stepping stone to a higher one or was likely to become the life work of an employee. In the latter case more steps are provided than in the former.

"The minimum named is to be looked upon as the entrance salary of a class, i.e., new appointees are always to receive the minimum salary. This also holds with promotion into another class. The maximum salary is to be the absolute limit of compensation to which an employee can attain while in a given class."

In considering the determination of a wage policy the commission directed its attention particularly to three questions: (1) the minimum living wage; (2) the feasibility of periodic wage adjustments on the basis of the changing purchasing power of the dollar, and (3), the effect of reclassification on the lump sum and statutory methods of appropriation. The results of these investigations are given in a special report.

Courting Trouble

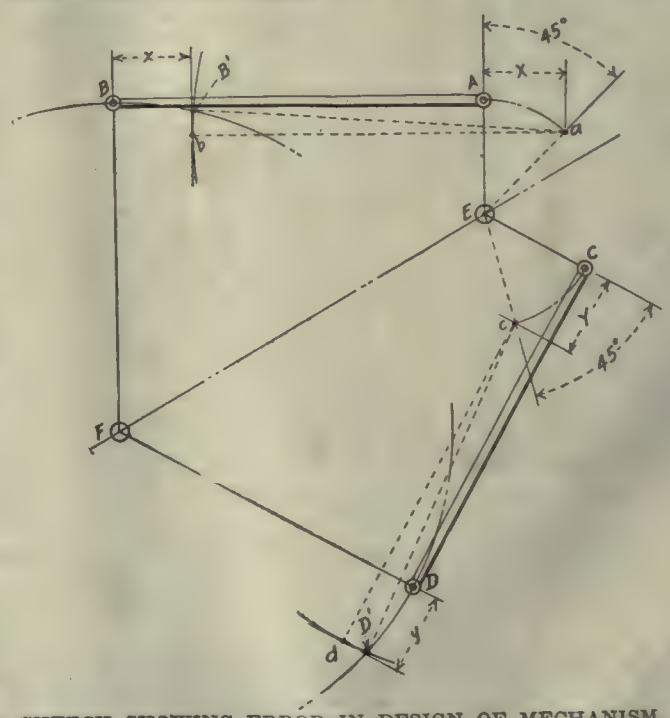
By Arthur L. Wilder

On page 31 of the *American Machinist* John S. Carpenter calls attention to the poor design of the operating mechanism of an hydraulic-turbine gate valve.

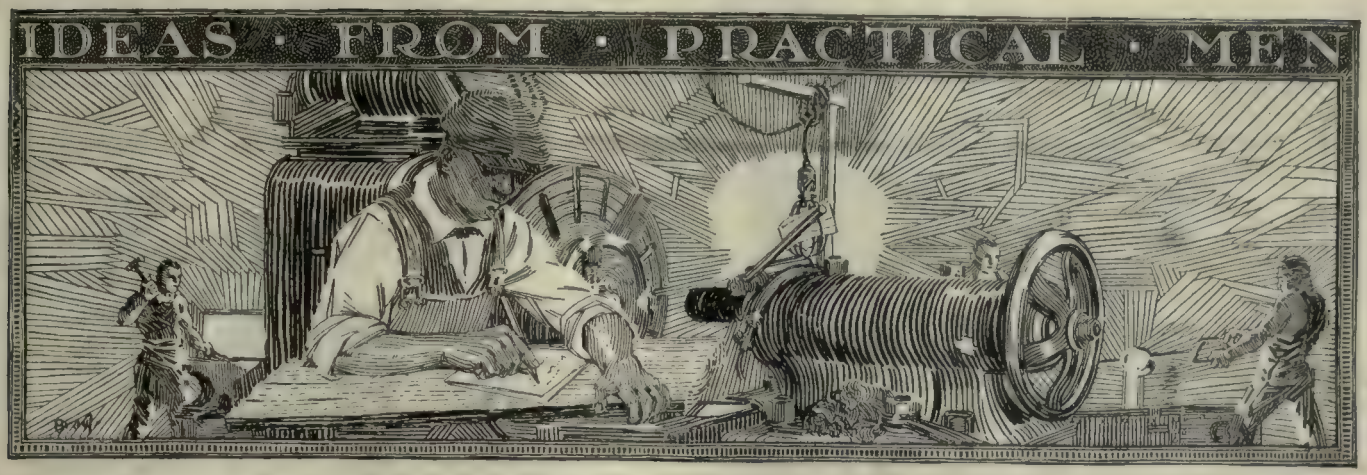
The drawing printed with Mr. Carpenter's letter shows a double operating lever rotating through an arc of 45 deg. and moving, by means of two connecting rods, a gate valve which rotates about 10 degrees.

On the sketch shown herewith, *F* is the center of the gate valve and *E* is the center of the double operating arm. The connecting links are *AB* and *CD*. Swing the arm *AE* a distance of 45 deg. to position *aE*, and arm *CE* to position *cE*, and lay out line *ab* parallel to, and of the same length, as *AB* and, similarly, *cd* the same length and parallel to *CD*. It is obvious, then, the dimensions *X*, *Y*, *z* and *y*, measured parallel to lines *AB* or *CD*, are all equal.

But, when the operating arms are moved 45 deg., the connecting rods *AB* and *CD* assume the positions *aB'* and *cD'*. Then, if dimension *x* is equal to dimension *y*, arc *BB'* is greater than *DD'* due to the side swing of the connecting rods. That is, the upper connecting link will tend to move the gate valve through a greater arc than the lower link, which is obviously impossible; and the mechanism will stand rigid except for the slight amount of motion that can be obtained due to play in the joints.



SKETCH SHOWING ERROR IN DESIGN OF MECHANISM FOR GATE VALVE



An Interesting Ring Gear Job

By I. B. Rich

The Pacific Gear and Machine Co., San Francisco, Cal., has many interesting jobs. One of them which happened to be going through at the time of my visit was the making of ring gears for repairing a lot of agricultural machinery by replacing cast ring gears with those of forged steel.

The gear housing casting at the left has to have the original cast teeth bored out to receive the steel ring gear shown in the center. These gears are made from blanks forged without a weld, opened out from a solid bar and shaped for machining in the usual way. The blanks are then turned all over as shown at the right in Fig. 1, the inside to the correct dimension but both the sides and the outside diameter being left $\frac{1}{8}$ in. large.

The teeth are cut in a Fellows gear shaper, a special chuck being provided that is easily handled and which allows the center to be kept filled with oil. As the cutter dips into this oil at every stroke it is automatically lubricated without difficulty or trouble.

After the teeth are cut a steel disk is placed in the center to prevent distortion during the carbonizing process which follows. Carbonizing is carried quite deep to insure a long wearing gear. The gear is then chucked in an engine lathe as in Fig. 2, the steel disk allowing the ring to be firmly clamped without distorting the ring with the pressure of the jaws.

The outside and both faces are then turned to size, a high-grade, high-speed steel having been found to give best results. After this, with the center disk still in place, the gear is heated and quenched. This hardens the teeth but as all the "case" has been turned from both the sides and the outside there is nothing left to harden except on the teeth. This leaves a gear with hard teeth and everything else tough, as it should be. The gear is then pressed into place and the job is done.

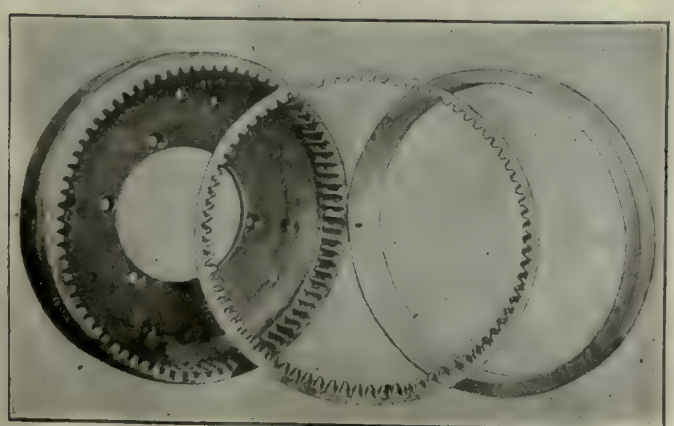


FIG. 1. THE BLANK AND THE FINISHED GEAR

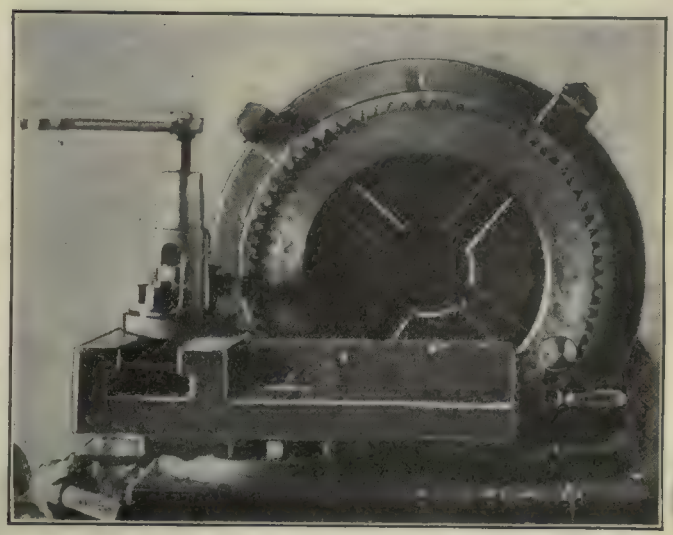


FIG. 2. FINISHING THE OUTSIDE

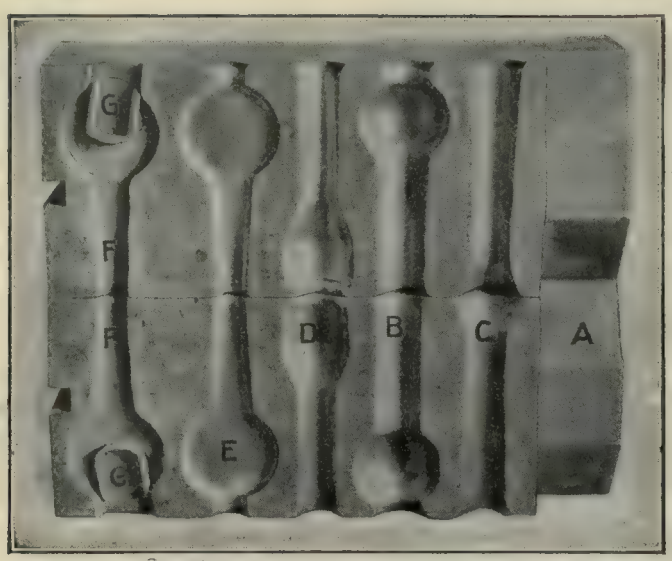
Making a Small Automobile Wrench

By John Vincent

A common form of wrench for use on an automobile is made with a jaw on one end and a socket on the other. On account of the large quantities produced, the dies shown in the illustration were designed for rapidly forging these wrenches under a Bradley hammer.

The heated bar is first broken down between the flats *A*, and then in the pass *B* a ball is formed on each end. The handle between the balls is drawn out and finished in the pass *C*. The socket end is finished cylindrical and smooth by rotating for a number of blows in the pass *D*, where at the same time the outer end is partially snubbed off so that it can more easily be sheared off later.

The ball on the other end of the handle is flattened down in the pass *E* to form the jaw end of the wrench. It is then shifted to the final pass *F*, where the hot-chisel edge *G* removes the majority of the stock from the interior of the jaw. The hot-chisels *G* are formed



DIES FOR FORGING AN AUTOMOBILE WRENCH IN A HAMMER

on the ends of round plugs inserted in the main dies, and are readily replaced.

The jaws are finished by grinding. The socket is first drilled to the size of the short diameter of the hexagon hole required, and then cut to shape in a punching machine with a punch corresponding to the finished size and shape of the hole desired.

Boring a Large Ring Gear Out West

By James W. Silver

It has been for many years a prevailing idea that when a job is too big for your shop the thing to do is to turn it over to the other fellow; but out in the West in nine cases out of ten the "other fellow" is not much better equipped than you are. So when we had two large girth-gears, like the one shown in the illustration, 10 ft. 8⅜ in. outside diameter with a 10-in. face, we had no machine large enough to bore and face the interior parts; our boring mill capacity being only 102 in. However, with a little study and a combination of two lathes the problem was solved. We turned the headstock on our 52-in. lathe end for end, cast four arms to fit on the façeplate, faced the outer ends of the arms and bolted the gear on. We then put a 20-in. x 12-ft. lathe parallel with the faceplate, bolted it to the floor and proceeded with the work. By this method we saved our customer a great deal of time, for if he had been obliged to send East for these gears, transportation being so badly demoralized, it would have been a long time before he could have obtained them.



A BIG JOB ON A COMPARATIVELY SMALL LATHE

Facing Some Slender Disks on the Boring Mill

By E. A. Dixie

The illustration shows a rather interesting job which has recently gone through our shop.

The disk *A* is 36 in. in diameter by ⅞ in. thick. The stem is 24 in. long by 7 in. in diameter and must be turned. The face of the disk must be square with the stem to within rather close limits. Several machines have been tried on the job but the best results have been obtained by facing the disk on the Colburn Mill shown in the illustration. The stem is previously turned on an engine lathe, the face of the disk being strapped to the faceplate.

The jig *B* has split hub *C* with cap *D*, secured by four screws. When preparing to bore the hub the cap was fitted with a piece of thick paper. The bore was made a neat fit for the stem of the disk. This allows the hub, with the paper removed, to securely bind the stem. Four wings *E* provide means for clamping the flange of the casting so that it will not be twisted out of square with the stem. The wings are drilled and tapped for the adjustable studs *F*, which are caused to abut against the underneath and unfinished surface of the flange, after the stem has been securely clamped in the hub. Bolts *G*, clamps *H* and "heels" *I*, are provided.

The job just about fills this size of boring mill. The cut on top varies from ⅛ in. to ¾ in., depending upon the amount by which the casting is out of true. With work as slender as this a heavy cut cannot be taken, so the output is somewhat restricted; however, under ordinary conditions, the operator can face from three to four of these castings in 10 hours.



FACING SLENDER DISKS ON THE BORING MILL

WHAT to READ
—for the man in a hurry



Suggested by the Managing Editor

THE leading article this week is by Associate Editor Sheldon. The title is "Automobile Engine Pistons as a Stock Proposition." It deals with the manufacturing operations of a company which produces pistons for all standard automobile engines. The fact that the article treats of "manufacturing" is one recommendation, and that it is written in Mr. Sheldon's clear style is another.

It is not an infrequent happening that assembly is seriously held up because of lack of production of one or more component parts. Many systems of production reports have been devised to overcome this drawback. Graphic systems, also, have been developed. One of these is explained by A. W. Sawyer in "Production Records at the Hart-Parr Factory." Page 445.

What to read was not a difficult matter to decide two hundred years ago when books were few and magazines unheard of. It is far different now when so much reading matter is offered to pass the time pleasantly or profitably as the reader chooses. We are doing our utmost to make the "American Machinist" not only profitable but indispensable as a clearing house of ideas and news of the machinery world. This page is the editors' advertisement of their section of the paper. It gives the high spots.

"Modern Welding and Cutting" is resumed after an intermission of six weeks—we now publish the twenty-fourth of this great series by Ethan Viall. The current installment deals with Welding Shop Layout, Equipment and Work Costs. Page 447.

John S. Watts gives an explanation of some of the causes of the high cost of living and labor troubles. You may not all agree with his statements—if you do, there is nothing gained by reading his argument. However, you'll need to read it to find out, and you'll find it very interesting and original. The title is "Should We Make Essentials or Non-Essentials?" Page 451.

E. A. Dixie must have an enviable time in his plant. He is a true mechanic at heart, and if we may judge from the methods he uses to accomplish difficult jobs, as told about in his articles, he is having one fine time after another. The job of making some ball-ended plugs appealed to Dixie as a job that he wanted to do for the experience. When he had finished the job he felt so good about it that he wrote it up for *American Machinist*. See what you think of it—"Making Some Ball-Ended Plugs." Page 453.

A special ball-thrust bearing supplies a subject for Western Editor Hunter's article "Press Work on the Bailey Ball-Thrust Bearing." Page 456. The article details the manufacture of this bearing, which was designed to take the place of the bronze washers used as thrust bearings in the differentials of some of the light automobiles.

The readers of the Manchester series on "The Evolution of the Workshop" will regret to learn that the current installment is the last. Many have followed this well written series with more than average interest. This week Mr. Manchester gives the history of the American metal-working industries during the Civil War. Page 459.

The report of the Classification and Compensation committee to Engineering Council is given in full, beginning on page 464. It includes a comparison of the December, 1919, report of Engineering Council's committee with the report of the Congressional Joint Commission on Reclassification of Salaries. The committee has to say: "It is the belief of the committee that, to say the least, the Federal Commission's classification, where it differs from that of your committee, has no advantages. The compensations for the various positions proposed in the Federal report are disappointing as they do not provide anything like the increases which are believed by your committee to be essential to the end that the engineering profession may attract and retain men of proper caliber to assume responsibilities successfully. The committee is hopeful that the plans which it has laid for continuing its work will bring to its assistance the earnest backing of engineers throughout the country in making the classification effective, and that information as to the value of engineering service and as to a wise employment policy will be obtained from such a wide variety of sources that it will be practicable to formulate definite recommendations along these lines."

The foregoing paragraphs are concerned chiefly with the longer articles. Among the shorter ones of note are "Operations in a New Orleans Foundry," by Frank A. Stanley, page 441; "Cost Keeping in the Small Shop," by Fred Colvin, page 442; "Combining Quantity Production with the Making of Special Parts," by Peter F. O'Shea, page 443, and "Wanted—Young Man, Fully Experienced," by Entropy.

Disfranchised Engineers

The so-called "election of officers" in a number of the big national engineering societies is an absolute farce.

A card bearing the names of the officers to be elected is sent out to the membership—only ONE nominee being listed for each office.

The "suggestion" is made in small type that if the member does not wish to vote for any of those listed he may write in the name of his choice.

What chance does any one stand of election whose name is not printed on the ballot? Not the slightest! It is a practical impossibility for a sufficient number of those opposed to any of the "selected" nominees to write in names on enough ballots to affect the final result.

Hardly a member of any of the societies following the "single-name nominee" plan has the slightest idea of who is to be nominated until he receives his "ballot."

The selection of names is made by the members of the nominating committee who are the real electors since the membership is disfranchised by the method of making out the ballots. This means that a small "group of insiders" consisting of a fractional percentage of the total membership, selects and puts into office all the national officers.

On their personal preferences and friendships rests the responsibility for the one-man-to-an-office selections made. If they selected two nominees for each office it wouldn't be so bad, but three, or even more, would be better.

The question is, "How long are the engineer members of such societies going to be content to stay disfranchised?"

Thos. Viall

Editor

EDITORIALS

The Right of Every American—Working Freedom

THERE is a part of Mr. Harding's acceptance speech which should be kept in mind by all—not especially because it comes from the Republican candidate, but because it reflects the thought of every real American:

"No party is indifferent to the welfare of the wage-earner. To us his good fortune is of deepest concern, and we seek to make that good fortune permanent. We do not oppose but approve collective bargaining because it is an outstanding right, but we are unalterably insistent that its exercise must not destroy the equally sacred right of the individual, in his necessary pursuit of livelihood. Any American has the right to quit his employment, so has every American the right to seek employment. The group must not endanger the individual, and we must discourage groups preying upon one another, and none shall be allowed to forget that government's obligations are alike to all the people."

Our ancestors came to these shores to seek religious freedom—to worship as they believed—and we Americans must not let our freedom of action in religion, life or labor be killed by those who insist that we must belong to a certain church, race, party or organization, in order to have the right to earn a livelihood or work for whom or where we please. E. V.

Increasing the Railway Car Supply by 100,000

THE Association of Railway Executives has resolved that all of its members and other carriers be urged to devote their utmost energies to the more intensive use of existing equipment." This is a good move, and is, of course, the very thing that should have been done right along, since it would have been equally effective before the grant of rate increases. However, the grant was very evidently necessary, and having been given, and approved by the country at large, the Association is to be commended for attempting real betterment before improvement can result from the rate increases.

The Association sets up several definite aims, among them "an average daily minimum movement of freight cars of not less than 30 miles per day," and "an average loading of 30 tons per car." These are the aims with which the public is chiefly concerned, not alone because of benefits from a greater movement of goods if the aims are attained, but also because of the amount of influence they may exert upon bringing these aims to a successful conclusion.

Interesting statistics are given by the Association:

"An increase of only one mile in the average movement per day would be equivalent to enlarging the available supply of cars by 100,000." This is a big figure and is worth thinking about. If a car is standing in someone's yard waiting to be loaded or unloaded it is not helping to increase the average daily movement.

"The average freight car is actually in a train moving between one terminal and another only 2.6 hours out of 24; it is actually at the service of the shipper or receiver 8.8 hours out of 24." Another statement not requiring explanation and furnishing food for thought.

The great opportunity of the buyer of car service is to use just as little as possible of the "free time" allowed for loading and unloading. All receiving and shipping departments are constantly careful not to incur demurrage; it will help out greatly, not only the railroads but the shippers and receivers themselves, if they will go a step further and save more "free time." Cars should be loaded to capacity whenever possible and should not be held in yards or on sidings when they are worth so much more rolling along. An increase of 100,000 to the available supply, without the actual addition of a single car, is an attractive proposition and one worth going after. L. C. M.

Automobile Fuels and Their Consumption

THE shortage of gasoline and its rising price naturally turns attention to the question of fuel for the hundreds of thousands of automobiles which are being built in this country each year. The first thought in most cases is to consider the use of heavier and cheaper fuels, but, according to what seems to be thoroughly reliable information, this is not the solution, as petroleum is not to be obtained in sufficient quantities.

Unless we can secure an entirely different fuel, such as alcohol, in sufficient quantities and at a low enough price, the only apparent solution is a material reduction in the amount of fuel used and this, after all, seems to be the real solution from an engineering standpoint.

Perhaps the most difficult part of the problem is the education of the motoring public away from the old standard of car perfection—the ability to "take any hill on high." It is to attain this distinction that we find huge motors of 50 to 100 horsepower in passenger cars, many times with a capacity of only three people. It is this same desire which brought about the development of the many-cylindered motor.

It is time we carefully considered the European point of view and abandoned our policy of using motors several times larger than are necessary, solely in order to avoid shifting gears on heavy grades. The European idea is to build a motor large enough to negotiate the worst hill on low gear and at low speed. Such a motor is capable of driving a car at reasonable road speed in high gear on most of our roads.

But the size of motor is not the only thing to consider. They must be made much more efficient and in this we can profit by the experience of the airplane motor builder. The Liberty motor, for example, develops a horsepower on practically a half pound of fuel, while the average automobile motor requires about double this amount. The time has come when these questions must be seriously considered by the engineers of the automobile industry. F. H. C.

What Other Editors Think

Larger Outputs with Fewer Men

From *Iron Age*

A MANUFACTURING company employing hundreds of men recently let it be known that it would hire no more workmen, for the present, at least. The psychological effect of this was apparent almost immediately in practical results. More and better work was done in that plant; there were fewer days off, less loafing on the job and greater production per man. Another company employing eighty men let thirty of them go. It was surprised to find that with the remaining fifty men it got an output equal to that which the eighty men had produced.

The cocksure attitude of workmen is not so common as it was a few months ago. In some branches of industry forces have been reduced, and while there is no great unemployment anywhere, men are becoming more jealous of their jobs. The workman, although he may not be in close touch with the "front office," knows that in some lines there have been many cancellations of orders, that production is being retarded by lack of raw materials and inability to ship.

Judging by the complaints of manufacturers, there is still much room for improvement in the attitude of workers toward their jobs, and particularly toward the common problem of maximum production. The manufacturer naturally loses patience with the worker who complains constantly of the high cost of living but on the other hand does nothing in his own job toward increasing the supply of goods.

In all the public discussions of the need for greater production, there have been few utterances from labor officials that show a proper appreciation of the true economics of the situation. It is significant, therefore, that a leading officer of the American Federation of Labor, in addressing Federation members at Montreal, pointed out that the wage earner's course is as much responsible for existing conditions and high prices as any other factor. The speaker was John H. Donlin of Chicago, president of the building trades department of the federation. In a plea for an "honest day's work" he said: "If every worker doing physical labor would insist that production equal to pre-war times would again take place there would soon be an appreciable recession in the prices of all commodities."

Speaking of another element entering into high prices Mr. Donlin said: "It is strange, but it is a fact that people complain about the price of necessities and we are squandering our money on non-essentials." He might have said, too, that it is not, for example, the bloated profiteer who today is buying silk shirts, but the workman who in days gone by would not have thought of such a piece of extravagance. "The higher the wage and the greater the underproduction," he added, "the more it is going to hurt the worker and the worker only."

If only these facts were better appreciated by wage earners better individual production might result. But, as we have pointed out repeatedly, the need of the time is not only that workers should understand that the present high wage levels mean high prices for all consumers and that the worker, when he reduces his output, thereby takes away from himself a part of any advance in wages he may secure. There is great need also—must we not say it is the first need—that both employers and employees think more of their obligations each to the other, rather than of new ways of asserting their respective rights. It has been demonstrated in many ways that even a great upheaval like the World War does not bring any radical change in human nature in industry; therefore, the cure for indifference and sloth must come through the realization by labor that the man who does not perform an honest day's work need expect little consideration when the supply of men begins to exceed the supply of jobs.

The Shipping Board Declares for the "Open Shop"

From *Manufacturers' Record*

THE Government of the United States is the Government of the whole people. Its powers cannot be exercised in behalf of any particular clique, clan, interest or organization without impairment of sovereignty.

There is no change in the character of the flame when changing from gas to ilquid fuel and the torch is readily available for use with either. For short jobs the liquid need not be turned on at all; the flame being turned on and off as required with as little trouble as an ordinary gas jet.

It is peculiarly meet and proper, therefore, that Admiral Benson, as chairman of the Shipping Board, should put that governmental instrumentality firmly on record in favor of the "open shop." Because it lays down a principle essential to the well-being of this country, the following telegram is worth reading:

Washington, July 2.

President Waterfront Employers' Union,
San Francisco, Cal.:

Further complaints are received that your organization is continuing discrimination on Shipping Board vessels. The Shipping Board must insist that proper longshoremen be given an opportunity to work on its vessels, regardless of affiliation with any particular organization. No other position is compatible with equality of opportunity for employment, which must be preserved in the public service. We do not intend to prohibit rational discrimination against individuals on account of their reputation, known participation in attacks on person or property in the course of industrial disputes, disloyalty or other legitimate disqualification for employment justifying their rejection by responsible management, nor can there be objection to reasonable means to establish the identity of such persons. Such means must under no circumstances be permitted to become or to be used as a means of arbitrary discrimination in employment. I have stated our position thus clearly in order that we may not be misrepresented by interested parties, and authorize you to give this telegram such publicity as you desire. (Signed) BENSON, Chairman.

The right of any man to work, "regardless of affiliation with any particular organization" must be forever preserved in the United States.

SHOP EQUIPMENT NEWS

-Edited By-
S. A. HAND

SHOP EQUIPMENT NEWS
A weekly review of modern designs and equipment

Descriptions of shop equipment in this section constitute editorial service for which there is no charge. To be eligible for presentation, the article must not have been on the market more than six months and must not have been advertised in this or any previous issue. Owing to the news character of these descriptions it will be impossible to submit them to the manufacturer for approval.

CONDENSED CLIPPING INDEX
A continuous record of modern designs and equipment

Cincinnati No. 9 Internal Grinding Machine

The illustration shows the No. 9 manufacturing internal grinding machine which has recently been placed on the market by the Cincinnati Grinder Co., Cincinnati, Ohio. The machine is particularly adapted to repetition work in the grinding of either straight or tapered holes in such parts as can be revolved in a chuck or on a faceplate. It consists essentially of a swiveling wheelhead carried upon a table which is provided with longitudinal motion only; a workhead mounted on a cross-slide in such a manner as to provide a transverse movement for adjustment and feeding the work to the wheel; a reverse plate mounted on the front of the base for automatically controlling the reversal of the table; a gear box for varying the speed of the table; an automatic feeding device for the cross-slide; a gear box for controlling the rotative speed of the work; a truing diamond carrier; and a coolant system.

A constant-speed drive is employed, thus requiring only a single pulley on the overhead lineshaft. The machine may be driven through a silent chain by a motor on the floor. From the main drive shaft at the rear, the drive is through a belt at the side of the machine to the drum-shaft, running on ball bearings in the base. The spindle is driven from the drum, a fixed and a floating idler being utilized to keep the belt tight. To permit of using different sized abrasive wheels, different heads are employed, each head being a complete unit and interchangeable with the the other heads. The diameter of the driving pulley on each spindle is proportional to the diameter of the wheels to be used on the spindle

The wheelhead can be swiveled 30 deg. from its normal position, so as to get the wheel out of the way of the operator when the work is being gaged or changed.

The wheel-truing fixture is carried on a bracket at the rear of the bed, the arm holding the diamond being readily moved to bring it to the operating position.

The reciprocating motion of the table is positively driven from the main drive shaft, three changes of speed being provided by a gear box at the front of the machine. Hand operation is obtained by means of a pilot wheel. Positive stops are provided.

The Workhead

The workhead is driven from the main drive shaft, three rotative speeds being provided by means of a gear box at the rear of the machine. A belt, tightened by idler pulleys, connects the workhead with a driving pulley provided with a clutch that is automatically disengaged whenever the wheelhead is swiveled out of its normal position. Simultaneously with the

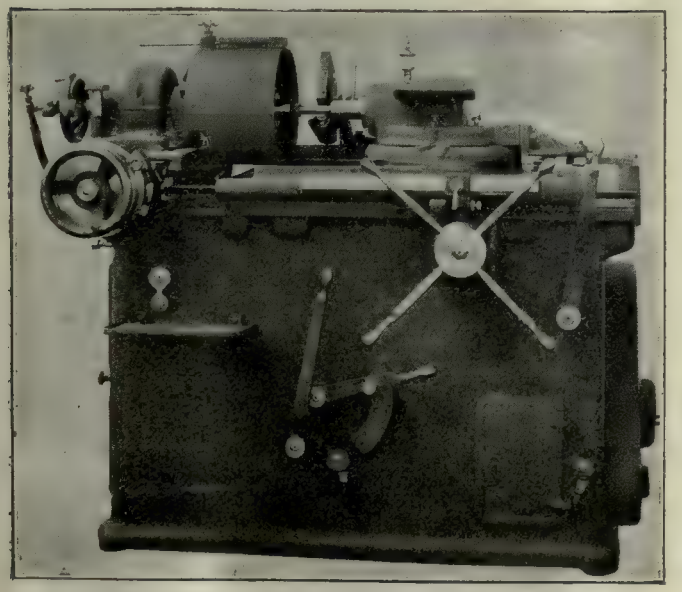


FIG. 1. FRONT VIEW OF CINCINNATI NO. 9 INTERNAL GRINDING MACHINE

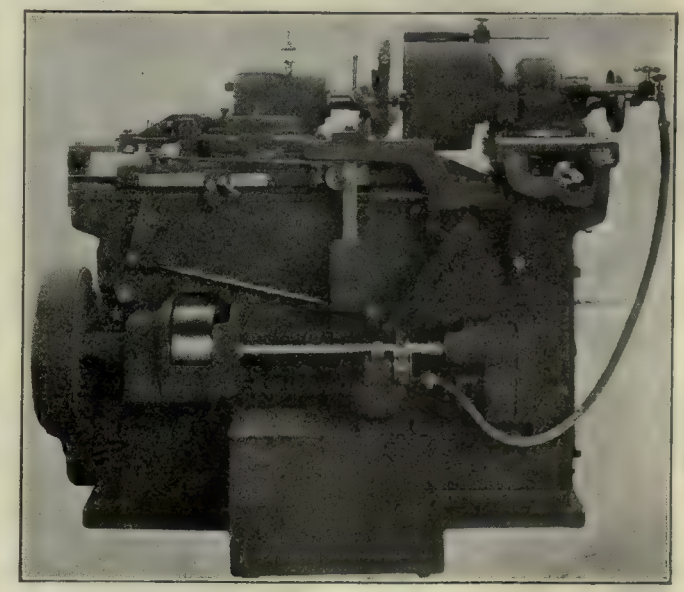


FIG. 2. REAR VIEW OF CINCINNATI NO. 9 INTERNAL GRINDING MACHINE

releasing of the clutch, a brake is applied to the pulley, thus instantly stopping the work when the wheel is swung out of the way.

The workhead can be swiveled for taper grinding to an angle as large as 45 deg. by means of the handwheel at the top actuating a pinion meshing with a segment on the circular base of the head.

The workhead is mounted on a cross-slide which can be fed either by hand or by power. The power feed is driven from the table motion by means of a pawl and ratchet, both the rate and the distance of travel being adjustable. A thumb latch is employed for fine feeding by hand and a handwheel for rapid traversing of the cross-slide. A direct-reading dial and positive stops are provided.

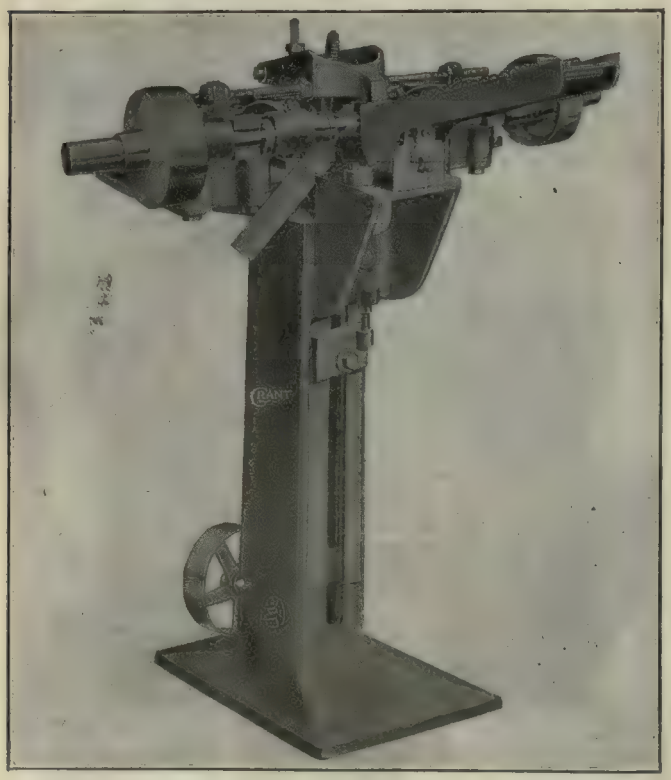
By using a cupped wheel, face grinding can be done in connection with hole grinding work requiring very accurate finishing.

The coolant pump is driven by a belt from the main driving shaft. The tank is separate from the machine, setting on the floor in the rear of it. The water guards are detachable from the machine, and it is claimed that they are of such size and shape as to catch all of the spray.

Grant Automatic Double-Spindle Chamfering Machine

The automatic double-spindle chamfering machine shown in the illustration was recently brought out by the Grant Manufacturing and Machine Co., 90 Silliman Ave., Bridgeport, Conn. The machine is intended for chamfering simultaneously both ends of automobile-engine piston pins; and it is claimed that a speed of 40 pins per min. with pins $\frac{5}{8}$ in. in diameter and 3 in. long can be maintained.

The pins, already cut to length from the bar or tube, are placed in the inclined hopper at the front of the machine. From the hopper they roll or slide down to the feeding mechanism, where they are taken, one at a time, by a slide and placed in the proper position in the clamp, which holds them while the cut is being taken. The opposed cutters advance from each side and chamfer the pin ends. They then recede, the clamp is released, and the feeding slide pushes another pin in place for cutting, thus ejecting the finished pin down the diagonal slide at the left of the table.

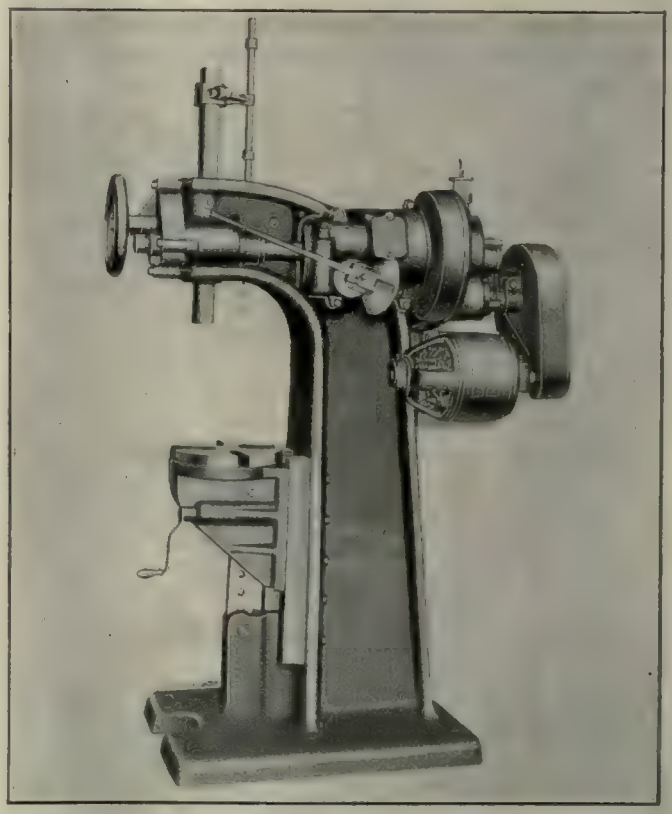


GRANT AUTOMATIC DOUBLE-SPINDLE CHAMFERING MACHINE

The use of the machine is not restricted to chamfering, as it can be applied to drilling, facing or counterboring opposite sides of small work. The work need not be round in section, as square or irregular shapes can be handled.

Hercules 15-Ton Press-Broach

The Hercules Machinery Co., Detroit, Mich., has recently re-designed its 15-ton arbor press and vertical broaching machine, shown in the illustration. It is claimed that the number of operations which the machine can handle has been increased.



HERCULES 15-TON PRESS-BROACH

The ram is driven either by a belt or by an individual motor mounted on the back of the column, and it has a travel of 18 in. The knee has a vertical adjustment of 14 in., being moved by means of a hand lever, and it is removable, so that fixtures or conveyors can be put in its place.

The press is guaranteed to have a capacity of 15 tons pressure, each machine being tested up to 18 tons pressure, at which point a pin in the drive shears in order to prevent breakage of the press. The travel of the ram is governed by means of an automatic trip.

The floor space occupied by the machine is only 6 square feet.

Guards for Modern Grinding Machines

The Modern Tool Co., Erie, Pa., is now equipping its plain cylindrical self-contained grinding machines with guards of the type shown in Figs. 1 and 2. These guards are intended to replace those of heavy cast iron formerly used, and to inclose the moving parts, at the same time permitting them to be seen.

The guard, known as the phantom type, is made of

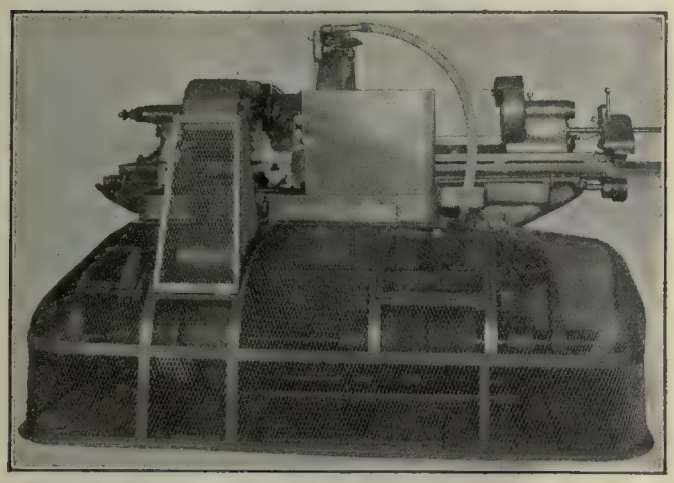


FIG. 1. PHANTOM GUARD FITTED TO MODERN GRINDING MACHINE

expanded metal riveted to a frame of angle iron. It is supplied as a unit and not in sections, and can be attached to the machine or removed without the use of a wrench or screwdriver. It is claimed that the guard is light and easily handled, but sufficiently strong to be a thorough protection to the moving parts, such as pulleys and belts, which it completely incloses. The corners are rounded so as to follow the lines of the machine, thus saving space.

Practically complete visibility of the inclosed parts

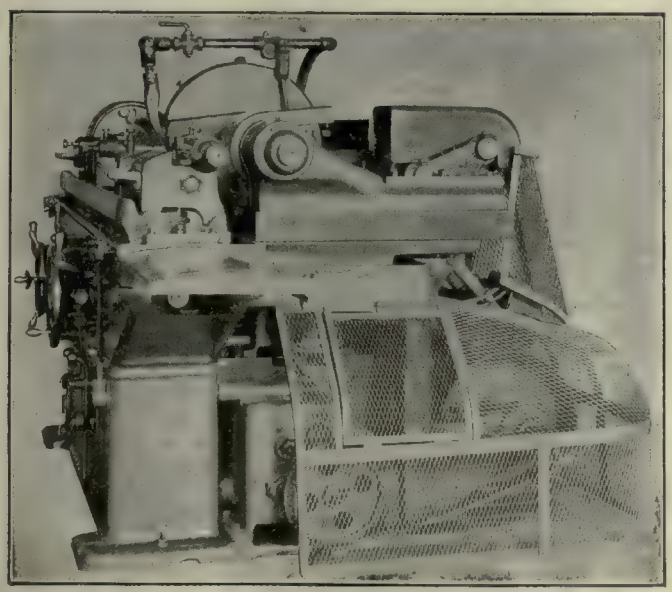
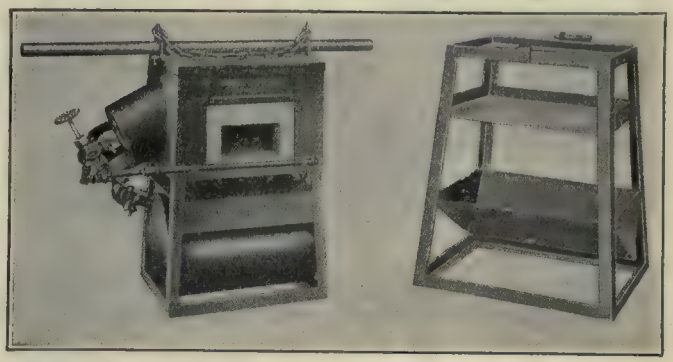


FIG. 2. SIDE VIEW OF PHANTOM GUARD ON MODERN GRINDING MACHINE

is obtained, thus insuring against the accumulation of dirt under the guards. Hinged portions and handholes are provided for the sake of accessibility, so that lubrication and minor adjustments of the moving parts can be attended to without removing the guard.

Mahr No. 12-D Hand-Portable Oil-Fuel Rivet Forge

The illustration shows the hand-portable, oil-fuel rivet forge and stand, No. 12-D, built by the Mahr Manufacturing Co., Minneapolis, Minn. This forge is intended especially for shipyard and scaffold work, and is of all-steel welded construction. It is composed of two units, the upper containing the forge and tank, while



MAHR NO. 12-D HAND-PORTABLE OIL-FUEL RIVET FORGE AND STAND

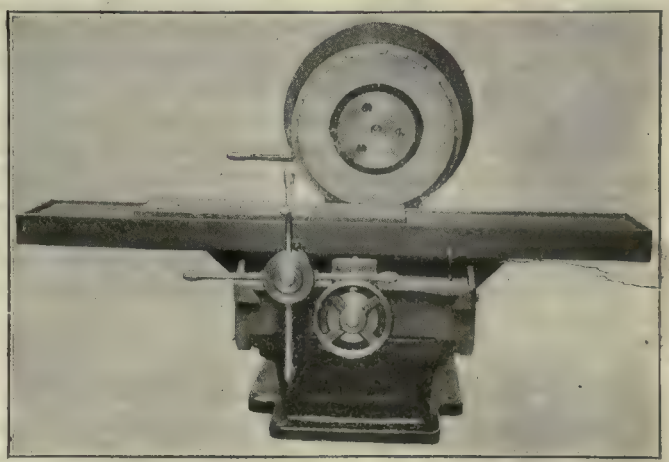
Specifications: Tank capacity, 5 gal. Oil consumption, 1¾ gal. per hour. Air consumption, 8 cu.ft. per minute. Height overall on stand, 46¾ in. Floor space of stand, 13 x 36 in. Net weight: forge and tank, 165 lb.; stand, 30 lb.

the stand is arranged with a long tray and rivet bin and fitted with a clasp so that it can be secured to the forge and moved with it if desired. It has a three-piece tile lining.

The burner works on the vacuum principle and draws oil directly from the tank below, thus avoiding the necessity of carrying air pressure in the oil tank. It is claimed that the burner will handle even dirty grades of oil without trouble, and that when once adjusted the forge requires but little attention.

Face-Grinding Table for Badger Disk-Grinding Machine

The Badger Tool Co., Beloit, Wis., has developed a face-grinding table to be used on its regular line of single-spindle disk and cylinder-wheel grinding machines. The illustration shows an end view of the No. 8 machine with the face-grinding table serving a 20-in. abrasive cylinder held in a chuck. The other end



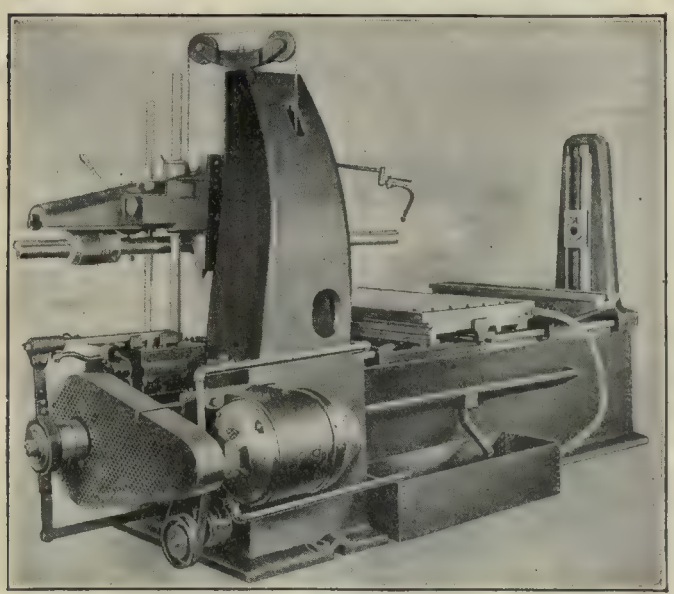
FACE-GRINDING TABLE FOR BADGER DISK-GRINDING MACHINE

of the spindle carries a 30-in. disk wheel and is served with a universal lever-feed table.

The working surface of the table is 10 x 32 in., with a longitudinal travel of 32 inches. The ways are 40 in. long, and the over-all dimensions of the table are 14 x 73 inches. Travel is produced by means of a pilot-wheel operating a gear engaging a rack, the leverage being 10 to 1. By means of a handwheel carrying a dial and operating through a screw and nut, a feed of 4 in. toward the grinding wheel can be obtained. Large adjustments can be made by moving the main saddle on the bed. All table and grinding-wheel equipments are interchangeable. Complete dust-exhaust or wet-grinding systems can be supplied. The net weight of the complete table in No. 8 size is 1,000 lb.

Universal Boring Machine Coolant System

The Universal Boring Machine Co., Hudson, Mass., is equipping its machines when so ordered with the coolant system shown in the accompanying illustration.



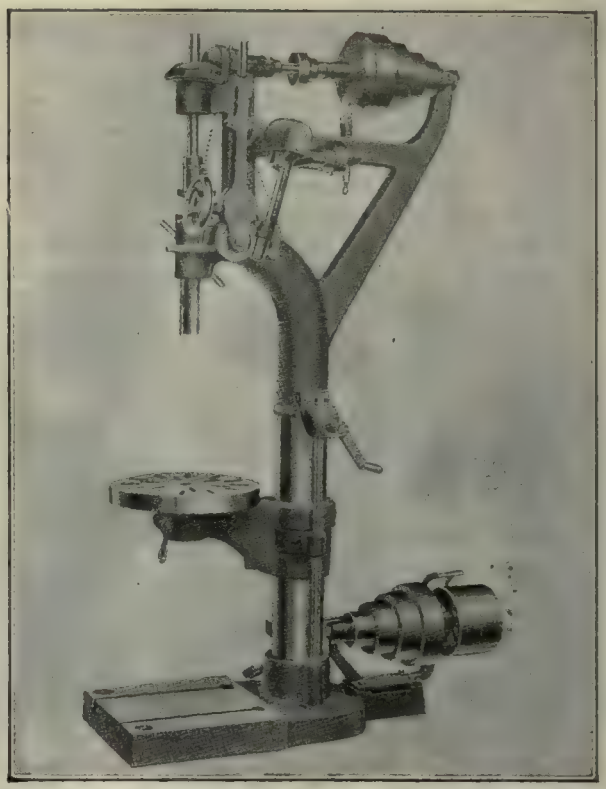
COOLANT SYSTEM OF UNIVERSAL BORING MACHINE

The pump is of the impellor type with a capacity of 12 gal. per minute, and it is driven by a belt from the motor driving the machine. The intake to the system is ¾ in. in diameter, and no part of the passage is smaller, so that all chips which enter the system are able to pass through it. The coolant is delivered to the cutting tool through a flexible-tube nozzle.

The table of the machine is provided with deep pockets and grooves for collecting the coolant, which is delivered to the tank through a flexible tube. Troughs on the front and rear of the bed of the machine serve to collect and carry off the lubricant which falls from the table. Another trough, also draining into the open tank at the rear of the machine, is provided between the ways of the bed.

Silver 20-Inch Drilling Machine

The Silver Manufacturing Co., Salem, Ohio, has recently redesigned its 20-in. drilling machine. The accompanying illustration shows the machine, the principal changes being in the style of the frame and an



SILVER 20-IN. DRILLING MACHINE WITH POWER FEED

Specifications: Height, 75 in. Travel of spindle, 12 in. Travel of table, 17½ in. Spindle to base, maximum, 42¾ in. Spindle to table, maximum, 28¼ in. Weight: net, 775 lb.; shipping, 860 lb.; boxed for export, 1,050 lb. Volume, boxed, 23 cu.ft.

increase in capacity under the spindle. It is intended as a general purpose tool.

The spindle is provided with an S.K.F. ball thrust bearing and usually with a No. 3 Morse taper hole. The base, as well as the table, is square with the spindle. The machine can be supplied with either hand or power feed, and with a tapping attachment if desired. It can be furnished with either geared or belted motor drive and in gangs of either two, three or four spindles.

A Short Proof for Long Division

By J. Madden

The articles by Walter R. Meyer in the August 19 issue, and by E. S. Mummert in the August 26 issue of *American Machinist* on "A Short Proof for Long Division," call to mind the method of proving division by "casting out the nines." Perhaps this method is not so commonly known as one would suppose and it may not be amiss to explain it.

To cast out the nines from a number, either divide the number by 9 or divide the sum of its digits by nine. The remainder in either case is the number sought. For example, to cast out the 9's from 8761:

$$\frac{8761}{9} = 973 \text{ with } 4 \text{ left over.}$$

$8 + 7 + 6 + 1 = 22 = 9 \times 2$ with 4 left over.

Four is the working number. In practice the usual procedure is this:

$8 + 7 = 15 - 9 = 6 + 6 = 12 - 9 = 3 + 1 = 4.$

The average mental pauses would be 15, 6, 13, 4; or the 8 and 1 might be grouped leaving merely 13, 4. By this it will be seen that a proof involving casting out the 9's does not add greatly to the length of the operation.

The rule for proving division is this: Find remainders by casting out the 9's in divisor, dividend, quotient and remainder. Multiply remainder from quotient by remainder from divisor. To this product add remainder from remainder. Cast out the 9's from this sum. The result, if the division is correct, will equal the remainder from the dividend. Example:

$$
\begin{array}{rrr}
 & 7 & \\
 & \| & \\
7 = 709) & 62314 & (87 = \quad 6 \\
 & 5672 & \quad\;\; 7 \\
 & \overline{\quad\quad} & \overline{\quad\quad} \\
 & 5594 & \quad 42 \\
 & 4963 & \quad\;\; 1 \\
 & \overline{\quad\quad} & \overline{\quad\quad} \\
 & 631 = 1 & \quad 43 = 7
\end{array}
$$

The same process reversed may be used to prove multiplication. The rule is: Find the remainders from multiplicand, multiplier and product. Multiply remainder from multiplicand by remainder from multiplier. Find the remainder from their product. This remainder, if the multiplication is correct, will equal the remainder from the product. Example:

$$
\begin{array}{rr}
709 = 7 & \\
87 = 6 & \\
\overline{\quad\quad} & \overline{\quad\quad} \\
4963 & 42 = 6 \\
5672 & \\
\overline{\quad\quad\quad} & \\
61683 = 6 &
\end{array}
$$

Addition and subtraction may be proved in a similar way. Rule for proving substraction: Find remainders from minuend, subtrahend and difference. Add remainder from subtrahend to remainder from difference. Find a remainder from this sum. If the subtraction is correct, this remainder will equal the remainder from minuend. Example:

$$
\begin{array}{r}
879654 = 3 \\
123007 = 4 \\
\overline{\quad\quad\quad} \\
756647 = 8
\end{array}
$$

$$8 + 4 = 12 \;\; ; \quad 12 - 9 = 3.$$

Rule for proving addition: Find remainder from each quantity being added and from the sum. Add the remainders from the quantities being added and find a remainder from this sum. If the addition is correct, this remainder will equal the remainder from the sum. Example:

$$
\begin{array}{r}
876579 = 6 \\
124632 = 0 \\
631854 = 0 \\
909071 = 8 \\
462175 = 7 \\
846197 = 8 \\
\overline{\quad\quad\quad} \quad \overline{\quad} \\
3850508 = 2
\end{array}
$$

To some, it may seem, after reading the preceding explanation and rules, that these proofs are complicated. I believe that if thoroughly understood and given a fair trial they will prove to be, on the contrary, quite simple.

There may be offered the objection that there is as much liability to make mistakes in casting out the 9's as in doing the original work. A little practice will show that this is not so. Even when mistakes are made in casting out the 9's they are soon discovered, as the proof is naturally the first step checked.

Representation of Local Organizations in the F. A. E. S.

The Constitution of the Federated American Engineering Societies states, in Article IV—Section 3: "provided that in the determination of the representation of local, state and regional organizations and affiliations no count shall be taken of any organization which is represented individually or through another local, state or regional organization or affiliation; . . ."

That is to say, if there were in a community five local engineering and allied technical organizations, all in a local affiliation, and one of them was a member of the Federated American Engineering Societies, then the remaining four societies would be entitled to representation as an affiliation in the Federated American Engineering Socieities, through its membership as a local affiliation, on the basis of the aggregate membership—less the membership of the local organization that already held membership in the Federated American Engineering Societies, or each of the four organizations could individually become a member of the Federated American Engineering Societies.

Revision of Weights for Sections of Minimum Web Thickness of American Standard Beams and Channels

In 1896 the Association of American Steel Manufacturers adopted a list of standard profiles of structural steel sections which are known as American Standard Structural Sections. In 1911 the association also adopted standard methods of computation for published weights and areas. The weights that were published for the minimum thickness of beams and channels did not correspond exactly to the published areas and it has long been known that it is impracticable to furnish these sections true to both the published weights and dimensions.

To correct this situation the Association has just adopted as American Standards the weights per foot shown in the third column of the table below for the section of *minimum* web thickness which do correspond to the published dimensions.

Section	Depth, Inches	Weight, Pounds per Foot	
		Present Weight	New Weight
Beams	3	5.5	5.7
	4	7.5	7.7
	5	9.75	10.0
	6	12.25	12.5
	7	15.0	15.3
	8	18.0	18.4
	9	21.0	21.8
	10	25.0	25.4
	12	31.5	31.8
	12	40.0	40.8
	15	42.0	42.9
	15	60.0	60.8
	15	80.0	81.3
	18	55.0	54.7
	20	65.0	65.4
	20	80.0	81.4
	24	80.0	79.9
	24	105.0	105.9
Channels	3	4.0	4.1
	4	5.25	5.4
	5	6.5	6.7
	6	8.0	8.2
	7	9.75	9.8
	8	11.25	11.5
	9	13.25	13.4
	10	15.0	15.3
	12	20.5	20.7
	15	33.0	33.9

The new weights as set forth above are to be put into effect Sept. 1 by all of the companies rolling these sections.

SPARKS FROM THE WOR

Valentine Francis

International Bureau of Weights and Measures Might Include Other Standards

The International Bureau of Weights and Measures will meet at Paris during September of this year. S. W. Stratton, director of the Bureau of Standards, has recently sailed to attend these sessions as the official representative of the United States.

There is in contemplation a considerable increase in the functions of the International Bureau to include other standards than those of simple weights and measures. This idea of extension of activity has been approved by representatives of the American Physical Society, the National Academy of Science, and the National Research Council.

It is anticipated that if the plan is adopted the International Bureau of Weights and Measures will have custody of numerous other types of standards and will eventually undertake the study of physical values and promulgation of constants based upon the best available information. Such constants would doubtless be adopted by most of the interested countries in the form of an international convention with respect to units and standards.

Underwood Typewriter Co. Takes Over Bullard's Bridgeport Plant

The old plant of the Bullard Machine Tool Co., of Bridgeport, Conn., located on Broad, Allen, Lafayette Sts. and Railroad Ave., has been purchased by the Underwood Typewriter Co., of Hartford, Conn., and will be used for the making of portable typewriters.

The Underwood people expect to employ between 1,500 and 2,000 workmen when this plant, which will be known as Plant No. 2, will be up to maximum production.

The Bullard company recently moved to its new plant in Black Rock, Bridgeport. The plant purchased by the Underwood company, has a total floor area of 168,222 sq.ft., and is modernly equipped; has all daylight space, adequate power plant, passenger and freight elevators, electric cranes, foundry, etc. The main building of the plant was built only a few years ago, and is a fireproof reinforced concrete structure five stories high.

Considerable alterations will be made to the plant to make it suitable for typewriter manufacturing use, and the Underwood concern expects to have the plant in operation about the middle of October.

Shall the Tail Wag the Dog?

The metric system of weights and measures having made little progress in the industries of this country, its advocates are now endeavoring to force it by law on a people who have found little merit in it.

The arguments which to their mind are unanswerable are summed up in the terms: "World Uniformity" and "Foreign Trade." They start with what they consider an indisputable assumption that the metric system users form an overwhelming majority and that the bulk of trade is carried on in their system.

But facts are stubborn things and the facts indicate that the nearest approach to world uniformity in manufacture and trade has been achieved by non-metric America and England. The overwhelming preponderance of American and British foreign and domestic trade and the dominating position held by their system of weights and measures in every commercial port have secured for them a universality, through natural processes, which no amount of compulsory legislation could have made possible.

We have only to remember that:

(1) 70 per cent of the world output of steel is manufactured in the United States and Great Britain on the inch and pound basis.

(2) Approximately two-thirds of the world production of machine tools is made to the inch.

(3) 80 per cent of the world production of screw threads is made to the inch.

(4) The United States and Canada consume for manufacture about 75 per cent of the world production of crude rubber.

(5) The United States manufactures 90 per cent of the world production of motor vehicles.

(6) The standard unit by which lumber is measured the world over is the board-foot, being a board one foot square by one inch thick.

(7) 95 per cent of the world's cotton spindles are spinning to the yard and pound; only 5 per cent are spinning to metric.

(8) Approximately two-thirds of the commerce of the world in manufactured products is on the basis of the American-English system of weights and measures.

In the light of these facts it is evident that the metric party is engaged in an effort to make the tail wag the dog.

Research Council Announces Chairmen for 1920

The National Research Council, with headquarters at Washington, D. C., has elected the following chairmen of its various divisions for the year beginning July 1, 1920:

Division of Foreign Relations, George E. Hale, director, Mt. Wilson Observatory, Carnegie Institution of Washington; Government Division, Charles D. Walcott, secretary of the Smithsonian Institution, and president of the National Academy of Sciences; Division of States Relations, John C. Merriam, professor of palæontology, University of California, and president-elect of the Carnegie Institution of Washington; Division of Educational Relations, Vernon Kellogg, Professor of Entomology, Stanford University, and permanent secretary of the National Research Council.

Division of Industrial Relations, Harrison E. Howe; Research Information Service, Robert M. Yerkes; Division of Physical Sciences, Augustus Trowbridge, Professor of Physics, Princeton University; Division of Engineering, Comfort A. Adams, Lawrence, Professor of Engineering, Harvard University; Division of Chemistry and Chemical Technology, Frederick G. Cottrell, director of the Bureau of Mines; Division of Geology and Geography, E. B. Mathews, Professor of Minerology and Petrography, Johns Hopkins University.

Division of Medical Sciences, George W. McCoy, director of the U. S. Hygienic Laboratory since 1915; Division of Biology and Agriculture, C. E. McClung, Professor of Zoology, University of Pennsylvania; and Division of Anthropology and Psychology, Clark Wissler, Curator of Anthropology, American Museum of Natural History, New York. These officers will assume charge of the activities of their individual departments.

A. I. E. E. Moves to Join F. A. E. S.

At the meeting of the Board of Directors of the American Institute of Electrical Engineers held in New York on Aug. 12 the following resolution to become a charter member of the Federated American Engineering Societies was unanimously adopted:

"*Resolved*, That the American Institute of Electrical Engineers accepts the invitation to it to become a charter member of the Federated American Engineering Societies, and pledges its hearty co-operation in the work thereof."

LD'S INDUSTRIAL FORGE
News Editor

Westinghouse Employees Take Voluntary Insurance

Over 90 per cent of the employees of the Westinghouse Electric and Manufacturing Co., at the East Pittsburgh works, have taken advantage of the additional insurance of an Insurance and Savings plan recently made effective by the organization.

This, in effect, means that nearly all employees have savings accounts, because to be eligible for additional insurance the company requires each worker to deposit a portion of his earnings in the Employees' Savings Fund.

Every employee when completing six months' service with the company is given a $500 life insurance policy, free of charge and without any restrictions. By continuing with the company and depositing, at least, 2 per cent of his earnings in the Employees' Savings Fund additional insurance of from $500 to $1,500 may be secured, the amount depending upon length of service. A policy of from $1,000 to $2,000 may, therefore, be obtained by every employee of the Westinghouse Co. depositing in the fund, which pays interest at the rate of 4½ per cent compounded semi-annually on all deposits. To assist an employee to meet an emergency, loans will be made from the Employees' Saving Fund.

Every depositor can borrow 90 per cent of the money he has in the fund, without in any way affecting the value of the insurance. Repayment can be made at the rate of 10 per cent monthly.

In addition to paying interest on the deposits, the company guarantees that the fund is not to be used for private enterprise, but is to be held in trust solely for the employee, who can withdraw his savings account with accumulated interest at any time.

The percentage of employees who have opened savings accounts with the company is much higher than has heretofore been obtained by other organizations with insurance plans. It is somewhat unique in industrial annals to know that 90 per cent of the workers in one of the largest organizations in the world have savings accounts and through their thrift have made themselves eligible for life insurance policies of $1,000 and over. It is expected that the derelict 10 per cent will soon join the ranks of the thrifty.

Individualism is a fine thing for initiative, but co-operation is necessary for progress.

Report Shows Biggest Year for U. S. Patent Office

An extraordinary increase in the business of the United States Patent Office during the fiscal year ended June 30 is disclosed by the report of the Commissioner of Patents, R. F. Whitehead, to Secretary Payne of the Interior Department, according to figures given out today.

There were 81,948 applications for inventions filed as compared with 62,755 during the previous year. The total number of applications of all kinds was 102,940, which is 27,283 more than were filed during the year 1919.

The number of patents granted, and trade marks, labels and prints registered was 47,409, an increase of 4,056 over the preceding fiscal year.

The cash receipts from all sources, the largest item of which is for first fees in connection with applications, amounted to $2,615,697.33. The total expenditures were $2,436,561.37, leaving a net surplus of $179,135.96. The total net surplus to date is $8,305,023.56. In 1918 and 1919 expenditures exceeded receipts by $27,955.62 and $65,228.13, respectively. It will be seen that the large increase of business is reflected in the net surplus of receipts during the past fiscal year.

The office shipped to foreign governments 999,862 copies of patents. It received for record 40,188 deeds of assignment.

One of the items which make up the large increase in the volume of business of the office is applications for the registration of trade marks, in which a gain of 72 per cent over the number received during the preceding fiscal year is recorded.

The gain in actual numbers of applications filed far exceeded any previous increase of business in any one fiscal year, and this gain is larger than the total receipts of any calendar year in the history of the Patent Office up to and including the year 1881.

N. I. C. Board Moves to New York

The National Industrial Conference Board announces that on and after Aug. 23 its headquarters (now in Boston) will be located at 10 East 39th St., New York City.

Business executives, economists and others interested in the board's work will find at the offices of the board much valuable information on industrial-economic subjects which is constantly being collected and analyzed by those in charge.

Consolidated Utilities Corporation Plans Wide Manufacturing Activities in the Near Future

The Consolidated Utilities Corporation, of Binghampton, N. Y., a combination of four large manufacturers, announces an extended program of business activity in the near future. The plants of the Emco Manufacturing Co., Woodworth Manufacturing Co., Osgood Scale Co., and Jones of Binghamton Co., have been acquired by the new concern and plans are now under way to set the machinery of the combination in motion for united production of automobile accessories, motor parts, belting and guards, chains and scales.

A recent addition to the Osgood Co.'s plant will enable the new body to produce a maximum of the well-known Osgood scales. A new concrete addition to the Woodworth factory is contemplated so that the production of this branch can be greatly increased.

Worrall & Kling Open Youngstown B. & T. Agency

H. C. Worrall, general sales manager of the Gilbert & Barker Manufacturing Co., and Elmer Kling, in charge of the factory sales department of the same concern, have resigned their positions to enter business for themselves.

Worrall & Kling have opened offices in the Stearns Building as sales representatives of the Youngstown Boiler and Tank Co., specializing in large and small storage tanks as well as pressure tanks and miscellaneous plate work, such as steel stacks, bins, etc. It is their intention as manufacturers' agents to add a few kindred lines.

Handley Page Co. to Build Freight Airplane

It is understood that the Handley Page Co., of England, will soon construct a special airplane suitable for carrying freight. This has been made necessary owing to the increased quantity of heavy and bulky freight which is now being carried to and from Paris by the company.

The new machine will be one of the 0-11 types and will have a large freight hold with a passenger cabin for two or three at the back and also a room will be made in the nose of the airplane for two passengers in addition to the pilot and mechanic.

Geo. B. Hodges Joins McVicker Engineering Co.

The McVicker Engineering Co. announces that George B. Hodges has been appointed manager of the industrial and production department.

Mr. Hodges has been identified with the production and industrial work on tractors, plows and power farming machinery for the past eighteen years.

The McVicker Engineering Co.'s service policy, in connection with the production work, is practically the same as with their consultation service, and enables companies in need of production and industrial service to get Mr. Hodges' assistance at a very moderate remuneration.

Engineers and architects from all parts of the State of Minnesota met at Duluth recently and took the first steps toward the formation of a state federation of engineers and architects.

Akron Public Works to Buy Machinery

Approximately $150,000 worth of machinery will be needed by the Akron department of public works next year, according to F. C. Tolles, superintendent.

The street cleaning department requires another sweeper and at least one more auto truck, he said. The street repair department will need four heavy tractors, a steam roller and a breaking plow. The garbage collection department will require at least one more truck and twenty additional trailers, Mr. Tolles said. The trailers used by the garbage collection department this year have proven successful.

The city started a policy of purchasing machinery to do a large part of the public work two years ago.

A large sum will be asked to equip the city yard with bins and tanks for storing material.

DOMESTIC EXPORTS FROM THE UNITED STATES BY COUNTRIES, DURING JUNE, 1920
METAL-WORKING MACHINERY

Countries	Lathes 491	Other Machine Tools 492	Sharpening and Grinding Machines 493	All Other 495
Belgium	$34,875	$16,356	$8,847	$54,803
Bulgaria	.....	624	.....	.....
Denmark	.....	358	298	1,130
Finland	.....	586	71	.....
France	71,627	192,051	19,543	126,578
Greece	.....	1,331	.....	.....
Italy	13,625	48,311	16,981	14,510
Netherlands	4,565	36,691	11,574	12,613
Norway	1,211	1,753	2,895	4,887
Poland and Danzig	.....	.....	500	.....
Portugal	.....	1,903	.....	1,595
Roumania	.....	168	.....	.....
Spain	25,530	23,888	1,525	9,672
Sweden	5,014	34,673	15,575	13,250
Switzerland	3,017	190	1,580	589
England	266,968	210,442	86,514	330,642
Scotland	133	11,431	608	.....
Ireland	.....	1,468	962	.....
Bermuda	.....	138	.....	.....
British Honduras	.....	.....	33	.....
Canada	141,814	196,969	74,092	191,458
Costa Rica	.....	697	.....	.....
Guatemala	.....	80	10	119
Honduras	.....	73	.....	225
Nicaragua	.....	.....	.....	9
Panama	.....	1,274	.....	576
Salvador	.....	487	15	.....
Mexico	13,211	3,667	8,609	12,045
Newfoundland and Labrador	4,359	207	.....	370
Jamaica	.....	1,492	.....	2,215
Trinidad and Tobago	75	23,274	.....	.....
Cuba	6,369	27,870	983	5,482
Haiti	.....	.....	30	.....
Dominican Republic	90	373	820	.....
Argentina	16,940	11,332	7,307	14,812
Brazil	2,037	8,528	1,811	7,579
Chile	547	3,935	2,084	836
Colombia	1,221	6,531	25	24
Ecuador	784	259	.....	.....
Dutch Guiana	.....	64	.....	.....
Paraguay	.....	127	51	.....
Peru	6,133	220	177	8,635
Uruguay	3,231	668	225	231
Venezuela	.....	2,587	93	8,600
China	19,460	17,945	1,206	4,133
British India	21,440	26,349	4,684	113,411
Straits Settlements	.....	244	.....	.....
Other British East Indies	.....	54	.....	.....
Dutch East Indies	4,789	5,190	250	6,097
French East Indies	.....	.....	.....	125
Hongkong	1,198	180	1,258	303
Japan	123,536	133,725	101,919	146,894
Siam	.....	.....	12	.....
Turkey in Asia	.....	35	.....	.....
Australia	30,610	40,035	15,157	17,648
New Zealand	3,422	7,793	986	191
French Oceania	.....	.....	.....	965
Philippine Islands	8,186	2,938	438	1,750
Belgian Kongo	.....	.....	460	.....
British West Africa	25	.....	.....	.....
British South Africa	3,755	18,002	1,746	17,529
British East Africa	.....	.....	3,805	1,829
Canary Islands	.....	1,027	.....	.....
French Africa	.....	223	.....	.....
Kamerun, etc	250	34	.....	21
Portuguese Africa	300	270	144	.....
Egypt	6,236	177	.....	559
Total	846,583	1,127,297	395,903	1,134,940

Gilbert & Barker Make Changes in Personnel

The sales department of the Gilbert & Barker Manufacturing Co., of Springfield, Mass., has announced the following changes at various offices of the company: Mr. Crosier, assigned to Los Angeles from Denver; Mr. Coolbroth, from Little Rock, Ark., to Portland, Ore.; Mr. Chauncey, from San Franciso to factory at Springfield, Mass.; Mr. Flynn, from plant to San Francisco, and Mr. Farrell, from plant to Portland, Ore.

J. F. Hamblen, formerly of the New York City sales force, has been assigned to the Sacramento, Cal., office of the company.

S. J. Taylor, formerly in charge of the Sacramento, Cal., office, has been transferred to San Francisco.

O. J. Skinner, formerly of the Standard Oil Co. of California, has joined the San Francisco office of the Gilbert & Barker Manufacturing Co., of Springfield, Mass.

Catalogs Wanted

The Aws Manufacturing Co., 398 Harman St., Brooklyn, N. Y., would be pleased to receive catalogs from manufacturers of machinery and tools with special reference to the manufacture of low-pressure valves, non-ferrous foundry equipment; also other catalogs of engineering interest for its files.

Forthcoming Meetings

The American Railway Tool Foremen's Association will hold its annual meeting at the Hotel Sherman, Chicago, on Sept. 1 to 3.

The National Gas Engine Association, Monadnock Bldg., Chicago, Ill., will hold its thirteenth annual convention at the Congress Hotel, Chicago, on Sept. 1, 2 and 3.

The American Steel Treaters' Society and the Steel Treating Research Society will hold their second annual convention and exhibition at the Commercial Museum, Philadelphia, Pa., on Sept. 14 to 18, inclusive. J. A. Pollak, of the Pollak Steel Co., Cincinnati, Ohio, is secretary of the former society.

The National Safety Council, 168 North Michigan Ave., Chicago, Ill., will hold its ninth annual safety congress in Milwaukee on Sept. 27 to Oct. 1.

The American Foundrymen's Association will hold its annual convention and exhibit at Columbus, Ohio, on Oct. 4 to 9. C. E. Hoyt, 1401 Harris Trust Building, Chicago, Ill., is secretary.

An exposition of U. S. manufacturers at Buenos Aires, Argentine Republic, S. A., has been arranged for the month beginning Nov. 15. Information can be obtained from the American National Exhibition, Inc., Bush Terminal Sales Building, 132 West 42nd St., New York.

The National Machine Tool Builders' Association will hold its 19th annual Fall convention at the Hotel Astor, New York City, on Thursday and Friday, Dec. 2 and 3, 1920. C. Wood Walter, care of the association at Worcester, Mass., is secretary.

The 1920 annual meeting of the American Society of Mechanical Engineers will be held in the Engineering Societies Building, 29 West 39th Street, New York City, from Dec. 7 to Dec. 10.

Condensed-Clipping Index of Equipment

Patented Aug. 20, 1918

Sub Press, "U. S."

U. S. Tool Co., Inc., 51-53 Lawrence St., Newark, N. J.

"American Machinist," Aug. 12, 1920



These sub-presses are intended for accurate work under a press ram. Special presses are built to suit particular jobs, and stock ones are carried in a range of platen sizes from 2 x 3 in. to 6 x 8 in.

Welding Machine, Spot, Automatic, Channel, "Federal"

Federal Machine and Welder Co., Warren, Ohio

"American Machinist," Aug. 12, 1920

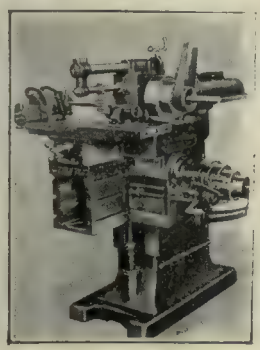


The machine is intended for welding together two steel channels to form an I-beam. Channels from 4 to 16 in. in depth can be handled, two spot welds from 4 to 12 in. apart being made simultaneously. A motor feeds the work at a speed of from 25 to 60 ft. per min. The machine is capable of welding two spots at a time on two pieces of material ½ in. thick at the rate of 60 welds per min. The welding current is controlled by auto transformers in the primary circuit in eight equal steps from 65 per cent to full line voltage, two 220-volt air-cooled transformers being provided. Copper disks are used to make the contact necessary for the secondary or welding current.

Milling Attachment, Shaper, "Tri-State"

Tri-State Milling Machine Co., Memphis, Tenn.

"American Machinist," Aug. 12, 1920



This milling attachment is intended for application to a shaper, it being mounted in the shaper ram-way after the ram has been moved back. The spindle is worm driven and is supported by a substantial overarm. The size and make of the shaper on which the attachment is to be used should be given when ordering. One arbor is furnished with the attachment. Diameter of cone pulley steps, 4, 6, 8 and 10 in. Table, 3 ft. long; mounted on swivel base. Crossfeed, 7 in.

Grinding Machine, Face, Extra-Heavy-Duty, "Diamond," 54-In.

Diamond Machine Co., 9 Codding St., Providence, R. I.

"American Machinist," Aug. 12, 1920



The machine is intended for heavier and larger work than any machines heretofore built of this type. A sectional-type grinding wheel is used, consisting of a number of abrasive blocks held in a chuck. The coolant tank is of large area, so that the necessary volume of coolant is of moderate depth, which facilitates the settling of sediment. Two sets of centralized controls are provided. The drive is by a motor mounted on the grinding wheel head, from which power is delivered to the spindle through a Morse silent chain. Spindle, 9 in. diameter. Grinding wheel, 54 in. diameter. Platen; width, 36 in.; longitudinal travel, 134 in. Speeds of table, 12, 17, 22, 28 ft. per min. Speed of grinding wheel, 324 r.p.m. Feeds, 0.002 to 0.20 in. per stroke of table. Motor, 100 hp. Approximate weight boxed for shipment, including motor, 35,000 lb.

Toolrack, "International"

International Purchasing Bureau, 203 East 15th St., New York, N. Y.

"American Machinist," Aug. 12, 1920



This rack or stand consists of cast-iron trays arranged to swivel. The small round tray at the top is intended to hold small tools such as micrometers.

Lathe, Turret, Hydraulic, "Moretti"

Alfred Herbert, Ltd., Coventry, Eng., and 54 Dey St., New York, N. Y.

"American Machinist," Aug. 19, 1920



The movements are operated hydraulically, the machine being intended for operation by disabled men. A minimum pressure of 75 lb. per square inch is required for operating the cross-slide, turret and chuck, the action of the actuating pistons being controlled by valves. The turret slide is provided with automatic stops. The drive is through a 3-step cone pulley. Swing over bed, 12 in. Bore of chuck, ¾ in. Turret; stroke, 3 in.; diameter, 5 in.; tool holes, 1 in. Range of feeds to cross and turret slides, ¾ to 80 in. per min. Floor space, 2 ft. x 5 ft. 8 in. Weight; net, 770 lb.; shipping, 1,000 lb. Cu.ft., 60.

Glue Pot, Electric, Dry-Type, "Westinghouse"

Westinghouse Electric and Manufacturing Co., East Pittsburgh, Pa.

"American Machinist," Aug. 19, 1920

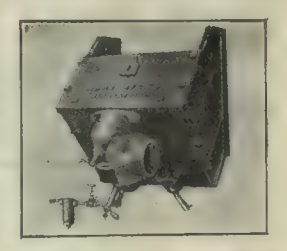


This is a two-quart size, electrically heated, dry-type glue pot, of the type described in the "American Machinist" of March 20, 1919. The time taken to heat the glue is approximately 15 minutes. Sizes made, 1 pint, 1, 2 and 4 quarts.

Calorizor, Oil or Gas, Industrial Furnace, "Mahr"

Mahr Manufacturing Co., Minneapolis, Minn.

"American Machinist," Aug. 19, 1920



This device is intended for attachment to industrial furnaces, it being a combination of oil atomizer and gassification and combustion chambers. It is made in angle and straight types. The former, which is illustrated, is recommended for moderate-temperature work, as in annealing furnaces and core ovens, and the latter type is for high-temperature work where a strong reducing action is required, as in drop-forging furnaces. Low-pressure air is used for both atomization and combustion, the pressure being not less than 8 oz. per square inch. Any grade of oil or gas can be used by making a slight change in the calorizor. There are three sizes, with oil-consumption capacities for the straight type of 5, 8 or 12 gal. per hour, and for the angle type of 4, 7 or 10 gal. per hour.

Clip, paste on 3 x 5-in. cards and file as desired

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Patented Aug. 20, 1918

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Griscom-Russell Co., 90 West St., New York, N. Y.
"American Machinist," Aug. 19, 1920



This device is intended for straining either oil, as in a lubricating, fuel or quenching oil system, or water, as on a supply line from a lake. The body of the strainer is cast iron and the strainer basket is perforated sheet steel, the basket being lined with wire mesh when the strainer is used on an oil line. The strainers are made with either screw or flange joints, for pressures up to 300 lb. per sq.in., and are furnished in a range of sizes to fit pipe from 1 to 6 in. in diameter, the smallest size weighing 15 lb. and the largest 550 lb. The strainer may be installed as a single unit or in a set, consisting of two strainers and two three-way valves with the necessary connections. The use of the set permits the cleaning of either of the two units without interruption of the service.

Lathe, Geared-Head, "Lo-Swing," 4-Inch
Fitchburg Machine Co., Fitchburg, Mass.
"American Machinist," Aug. 19, 1920



The machine is intended for shaft turning, it being fitted with two carriages, each carrying three tools and running on V's so located that the carriages can be run past the tailstock. The machine has a constant-speed drive and the speeds are controlled by the two upper levers on the headstock, while the feeds are controlled by the two lower levers. With the drive pulley running at 500 r.p.m., six speeds varying from 38 to 316 r.p.m. and nine feeds from 0.007 to 0.120 in. per rev. of the spindle are available. Flexible tubes carry coolant to the tools and to the tail center. The shipper rod runs the whole length of the machine. The lathe swings 4-in. in diameter and is made in three lengths to accommodate work up to 60, 80 or 108 in. between centers. The 60-in. lathe requires a floor space of 37½ x 123 inches.

Sander, Belt, Automatic-Stroke, "Mattison," No. 124
Mattison Machine Works, Rockford, Ill.
"American Machinist," Aug. 19, 1920



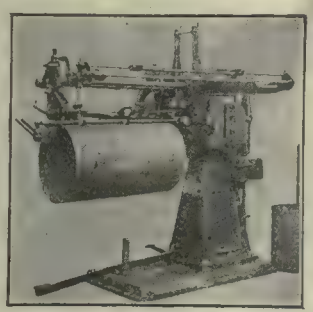
The machine is intended to eliminate hand-stroking by the use of a device which automatically presses the sand-belt against the surface being sanded. The columns of the machine are mounted on a cast-iron base, and a casting across the top carries all of the power-drive mechanism. At each end of the casting the heads for the sand-belt pulleys are mounted on ways to permit adjustment of the belt tension. The shoe for applying the sand-belt slides on a bar extending across the front of the machine, it being driven with a rapid reciprocating motion by a steel belt running over two flanged pulleys. The reciprocating parts are made of aluminum. The length of stroke can be varied to suit the work, and two speeds are provided for the shoe, which may be disconnected from the belt for hand-stroking. The work is carried on a light table mounted on ball-bearing rollers and adjustable for height.

Heater, Rivet, Electric, Portable, "A-1"
A-1 Manufacturing Co., Bradford, England
"American Machinist" (European Edition), July 3, 1920



The machine is intended for heating rivets, being made in four sizes from 10 to 30 kw. capacity. It has three independently operated sets of electrodes, so that three rivets can be heated simultaneously. No switch is employed, the circuit being closed by inserting a rivet between the electrodes, the bottom electrode of each pair being lowered for this purpose by means of the pedal. The machine requires no preliminary heating up, and the rivets are kept clean and free from scale. Flexible copper conductors join the electrodes and the transformer. Eight heating speeds are obtainable by the use of the plug box. The machine is portable, the tray being provided for carrying the rivets.

Welding Machine, Seam, Electric, "A-1"
A-1 Manufacturing Co., Bradford, England
"American Machinist" (European Edition), July 3, 1920



The machine is intended especially for welding longitudinal seams of drums as small as 9 in. in diameter, handling a total thickness of metal of $\frac{3}{32}$ in. Clamps hold the work in position on the long arm, stops being provided so as to insure alignment of the edges of the sheet. The lower arm has a copper-strip electrode and is water cooled. The upper electrode consists of a roller mounted on an arm, its motion being controlled by means of a pedal. An automatic trip is provided for the travel of the roller. By means of a plug box, eight heating speeds are obtainable. Drums welded on the machine can be corrugated or spun afterward.

Grinding Machine, Surface, "Armstrong-Whitworth"
Armstrong, Whitworth & Co., Ltd., Openshaw, Manchester, Eng.
"American Machinist" (European Edition), July 10, 1920



The machine is intended for plane grinding on work up to 24 in. long, 6½ in. wide and 9½ in. high. The abrasive wheel used is 7 in. in diameter, it being adjustable for height by means of a handwheel. The table is 57 x 8½ in. and has three T-slots. A vise having an opening of 2 in. is provided. The travel of the table is automatic, being controlled by dogs operating the reversing lever. The power crossfeed has an automatic trip. The machine weighs approximately 12½ cwt.

Control, Planer, Electric, "Thompson-Houston"
British Thompson-Houston Co., Ltd., Rugby, Eng.
"American Machinist" (European Edition), July 17, 1920



The device is intended for controlling the action of a planer table, starting, stopping, reversing and speed variation of the motor being automatically accomplished merely through the pressing of the control buttons. The control operates on the Ward-Leonard system, the driving motor being separately excited and having a variable voltage impressed across the armature terminals. The complete equipment consists of a motor-generator set, variable-speed reversible driving motor, rheostats, master controller for table motion, automatic contactor equipment, control gear for the motor-generator set, limit switch to open contactors and apply dynamic braking in case of over-run of the table, and push-button stations. Different arrangements for mounting the motors and equipment can be provided.

Holder, Die-Head, Elevating, "Herbert"
Alfred Herbert, Ltd., Coventry, Eng.
"American Machinist" (European Edition), July 17, 1920



This die-head holder is intended for use on the No. 4 capstan lathe when it is desired to thread work larger than 1 in. in diameter. The ordinary 1¼-in. die-head is too large to allow of rotating the turret, the purpose of the holder being to raise the head so that the turret may be swung. The slide carrying the head is raised by means of an eccentric operated by the handle at the top of the holder. A stop limits the downward travel of the slide.

Clip, paste on 3 x 5-in. cards and file as desired

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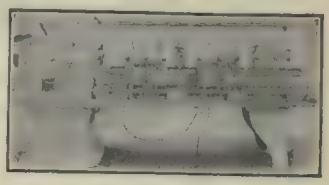
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Fitchburg Machine Co., Fitchburg, Mass.
"American Machinist," Aug. 19, 1920



The machine is intended for shaft turning, it being fitted with two carriages, each carrying three tools and running on V's so located that the carriages can be run past the tailstock. The machine has a constant-speed drive and the speeds are controlled by the two upper levers on the headstock, while the feeds are controlled by the two lower levers. With the drive pulley running at 500 r.p.m., six speeds varying from 38 to 316 r.p.m. and nine feeds from 0.007 to 0.120 in. per rev. of the spindle are available. Flexible tubes carry coolant to the tools and to the tail center. The shipper rod runs the whole length of the machine. The lathe swings 4-in. in diameter and is made in three lengths to accommodate work up to 60, 80 or 108 in. between centers. The 60-in. lathe requires a floor space of 37½ x 123 inches.

Sander, Belt, Automatic-Stroke, "Mattison," No. 124
Mattison Machine Works, Rockford, Ill.
"American Machinist," Aug. 19, 1920



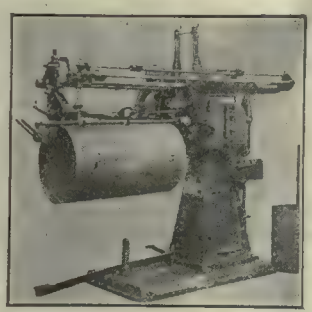
The machine is intended to eliminate hand-stroking by the use of a device which automatically presses the sand-belt against the surface being sanded. The columns of the machine are mounted on a cast-iron base, and a casting across the top carries all of the power-drive mechanism. At each end of the casting the heads for the sand-belt pulleys are mounted on ways to permit adjustment of the belt tension. The shoe for applying the sand-belt slides on a bar extending across the front of the machine, it being driven with a rapid reciprocating motion by a steel belt running over two flanged pulleys. The reciprocating parts are made of aluminum. The length of stroke can be varied to suit the work, and two speeds are provided for the shoe, which may be disconnected from the belt for hand-stroking. The work is carried on a light table mounted on ball-bearing rollers and adjustable for height.

Heater, Rivet, Electric, Portable, "A-1"
A-1 Manufacturing Co., Bradford, England
"American Machinist" (European Edition), July 3, 1920



The machine is intended for heating rivets, being made in four sizes from 10 to 30 kw. capacity. It has three independently operated sets of electrodes, so that three rivets can be heated simultaneously. No switch is employed, the circuit being closed by inserting a rivet between the electrodes, the bottom electrode of each pair being lowered for this purpose by means of the pedal. The machine requires no preliminary heating up, and the rivets are kept clean and free from scale. Flexible copper conductors join the electrodes and the transformer. Eight heating speeds are obtainable by the use of the plug box. The machine is portable, the tray being provided for carrying the rivets.

Welding Machine, Seam, Electric, "A-1"
A-1 Manufacturing Co., Bradford, England
"American Machinist" (European Edition), July 3, 1920



The machine is intended especially for welding longitudinal seams of drums as small as 9 in. in diameter, handling a total thickness of metal of ⅜ in. Clamps hold the work in position on the long arm, stops being provided so as to insure alignment of the edges of the sheet. The lower arm has a copper-strip electrode and is water cooled. The upper electrode consists of a roller mounted on an arm, its motion being controlled by means of a pedal. An automatic trip is provided for the travel of the roller. By means of a plug box, eight heating speeds are obtainable. Drums welded on the machine can be corrugated or spun afterward.

Grinding Machine, Surface, "Armstrong-Whitworth"
Armstrong, Whitworth & Co., Ltd., Openshaw, Manchester, Eng.
"American Machinist" (European Edition), July 10, 1920



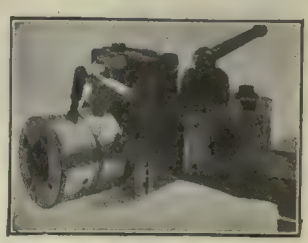
The machine is intended for plane grinding on work up to 24 in. long, 6½ in. wide and 9½ in. high. The abrasive wheel used is 7 in. in diameter, it being adjustable for height by means of a handwheel. The table is 57 x 8½ in. and has three T-slots. A vise having an opening of 2 in. is provided. The travel of the table is automatic, being controlled by dogs operating the reversing lever. The power crossfeed has an automatic trip. The machine weighs approximately 12½ cwt.

Control, Planer, Electric, "Thompson-Houston"
British Thompson-Houston Co., Ltd., Rugby, Eng.
"American Machinist" (European Edition), July 17, 1920



The device is intended for controlling the action of a planer table, starting, stopping, reversing and speed variation of the motor being automatically accomplished merely through the pressing of the control buttons. The control operates on the Ward-Leonard system, the driving motor being separately excited and having a variable voltage impressed across the armature terminals. The complete equipment consists of a motor-generator set, variable-speed reversible driving motor, rheostats, master controller for table motion, automatic contactor equipment, control gear for the motor-generator set, limit switch to open contactors and apply dynamic braking in case of over-run of the table, and push-button stations. Different arrangements for mounting the motors and equipment can be provided.

Holder, Die-Head, Elevating, "Herbert"
Alfred Herbert, Ltd., Coventry, Eng.
"American Machinist" (European Edition), July 17, 1920



This die-head holder is intended for use on the No. 4 capstan lathe when it is desired to thread work larger than 1 in. in diameter. The ordinary 1¼-in. die-head is too large to allow of rotating the turret, the purpose of the holder being to raise the head so that the turret may be swung. The slide carrying the head is raised by means of an eccentric operated by the handle at the top of the holder. A stop limits the downward travel of the slide.

Clip, paste on 3 x 5-in. cards and file as desired



THE WEEKLY PRICE GUIDE

IRON AND STEEL

PIG IRON—Quotations compiled by The Matthew Addy Co.:

CINCINNATI	Current	One Year Ago
No. 2 Southern	$45.60	$29.80
Northern Basic	44.80	27.55
Southern Ohio No. 2	46.80	28.55
NEW YORK—TIDEWATER DELIVERY		
2X Virginia (Silicon 2.25 to 2.75)	52.65	31.90
Southern No. 2 (Silicon 2.25 to 2.75)	50.70	33.95
BIRMINGHAM		
No. 2 Foundry	42.00@44.00	25.75
PHILADELPHIA		
Eastern Pa., No. 2x, 2.25-2.75 sil.	47.00@49.50*	30.65
Virginia No. 2	47.00*	30.85
Basic	44.50†	29.90
Grey Forge	43.50*	29.90
CHICAGO		
No. 2 Foundry local	46.00	27.25
No. 2 Foundry, Southern	48.70	31.75
PITTSBURGH, INCLUDING FREIGHT CHARGE FROM VALLEY		
No. 2 Foundry	45.65	28.15
Basic	46.00	27.15
Bessemer	46.00@47.00	29.35
MONTREAL		
Silicon 2.25 to 2.75%	43.25	.....

* F.o.b. furnace. † Delivered.

STEEL SHAPES—The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses at the cities named:

	New York			Cleveland		Chicago	
	Current	One Month Ago	One Year Ago	Current	One Year Ago	Current	One Year Ago
Structural shapes	$4.47	$3.97	$3.47	$5.00	$3.37	$3.97	$3.47
Soft steel bars	4.62	4.12	3.37	4.50	3.27	3.87	3.37
Soft steel bar shapes	4.62	4.12	3.37	....	3.27	3.87	3.37
Soft steel bands	6.32	5.32	4.07	6.25	....	....	....
Plates, ¼ to 1 in. thick	4.67	4.17	3.67	4.50	3.57	4.17	3.67

BAR IRON—Prices per 100 lb. at the places named are as follows:

	Current	One Year Ago
Mill, Pittsburgh	$4.25	$2.62
Warehouse, New York	4.57	3.37
Warehouse, Cleveland	3.52	3.22
Warehouse, Chicago	3.75	3.37

SHEETS—Quotations are in cents per pound in various cities from warehouse; also the base quotations from mill:

Blue Annealed	Large Mill Lots Pittsburgh	New York Current	New York One Year Ago	Cleveland	Chicago
No. 10	3.55-7.00	7.12@8.00	4.57	8.10	7.02
No. 12	3.60-7.05	7.17@8.05	4.57	8.15	7.07
No. 14	3.65-7.10	7.22@8.10	4.67	8.20	7.12
No. 16	3.75-7.20	7.32@8.20	4.77	8.30	7.22
Black					
Nos. 18 and 20	4.20-6.20	8 30@ 9.80	5.30	8.70	7.80
Nos. 22 and 24	4.25-6.25	8.35@ 9.85	5.35	8.75	7.85
No. 26	4.30-6.30	8.40@ 9.90	5.40	8.80	7.90
No. 28	4.35-6.35	8 50@10.00	5.50	8.90	8.00
Galvanized					
No. 10	4.70-8.00	8 80@11.50	6.20	9.00	8.15
No. 12	4.80-8.10	8.90@11.50	6.25	9.10	8.20
No. 14	4.80-8.10	8.90@11.60	6.30	9.10	8.35
Nos. 18 and 20	5.10-8.40	9.15@11.90	6.60	9.40	8.65
Nos. 22 and 24	5.25-8.55	9.30@12.05	6.75	9.55	9.05
No. 26	5.40-8.70	9.45@12.20	6.90	9.70	9.20
No. 28	5.70-9.00	9.75@12.50	7 20	10.00	9.50

Acute scarcity in sheets, particularly black, galvanized and No. 16 blue enameled.

Automobile sheets are unavailable except in fugitive instances, when prices are 9.45c per lb. for No. 16; 9.50 for Nos. 18 and 20, and 9.55c for Nos 22 and 24.

COLD FINISHED STEEL—Warehouse prices are as follows:

	New York	Chicago	Cleveland
Round shafting or screw stock, per 100 lb. base	$6.25	$5.80	$6.00
Flats, square and hexagons, per 100 lb. base	6.75	6.30	6.50

DRILL ROD—Discounts from list price are as follows at the places named:

	Per Cent.
New York	50
Cleveland	50
Chicago	50

NICKEL AND MONEL METAL—Base prices in cents per pound F.O.B. Bayonne, N. J.

Nickel	
Ingot and shot	43
Electrolytic	45

Monel Metal			
Shot and blocks	35	Hot rolled rods (base)	40
Ingots	38	Cold rolled rods (base)	56
Sheet bars	40	Hot rolled sheets (base)	55

Special Nickel and Alloys	
Malleable nickel ingots	45
Malleable nickel sheet bars	47
Hot rolled rods, Grades "A" and "C" (base)	60
Cold drawn rods, grades "A" and "C" (base)	72
Copper nickel ingots	42
Hot rolled copper nickel rods (base)	52
Manganese nickel hot rolled (base) rods "D"—low manganese	64
Manganese nickel hot rolled (base) rods "D"—high manganese	67

Domestic Welding Material (Swedish Analysis)—Welding wire in 100-lb lots sells as follows, f. o. b. New York: ⅛, 8½c. per lb.; ¼, 8c.; ⅝ to ½, 7½c. Domestic iron sells at 12c. per lb.

MISCELLANEOUS STEEL—The following quotations in cents per pound are from warehouse at the places named:

	New York Current	Cleveland Current	Chicago Current
Openhearth spring steel (heavy)	7.00	8.00	9.00
Spring steel (light)	10.00	11.00	12.25
Coppered bessemer rods	9.00	8.00	6.75
Hoop steel	6.57	6.50	5.32
Cold-rolled strip steel	12.50	8.25	10.75
Floor plates	6.80	6.00	6.77

PIPE—The following discounts are to jobbers for carload lots on the Pittsburgh basing card, discounts on steel pipe, applying as from January 14, 1920, and on iron pipe from January 7, 1920.

Inches	Steel Black	Steel Galvanized	Inches	Iron Black	Iron Galvanized
BUTT WELD					
⅜ to 3	54–57½%	41½–44%	⅜ to 1½	24½–34½%	8 –18½%
LAP WELD					
2	47 –50½%	34½–38%	1¼	.....	.....
2½ to 6	50 –53½%	37½–41%	1½	.....	.....
7 to 12	47 –50½%	33½–37%	2	20½–28½%	6½–14½%
13 to 14	37½–41 %	.....	4½ to 6	22½–30½%	9½–17½%
15	35 –38½%	.....	2½ to 4	22½–30½%	9½–17½%
			7 to 12	19½–27½%	6½–14½%
BUTT WELD, EXTRA STRONG PLAIN ENDS					
⅜ to 1½	52 –55½%	39½–43%	⅜ to 1½	24½–34½%	9½–19½%
2 to 3	53 –56½%	40½–44%			
LAP WELD, EXTRA STRONG PLAIN ENDS					
2	45 –48½%	33½–37%	1¼	.....	.....
2½ to 4	48 –51½%	36½–40%	1½	.....	.....
4½ to 6	47 –50½%	35½–39%	2	21½–29½%	8½–16½%
7 to 8	43 –46½%	29½–33%	2½ to 4	23½–31½%	11½–19½%
9 to 12	38 –41½%	24½–28%	4½ to 6	22½–30½%	10½–18½%
			7 to 8	14½–22½%	2½–10½%
			9 to 12	9½–17½%	5½–+2½%

	New York Black	New York Galv.	Cleveland Black	Cleveland Galv.	Chicago Black	Chicago Galv.
⅜ to 3 in. steel butt welded	40%	24%	40%	31%	54%40%	40@30 %
2½ to 6 in. steel lap welded	35%	20%	42%	27%	50@40%	37½@27½%

Malleable fittings. Classes B and C, banded, from New York stock sell at plus 32%. Cast iron, standard sizes, net.

METALS

MISCELLANEOUS METALS—Present and past New York quotations in cents per pound, in carload lots:

	Current	Month Ago	Year Ago
Copper, electrolytic	19.00	19.25	21.75
Tin in 5-ton lots	49.00	61.50	70.00
Lead	9.50	9.00	5.50
Zinc	8.35	8.70	8.00
ST. LOUIS			
Lead	8.90	8.87½	5.25
Zinc	7.70@8.40	8.37½	7.65

At the places named, the following prices in cents per pound prevail, for 1 ton or more:

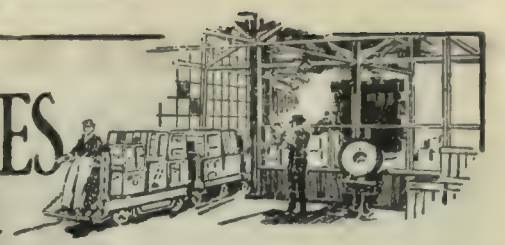
	New York Current	New York Month Ago	New York Year Ago	Cleveland Current	Cleveland Year Ago	Chicago Current	Chicago Year Ago
Copper sheets, base	33.50	33.50	29.50	34.00	33.50	36.00	36.50
Copper wire (carload lots)	31.25	31.25	26.50	29.00	29.50	27.00	25.00
Brass sheets	28.50	28.50	23.00	36.00	29.00	27.00	28.00
Brass pipe	33.00	33.00	34.00	34.00	36.00	35.00	37.00
Solder (half and half) (case lots)	38.00	33.00	45.00	40.50	41.00	38.00	41.00

Copper sheets quoted above hot rolled 16 oz., cold rolled 14 oz. and heavier, add 2c.; polished takes 5c. per sq.ft. extra for 20-in. widths and under; over 20 in., 7½c.

BRASS RODS—The following quotations are for large lots, mill. 100 lb. and over, warehouse; net extra:

	Current	One Year Ago
Mill	25.00	19.00
New York	27.00	21.50
Cleveland	27.00	30.00
Chicago	29.00	30.00

SHOP MATERIALS AND SUPPLIES



ZINC SHEETS—The following prices in cents per pound are f.o.b. mill less 8% for carload lots..... 12.50

	Warehouse			
	In Casks		Broken Lots	
	Current	One Year Ago	Current	One Year Ago
Cleveland	15.00	12.50	15.50	13.00
New York	14.00	11.50	14.50	12.50
Chicago	15.00	16.50	15.00	16.00

ANTIMONY—Chinese and Japanese brands in cents per pound, in ton lots for spot delivery, duty paid:

	Current	One Year Ago
New York	7.50	9.50
Chicago	7.75	10.25

OLD METALS—The following are the dealers' purchasing prices in cents per pound:

	New York			
	Current	One Year Ago	Cleveland	Chicago
Copper, heavy, and crucible	16.25	17.00	15.00	15.50
Copper, heavy, and wire	15.25-15.75	16.00	14.50	15.00
Copper, light, and bottoms	13.00	14.00	13.00	14.00
Lead, heavy	7.25	4.75	7.00	7.50
Lead, tea	5.00	3.75	4.50	6.00
Brass, heavy	10.25	10.50	11.00	15.50
Brass, light	7.75- 8.00	7.50	8.00	9.50
No. 1 yellow brass turnings	9.00- 9.50	10.00	8.50	9.50
Zinc	5.25	5.00	4.50	5.50

ALUMINUM—The following prices are from warehouse at places named:

	New York	Cleveland	Chicago
No. 1 aluminum, 98 to 99% pure, in ingots for remelting (1-15 ton lots), per lb	$33.00	$33.00	$33.50

COPPER BARS—From warehouse sell as follows in cents per pound, for ton lots and over:

	Current	One Year Ago
New York (round)	38.00	33.00
Chicago	29.00	31.00
Cleveland	34.00	35.00

BABBITT METAL—Warehouse price per pound:

	New York		Cleveland		Chicago	
	Current	One Year Ago	Current	One Year Ago	Current	One Year Ago
Best grade	90.00	90.00	60.50	75.00	60.00	60.00
Commercial	50.00	50.50	21.00	16.50	15.00	13.00

SHOP SUPPLIES

NUTS—From warehouse at the places named, on fair-sized orders, the following amount is deducted from list:

	New York		Cleveland		Chicago	
	Current	One Year Ago	Current	One Year Ago	Current	One Year Ago
Hot pressed square	+ $6.00	$1.50	$ .50	$2.25	List	1.85
Hot pressed hexagon	+ 6.00	1.50	.50	2.25	List	1.85
Cold punched hexagon	+ 6.00	1.50	.50	2.25	List	1.30
Cold punched square	+ 6.00	1.50	.50	2.25	List	1.30

Semi-finished nuts, ⅝ and smaller, sell at the following discounts from list price:

	Current	One Year Ago
New York	30%	50-10%
Chicago	50%	50%
Cleveland	50%	60-10-10%

MACHINE BOLTS—Warehouse discounts in the following cities:

	New York	Cleveland	Chicago
½ by 4 in. and smaller	+ 20%	20%	20%
Larger and longer up to 1½ in. by 30 in.	+ 20%	20%	10%

WASHERS—From warehouses at the places named the following amount is deducted from list price:

For wrought-iron washers:

New York..... list Cleveland..... $2.50 Chicago..... $3.00

For cast-iron washers, ⅜ and larger, the base price per 100 lb. is as follows:

New York..... $7.00 Cleveland..... $4.50 Chicago..... $4.75

CARRIAGE BOLTS—From warehouses at the places named the following discounts from list are in effect:

	New York	Cleveland	Chicago
½ by 6 in. and smaller	+ 20%	35%	10%
Larger and longer up to 1 in. by 30 in.	+ 20%	20%	5%

COPPER RIVETS AND BURS sell at the following rate from warehouse:

	Rivets		Burs	
	Current	One Year Ago	Current	One Year Ago
Cleveland	20%	20%	10%	10%
Chicago	net	20%	net	20%
New York	25%	40%	net	20%

RIVETS—The following quotations are allowed for fair-sized orders from warehouse:

	New York	Cleveland	Chicago
Steel ⅜ and smaller	List Net	40%	30%
Tinned	List Net	40%	30%

Boiler, ¼, ⅜, 1 in. diameter by 2 to 5 in. sell as follows per 100 lb.:

New York..... $6.00 Chicago..... $5.62 Pittsburgh..... $4.5

Structural, same sizes:

New York..... $7.10 Chicago..... $5.72 Pittsburgh..... $4.60

MISCELLANEOUS

SEAMLESS DRAWN TUBING—The base price in cents per pound from warehouse in 100-lb. lots is as follows:

	New York	Cleveland	Chicago
Copper	$34 00	$36.00	$35.00
Brass	33.00	36.00	34.00

The prices, of course, vary with the quantity purchased. For lots of less than 100 lb., but not less than 75 lb., the advance is 1 c.; for lots of less than 75 lb., but not less than 50 lb., 2½c. over base (100-lb. lots); less than 50 lb., but not less than 25 lb., 5c. should be added to base price; quantities from 10-25 lb., extra is 10c.; less than 10 lb., add 15-20c.

Double above extras will be charged for angles, channels and sheet metal mouldings if ordered in above quantities. Above extras also apply to brass rod other than standard stock sizes—stock sizes being considered as ¼-2 in. inclusive in rounds, and ¼-1½ in., inclusive, in square and hexagon—all varying by thirty seconds up to 1 in. by sixteenths over 1 in. On shipments aggregating less than 100 lb., there is usually a boxing charge of $1.50.

LONG TERNE PLATE—In Chicago No. 28 primes from stock sell, nominally, for $12.50 per 100 lbs.

In Cleveland—$10 per 100 lbs.

COTTON WASTE—The following prices are in cents per pound:

	New York		Cleveland	Chicago
	Current	One Year Ago		
White	15.00@17.00	13.00	16.00	11.00 to 14.00
Colored mixed	9.00@14.00	9.00-12.00	12.00	9.50 to 12.00

WIPING CLOTHS—Jobbers' price per 1000 is as follows:

	13½x13½	13½x20½
Cleveland	55.00	65.00
Chicago	41.00	43.50

SAL SODA sells as follows per 100 lb.:

	Current	One Month Ago	One Year Ago
New York	$2.00	$3.00	$1.75
Philadelphia	2.75	2.75	1.75
Cleveland	3.00	2.50	2.75
Chicago	2.75	2.50	2.00

ROLL SULPHUR in 360-lb. bbl. sells as follows per 100 lb.:

	Current	One Month Ago	One Year Ago
New York	$3.90	$3.90	$3.65
Philadelphia	3.65	3.65	3.62
Chicago	4.10	5.00	4.12½

COKE—The following are prices per net ton at ovens, Connellsville:

	August 30	August 23	August 16
Prompt furnace	$17.00@$18.00	$17.00@$18.00	$17.00@$18.00
Prompt foundry	18.00@ 20.00	18.00@ 20.00	18.00@ 20.00

FIRE CLAY—The following prices prevail:

		Current
Ottawa, bulk in carloads	Per Ton	$8.00
Cleveland	100-lb. bag	1.00

LINSEED OIL—These prices are per gallon:

	New York		Cleveland		Chicago	
	Current	One Year Ago	Current	One Year Ago	Current	One Year Ago
Raw in barrels, (5 bbl. lots	$1.48	$2.25	$1.86	$2.15	$1.67	$2.48
5-gal cans, (without cans)	1.51*	2.40	2.15	2.40	1.92	2.68

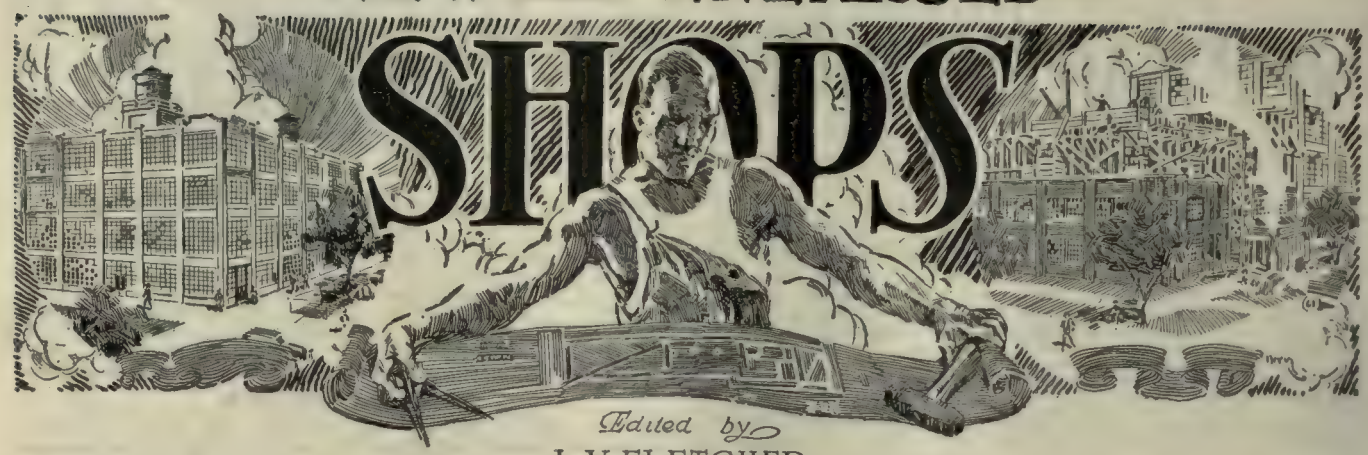
*To this *oil* price must be added the cost of the cans (returnable), which is $2.25 for a case of six.

WHITE AND RED LEAD—Base price per pound:

	Red				White	
	Current		One Year Ago		Current	One Year Ago
	Dry	In Oil	Dry	In Oil	Dry and In Oil	Dry and In Oil
100 lb. keg	15.50	17.00	13.00	14.50	15.50	13 00
25 and 50-lb. kegs	15.75	17.25	13.25	14.75	15.75	13 25
12½-lb. keg	16.00	17.50	13.50	15.00	16.00	13.50
5-lb. cans	18 50	20.00	15.00	16.50	18.50	15.00
1-lb. cans	20.50	22.00	16 00	17.50	20.50	16 00

500 lb. lots less 10% discount. 2000 lb. lots less 10-2½% discount.

NEW and ENLARGED



Edited by
L·V·FLETCHER

Machine Tools Wanted

If in need of machine tools send us a list for publication in this column

Conn., Hartford—B. Martoocchio, 194 Copen St.—garage equipment.

Mass., Boston—The Boston Elevated Ry., 108 Massachusetts Ave., E. Mahler, Purch. Agt.—garage repair shop equipment.

Mass., Springfield—T. E. King, 107 Mulberry St.—garage equipment.

Vt., Hyde Park—The Belvidere Lumber Co.—heavy hand saw-rig, with 10-in. blades, right-hand make, complete (used).

Md., Baltimore—The Maryland Motor Car Co., 631 Munsey Bldg.—several internal grinding machines.

N. J., Atlantic City—The Roberts Mfg. Co., Hotel Belfort, 106 South Tennessee Ave.—power punches and foundry machinery for Tuckahoe, N. J., plant.

N. Y., Albany—The Federal Signal Co., Troy Rd.—miscellaneous machine tool equipment.

N. Y., New York (Borough of Manhattan)—The Equitable Motor Truck Co., 335 East 97th St.—presses, lathes and drills.

N. Y., Schenectady—The General Electric Co., River Rd.—one 20 in. upright drill with 2⅝ in. drill head and arranged for gear or belted motor drive.

Pa., Philadelphia—A. Box & Co., 1813 North Front St.—30-ton forcing press.

Pa., Philadelphia—The Dodge Steel Co., Morris Bldg.—Manning, Maxwell & Moore cold cut saw.

Pa., Philadelphia—J. G. Duncan Co., 1228 Race St.—garage equipment.

Pa., Philadelphia—J. Hiller, 1307 Stephen Girard Bldg.—heavy duty drill presses.

Pa., Philadelphia—The McCaffrey File Co., 5th and Berks Sts.—garage equipment.

Pa., Philadelphia—The National Umbrella Frame Co., 30th and Thompson Sts.—machine shop equipment.

Pa., Philadelphia—The Wright Roller Bearing Co., 20th and Indiana Sts.—Luster inspection tools.

Pa., Reading—The Reading Steel Casting Co.—machine tool equipment.

Pa., Scranton—S. Mintz, 404 Penn Ave.—one power press, equivalent to No. 72 B Toledo press (used).

La., New Orleans—The Motor Car Service Co., 1423 Canal St.—16-in. lathe.

La., New Orleans—I. Solomon, 1004 Pondras St.—lathe, striking tools, side cutters, cutting pliers.

Ill., Freeport—Hoefer Paper Co.—one No. 1 Fairwell gear hobber.

Mich., Ann Arbor—The Merco Engineering Co., P. C. Haas, Purch. Agt.—power punches, lathes, boring mills, one sawing machine, one mill cutter and vises.

O., Elyria—The H. and T. Spring Co., B. C. Heacock, Purch. Agt.—lathe, press, cutters, etc.

Wis., Milwaukee—The Milwaukee Ice Machine Co., 1001 Cold Spring Ave.—additional machine tools for manufacture of ice machines at its West Allis plant.

Wis., Milwaukee—S. K. Williams, 412 Montgomery Bldg.—one planer.

Wis., Racine—The perfex Radiator Co., 11th and Holmes Sts., back geared press with 5 or 6-in. stroke, similar to No. 75 Toledo or No. 6 Niagara.

Minn., Hancock—K. M. Knudsen—watchmakers lathe and instruments.

Mo., St. Louis—The Bowen Motor Ry. Co., Title Guarantee Bldg.—cranes, lathes, punches, planers, presses and small pneumatic tools.

Machinery Wanted

Conn., Middletown—A. Brazos & Sons, Inc., 68 Oak St.—Lane saw mill.

N. H., Franklin—H. L. Powell—light portable steam sawmill complete.

Md., Baltimore—The People's System of Bakeries, 106 North Charles St.—prices on bakery machinery, including moulders, proofers, etc.

N. Y., Astoria—The Astoria Silk Wks., 727 Steinway Ave.—weaving machinery for new mill at Cold Spring, N. Y.

Pa., New Castle—The Bd. of Educ.—work benches and machinery for manual training department.

Ill., Chicago—The Illinois Malleable Iron Co., 1801 Diversy Blvd.—one 10-ton traveling crane.

Ill., Decatur—The U. S. Wire Mat Co., 260 East Wood St.—woodworking machinery for turning handles.

Ind., Bedford—The Bedford Steel & Constr. Co., engrs., Bedford—catalogues on canning machinery and conveying systems.

Mich., Alma—F. W. Ruggles—special machinery for the manufacture of motor trucks, including lathes, presses and planers for plant in London, Ont.

Wis., Medford—The Northern Specialties Co., E. M. White, Purch. Agt.—woodworking machinery.

Wis., Milwaukee—The Milwaukee Grey Iron Fdry. Co.—T. Bentley, 609 Majestic Bldg.—mono rail crane.

Wis., Neenah—The Kimberly Clark Co.—traveling crane for Canada branch.

Minn., Minneapolis—The Franklin Co-operative Creamery Co., 26th St. and Franklin Ave.—$25,000 worth of power and refrigerating machinery.

Ont., Listowel—M. I. Adolph—complete machinery equipment for the manufacture of oil engines and farm power machinery.

Ont., Watford—The Andrews Wire Co., Wall St.—special machinery for manufacturing all kinds of wire products.

Metal Working

NEW ENGLAND STATES

Conn., Hartford—The S. K. F. Ball Bearing Co., 30 New Park Ave., has awarded the contract for the construction of a 1 story, 77 x 200 ft. factory. Estimated cost, $75,000.

Conn., Hartford—P. Ballotti & Son, 26 State St., will soon award the contract for the construction of a 1 story, 50 x 60 ft. garage on Otis St. Estimated cost, $10,000.

Conn., Hartford—B. Martoocchio, 194 Copen St., will build a 1 story, 50 x 50 ft. garage. Estimated cost, $10,000.

Conn., New Britain—The B. Jahn Mfg. Co., 6 Chestnut St., will soon award the contract for the construction of a 2 story, 40 x 150 ft. factory on Cherry and Ellis Sts. for the manufacture of dies, tools, etc. Estimated cost, $50,000. Noted July 10.

Conn., New London—F. Prottas, 317 Williams St., plans to build a 1 story garage at Ocean Beach. Estimated cost, $20,000.

Conn., Plantsville—The Atwater Mfg. Co. has awarded the contract for the construction of a 2 story, 62 x 80 ft. machine shop. Estimated cost, $50,000.

Conn., Portland—The Portland Fdry. Co., Freestone St., has awarded the contract for the construction of a 2 story, 40 x 50 ft. foundry addition at plant, here. Estimated cost, $50,000.

Conn., Waterbury—The Lux Clock Mfg. Co., 105 Sperry St., plans to build a 4 story factory. Private plans.

Conn., Waterbury—The Maltby Garage, 33 Union St., has awarded the contract for the construction of a 1 story, 65 x 200 ft. garage on East Main St. Estimated cost, $50,000.

Me., Biddeford—Cleaves & Sawyer, Saco, Me., have awarded the contract for the construction of a 1 story, 60 x 110 ft. garage on Elm St., here. Estimated cost, $25,000.

Mass., Holyoke—N. Robert, 72 Center St., has awarded the contract for the construction of a 1 story addition to his garage. Estimated cost, $12,000.

Mass., Mattapan (Boston P. O.)—J. Barrett, c/o A. D. Boyle, archt., 498 Norfolk St., will soon award the contract for the construction of a 1 story addition to his garage on Milton St. Estimated cost, $15,000.

Mass., Peabody—The A. C. Lawrence Leather Co., 161 South St., Boston, has awarded the contract for the construction of a 1 story, 70 x 70 ft. garage at plant. Estimated cost, $50,000.

Mass., Pittsfield—The General Electric Co. plans to build a 5 story, 70 x 400 ft. factory addition. M. M. Throne, care of owner, Engr.

Mass., South Hanover—R. C. Waterman Co., 101 Milk St., Boston, has awarded the contract for the construction of a 1 story factory. Estimated cost, $70,000.

Mass., Springfield—The Armory Square Realty Trust, 274 Main St., will build a 1 story, 80 x 125 ft garage on North Main St. Estimated cost, $75,000.

Mass., Springfield — J. Freedman, 80 Greenwood St., will soon award the contract for the construction of a 1 story, 85 x 170 ft. garage on Church St. Estimated cost, $25,000. J. W. Foster, 38 Stockman St., Archt.

Mass., Springfield—A. A. Geisel, 111 Magnolia Terrace, has awarded the contract for the construction of a 1 story, 60 x 120 ft. factory on Pecousic St., for the manufacture of motor truck parts. Estimated cost, $40,000.

Mass., Springfield—T. E. King, 107 Mulberry St., has awarded the contract for the construction of a 1 story, 70 x 100 ft. garage. Estimated cost, $15,000.

Mass., Springfield—The New York, New Haven & Hartford R.R., Meadow St., New Haven, Conn., has awarded the contract for improvements to its machine shops, etc., at freight yard on Water St., here. Estimated cost, $25,000.

Mass., West Springfield (Springfield P. O.)—The Springfield Automatic Screw Machine Corp. will soon award the contract for the construction of a 2 story factory. Estimated cost, $200,000. McClintock & Craig, 33 Lyman St., Springfield, Archts.

Mass., Worcester—H. Glick, 36 Portland St., plans to build a 2 story, 60 x 135 ft. garage addition. Estimated cost, $80,000. E. T. Chapin, 310 Main St., Archt.

MIDDLE ATLANTIC STATES

Maryland, Baltimore.—The Amer. Can Co., 120 Bway, New York City, plans to build a factory, here. Estimated cost, $500,000.

Md., Frederick—The Frederick Furniture Co., 43 Patrick St., will remodel a building and use same for the manufacture of furniture.

Md., Salisbury—W. F. Messick Ice Co. plans to establish a plant with 30 ton daily capacity and 3,000 ton storage capacity.

N. J., Hoboken—J. Paul plans to build a garage and show room at 6th and Washington Sts. Estimated cost, $45,000.

N. J., Homestead—The Amer. Chocolate Products Co., 206 Bway., New York City, will soon award the contract for the construction of a 5 story, 85 x 205 ft. factory at plant here. Estimated cost, $350,000. Andrews, Tower & Lavalee, 33 Lyman St., Springfield, Mass., Engrs. and Archts.

N. J., Trenton—The Amer. Bridge Co. is building a 60 x 221 ft. templet shop, 195 x 605 ft. main bridge shop, 78 x 198 ft. blacksmith shop and a 34 x 122 ft. paint shop. Estimated cost, $2,000,000.

N. J., Trenton—The Puritan Rubber Mfg. Co., Perrine Ave., will build a plant. Estimated cost, $7,000.

N. Y., New York (Borough of Brooklyn)—G. Simonelli, c/o G. Erda, Archt., 728 Manhattan Ave., will build a 1 story, 100 x 140 ft. garage on Morgan Ave. Estimated cost, $35,000.

N. Y., New York (Borough of Brooklyn)—J. Riley, care of H. Holder, archt., 242 Franklin Ave., will soon award the contract for the construction of a 1 story, 100 x 250 ft. foundry on Columbia St. Estimated cost, $250,000.

N. Y., New York (Borough of Brooklyn)—Charlotte Pl. Corp., c/o Shampan & Shampan, Engrs., 50 Court St., will build a 1 story, 90 x 100 ft. garage on Covert St. Estimated cost, $45,000.

N. Y., New York (Borough of Brooklyn)—J. F. Trommer Co., Inc., 1632 Bushwick Ave., will build a 2 story, 40 x 180 ft. garage. Estimated cost, $90,000.

N. Y., New York (Borough of Manhattan)—Dunnellen Constr. Co., 362 West 23rd St., will build a 1 story garage at 662 11th Ave. Estimated cost, $25,000.

N. Y., New York (Borough of Manhattan) J. P. Jacobs, 326 Audubon Ave., will build a 1 story, 100 x 250 ft. garage on Gerard Ave. and 149th St. Estimated cost, $100,000. H. J. Ozer, 1400 Bway., Engr. and Archt.

N. Y., Elmhurst—W. J. Muller will alter his 1 story garage. Estimated cost, $15,000.

N. Y., New York (Borough of Queens).—J. P. Conato, 8th St., Long Island City, will soon award the contract for the construction of a 1 story, 67 x 100 ft. garage. Estimated cost, $50,000.

Pa., Johnstown—The Knickerbocker Fuel Co., 1st Natl. Bank Bldg., plans to remodel and construct a 15 room addition to its present office building, also construct garage on Vine St. Estimated cost, $100,000. H. M. Rogers, Trust Bldg., Archt.

Pa., Kittanning—The Kittanning Iron and Steel Co. is having plans prepared for the construction of a 1 story addition to its plant. Estimated cost, $100,000. A. G. McKee Co., 2422 Euclid Ave., Cleveland, O., Engrs. and Archts.

Pa., New Castle—The Bd. of Educ. will soon award the contract for the construction of a 3 story, 248 x 340 ft. junior high school to include a manual training department. Estimated cost, $800,000.

Pa., Philadelphia—The McCaffrey File Co., 5th and Berks Sts., has awarded the contract for the construction of a 2 story, 80 x 80 ft. garage. Estimated cost, $25,000.

Pa., Philadelphia—The National Umbrella Frame Co., 30th and Thompson Sts., will build a 1 story, 50 x 50 ft. machine shop on Pennsylvania and Belfield Sts. Estimated cost, $5,000.

Pa., Pittsburgh — The Pittsburgh Forge and Iron Co., Chamber of Commerce Bldg., will soon award the contract for the construction of a 2 story, 18 x 22 ft. and 35 x 88 ft. coal mill building at its plant. Estimated cost, $40,000.

Pa., Reading—The Reading Steel Castings Co. has awarded the contract for the construction of a 1 story machine shop. Estimated cost, $200,000.

MIDDLE WEST

Ind., Michigan City—The Amer. Iron and Steel Corp. plans to build a 1 story concrete, brick and steel plant, to have 250 tons daily capacity, first unit to include 6 open-hearth furnaces, 12 mill sheet steel plant and other mills, for manufacture of plates, rods, bars, slabs, rails, wire and other direct and by-products of the industry. Total cost, $50,000,000. L. L. Slick, Engineers' Bldg., Cleveland, O. Dir. archt.'s name withheld.

Ind., Valparaiso—The Pioneer Truck Co. plans to build a 100 x 304 ft. factory for the manufacture of trucks. Estimated cost, $100,000. O. M. Frier, Pres.

Mich., Detroit—The Detroit Motor Bus Co., 1701 Dime Bank Bldg., plans to build a 1 story garage on Jefferson Ave.

Mich., Detroit—The Fort Shelby Garage, care of J. Gillespie, Fort Shelby Hotel, plans to build a 4 story, 130 x 150 ft. garage on Howard and 1st Sts. A. Kahn, Marquette Bldg., Archt.

O., Bedford—D. Round & Son Co. has awarded the contract for the construction of a 1 story, 90 x 120 ft. addition to its foundry at Stop 2. Estimated cost, $50,000.

O., Cincinnati—The Nash Motor Car Co., Gilbert Ave., has awarded the contract for the construction of a 2 story, 80 x 225 ft. garage, on Reading and Morgan Sts. Estimated cost, $150,000.

O., Cleveland—The Bd. of Educ., East 6th St. and Rockwell Ave., has awarded the contract for the construction of a 1 story, 40 x 200 ft. machine shop addition to its high school on Bway. and Fullerton Ave. Estimated cost, $1500,000. Noted May 13.

O., Cleveland—R. F. Carpenter Mfg. Co., 978 East 64th St., manufacturer of metal partitions, will build a 1 story, 14 x 37 ft. addition to its factory. Estimated cost, $5,000.

O., Cleveland—The Crossley Rubber Co., 1305 Prospect Ave., has awarded the contract for the construction of a 1 story, 30 x 50 ft. garage at 2170 East 18th St. Estimated cost, $10,000.

O., Cleveland—The Ferro Machine and Fdry. Co., East 66th St. and Hubbard Ave., has awarded the contract for the construction of a 1 story, 18 x 99 ft. garage. Estimated cost, $10,000.

O., Cleveland — The Rickersburg Brass Co., 3612 Perkins Ave., is building a 1 story addition to its foundry. Estimated cost, $5,000. A. Sickersberg, Pres.

O., Cleveland—M. Schmidt, 6305 Sargent Ave., will build a 1 story, 50 x 54 ft. garage at 11515 Lorain Ave. Estimated cost, $10,000.

O., Cleveland—A. Schmoldt, 1407 St. Clair Ave., has awarded the contract for the construction of a 1 story, 52 x 110 ft. addition to its garage at 1815 Oregon Ave. Estimated cost, $25,000.

O., Hamilton—The Herring-Hall-Marion Safe Co. plans to build a 2 story factory. Estimated cost, $75,000.

O., Massillon—The Lucius Reinforced Tank Co. has awarded the contract for the construction of a 1 story, 70 x 160 ft. factory. Estimated cost, $75,000.

O., Norwood (Cincinnati P. O.)—The Safe Cabinet Co. will soon award the contract for the construction of a 1 story, 80 x 150 ft. factory. B. L. Baldwin, 2nd Nat. Bank, Archt. and Engr.

O., Painesville—The Light Alloys Co. has awarded the contract for the construction of a 1 story, 75 x 140 ft. factory. Estimated cost, $65,000.

Wis., Janesville—The Sampson Motor Truck Co., is building a 70 x 200 ft. factory. A. J. Ferrielle, branch mgr.

WEST OF THE MISSISSIPPI

Col., Denver—The Western Mfg. Co., Evans Blk., plans to build a 1 story factory for the manufacture of locks and bolts. Estimated cost, $250,000.

Mo., St. Louis—The Bowen Motor Ry. Co., Title Guarantee Bldg., is having plans prepared for a factory. Estimated cost, $385,000. O. J. Popp, Odd Fellows Bldg., Archt.

CANADA

Ont., Brantford—The Caxslutt Plow Co. has awarded the contract for the construction of a 1 story, 70 x 200 ft. factory. Estimated cost, $75,000.

Ont., Ford City—The Fisher Body Co. of Canada plans to build a 4 story, 90 x 192 ft. factory for the manufacture of auto bodies, on St. Lukes Rd. A. Kahn, Walker Rd., Walkersville, Archt.

Ont., Kingston—The T. Watson Co., Woodstock, will soon award the contract for the construction of a factory here, for the manufacture of machinery. Estimated cost, $100,000.

Ont., Listowel—M. I. Adolph has purchased factory and plans to equip same for the manufacture of oil engines and farm power machinery.

Ont., London — F. W. Ruggles, Alma, Mich., will soon award the contract for the construction of the first unit of its auto truck factory on East London St., here. Estimated cost, $2,000,000.

Ont., Sudbury—The International Nickel Co. plans to build a rolling mill. Estimated cost, $3,000,000.

Ont., Tilbury—W. H. Hutton plans to take over factory and install new equipment for the manufacture of truck bodies. Estimated cost, $55,000.

Ont., Watford—The Andrews Wire Co., Wall St., will soon award the contract for the construction of a 60 x 150 ft. extension to its factory. Estimated cost, $50,000.

General Manufacturing

NEW ENGLAND STATES

Conn., New Haven—The New York, New Haven & Hartford R.R., Meadow St., has awarded the contract for remodeling machine shops, locker buildings and stockhouse; also building a 1 story, 100 x 120 ft. addition to the local freight yard. Estimated cost, $150,000.

Conn., Newtown—H. Curtiss & Sons Co. plans to build a 1 story factory on Foot Rd. for the manufacture of paper boxes. Estimated cost, $25,000.

Conn., Stamford—The Erskine Danforth Corp., 490 Pacific St., has awarded the contract for the construction of a 1 story, 60 x 100 ft. addition to factory for the manufacture of furniture. Estimated cost, $15,000.

Mass., Cambridge—The C. A. Briggs Co., 420 Main St., has awarded the contract for the construction of a 5 story, 90 x 180 ft., confectionery factory on Ames St. Estimated cost, $200,000.

Mass., Everett—The Boston Varnish Co., 2nd St., has awarded the contract for the construction of an 3 story, 60 x 100 ft. factory on East Sumner St. Estimated cost, $75,000.

Mass., Lynn—Hilliard & Merrill, Inc., 206 Broad St., manufacturer of soles, has awarded the contract for the construction of a 7 story, 130 x 480 ft. factory and warehouse on Eastern Ave. Estimated cost, $1,000,000.

Mass., New Bedford—The Nashawena Mills Co., Bellevue Ave., has awarded the contract for the construction of a 2 story, 70 x 150 ft. textile mill, at plant. Estimated cost, $100,000.

Mass., Plymouth—The Bradley Rug Co., Park Ave., has awarded the contract for the construction of a 2 story, 50 x 100 ft. factory. Estimated cost, $35,000.

Mass., Wrentham—The Commonwealth of Massachusetts, c/o Kendall Taylor & Co., Engrs. and Archts., 93 Federal St., Boston, will soon award the contract for the construction of a 1 story, 50 x 70 ft. cold storage building and a 1 story, 40 x 90 ft. industrial building at the State School, here. Estimated cost, $100,000. Noted May 6.

R. I., Auburn (Providence P. O.)—The Universal Winding Co. has awarded the contract for the construction of a 1 story and a 3 story addition to its plant. Estimated cost, $25,000 and $175,000, respectively.

R. I. Pawtucket—The Hope Webbing Co., 1005 Main St., plans to build a large addition to mill. Perry & Whipple, Rhode Island. Hospital Trust Bldg., Providence, R. I. Engrs. and Archts.

Vt., Bellows Falls—The Liberty Paper Co., Inc., has awarded the contract for the construction of a 3 story, factory. Estimated cost, $130,000.

MIDDLE ATLANTIC STATES

Md., Baltimore—The Coca Cola Co., Pratt St. and Market Pl., has awarded the contract for the construction of a 4 story, 196 x 534 ft. coca cola factory and cooperage plant on Fort Ave. Estimated cost, $1,250,000.

Md., Baltimore—The Republic Belting Co., Pratt and Smallwood Sts., is remodeling a building and will use same for the manufacture of belting, etc.

Md., Crisfield—The Potomac Poultry Food Co., 802 Keyser Bldg., Baltimore, has awarded the contract for the construction of a 1 story, 125 x 144 ft plant here. Estimated cost, $150,000

Md., Curtis Bay (Baltimore P. O.)—The Union Acid Wks. has acquired a 250 x 520 ft. site on Aspen St. near Curtis Ave. and plans to extend its plant.

N. Y., New York (Borough of Brooklyn)—The Chapman Printing Co., c/o H. J. Nurich, Archt., 72 Bway., is having sketches made for a 1 story, 100 x 200 ft. printing plant on Morgan Ave. and Grand St. Estimated cost, $55,000.

Pa., Philadelphia—J. G. Duncan Co., 1228 Race St., has awarded the contract for the construction of a 2 story, 18 x 100 ft. sales and service building at 661 North Broad St.

Pa., Philadelphia—The Hellwig Silk Dyeing Co., 9th and Buttonwood Sts. has awarded the contract for the construction of a 2 story, 95 x 235 ft. factory on Homestead and Milnor Sts. Estimated cost, $90,000.

Pa., Philadelphia—The Philadelphia Felt Co. has awarded the contract for the construction of a 2 story, 52 x 68 ft. factory on Powder Mill Lane and Frankford Ave.

Pa., Pittsburgh—The Natl. Casket Co., Reedsdale St., has awarded the contract for the construction of a 2 story, 30 x 87 ft. addition to its factory. Estimaed cost, $30,000. Noted Aug. 26.

SOUTHERN STATES

Fla., Tampa—The Bd. of Port Comrs. are considering plans submitted by W. M. Black, for a terminal to include 850 ft. slip, warehouses on both sides, phosphate elevator, naval stores, general terminal facilities, machinery, etc. Estimated cost, $1,500,000.

Ky., Covington—The City Ice Co., 3210 Jefferson Ave., Cincinnati, O., has awarded the contract for the construction of an ice factory on Indiana and Scott Sts., here. Estimated cost, $30,000.

N. C., China Grove—United Mills Co., Hickory, plans to build a 1 story, 125 x 400 ft. cotton mill along the tracks of the Southern R.R. here. Estimated cost, $50,000.

MIDDLE WEST

Mich., Detroit—The Detroit Belt Lacer Co., 27 A St., has awarded the contract for the construction of a 2 story, 80 x 100 ft. belt-lacing factory. Estimated cost, $35,000. Noted Mar. 4.

O., Cincinnati—The C. F. Streit Mfg. Co., 1040 Kenner St., has awarded the contract for the construction of a 2 story, 31 x 50 ft. furniture factory.

O., Cincinnati—The Wheatley Pottery Co., Reading Rd., will soon award the contract for the construction of a 1 story factory, to have 45,000 sq.ft. floor space, on Lester Rd. Rendigs, Panzer & Martin, Palace Theatre Bldg., Archts.

O., Cleveland—J. A. Moffett, 1836 Euclid Ave., plans to build a 1 story, 32 x 40 ft. woodworking factory at 4539 Hough Ave. Estimated cost, $10,000. Private plans.

O., Cleveland—The Rie Armand Drug Co., 1234 St. Clair Ave., has awarded the contract for the construction of a 1 story, 33 x 47 ft. factory. Estimated cost, $10,000.

Wis., Sheboygan—The Sheboygan Parlor Furniture Co., South Water St., plans to build a 4 story, 60 x 174 ft. furniture factory. Estimated cost, $75,000. Juul & Smith, Imig. Bldg., Archts.

Wis., Sheboygan—The Wisconsin Textile By-Products Co., Calumet Drive, has awarded the contract for the construction of a 2 story, 60 x 187 ft. factory. Estimated cost, $30,000.

WEST OF MISSISSIPPI

Col., Denver — The Federal Glass Co., c/o Sylvester & Co., 1st National Bank Bldg., plans to build a plant to include office building, circular glass house, factory with 10,000 sq.ft. of floor space, and a gas plant. Estimated cost, $250,000.

Col., Denver—The Mountain States Packing Co., Gas and Electric Bldg., plans to build a packing plant adjoining their stock yards in the northeastern section of city. Estimated cost, $2,000,000.

Minn., Minneapolis—The Flour State Baking Co., 12th and Minnehaha Aves., has awarded the contract for the construction of a 4 story, 60 x 150 ft. bakery at 500 E. 37th St. Estimated cost, $250,000. E. C. Foley, Secy.

Minn., Minneapolis—The Franklin Cooperative Creamery Co., 26th St. and Franklin Ave., is having plans prepared for the construction of a 1 story, 64 x 85 ft. creamery. Estimated cost, $50,000. O. K. Westphal, 319 Kasota Bldg., Engr.

Minn., Winona—The Webster Woolen Mills, Rushford, is building a 3 story, 75 x 150 ft. factory, here. W. W. Webster, Mgr.

Mo., Aurora—The Juvenile Shoe Co., Advertising Bldg., St. Louis has had plans prepared for the construction of a factory here. Estimated cost, $60,000. T. P. Burnett Co., Arcade Bldg., Archts. and Engrs. Noted June 17.

Mont., Forsyth—The Montana Sugar Co. is having preliminary plans prepared for the construction of a sugar factory. Estimated cost, $1,500,000.

Okla., Henryetta—The Cogswell Refining Co. is having plans prepared for a 2,000 bbl. petroleum refinery. Estimated cost, $250,000. J. C. Bertsch, Tulsa, Engr.

Tex., Floydada—The Farmers' Gin Co. has awarded the contract for the construction of a 1 story factory, to have 6,134 sq.ft. floor space. Estimated cost, $30,000. About $16,000 worth of machinery will be installed.

CANADA

Que., Allard Falls—The Manouaw Pulp and Paper Co. will soon award the contract for the construction of a plant along the St. Maurice River, here. F. L. Moore, c/o Newton Falls Paper Co., Watertown, N. Y., is interested.

"Live" Business Propositions—

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See Pages 374 to 405

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Millholland Geared-Head Turret Lathe

By J. V. HUNTER
Western Editor, *American Machinist*

WITH a view to producing a machine especially adapted for intensive production, the Millholland Machine Co., Indianapolis, Ind., has developed a geared-head type of turret lathe which is shown in Fig. 1. A special feature is the design of the headstock, which is a departure from what has been the more generally accepted practice. Only four geared spindle speed changes are furnished instead of the wide variety of speeds that are common in machines of this type.

An unusual feature of the machine described in this article is that the number of speeds and feeds have been reduced to conform to those more frequently used in actual practice.

The builders claim that their many years of observation of modern turret-lathe practice, have convinced them that greater production is obtained from these machines where little latitude is left to the operator's judgment as to the the speeds and feeds used. For this reason no speeds or feeds are obtainable in this machine that are not actually necessary for the best high-speed production practice.

The headstock is shown in Fig. 2. It contains eight broad-faced gears and two friction assemblies which give the four speed changes just mentioned. The two-step driving pulley is mounted on the back-shaft, which doubles the geared speed range. The friction assemblies are of the same design as used on the other types of turret lathes built by this company, and have large driving surfaces with simple adjustments for wear. The entire headstock assembly runs in a bath of oil, insuring ample lubrication for the moving parts.

In the end view of the machine, Fig. 3, the two speed-change levers are shown near the front end of the headstock in a position easily accessible for the operator. The headstock cover has T-slots milled in the top to facilitate the placing of a motor for individual drive if desired. Sight feed lubricators are furnished on both the main spindle and back-shaft bearings.

In general, the design of this machine closely follows the lines of the machines built by this concern in the past, and aside from the introduction of the four-speed geared head, few changes will be noted. The bed is a well-ribbed box section, with the headstock cast

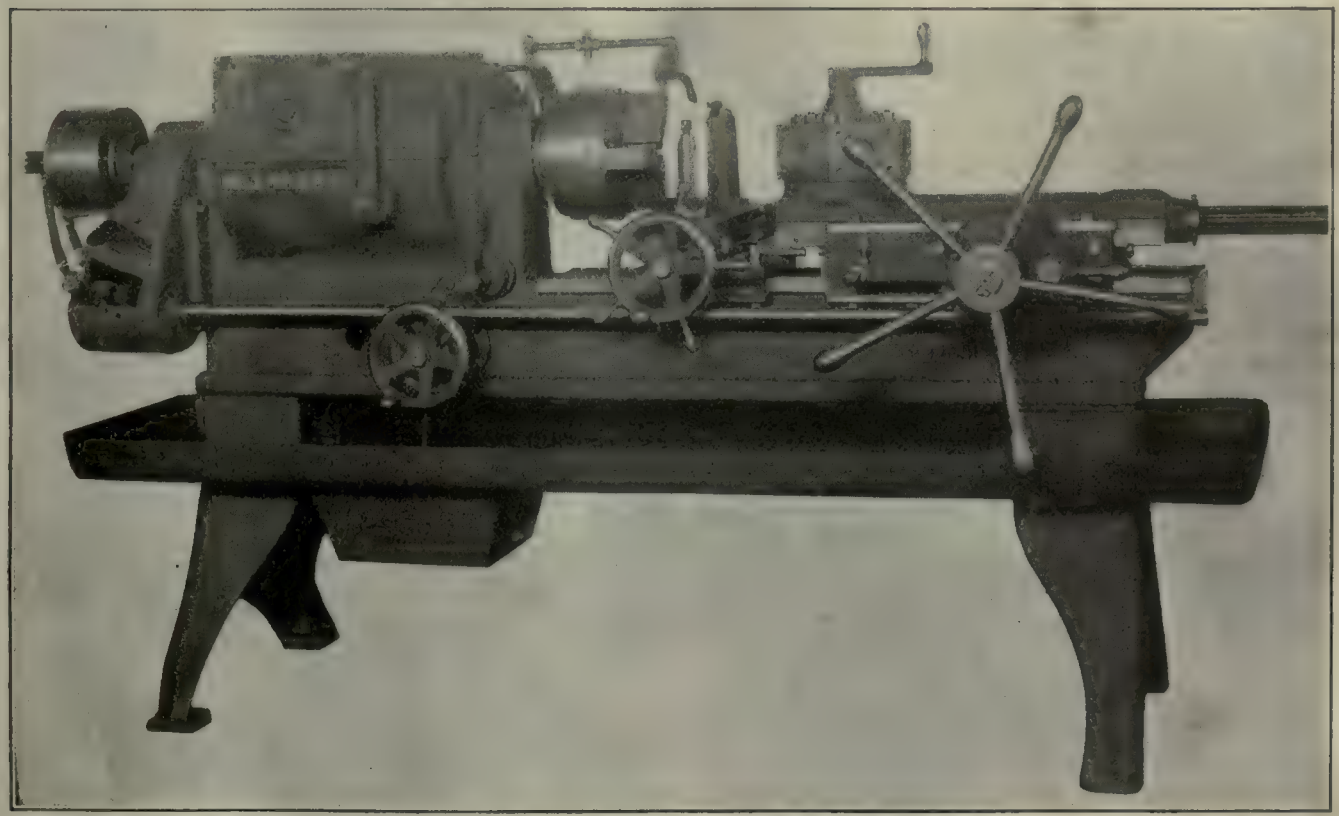


FIG. 1. MILLHOLLAND GEARED-HEAD TURRET LATHE

Specifications: Built in three sizes, Nos. 3, 4 and 6. Capacities given respectively: Automatic chuck capacity, 1⅝, 1⅞ and 2¼ in. round. Hole in spindle, 1$\frac{21}{32}$, 2$\frac{1}{32}$ and 2⅝ in. Diameter of swing, over turret slide, 6, 6¾ and 8 in. Length that can be turned, 8, 10 and 14 in. Diameter of swing over bed, 16½, 18¾ and 21⅝ in. Diameter of swing over cutoff, 7¾, 9 and 11 in. Width of belt for cone, 3, 3½ and 4 in. Pulleys on countershaft, 12 x 4, 12 x 4½ and 12 x 5½. Countershaft speed, 345, 306 and 283 r.p.m. Net weight, 2,250 2,900 and 3,500 lb. Weight crated, 2,500, 3,250 and 4,000 lb. Weight boxed, 2,850, 3,500 and 4,600 pounds.

integral with it. The turret slide and saddle unit is of standard design and is provided with a supplementary taper base and taper gibs for horizontal and vertical adjustment. The turret slide is operated by a rack-and-pinion movement, and the turret is automatically indexed on the backward movement of the slide, as usual. The stud on which the hexagon turret revolves

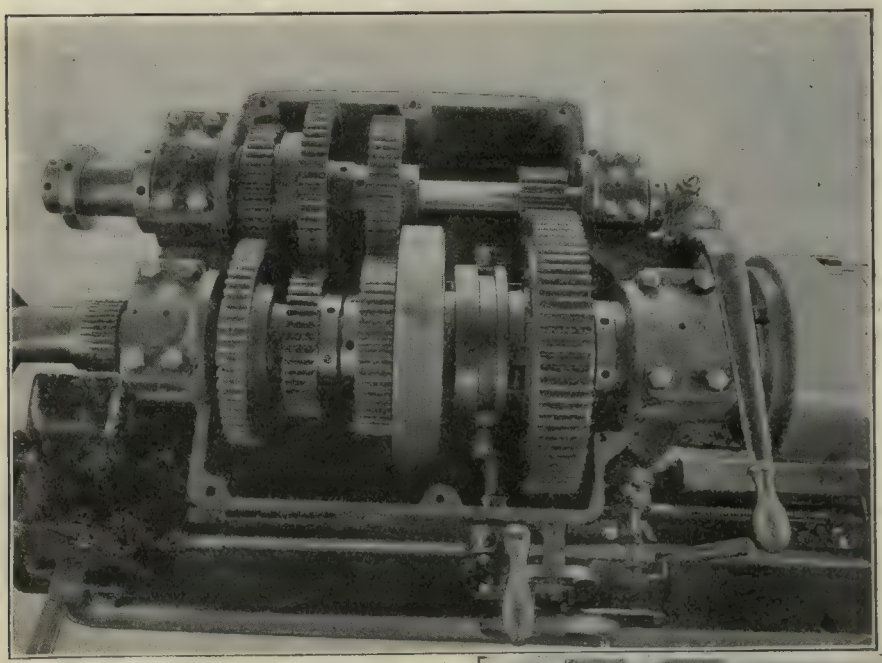


FIG. 2. INTERIOR OF GEARED HEADSTOCK

is bored so that long stock can pass through it and the turret, thus making it possible to use short, stiff tools.

INTERCHANGEABILITY

The turret and turret-feed mechanism is made interchangeable with that of the corresponding size of their cone-head machine. The turret feed is engaged by means of the lever of the friction clutch and eight feed changes are available through the feed box. The feeds are automatically tripped by independent adjustable stops. These stops operate automatically for each position of the turret, and when adjusted for the length of each cut may be locked in position.

A substantial cut-off slide with broad, flat, well-gibbed bearings insures rigidity under forming and turning cuts. The hand longitudinal feed adjustment is provided with a large diameter dial with adjustable clips, so that different shoulder lengths can be duplicated.

The bed is fitted with pressed steel oil pan having a cast-iron reservoir bolted on underneath. The coolant pump is driven from a pulley on the back-gear shaft and operates when running in either direction.

What Shall the School Shop Produce?

By W. D. Forbes

In all the trade schools I have known, the question of obtaining work has been a serious one. Mr. George Heald, under the above heading on page 642, Vol. 52 of the *American Machinist*, brings out this point and makes some suggestions that are of practical value. A free discussion of the matter by those interested in the subject should serve to uncover new ideas that will be of value.

I know of two trade schools that have included in their work the rebuilding of machines and machine tools. One of them was in a large manufacturing city and had acquired the material from various sources; some having been given to the school, some purchased, and some that had been through fires were obtained. The latter were not infrequently of modern design and were the most valuable from the point of view of the school, for the reason that they would give the greatest returns in the way of educational value; while others, especially those donated. were of older design.

Just how well the idea of rebuilding

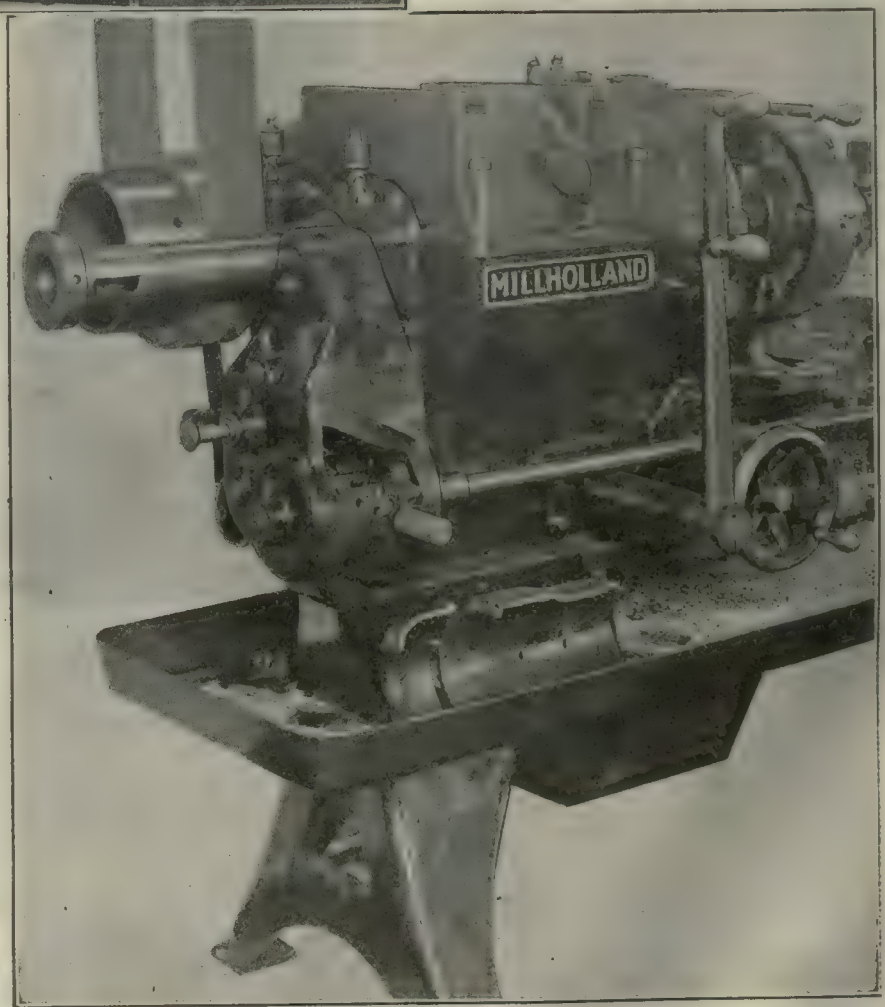


FIG. 3. HEADSTOCK END OF MILLHOLLAND TURRET LATHE

these machines worked out financially I do not know, but I *do* know that the work was most interesting and instructive to the students, for they not only remachined the parts, but they reassembled them as well. Quite often entirely new parts would have to be made.

In my own teaching experience I have combined the production of parts used by manufacturers with that of articles which could be readily disposed of in the open market, and I adopted the system of paying the students a part of the money obtained from the sources indicated.

Some of the parts made by the students were for use in some machine, as for instance: shafts for dynamos; governor pins for engines; handles for various kinds of machines; screws for lifting jacks, as well as the complete jacks; gears for machinery; pipe flanges; studs; special screws; complete deadlights for ships; and also hinge pins, screws and nuts for them. Quite a number of nuts were given to us to castellate; in fact, so many that we could not do them all.

Some of the Articles Made

The articles that we made for the market were taper pins, both soft and tool-steel; special tool-steel set-screws; taper reamers; chucking reamers; reamers for pipe work; countersinks; plug and ring gages, etc.

Of course in the beginning there was much waste from the commercial point of view, although there was not as much entirely bad work as I feared there would be; but the experience acquired and the lessons learned from the bad work were of incalculable value.

In making plug gages a standard size of handle was adopted and if the gage end was spoiled in machining to the nominal size it could still be reduced to the next smaller size and much of the work saved. It was in hardening the reamers that we met with the greatest loss, but this was primarily due to not having the proper appliances for such work.

To dispose of the marketable portion of our product was not difficult as we let the shops around us know that we had such articles on hand and those who were interested in the school would get their supply houses to take our goods, paying therefor the lowest market rates. The taper pins sold very well. We centered both ends; the small end from necessity, and the large end, we found, if centered, allowed the men to give the pin a brush with a file without the necessity of using a chuck.

In connection with these taper pins there is a point I wish to make. As they were made in quite large quantities it gave the student repetition work to do, and to make one thing over and over again is, I believe, of great advantage to him. It is true that a student may protest against this at first, but after a time he sees that it is to his advantage to acquire skill, and that this can be done only by the constant doing of the things upon which skill is to be attained.

Not being in a position to give their students work of a repetitive nature is where many trade schools are at a disadvantage. Doing a piece of work but once teaches little; the student is unable to see how much he gains in proficiency by becoming "at home" on the job. One young man under my tuition took three hours to make his first taper pin properly, but before he had finished the lot he could make one in three minutes.

To get work such as I have noted is not easy. If you leave it to one hired to search for it he must be a man of great tact and be known to local foremen and to men higher up. I have found that a personal letter to a manufacturing concern telling them just why the work was wanted, as a rule, brought results. It took time, but I found it worth while, and many a student has worked into a position by stating that he had made such and such pieces used by the people to whom he applied for a job.

Such articles as pipe flanges we tapped, faced, and drilled, but while the work was satisfactory from an educational point of view, the great weight of these articles made the freight and cartage rather a burden. Such pieces as shafts for generators or motors were finished complete except for two or three lands which were left large enough to grind to fit the bored holes in the spiders. The fact that the shafts had a thread cut on one end and a keyway on the other made them most acceptable as practice pieces. The deadlights supplied lathe work, milling, drilling and tapping, and fits had to be made in several places; yet the weight made the transportation charges high and thus lessened the profits.

On all the work the student was given a commercial time limit and it was his aim to equal or approach it.

Any spoiled work was used as an example of "how not to do it," and the students were shown the mistakes that were made. This made the students far more careful, for none cared to be shown up as having made a blunder.

I rather like the idea of a trade school making something in the shape of a machine tool, as a complete machine is much more interesting to the student and they take pride in the work.

Just to make an article that is to function in a machine and is never seen, is hardly interesting; while in assembling a machine the student is brought face to face with the necessity of working close to drawings and he gets to know what a fit is in a way he understands and remembers. Making things that only go to the scrap pile, as Mr. Heald puts it, is to my mind a great waste of time and I am glad to think that little such work is done in trade schools today.

Drawing Classes

I found in the drawing classes that drawing alone was but mildly interesting; unless the student knew that something was to be made from his drawing his interest was not held. I got some tracings to make for various concerns and I found that the student always wanted to go to the works where the drawings came from in order to see the pieces made in metal.

If a drawing showed a casting, the molding always greatly interested the student. It was so attractive to see the cores made, dried, and set. When the mysteries of core prints were dissipated, it was a tale well worth telling to others how the flasks were rammed up and patterns drawn, cores set, flasks closed, weighted or clamped, and how the metal was poured. Then would follow the story of how the flasks were dumped and the castings allowed to cool; how they were cleaned or tumbled, and at last made ready for the machine work.

I think that the work I have outlined in the foregoing paragraphs is about the class needed for trade schools, as among the kinds mentioned there is both rough and fine work; whether it is for the market or for some manufacturing concern does not matter much. In selecting some tool or other article for the school to make

the general condition of finances in craft schools makes it necessary to expend as little for material as possible.

A punch press, for example, which would weigh in the neighborhood of 600 lb. would not be a wise selection, although the work on it would be what is wanted, as in undertaking to make ten such presses, too much money would be locked up; and also if the main piece should be spoiled, the loss would be severe. A sensitive drill would be a better selection as the weight is small, the work is varied, and the tool will sell.

In conclusion, I wish to say that in speaking of profits, I do not mean to convey the idea that making profits, in the real sense of the word, is to be expected or is advisable in a trade school. Perhaps I should have used the word profitable, rather than profits. The heavy articles referred to would not give as much profitable return in work for a dollar expended as would lighter articles.

Building Up Subordinates

By Entropy

In any meeting of business men, start to complain that it is impossible to get reliable subordinates and you are sure of an audience. The conversation will become even violent. But you may be almost sure that the really big fellows will not join in. They may look wise, but they stay out of it. How is it that they so uniformly secure the cream of the available employees? It is of no use to ask them. They simply do not know what the problems of the little fellows are. They say they have always had good men around them and that they have no special method of selection. It simply happens that way.

Let's try their employees. A dozen interviews, or a hundred, show just one thing on which they are united and that is that they all like to work for the people in their respective organizations—that each will swear by his particular boss. Beyond that the next noticeable thing is that they all feel as if they were of some account in the organization, and yet they do not often have swelled heads. They may have a higher opinion of the boss and of the organization than the rest of the world entertains, but they do not show egotism. It seems as though the big men all have the faculty of putting their assistants in just the highest niches that they can safely occupy, and that those niches are so much higher than anyone else would put them and so much higher than they would dare to take without the man higher up backing them that they are more than content to occupy them.

Everyone, no matter how modest or self deprecating, has a secret ambition to hold a good job. He may not dare to ask for it. If he gets it he may be scared to take it, but he dreams of it nevertheless. When his dream comes true he realizes that some substantial force has placed him there and is backing him to stay; he recognizes his dependence on that force and comes almost to worship it.

No matter how powerful the man may be who places men in the higher jobs he could not hold them there unless they were capable. How is it that these men prove capable? The answer is simple just as soon as you see the big man in action. He knows how to give directions. He does not tell a subordinate a lot of things which he knows better than his boss. Neither does he leave the essential directions untold. He understands each man's limitations and frames his orders accordingly. He does not, strange to say, give his orders like those cited in the famous "Letter to Garcia" except to the men like Rowan, who know where to take the message. In fact that story while it was a wonderful little bit of English has undoubtedly sent off on a wild-goose chase many an otherwise sensible man who if he had not read it would have waited to get all available information before he started. It should be a principle of giving orders that all details be given which the man's own knowledge does not furnish.

On top of explicit and complete instructions these big fellows, almost without exception, do not want too implicit and literal obedience. They want results, and while they are always interested to know how the results were obtained they are only too glad when a subordinate finds a better way than they have thought of. It takes a big man to do this. In fact this ability is almost a criterion for bigness. It is so easy for a man who has built up a substantial business to believe that "he" did it that it is no wonder if he feels that he himself must decide every little detail. On the other hand the very biggest men, and the men who have made the most money and the most fame, are those who are able to give full credit for everything that their subordinates have done and yet have plenty left over for themselves. Really, while we all like to talk about working for larger and larger salaries we all know that we would rather work for the man who gives us credit for what we do than for the man who wants it for himself.

What would be the effect if we, all of us, should decide to do these things, to give subordinates freedom of action and to give them credit for performance? Would we then find that there were not enough capable subordinates to go around? Very likely we would, for a time at least. Take a man who has always worked hard and faithfully, but always tied to his boss, never daring to think of going from the beaten track and never encouraged to do more than an essential minimum to stay on the payroll. Such a man could not respond to the better treatment which he might get under a bigger boss. He has grown into the rut and it has conquered him. His son, however, under broader treatment, may do exactly what the father would have done under similar circumstances and become a big man himself. We cannot hope for many more capable subordinates from the present crop of mature men, and if we want to hold our place in manufacturing and take the share of export trade that belongs to us we will have to handle the younger crop, the boys just coming into our establishments, with a freer rein, and with more confidence in their ability to do large things.

Of course there are many men who can never rise to responsibility, no matter what the incentive, but such men do not apply in large numbers for these positions as minor executives. Once in a while one of them does develop, but he is the exception that proves the rule. The man to develop is the young chap, with the look of a fighter in his eye, with a mind trained either by experience or precept to keep his mind's eye on the mark and not to be swerved by little obstacles in the road, capable of diplomacy, but not too ready to blarney—the sort of chap who can go into athletics in school and yet make a presentable showing in the studies which bear on the employment he seeks. Such a man can fit into some place in almost any organization, but he will not be content to be a tail to any man's kite for a long time.

Using the Trade Magazine to Capacity

By E. L. BOWMAN

What do you do with the back numbers of your "American Machinist"? Do you burn them, sell them to the junkman, or give them away; only to be confronted in a few days or weeks with a problem the solution of which has been suggested, as you recall, in one of those back numbers that you discarded? Or do you stack the bulky numbers up in some dark corner, to catch the dust, till you remember an article you want, and then rummage frantically till you either find it or give up in disgust? And the next time you look for an article you find the whole pile out of order!

ENCLOSED in the thick husk of advertising that covers the modern metal-trades journal will be found many kernels of splendid reference data and instructional material. The advertising is essential at the moment of issue, but of little use after the appearance of the next number of the magazine. It is necessary, therefore, to find some way of making the body of the magazine easily accessible, for future reference at a time when the advertising sections will have lost their value through obsolescence.

Not only is this problem of interest to the engineer and craftsman, but to the instructors in trade schools as well. The classes carried on under the Smith-Hughes act require the latest and most practical material for schoolroom use.

How shall we preserve the editorial parts of these magazines and how shall we make them available for quick reference? The plan in use in the trade and industrial classes in Erie, Pennsylvania, will suggest to engineers and instructors a readily adaptable method for meeting the situation.

First, the outside covers of the magazine are removed, and the wire staples are loosened with the blade of a screwdriver. The title-page, with its table of contents, is carefully removed and laid aside for future use.

Next, the advertising pages are removed with care, leaving the body of the magazine ready for preservation. A paper clip holds the title-page to the corresponding body. When a sufficient number of these are collected they are sent to the school printshop and a bare eighth of an inch trimmed from the binding edges to insure evenness and freedom from the glue used in the original makeup.

Every business office discards each month a number of the manila folders used for filing letters. These are saved and the tabs are trimmed off, leaving a folder about nine by twelve inches. Boys in the pre-vocational classes print the name of the magazine to be bound on the first page of this folder, together with place for the date, page numbers and any other data that is found desirable, and a line to act as index when the folders are finally filed (See Fig. 1).

Into each of these printed folders is inserted the body of one issue of the magazine. Three or four wire staples are driven through folder and contents along the folded side, and the pamphlet is ready for use.

Besides the *American Machinist*, with which the plan was begun, there are now preserved in this manner *Power*, *Foundry*, and the *Iron Age*. The pages of *Machinery* are trimmed to the size of the folders before binding, a procedure which leaves about a quarter of an inch on the free edges of the magazine. The *Scientific American* and *Scientific American Supplement* are indexed but not bound. The new form of the latter, the *Scientific American Magazine*, will be bound as is the *Machinist*.

All articles of possible interest are indexed by the use of four by six cards, a number of which are shown in



FIG. 1. THE FOLDER USED FOR FILING

Fig. 2. Two or more copies of each card are made, one for the use of each instructor involved and one to serve as a master index. After indexing, the pamphlets are placed in a vertical letter file with guides labeled with the name of the magazine and the volume number and date.

When the instructors receive the index cards, they are stored in cabinets on the desks. Thus, the instructor in drafting practice receives cards on such articles as that on cams by Furman, in the *Machinist*, the tables of standard dimensions for machine parts, and all other articles bearing on this particular subject of instruction. The science teacher receives the cards on mechanics, strength of materials, metallurgy, heat, thermo-dynamics, electricity and light. The mathematics teacher is given the cards locating problems in applied mathematics, such as are found in *Machinery's* prac-

tical problems sections, and in other places. The English teacher finds indexed such articles of general descriptive or expositional interest as are suitable as bases for oral or written compositions, or articles from which condensations are to be made. Here, too, are found references to the biographies on the back of the title-pages from the *Machinist*. The social-science teacher finds

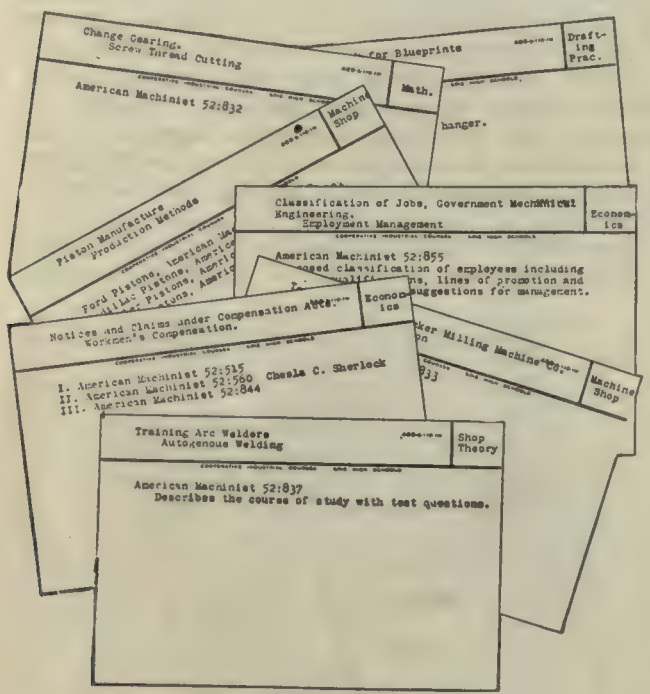


FIG. 2. THE INDEX CARDS

before him references to such articles as the series on compensation by Chesla Sherlock, the discussion of the wage controversy, etc.

The cards for each subject are subdivided and indexed under appropriate heads. Each short unit in the courses taught is made the subject of a guide, and material illustrative of the unit is arranged under this guide.

In planning his instruction and assignments of reference work, the instructor has but to refer to his card index and there find indicated appropriate articles for assignment of outside work.

It will be noticed that the headings of the cards are typewritten, and that a large space is left for notes, which should be made by the instructor at the time the article is used. Hence the cards grow in value year after year as they are used by the teachers.

What has been done in indexing for use in a trade school can be done for use in an engineer's office or at a foreman's desk. Anyone who has occasion to use for reference the back numbers of technical magazines will find the above system one easily put in practice, inexpensive, readily followed, not easily disarranged, a time-saver, and a preserver of priceless data.

A Difficult Job of Broaching

By Herbert M. Darling

While building a special machine, I had to make the shaft, shown in Fig. 1, $\frac{5}{8}$ in. outside diameter and $5\frac{1}{2}$ in. long, with a $\frac{3}{8}$-in. square hole through it lengthways. It was required that this hole should be straight and parallel with the outside of the shaft. It will be noticed that it is rather a difficult hole to broach, owing to its small size and extreme length. We had no special facilities for such work, so I had to devise some means of doing it.

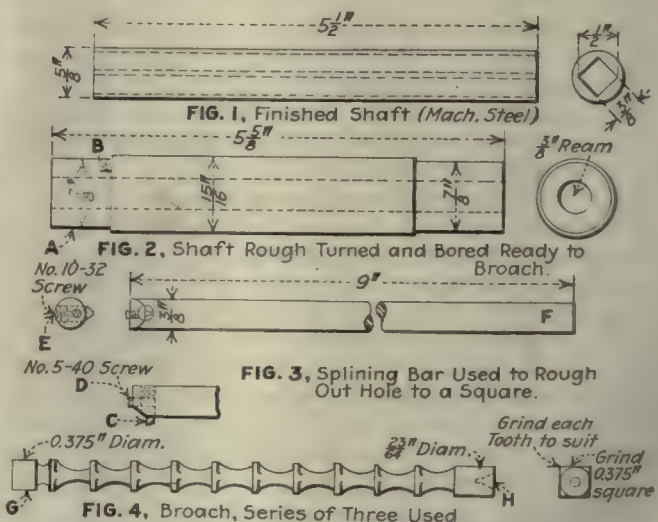
First I cut off a piece of 1-in. machine steel $5\frac{5}{8}$ in. long. After centering, I turned it to the dimensions shown in Fig. 2. I trued up the end *A* in my lathe chuck, running the other end in the steadyrest. The shoulder *B* was brought directly up against the face of the chuck jaws for the purpose of taking the thrust in the later broaching operation.

My next operation was to drill and ream a $\frac{3}{8}$-in. hole entirely through the shaft. For roughing out the hole to an approximate square, I used the tool shown in Fig. 3. This is a steel rod, which would just slide through the $\frac{3}{8}$-in. reamed hole. The small splining tool *C* is held by the setscrew *D*, and adjusted by the screw *E*. For the full range of adjustment, I needed two adjusting screws one being $\frac{3}{32}$ in. long and the other $\frac{5}{32}$ in. long.

The end of the shank *F* was held in a drill chuck in the tailstock of the lathe. The shank carrying the tool *C* was then forced through the $\frac{3}{8}$-in. reamed hole by the tailstock screw. This was repeated a number of times, the tool *C* being adjusted each time until one corner of the square was roughed out. The work was indexed to four different positions, using the large spindle gear of the lathe to index by. In each position the splining operation was repeated until the hole assumed the shape of a rough square.

I made a series of three broaches similar to Fig. 4; the four flat sides being ground and the cutting edges ground so that each tooth did its proper share of the work.

The drill chuck was removed from the tailstock of the lathe and the center inserted in its place. Start-



FIGS. 1 TO 4. THE BROACHING JOB AND TOOLS USED

Fig. 1—The piece to be broached. Fig. 2—The roughed-out shaft. Fig. 3—The splining tool. Fig. 4—One of the broaches.

ing with broach number 1 the pilot *G* was inserted in the roughed-out hole and the tail-center forced into center-hole *H*. By means of the tailstock screw, the broach was forced clean through the hole, as were the other two broaches This left a very nice, clean, straight hole of the proper size. The shaft was then pushed onto a $\frac{3}{8}$-in. square arbor, and turned, squared to length, and ground to $\frac{5}{8}$-in. diameter, thus completing the job satisfactorily.

Making a Hobbing Machine for Precision Work

BY SIMEON COLLEY
National Cash Register Co., Dayton, Ohio

To produce wormwheels of the accuracy required for azimuth heads, the National Cash Register Co. built a special hobbing machine, the design and construction of which are herein described. The principle of this design involved the application of a very large skew gear, made as accurate as possible, to revolve the small wormwheel blank which it was required to hob with a minimum of error.

AN AZIMUTH head is an instrument of precision used in conjunction with telescope or periscope for taking observations by which to direct shell fire. The head is shown in Fig. 1. The usual working arrangement is to mount the azimuth head on a tripod and mount the telescope or periscope on the head, as shown by Figs. 2 and 3.

The necessity for accuracy in this mechanism is indicated by Fig. 4, which is a diagram of the amplification test to which the azimuth head is subjected. This test involves the use of a test disk, a telescope and a target. The disk has a zero point and a test point exactly 45 deg. apart. The azimuth head is mounted on the disk and the telescope on the head. In the set-up, the head, micrometer screw knob and disk are placed at zero, with the hair line of the telescope registering with the zero line of the target. The disk, carrying the head with it, is rotated through 45 deg. and clamped; the head is then turned back by means of the micrometer screw, through 45 deg. If exactly correct the zero lines of the telescope and target will coincide. As shown by the diagram, an error of 0.001 in. in the head produces errors of 2.448 in. at a distance of approximately 205 ft., and 25 ft. at a distance of 5 miles.

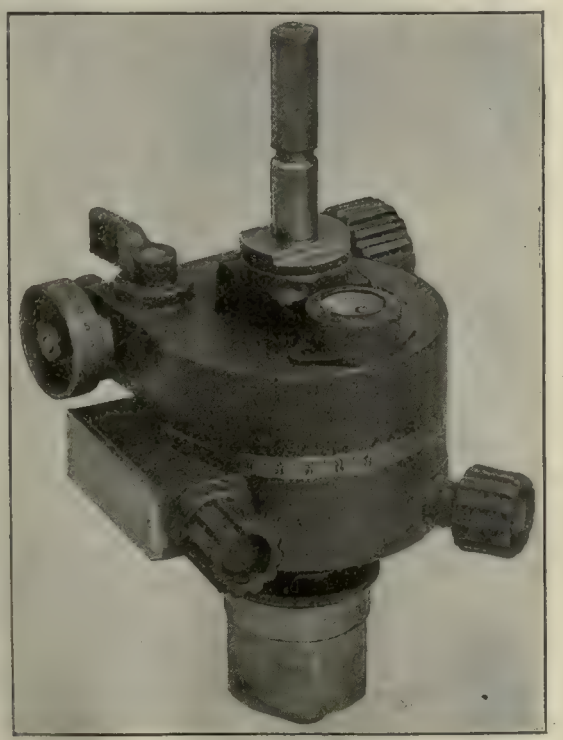


FIG. 1. THE AZIMUTH HEAD

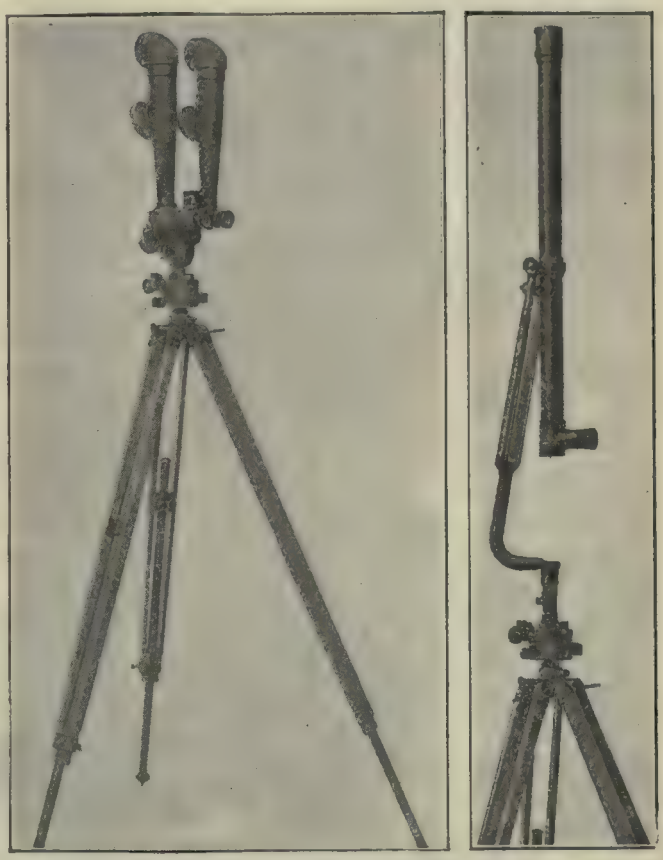


FIG. 2. AZIMUTH HEAD MOUNTED WITH PERISCOPIC DEVICE. FIG. 3. AZIMUTH HEAD MOUNTED WITH TELESCOPIC DEVICE

The component of the azimuth head upon which accuracy is most dependent is the double wormwheel, 2½ in. in diameter, 64 teeth, shown in Fig. 5. The Government tolerances were 0.0000198 in. per tooth space, which permits a total cumulative error in one direction of 0.0012 in.

The machine built to hob these wormwheels is shown in Fig. 6. A bronze skew gear of 48 in. pitch diameter, mounted on ball bearings, rotates the wormwheel blank, which is mounted on the same shaft. This large gear, of 1,152 teeth, 24 pitch, is driven by a pinion of 18 teeth, 24 pitch, ¾ in. pitch diameter, that is operated by pulley and gearing. A shaft containing two universal joints and a sliding coupling connects the pinion and the hob, the latter being mounted in suitable bearings in a feed slide. The feed slide is fed to the work by a large cam operated by worm and wormwheel, which is driven by sprocket and auxiliary shaft. A handwheel is provided on the feed slide for adjustment. At the completion of the cut, that is, one revolution of large gear and wormwheel blank, the feed is auto-

matically released and the slide is raised by the large spiral spring.

The bronze skew gear blank was rough machined and mounted permanently upon its shaft. It was then

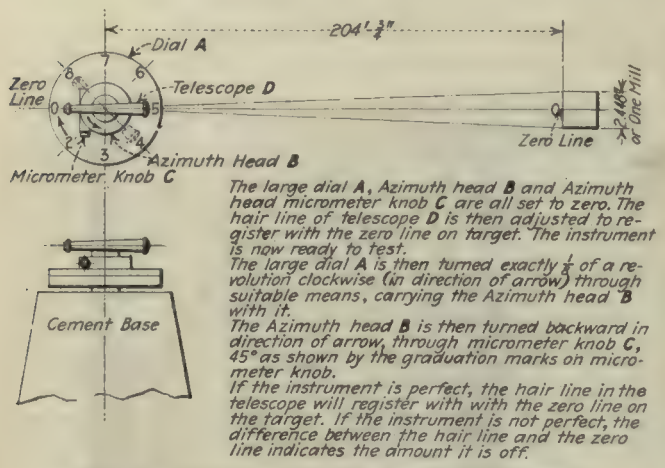


FIG. 4. DIAGRAM OF AMPLIFICATION TEST

placed in accurately tested ball bearings in rigid housings, and turned true and finished to size in position, with all end thrust and backlash eliminated. The rim section, Fig. 7, shows the shape of the finished blank.

By the use of dividers sixteen points were located on the tooth-face side of the flange and then center-punched, the distances between successive points being approximately equal. A bench lathe head, clamped to a bracket fastened to the machine base was used to drill at the sixteen points, as shown by Fig. 8. The holes so drilled were then tapped for $\frac{1}{4}$-in. screws.

Sixteen ground and lapped steel buttons $\frac{1}{2}$ in. in diameter with $\frac{5}{16}$-in. hole in the center were attached with $\frac{1}{4}$-in screws. This arrangement held the buttons sufficiently tight, while the clearance of $\frac{1}{16}$ in. on diameters, between screw and hole, allowed for the necessary later adjustment to exactly locate the sixteen buttons so that the distances between any two successive buttons would be equal. The outside diameter of the blank being known, the radius to center of buttons was computed, the thickness of a Johansson block to be inserted between button and gear rim being included in the computation. This radius equaled the radius to rim plus the thickness of gage block, plus half the diameter of the button. Having obtained this radius, the chordal distance from center to center of buttons for equal spacing was calculated. The Johansson gage holder was set to this dimension plus the diameter of one button and the buttons adjusted with equal distances between them. The Johansson block was used between button and rim of gear as previously described and as shown in Fig. 7.

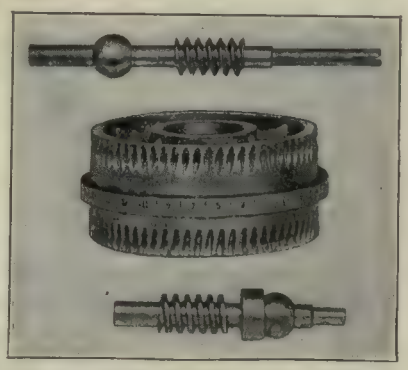


FIG. 5. WORMWHEEL AND WORMS OF AZIMUTH HEAD

Chord distances from center of button to centers of tooth spaces were calculated for the 72 spaces contained in each one-sixteenth section. These were tabulated for

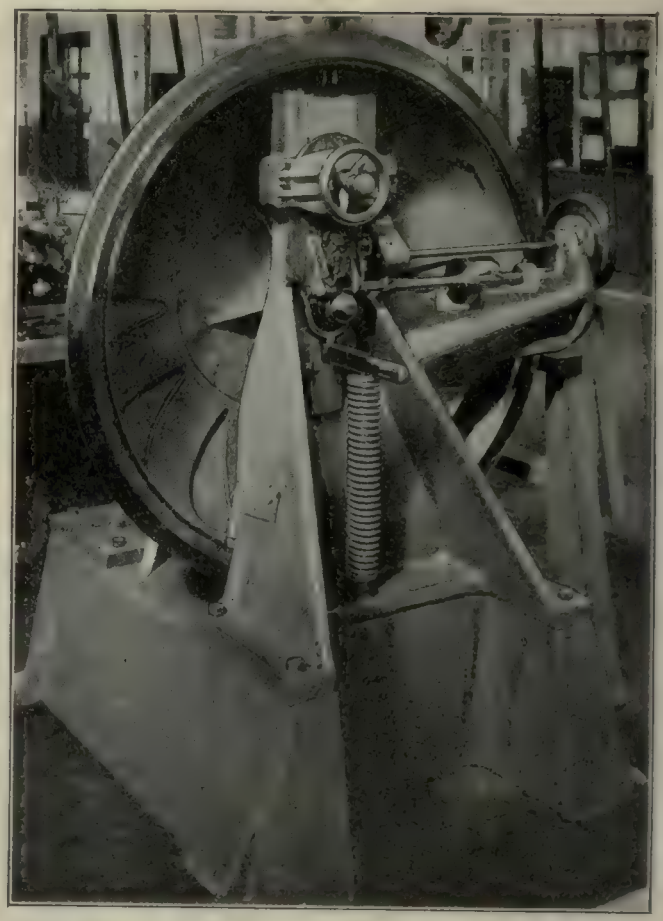


FIG. 6. HOBBING MACHINE FOR AZIMUTH HEAD WORMWHEELS

future use in actually locating the skew gear blank for cutting the tooth spaces.

The next step was to arrange for the use of a plug gage at the sixteen accurately located points, this gage to be used in indexing. A jig with a $\frac{1}{2}$-in. diameter lapped hole and two $\frac{5}{16}$-in. guide holes was located on one of the buttons, clamped to the gear flange, and the two holes drilled and tapped for $\frac{1}{4}$-in. screws as shown at *AA*, Fig. 9. This was repeated on the other buttons. When the $\frac{1}{4}$-in. screw holes were finished the jig was again placed on the buttons, one after the other, fastened to the flange by $\frac{1}{4}$-in. screws in the holes

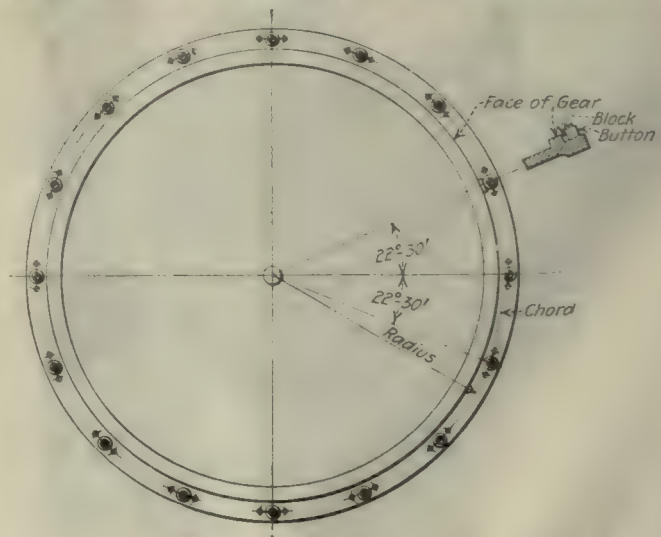


FIG. 7. METHOD OF LOCATING BUTTONS

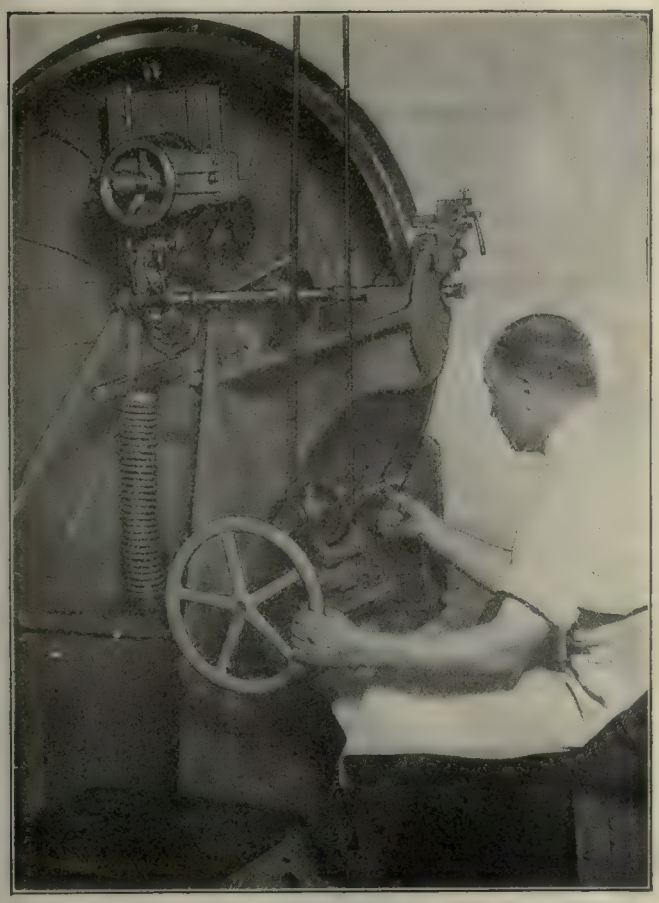


FIG. 8. DRILLING SCREW HOLES AT THE SIXTEEN LOCATING POINTS

just tapped and the buttons removed from the flange. Using a $\frac{5}{16}$ x $\frac{1}{2}$-in. slip bushing in the jig, the screw holes where the buttons had been secured were drilled, rough reamed and finish reamed for a $\frac{5}{16}$-in. plug gage.

A bracket was located upon the machine base at such an angle that the gear cutter, supported thereon, would mill each tooth space on a line drawn from the center of the hob. The diagram, Fig. 10, shows the method whereby the cutter was located at the correct angle and height to cut the tooth spaces as required. By the use of try-square *H*, and Johansson blocks *I*, *K* and *J*, the distance *A* was measured. Knowing this distance and the distances *B* and *E* as well, the distance *F* was easily calculated.

The cutter was mounted in a special device, shown by Fig. 11, and driven from the motor by a belt. The

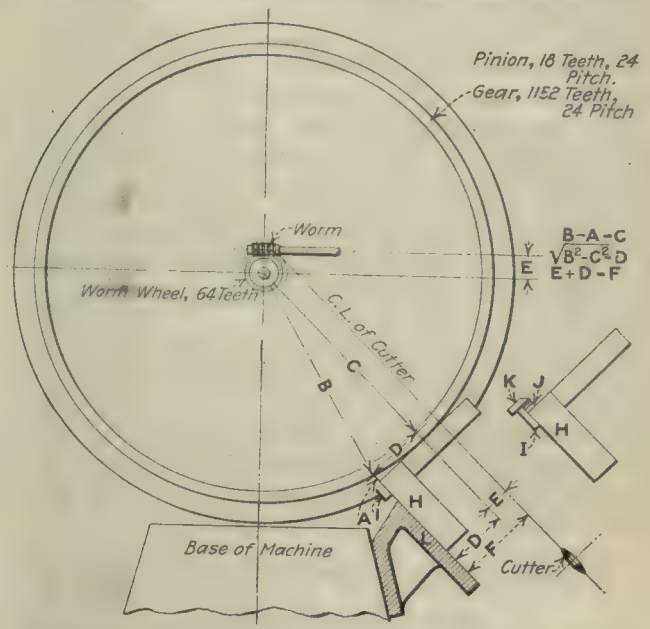


FIG. 10. METHOD OF DETERMINING ANGLE AND HEIGHT OF CUTTER

apparatus shown just above the operator's head in the figure referred to is for locking the gear in position after indexing.

The plug gage, for which the sixteen holes in the flange were prepared, was used in conjunction with a second plug gage, $\frac{5}{16}$ in. in diameter, supported in an auxiliary frame attached to the bracket which supported the cutter head. See *B*, Fig. 9. The location of this stationary plug gage from the plug gage in the gear

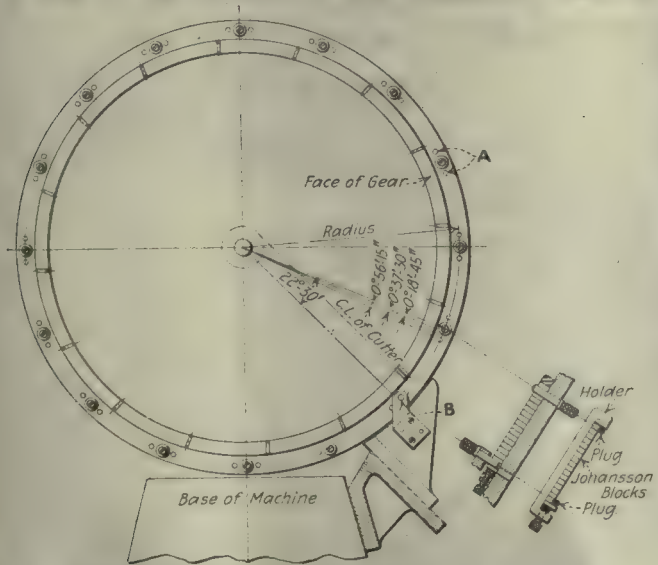


FIG. 9. METHOD OF INDEXING FOR MILLING TOOTH SPACES

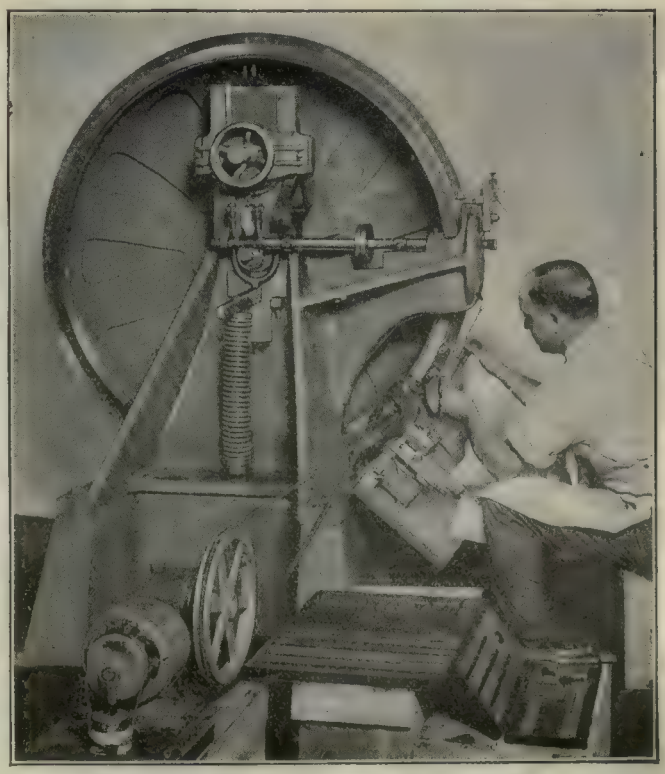


FIG. 11. GAGING FROM PLUG TO PLUG TO LOCATE THE GEAR FOR CUTTING A TOOTH SPACE

flange, for any desired setting, was determined by using the Johansson blocks and holder, the settings of the gages for chord distances being obtained from the table of chord distances previously calculated.

The first sixteen spaces cut were those which corresponded with the sixteen plug-gage holes in the flange. The holder was then reset and the next series of sixteen spaces cut, and so on until the gear was completed.

The hobbing machine thus constructed was for a finishing operation only, the wormwheels being gashed previously. The results obtained justified the time and expense expended in making the machine. Production was greatly increased and the finished wheels were well within the Government's limits. Several thousands of rejected wheels which had been produced by other methods were reclaimed.

This method of accomplishing quantity manufacture to exceedingly close limits necessitated some very good design and engineering work, but it was equally dependent upon the use of Johansson blocks and gages. M. E. Service, efficiency engineer of the National Cash Register plant, was largely responsible for the development of this work.

Western Automobile Repair Shops

SPECIAL CORRESPONDENCE

Those who are accustomed to the usual small automobile repair shops with their meager equipment of machine tools are agreeably surprised to find such excellent equipment in many of the repair shops in the Far West. This condition is probably influenced to a considerable extent by distance from the center of production and the time required to transport repair parts.

It is no uncommon thing to find a good equipment of modern machine tools, including grinding machines of various kinds, in the larger cities.

The accompanying illustration is from the shop of the Oregon Auto Repair, Inc., of Portland, Ore., and shows an interesting six-cylinder regrinding job on a Heald machine. As can be seen in the background, there is also a fair equipment of lathes and other machinery. Shops of this kind are doubtless largely responsible for the numerous businesses which have been built up for the making of oversize pistons, piston rings and piston pins at various points on the Coast. While the individual shops would hardly be considered large from a manufacturing standpoint, they make up an interesting total which makes a market for a much larger number of grinding and similar machines than would be supposed.

Instruction Sheets That Instruct

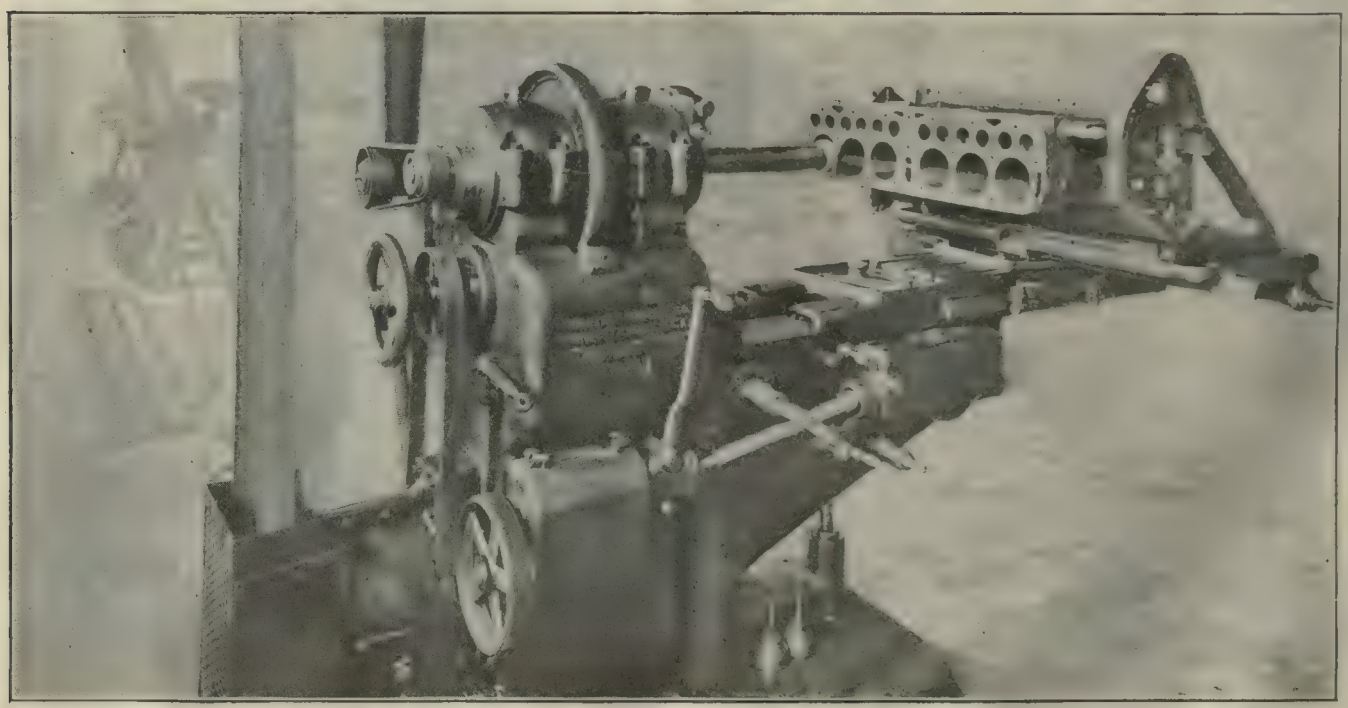
The combination of operation and instruction sheets has much to commend it and the examples shown herewith are full of suggestions which can readily be adapted for other kinds of work. They are from the shop of Mees & Gottfried Co., San Francisco, Cal., having been devised by H. P. Phillips, superintendent.

As will be seen from Fig. 1, the sheet shows the two operations necessary on the pieces in question. The outline layout makes the tooling very clear and the list of sub-operations shows exactly what is to be done to the piece. In operation 2, the piece is reversed and a different tool layout brought into play.

At the right is a list of the tool equipment including gages and the table below makes the same sheet available for six different sizes. Another interesting feature is the showing how the gages are used in the two operations, the way in which one gage can be used for three purposes being particularly interesting. The use of the plug gages is, of course, obvious.

Fig. 2 shows a somewhat different piece and the different methods used in machining it. A pilot bushing in the machine spindle is used in the first operation in this case and specially formed jaws are used to hold the piece. It will be noted that spiral chip-grooves are provided in the boring bars behind the cutters in the first operation and that in the second operation only two tools are used.

Here again a single flat contour gage is all that is



A SIX CYLINDER GRINDING JOB

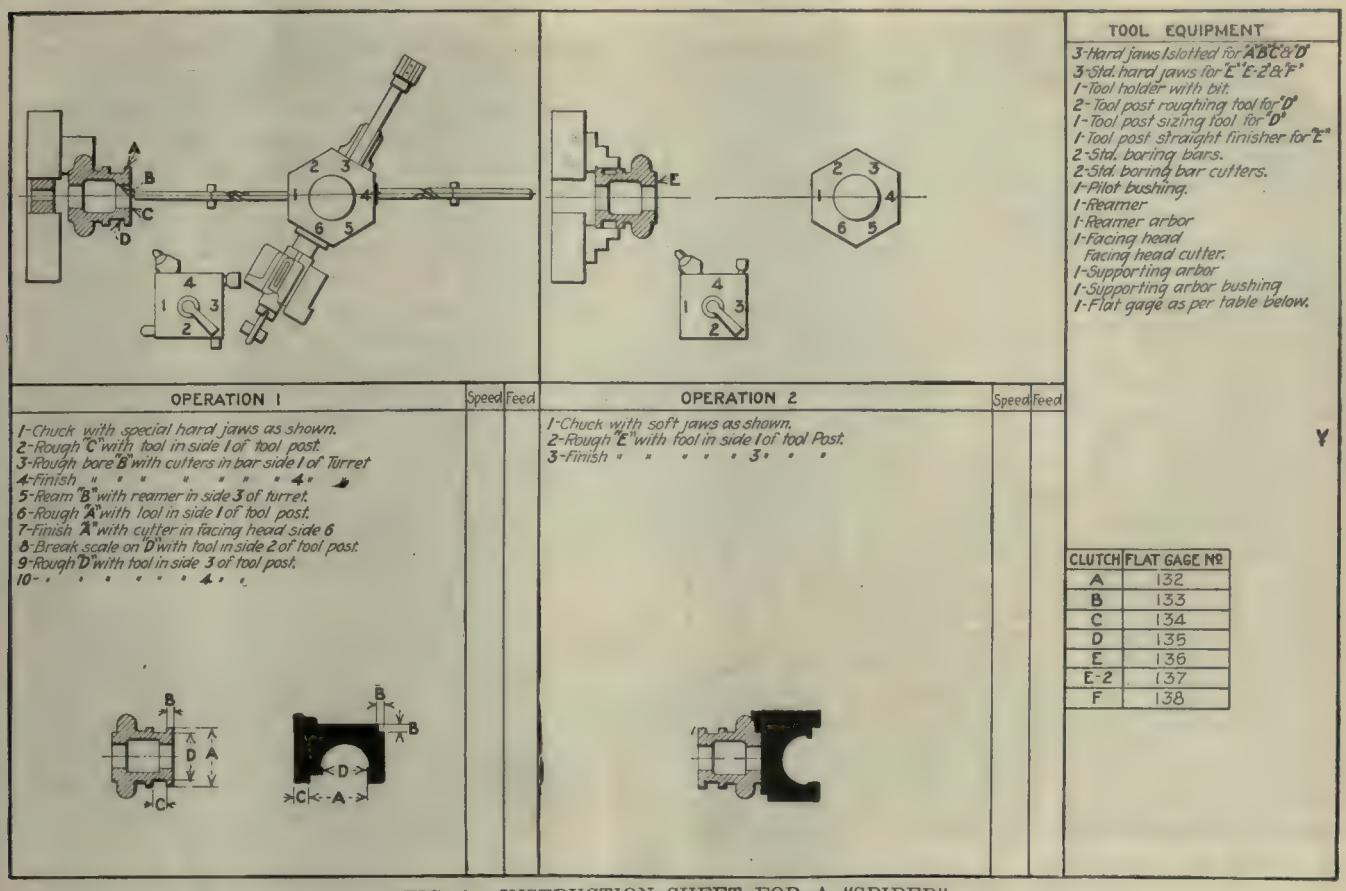


FIG. 1. INSTRUCTION SHEET FOR A "SPIDER"

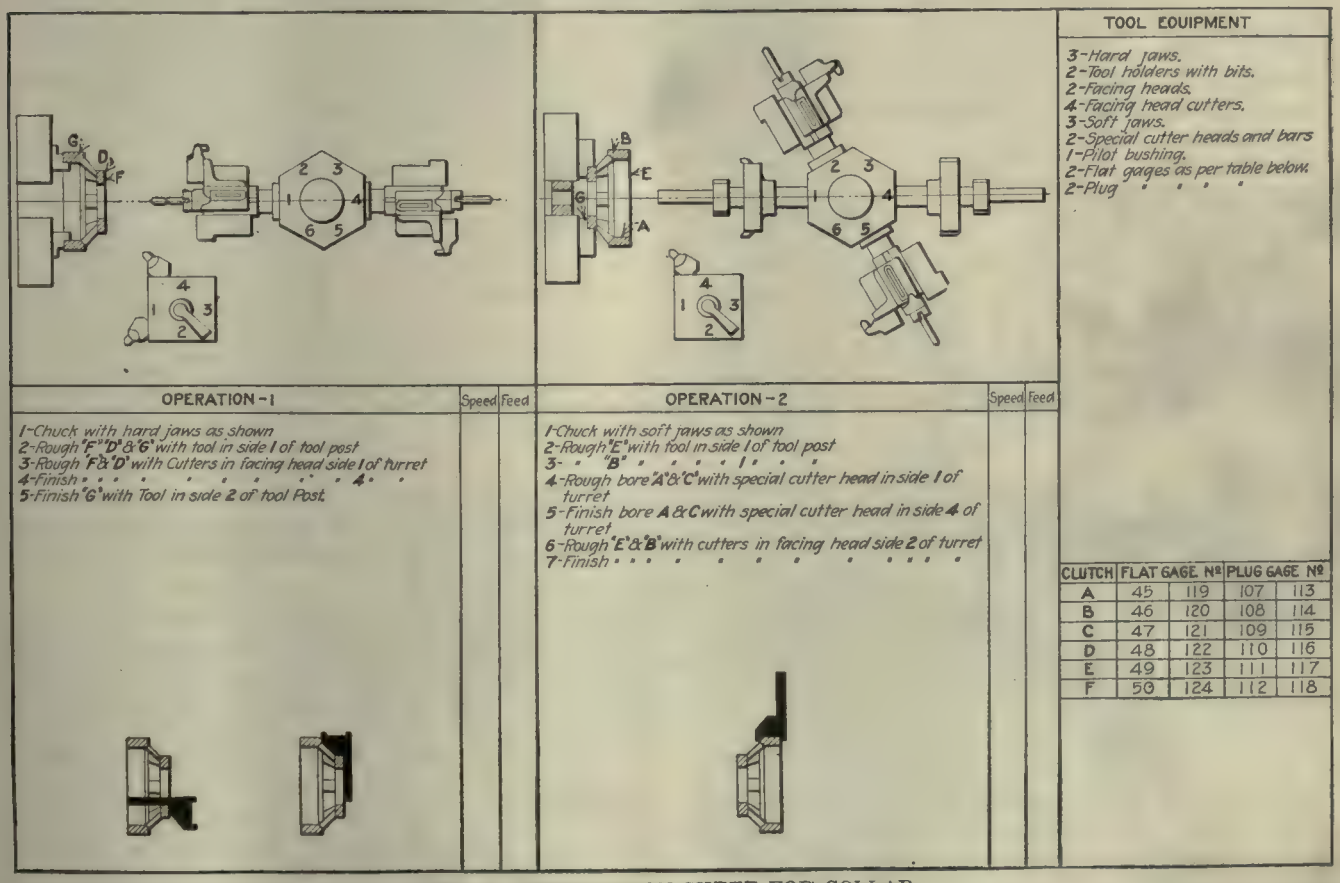


FIG. 2. INSTRUCTION SHEET FOR COLLAR

needed, the different applications being plainly shown on the sheet. Instruction sheets of this kind make it much easier for the man who is not thoroughly familiar with the particular job to avoid mistakes, and when it comes to instructing apprentices or even training special operators, such a sheet is of great help.

Aids to the Construction of Logarithmic Charts

By John L. Alden

Anyone who has had occasion to make many alignment charts for calculating purposes has found the graduation of the scales a slow and tedious task. This is especially so in the case of charts involving multiplication, division, powers, or roots, since the graduations are logarithmic. It is common practice to graduate the scales using a table of logarithms and an engineer's or decimal scale. The writer has found the three schemes described below to be of considerable assistance. Their use has made it so easy to construct these charts that the labor is no longer a bar even though a chart is to be used but a few times.

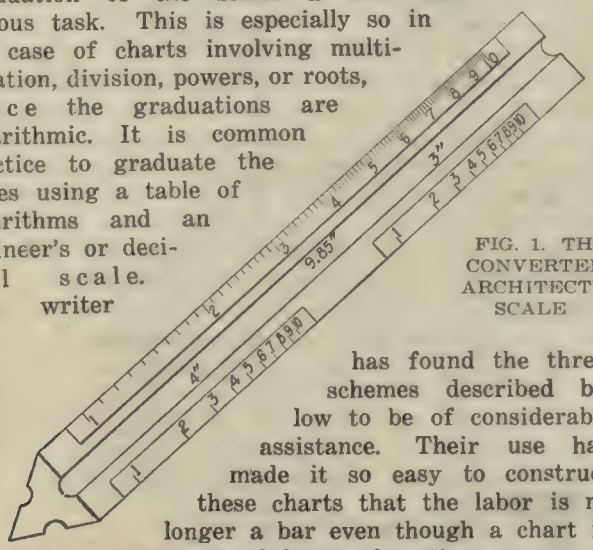


FIG. 1. THE CONVERTED ARCHITECT'S SCALE

The graduations on a triangular architect's scale were planed off, exposing the bare wood. Along the edges of the rule were glued logarithmic scales of paper, Fig. 1. The lengths of these scales for a complete unit from 1 to 10 are 2, 3, 4, 4.92, 6 and 9.85 in. The 4.92- and 9.85-in. scales are the half and full length of the 10-in. slide rule, and were cut from a diagram in a slide rule instruction book. One of these books will yield nearly a dozen scales. The rest of the scales were laid out and inked on bond paper.

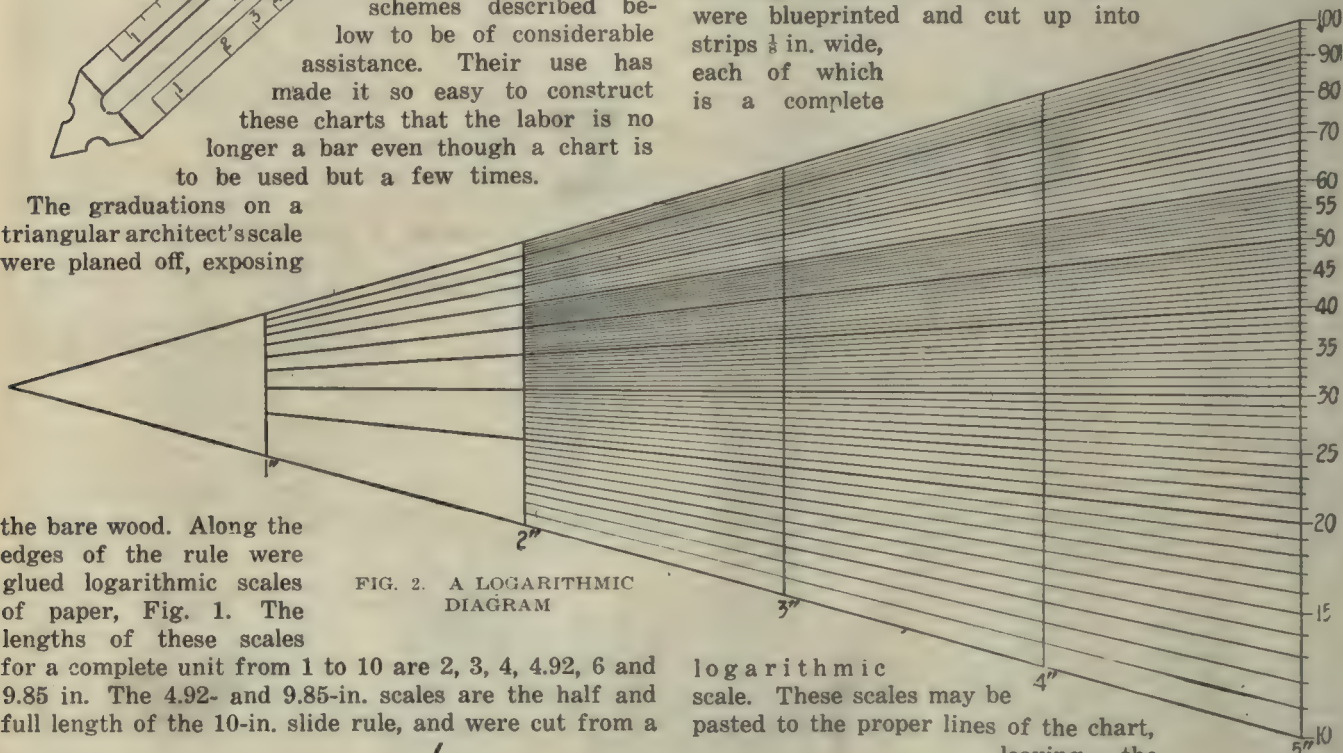


FIG. 2. A LOGARITHMIC DIAGRAM

While the scales of two factors can be laid off in definite lengths on the chart, the scale of the third factor is usually an odd length which must be graduated especially. A logarithmic diagram constructed on tracing cloth, as shown in Fig. 2, may be used to advantage in laying off the desired divisions on such lines of indeterminate length. The vertical axis of this diagram must always be parallel to the line to be graduated. A modification is shown in Fig. 3. This is a rectangular diagram ruled on tracing cloth, which is to be placed diagonally on the line to be graduated. In each case the graduations must be pricked through the transparent cloth onto the line.

The writer has found that the two scales of slide rule length satisfy most requirements and are by far the most commonly used. He therefore constructed two scales of these lengths with graduating lines about 10 in. long, similar to Fig. 3. These were blueprinted and cut up into strips $\frac{1}{8}$ in. wide, each of which is a complete logarithmic scale. These scales may be pasted to the proper lines of the chart, leaving the only lines to be graduated the scales of odd length for the third and succeeding factors.

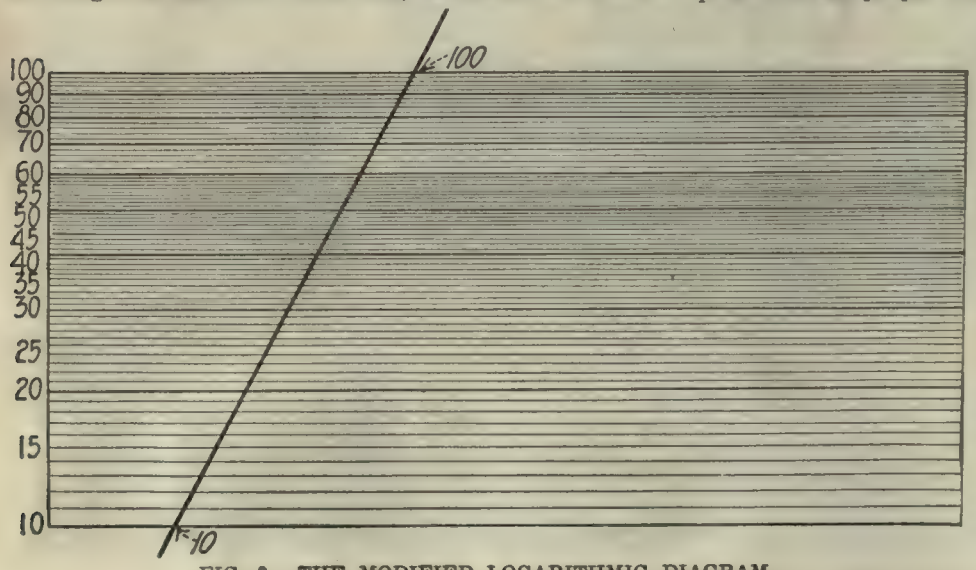


FIG. 3. THE MODIFIED LOGARITHMIC DIAGRAM

"Say dad," inquired the machinist's little boy, "you know that dingus with a hook on one end and a wooden handle on the other that has a wing-wang in the middle to slide up and down when you twiddle the screw? Well! why do they call it a 'monkey wrench'?"

"Cos it's the first thing a fool guy picks up when he starts monkeying with the machinery," growled dad.



ALL electric welding may be divided into two general classes—arc welding and resistance welding. In each class there are a number of ways of obtaining the desired results. Arc welding is the older process, and appears to have been first used by de Meritens in 1881 for uniting parts of storage batteries. He connected the work to the positive pole of a current supply capable of maintaining an arc. The other pole was connected to a carbon rod. An arc was struck by touching the carbon rod to the work and withdrawing it slightly. The heat generated fused the metal parts together, the arc being applied in a way similar to that of the flame of the modern gas torch.

XXV. Electric Welding—Historical*

The evolution of electric arc and resistance welding can be pretty clearly traced, owing to the comparative newness of such work. This article briefly outlines the high spots.

(Part XXIV appeared in last week's issue.)

Of the several methods of arc welding, there are the Zerner, the Bernardos, the Slavianoff and the Strohmenger-Slaughter processes, as well as some modifications of them. The different methods are named after the men generally credited with being responsible for their development. The LaGrange-Hoho process is not a welding process at all, as it is merely a method of heating metal which is then welded by hammering, as in blacksmith work. It is sometimes called the "water-pail forge."

The Zerner process employs two carbon rods fastened in a holder so that their ends converge like a V, as shown in Fig. 302. An arc is drawn between the converging ends and this arc is caused to impinge on the work by means of a powerful electromagnet. The flame acts in such a manner that this process is commonly known as the electric blowpipe method. The Zerner process is so complicated and requires so much skill that it is practically useless. A modification of the Zerner process, known as the "voltex process," uses carbon rods containing a small percentage of metallic oxide which is converted into metallic vapor. This vapor increases the size of the arc and to some extent prevents the excessive carbonizing of the work. This process, however, is about as impractical for general use as the other.

The Bernardos process employs a single carbon or graphite rod and the arc is drawn between this rod and the work. A sketch of the original apparatus is shown in Fig. 303. This is commonly called the carbon-electrode process. In using this method it is considered advisable to connect the carbon to the negative side and the work to the positive. This prevents the carbon of the rod from being carried into the metal and a softer weld is produced.

In the Slavianoff process a metal electrode is used instead of a carbon. This process is known as the metallic-electrode process.

The Strohmenger-Slaughter, or covered electrode, process is similar to the Slavianoff except that a coated metallic electrode is used. In this process either direct or alternating current may be used.

The LaGrange-Hoho heating process makes use of a wooden tank filled with some electrolyte, such as a solution of sodium or potassium carbonate. A plate connected to the positive wire is immersed in the liquid and the work to be heated is connected to the negative wire. The work is then immersed in the liquid. When

*For the author's forthcoming book, "Welding and Cutting."

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the piece has reached a welding temperature it is removed and the weld performed by means of a hammer and anvil.

The idea of joining metals by means of an electric current, known as the resistance or incandescent process, was conceived by Elihu Thomson some time in 1877. Little was done with the idea from a practical standpoint for several years. Between 1883 and 1885 he developed and built an experimental machine. A larger machine was built in 1886. He obtained his first patent on a device for electric welding Aug. 10, 1886. The general outline of this first device is shown in Fig. 304. The first experiments were mostly confined to what is now known as butt welding, and it was soon found that the jaws used to hold the parts heated excessively. To remedy this water-cooled clamping jaws were developed.

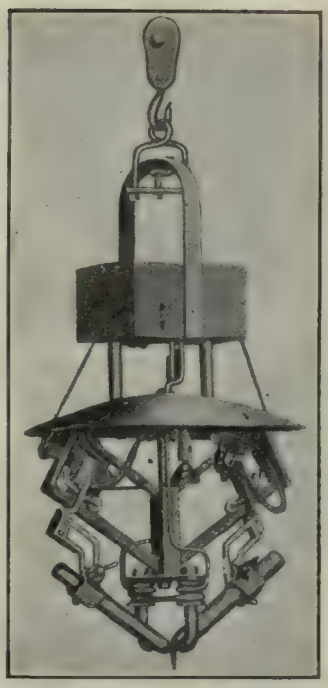


FIG. 302. THE ZERNER ELECTRIC "BLOW-PIPE"

Closely following the butt welding came other applications of the resistance process, such as spot, point or projection, ridge and seam welding. Percussive welding, which is a form of resistance welding, was developed about 1905. Since spot welding is such an important factor in the manufacturing field today the evolution

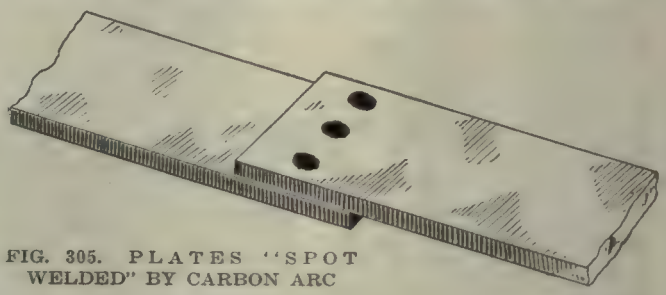


FIG. 305. PLATES "SPOT WELDED" BY CARBON ARC

of this process, as indicated by the more prominent patents, will be of considerable interest: Fig. 305 shows plates spot welded together by means of the carbon arc. This was patented by DeBenardo, May 17, 1887, Pat. No. 363,320. The claims cover a weld made at points only. The darkened places indicate where the welds were made. Fig. 306 shows the apparatus made by DeBenardo for making "spot welds," as they are known today. He patented this in Germany, Jan. 21, 1888. Carbon electrodes were used. This patent was probably the first to cover the process of welding under pressure and also for passing the current through the sheets

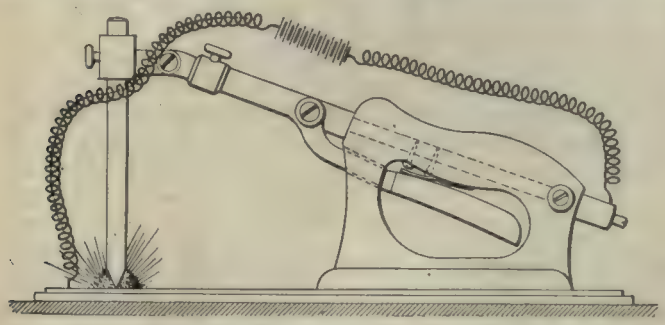


FIG. 303. ORIGINAL BERNARDOS CARBON ELECTRODE APPARATUS

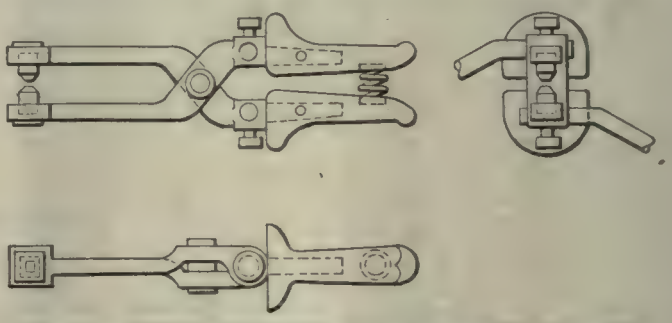


FIG. 306. THE DEBENARDO CARBON ELECTRODE SPOT WELDING APPARATUS

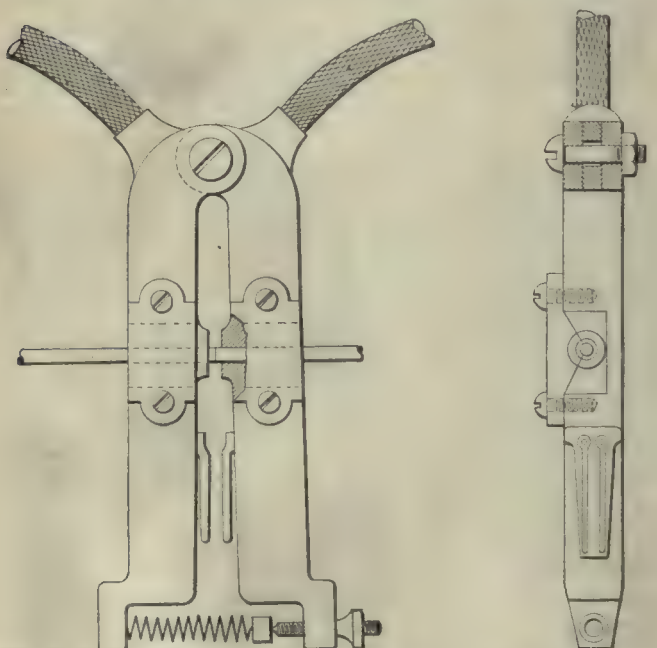


FIG. 304. FIRST PRACTICAL ELECTRIC BUTT WELDING DEVICE, PATENTED BY ELIHU THOMSON, AUG. 10, 1886

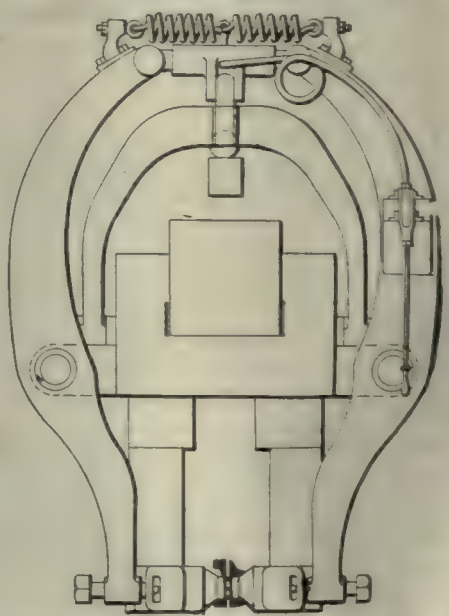


FIG. 307. THE KLEINSCHMIDT APPARATUS, USING COPPER ELECTRODES

being welded. The German patent number was 46,776—49.

The apparatus shown in Fig. 307 is known as the Kleinschmidt patent, No. 616,463, issued Dec. 20, 1898. The patent claims cover the first use of pointed copper electrodes and raised sections, or projections, on the work in order to localize the flow of the current at the point where the weld was to be effected. Considerable pressure was also applied to the electrodes and work by mechanical means.

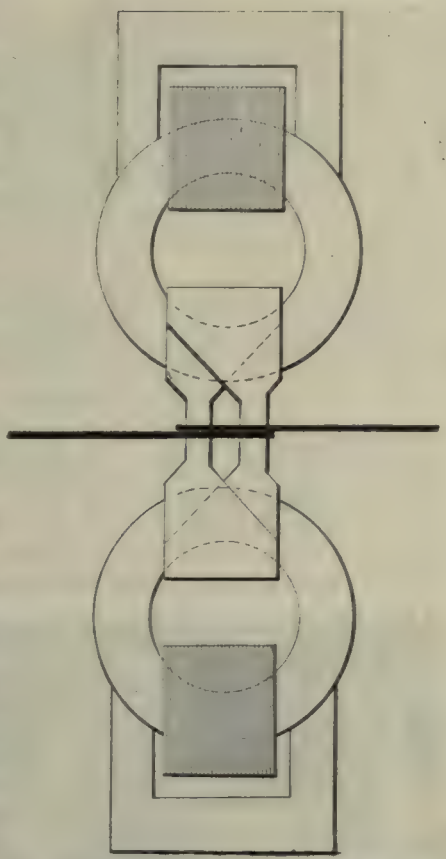


FIG. 308. BOUCHAYER'S SPOT WELDING MACHINE, USING DUPLEX COPPER ELECTRODES

Fig. 308 shows diagrammatically Bouchayer's spot welding machine, patented in France, March 13, 1903, No. 330,200. He used two transformers, one on each side of the work. Duplex copper electrodes were used, and if the transformers were connected parallel one spot weld would be made at each operation. If the transformers were connected in series two spot welds would be made.

Fig. 309 illustrates the principle of the Harmatta patent, No. 1,046,066, issued Dec. 3, 1912. This is practically the same as the DeBenardo patent, No. 46,776—49, except that copper electrodes are used. However, it is under the Harmatta patent that a majority of the spot welding machines in use today are made.

Fig. 310 illustrates the principle on which the Taylor patent is founded. This patent was issued Oct. 16, 1917, No. 1,243,004. It covers the use of two currents which are caused to cross the path of each other in a diagonal direction, concentrating the heating effects at the place of intersection.

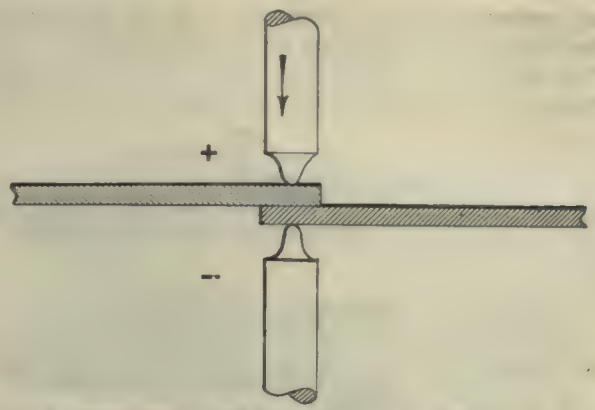


FIG. 309. PRINCIPLE OF THE HARMATTA PROCESS, USING COPPER ELECTRODES

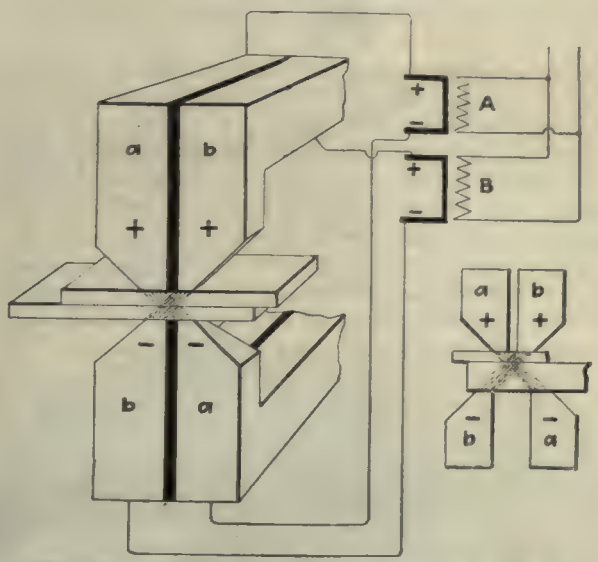


FIG. 310. THE TAYLOR CROSS-CURRENT SPOT WELDING METHOD

From the foregoing it will be seen that spot welds, as this term is now understood, can be produced in a number of ways, none of which methods are identical. As a matter of fact, spot welds can be produced by means of the gas torch or by the blacksmith forge and anvil, although these methods would not be economical.

Carbon-Electrode Arc Welding and Cutting

By O. H. ESCHHOLZ
Research Engineer, Westinghouse Electric and Manufacturing Company, Pittsburgh

This outline of welding and cutting by means of the carbon arc is offered as an aid in the application of these processes. A number of advantageous applications are enumerated.

THE basic principles involved in the graphite-arc process, as formulated by the author, are here set forth in the belief that they have not had sufficiently concrete treatment and that the development of methods of handling the work is too frequently left for the welder to work out. An understanding of these problems should greatly assist welders and result in a more intelligent application of the processes to practical foundry and shop work. This may be considered a companion article to "Training Arc Welders," which appeared on page 837, Vol. 52 of the *American Machinist*.

Carbon or graphite electrode arc welding is the oldest of the electric fusion arc processes now in use. The original process consisted in drawing an arc between the parent metal and a carbon electrode in such a manner that the thermal energy developed at the metal crater fused together the edges of the joint members.

This process was early modified by adding fused filling metal to the molten surface of the parent metal.

The equipment now used consists of a direct-current arc-circuit possessing inherent means for stabilizing

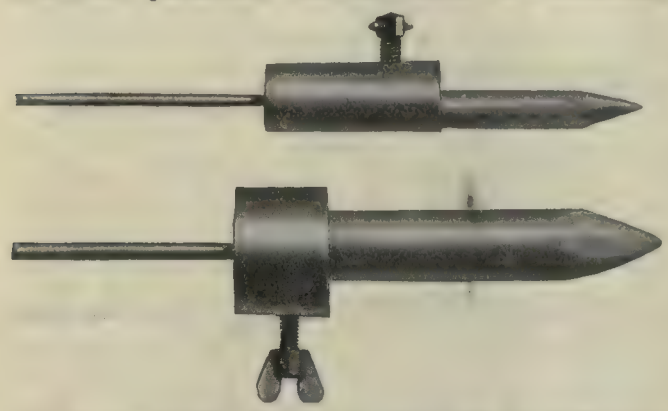


FIG. 1. ADAPTERS FOR USING CARBONS IN METALLIC-ELECTRODE HOLDER

the carbon arc, a welding hood for the operator, an electrode holder that does not become uncomfortably hot in service and suitable clothing such as bellows-tongued shoes, gauntlets and apron of heavy material.

When arc currents of less than 200 amp. are used, or when a graphite arc process is employed intermittently with the metallic electrode process, the carbon-holding adapter shown in Fig. 1 may be used with the metallic electrode holder, the shank of the adapter being substituted for the metal electrode. With very high arc cur-

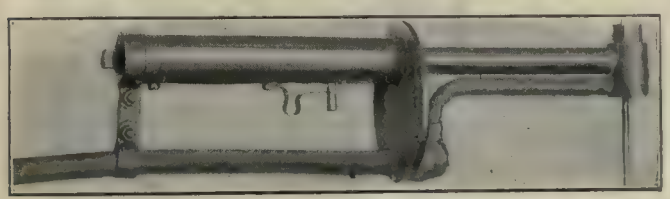


FIG. 2. METALLIC-ELECTRODE HOLDER

rents, 750 amp. or more, special holders should be constructed to protect the operator from the intense heat generated at the arc. Typical holders are shown in Figs. 2 and 3.

Electrodes

Although hard carbon was originally employed for the electrode material, experience has shown that a lower rate of electrode consumption as well as a softer weld may be obtained by substituting graphite electrodes. While both electrodes have the same base and binder, the graphite electrode is baked at a sufficiently high temperature (2,000 deg. C.) to graphitize the binder, thereby improving the bond and the homogeneity of the electrode. The graphite electrode is readily distinguishable by its greasy "feel" and the characteristic streak it makes on paper.

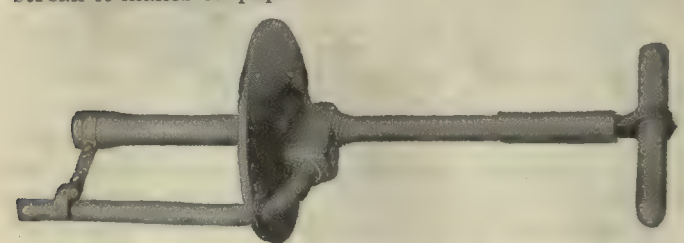


FIG. 3. CARBON- OR GRAPHITE-ELECTRODE HOLDER

The diameter of the electrode is determined partly by the arc current. To fix the position of the carbon arc terminal, thereby increasing arc stability and arc control, all electrodes should be tapered. This precaution is particularly important when using low value of arc current or when maintaining an arc under conditions which cause distortion and instability. The following table gives electrode diameters in most common use with various arc currents:

Amperes	Diameter
50 to 150	$\frac{1}{4}$ in. tapered to $\frac{1}{8}$ in.
150 to 300	$\frac{3}{8}$ in. tapered to $\frac{1}{4}$ in.
300 to 500	1 in. tapered to $\frac{3}{8}$ in.
500 to 750	$1\frac{1}{4}$ in. tapered to $\frac{3}{4}$ in.
750 to 1000	$1\frac{1}{2}$ in. tapered to $\frac{7}{8}$ in.

Filler Material

A strong, sound weld can be obtained only by using for filler metal low-carbon, commercially pure iron rods having a diameter of $\frac{3}{8}$ in. or $\frac{1}{2}$ in., depending on the welding current used. Cast iron or manganese steel filler rods produce hard welds in which the fusion between the parent and added metals may be incomplete.

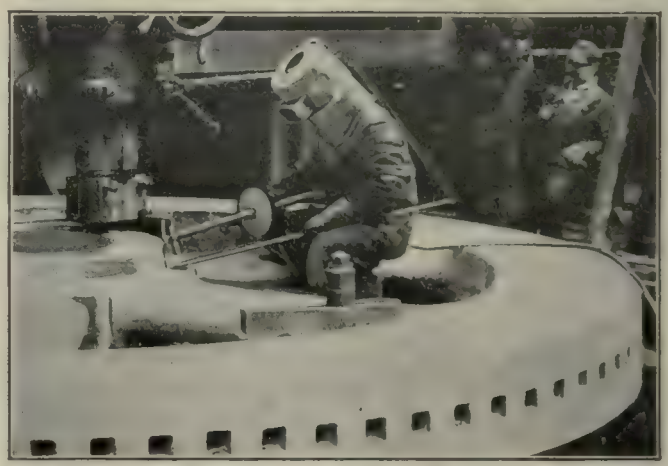


FIG. 4. CORRECT WELDING POSITION WHEN USING CARBON ARC AND A FILLER ROD

Short rods of scrap metal, steel turnings, etc., are frequently made use of for filler metal when the purpose of the welder is merely to fill a hole as rapidly as possible. It should be understood that welds made with such metal are weak, contain many blowholes and are frequently too hard to machine.

It is as difficult for the user of graphite arc processes as it is for the oxy-acetylene welder to estimate the degree of fusion obtained between deposited and parent metals. Therefore the operator must follow conscientiously the correct procedure, recognizing that the responsibility of executing a faulty weld rests solely with himself. He should, of course, have a working knowledge of metals, must be able to distinguish colors and possess a fair degree of muscular co-ordination, although the manipulative skill required is less than that necessitated by the metallic electrode process.

For graphite arc welding employing a filler the correct posture is illustrated in Fig. 4. The filler rod is shown grasped by the left hand with the thumb uppermost. When held in this position the welder may use the rod to brush off slag from the surface of molten metal or to advance the rod into the arc stream.

The surfaces to be welded should be chipped clean. Where they are scarfed the angle should be wide enough to enable the operator to draw an arc from any point

without danger of short-circuiting the arc. It is the practice of some welders to remove sand and slag from the metal surfaces by fusing them with the aid of the arc and then striking the fluid mass with a ball-peen hammer. This method should be discouraged since both operator and nearby workmen may be seriously injured by the flying hot particles.

Arc Manipulation

The arc is formed by withdrawing the graphite electrode from a clean surface of solid metal or from the end of the filler rod when it is held in contact with the parent metal. If the arc is formed from the surface of

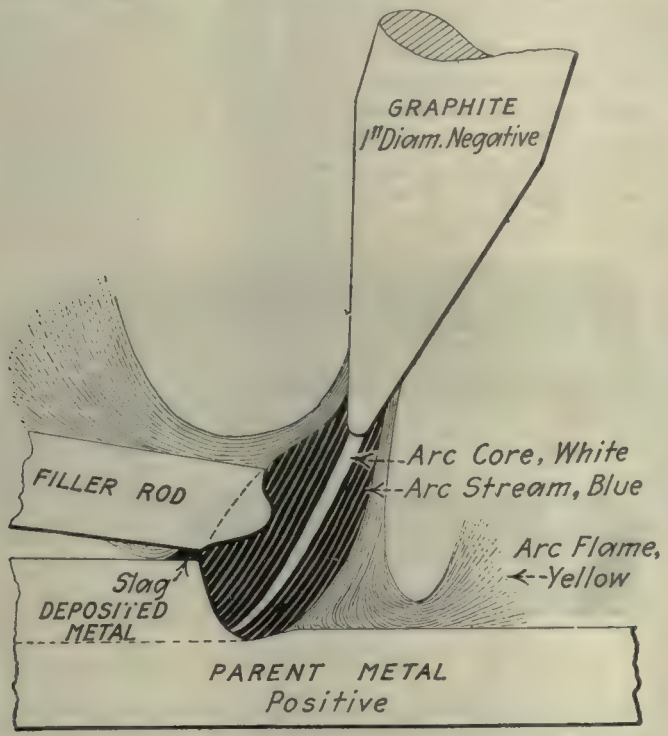


FIG. 5. POSITION OF ELECTRODE AND CHARACTERISTICS OF THE ARC

the deposited metal or from that of a molten area, slag particles may adhere to the end of the electrode, deflecting the arc and increasing the difficulty of manipulating it.

By inclining the electrode approximately 15 deg. to the vertical the control of the position, direction and speed of the arc terminal is facilitated. When the electrode is held vertically irregularities in the direction and force of convection currents deflect the arc first to one side and then to another, causing a corresponding movement of the metal arc terminal. By inclining the graphite electrode the deflecting force is constant in direction, with the result that the electrode arc stream and arc terminal remain approximately in line, as shown in Fig. 5, and may then be moved in any direction or at any speed by a corresponding movement of the graphite electrode.

Polarity

It is common knowledge that the positive terminal of a carbon arc is hotter and consumes more energy than the negative terminal. If the graphite electrode of the welding arc is made the positive terminal, energy will be uselessly consumed and the resulting higher temperature will increase the loss of carbon through excessive oxidation and vaporization. Moreover, for reasons well known to those familiar with the phenomena of arc formation, a very unstable arc is obtained with the iron parent metal functioning as the negative electrode. The



FIG. 6. STARTING TO BUILD UP A SURFACE

graphite electrode should therefore always be connected to the negative terminal, reversal of polarity being detected when the arc is difficult to hold and when the carbon becomes excessively hot.

Arc Length

Even when the graphite electrode serves as the negative arc terminal, its temperature is great enough to cause vaporization of a considerable quantity of carbon.

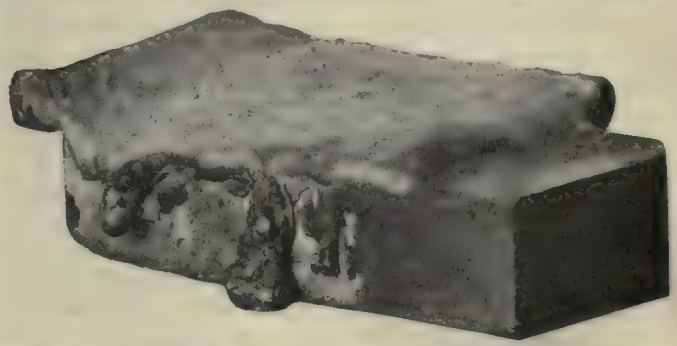


FIG. 7. BUILDING-UP PROCESS NEARLY COMPLETED

If this carbon is permitted to be transferred to and absorbed by the fluid metal, a hard weld will result. To insure a soft metal practically all of the volatilized carbon should be oxidized. This may be accomplished by regulating the arc length so that atmospheric oxygen will have ample time to diffuse through the arc stream and combine with all of the carbon present. The correct arc length is dependent upon the welding current and the degree of confinement of the arc. Since the arc diameter varies as the square root of the current the arc length should be increased in proportion to the

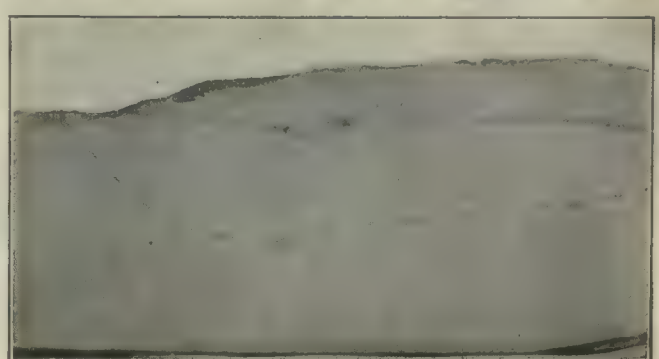


FIG. 8. SECTION THROUGH A BUILT-UP WELD

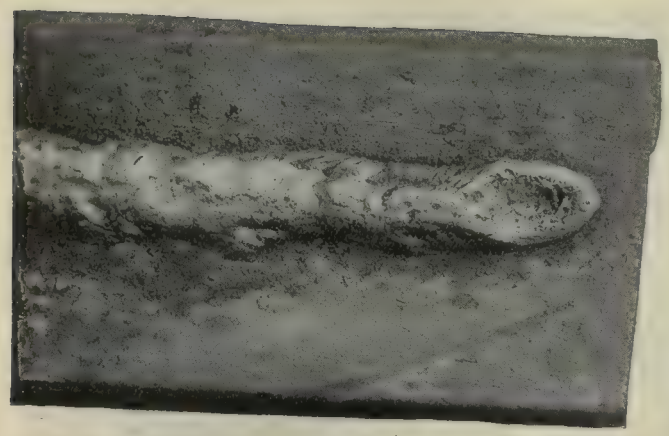


FIG. 9. METHOD OF DEPOSITING FILLING MATERIAL IN LAYERS

square root of the current. It is also obvious that when an arc is drawn from a flat, open surface the vaporized carbon is more accessible to the atmospheric gases than when it is inclosed by the walls of a blowhole. This means that to secure the same amount of oxidized carbon under both conditions the confined arc should be the longer. Many welders are not familiar with this phenomenon, with the result that metal deposited in holes or corners appears to be inexplicably hard.

The length of a 250-amp. arc should not be less than ½ in. and that for a 500-amp. arc should not be less than ¾ in. when drawing the arc from a flat surface. The maintenance of excessive arc lengths causes the diffusion, through convection currents, of the protecting envelope of carbon dioxide, with the result that the exposed hot metal is rapidly oxidized or "burned." For most purposes a 250-amp. arc should not exceed a length of 1 in. and the length of a 500-amp. arc should not exceed 1½ in. In view of the large variation permissible, the welder should be able to maintain an arc length which assures a soft weld metal with but little slag content.

The arc serves to transform electrical energy into thermal energy. The energy developed at the metal terminal or arc crater is utilized to melt the parent metal, while that generated in the arc stream serves to melt the filling material. If the molten filler is not properly guided and, as a consequence, overruns the fused parent metal, a poor weld will result. This process necessitates, therefore, a constant observation of the distribution of the fused metals as well as a proper control of the direction of flow and speed of deposition of the filling metal.

There are two methods in use for adding the filler

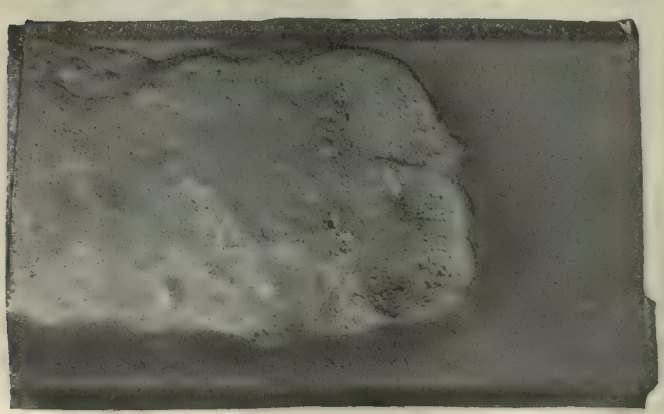


FIG. 10. LAYERS OF DEPOSITS SMOOTHED OVER

with a minimum overlap. One is called the "puddling" process. It consists in melting a small area of the parent metal, thrusting the end of the filler rod into the arc stream, where a small section is melted or cut off, withdrawing the rod and fusing the added material with the molten parent metal by imparting a rotary motion to the arc. This puddling of the metals serves also to float slag and oxidized material to the edge of the fused area, where they may be brushed or chipped off.

The rapid building up of a surface by this method is shown in Fig. 6. The short sections of filler rod were welded to the sides of the casting in order to prevent the molten material from overflowing and to indicate the required height of the addition. The appearance of the nearly completed "fill" is shown in Fig. 7. One side of the added metal is lower than the others to facilitate the floating off of the slag, some of which may be observed adhering to the edge of the plate. Fig. 8 shows a section through a weld produced in this manner, the continuous line indicating the zone of fusion and the broken line the boundary of crystal structural change

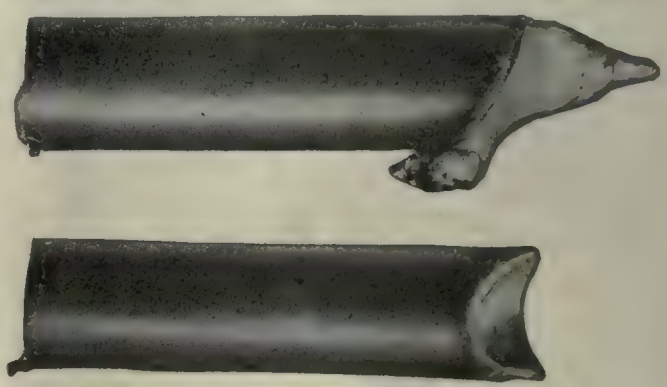


FIG. 11. FUSED ENDS OF FILLER RODS

produced by the temperature cycle through which the parent metal has passed as a result of the absorption of the arc energy.

Some users of this method advocate puddling short sections of the filler rod, 1 to 3 in. in length, with the parent metal. Where this is done, the filler may be incompletely fused and therefore not welded to the surface of the parent metal.

In the second method the filler material is deposited in layers, as shown in Figs. 9 and 10, the deposits being similar to those obtained with the metallic electrode process but wider and higher. In these examples a welding current of 250 amp. with a filling rod ⅜ in. in dia. were used. This method simply requires the operator to feed the filling rod continuously into the arc stream so that the molten filler deposits on the area of parent metal fused by the arc terminal while the arc travels across the surface. If the end of the rod is moved forward while resting on the surface of the newly deposited metal, most of the slag produced by the oxidation of the hot metal is floated to the sides of the deposit, where it may be brushed or chipped off.

The appearance of fused filler rod ends when correctly manipulated is shown in Fig. 11. Slag may be observed still adhering to the bottom of one of the rods. The fusion between parent and added metal is shown in Fig. 12. Four layers of added metal are shown at the upper surface.

To remove slag or improve the appearance of the de-

posits the surface of the added metal may be remelted by running the arc terminal over it, provided "burning" and hardening of the metal is avoided. Figs. 9 and 10 illustrate plainly the appearance of deposits before and after the surfacing operation.

The expedient of hammering or swaging the hot deposited metal is frequently resorted to where a refinement in the structure of the crystal grains is desirable.

Flanged Seam Welding

Fig. 13 illustrates a useful application of the original carbon-arc process wherein no filler metal is used, the metal arc terminal serving to melt together the flanged edges.

This process is easily performed. To obtain adequate fusion the arc current selected should have such a value that the metal-arc crater nearly spans the edges of the seam. To assure the maintenance of a stable arc a small, tapered electrode should be employed, the diameter of the electrode end remaining less than ⅛-in. during use.

This graphite arc process is used occasionally to form

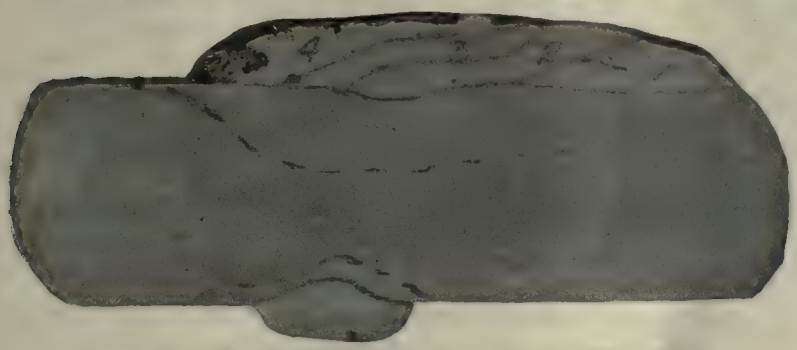


FIG. 12. SHOWING THE FUSION OF PARENT METAL AND FOUR LAYERS

butt and lap welds by melting together the sides of the joint without the use of filler metal. Examination of sections through joints made in this manner reveals that the weld is very shallow and therefore weak.

Welding of Non-Ferrous Metals

Copper and bronzes have been successfully welded with the graphite arc when employing a bronze filler rod low in tin and zinc and high in phosphorus, at least 0.25 per cent. The best filler material for the various analyses of parent metals has not been determined, but it is recognized that the presence of some deoxidizing agent such as phosphorus is necessary in order to insure sound welds free from oxide and blowholes. Since copper and its alloys have a high thermal capacity and conductivity, preheating of the structure facilitates the fusion of the joint surfaces. The grain of the completed weld may be refined by subjecting the metal to a suitable mechanical working and temperature cycle.

Low-melting-point metals such as lead may be welded by holding the graphite electrode in contact with the surfaces to be fused without drawing an arc, the current value used being sufficient to heat the end of the carbon to incandescence. The hot electrode tip may also be used to melt the filler rod into the molten parent metal.

Application

The graphite arc processes may be used for the following purposes:

(1) Welding of cast steel and non-ferrous metals.

(2) Cutting of cast-iron and cast-steel risers and fins and non-ferrous metals.

(3) Rapid deposition of metal to build up a surface or fill in shrinkage cavities, cracks, blowholes and

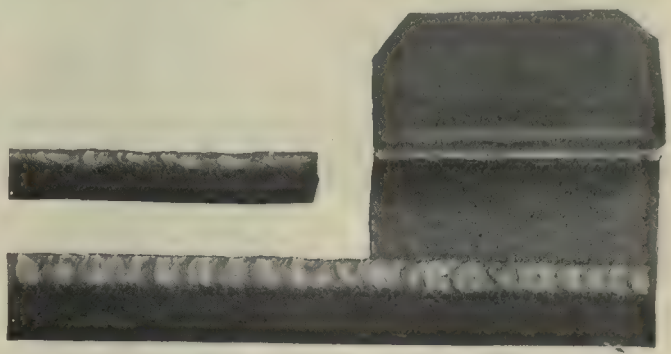


FIG. 13. FLANGED EDGES WELDED WITH GRAPHITE ARC

sand pockets where strength is of minor importance.

(4) Fusion of standing seams.

(5) Melting and cutting of scrap metal.

(6) Remelting of a surface to improve its appearance or fit.

(7) Preheating of a metal structure to facilitate the welding operation, to reduce locked-in stresses or to alter some dimension.

(8) Deposition of hard metal or the hardening of a surface by the inclusion of vaporized carbon, such as rails, frogs and wheel treads.

(9) Automatic cutting and welding of sheet metal.

Cutting

The manipulation of the cutting arc is exceedingly simple, the operator merely advancing the arc terminal over the section to be cut at a rate equal to that at which the molten metal flows from the cut. The cutting speed increases with the value of arc current used. The width of the cut increases with the arc diameter and therefore as the square root of the arc current. Fig. 14 shows the appearance of cuts made in ship steel plate ½ in. thick. The following data applies in this case:

Position of Cut	Amp.	Width, in.	Length, in.	Time, min.
Upper	250	0.5	8	2½
Lower	650	0.8	8	1

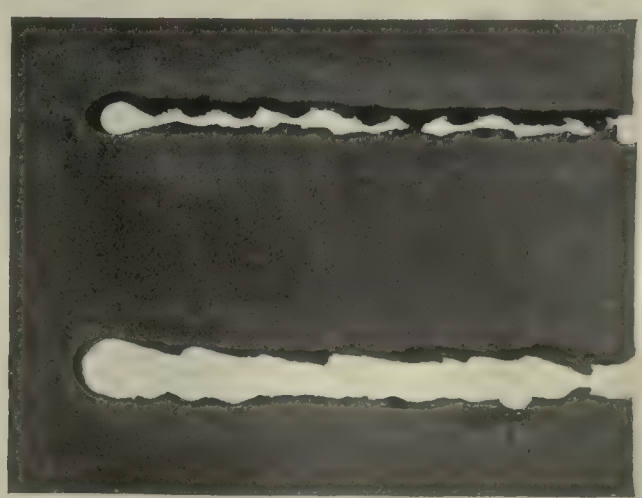


FIG. 14. TYPICAL CARBON-ELECTRODE CUTS IN ½-IN. SHIP PLATE

Before cutting this plate the welder outlined the desired course of the cut by a series of prick-punch marks.

When cutting deeper than 4 in. the electrode should not come in contact with the walls of the cut and thereby short-circuit the arc.

This process may be used for cutting both ferrous and non-ferrous metals. It has found a particularly useful field in the cutting of cast iron. It is often used for the "burning" out of blast-furnace tap holes and the melting or cutting of iron frozen in such furnaces.

Making a Milling Cutter in a Railroad Shop

By Frank A. Stanley

The milling cutter shown by Figs. 1 and 2 is one of a number made in a railroad shop toolroom in the West.

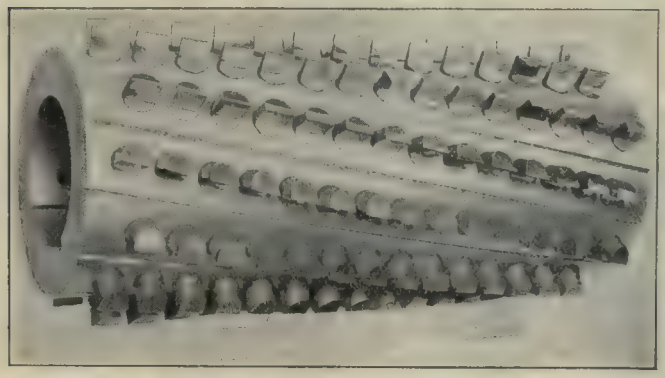


FIG. 1. INSERTED-TOOTH SLABBING-CUTTER

The cutters are for use on large horizontal milling machines in slabbing off such work as connecting rods, and are used under heavy cuts and coarse rates of feed. The body of the cutter shown is made of axle steel and the inserted peg teeth are of high-speed steel.

The cutter illustrated is nearly 2 ft. in length and its diameter is 10½ in. There are twelve rows of teeth, six rows with fifteen each and six with fourteen teeth. The total number of pegs is 174. As the teeth are set on helical lines having a lead of 115½ in. with a diameter of 10½ in. the lead is equivalent to a helix angle of about 16 deg. The pegs are offset in each row half way between those of the preceding and following rows so that a staggered arrangement is secured around the cutter body.

The cutter body is 8½ in. in diameter. The teeth or pegs are 1 in. in diameter and 2⅛ in. long. They are ground to a top rake of 30 deg. and a side angle of 12 deg. The holes for the insertion of the pegs are drilled through the body wall into the bore with a diameter of ¾ in. and enlarged with a counterbore to a diameter of 1 in. and a depth of 1⅛ in., so that the peg projects 1 in. from the body when new. Midway between the rows of holes for the pegs there is a ¼-in. helical groove which is used as a guide for sharpening the cutter on the grinding machine.

The cutter body has a hole clear through to a diameter of 5.005 in. The boring of this hole is illustrated by Fig. 3. As only one cutter was made at a time

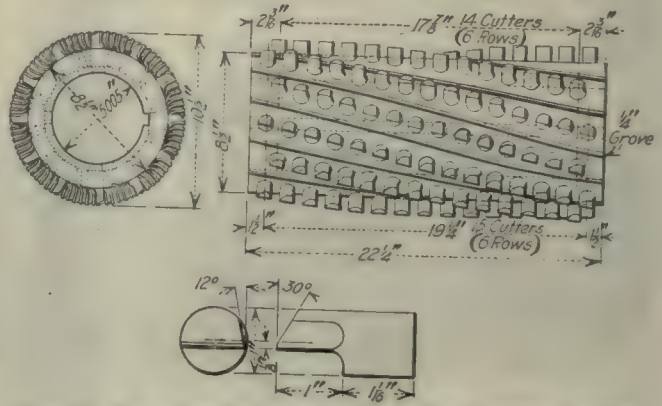


FIG. 2. DETAILS OF CUTTER AND ONE OF THE PEGS

no special tools were developed for the various operations and such machines as were available at the moment were made use of for boring, etc. With the cutter job in Fig. 3 a horizontal boring machine was utilized for putting through the main hole. The axle-steel body cut off from a length somewhat over size was placed in a heavy V-block on the table of the boring machine and here it was braced by struts and fastened by clamps over the top. First the stock was

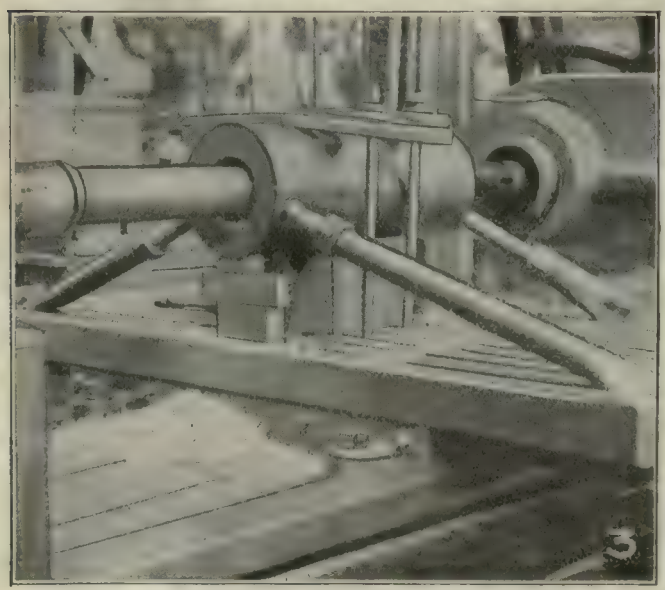


FIG. 3. BORING THE CUTTER BODY



FIG. 4. DRILLING AND COUNTERBORING THE PEG SEATS

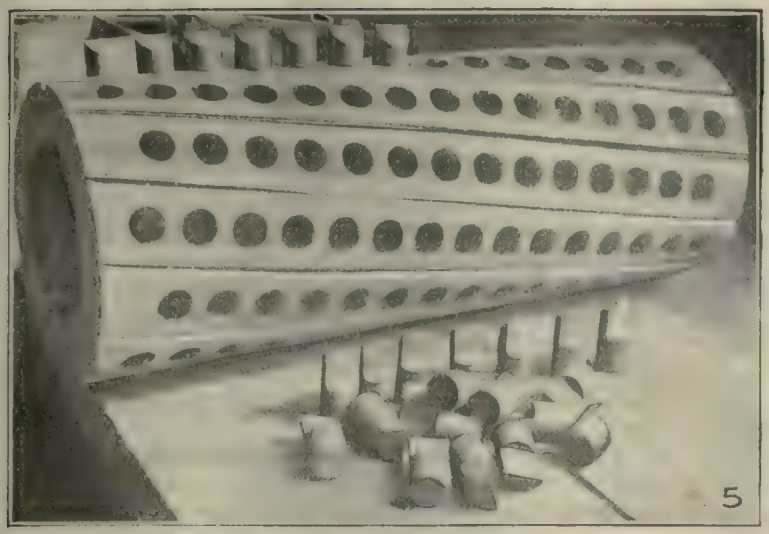


FIG. 5. THE CUTTER PARTLY ASSEMBLED

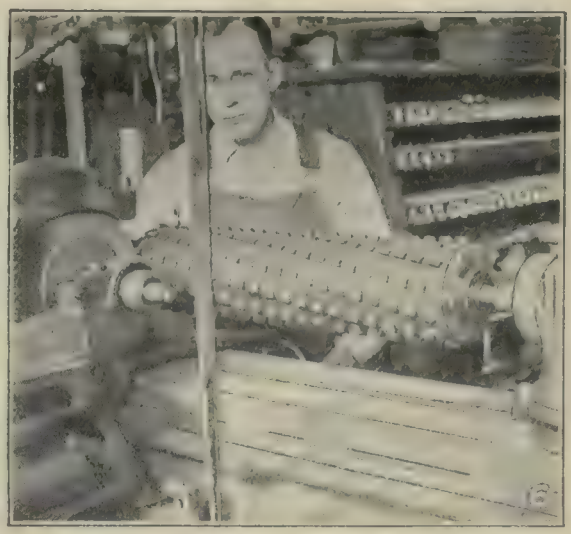


FIG. 6. EVENING THE TEETH LENGTHS BY GRINDING

drilled out and then a boring bar and cutters were used for sizing the hole. Then a $\frac{5}{8}$-in. keyway was cut through the bore and the outside was turned to the required diameter the ends being faced square and to length.

The cutter body was placed on an arbor and mounted between the universal dividing head and tailstock on the toolroom milling machine and the helical guide grooves for grinding the teeth were milled in the body. Also layout lines were traced in the same way for the helical positions of the rows of cutter teeth or pegs and with the body still on the arbor circumferential lines about its surface were scribed at the right distance apart for the lateral positions of the cutter peg holes.

The drilling and counterboring of the holes for the cutter pegs was accomplished under the drill press as shown in Fig. 4. With the holes laid off for correct centers the cutter body was held in a large table vise and one hole after another drilled, and counterbored to size and depth. The appearance of the cutter body when ready for the insertion of the high-speed teeth is shown in Fig. 5.

The operation of grinding the teeth of this type of cutter to an even length is illustrated in Fig. 6. This is accomplished on a Brown & Sharpe grinding machine with the work running at 22 r.p.m. and a surface speed of 65 ft. per min. The wheel used on the high-speed teeth is a Norton 9 x $\frac{1}{2}$ in. alundum 46-J, operated at a peripheral speed of 6,000 ft. per min. The rate of traverse or feed travel is 48 in. per minute.

In general use on the horizontal milling machine in this shop the cutters of this type are run in steel forgings with cuts of $\frac{1}{4}$ to 1 in. or more in depth. In milling the fillets where the bodies join the stub-ends of connecting rods the depth of cut increases up to $2\frac{1}{2}$ in. or more. In milling the flat sides of rods the full width of the cutter is occupied with the broad surfaces as the head of the rod forging is approached. When milling the edges of the rods two or more rods are milled at once under the one cutter. It is common practice here to place two cutters of this kind on the arbor of the machine and thus provide for the milling of two rods simultaneously on the flat faces, and for two pairs of rods at once when milling the edges.

An average rate of speed in running such cutters is 24 r.p.m. with a feed of from $1\frac{1}{2}$ to 2 in. per minute. The feed is naturally greater while the cutter is operating under the comparatively light cuts at the thin ends of the rods but is somewhat reduced when the very deep metal at the large ends of the forgings are approached.

The cutter and methods illustrated are shown as photographed at the shops of the Southern Pacific Co. at Sacramento, California.

Keeping Up the Labor Morale

By J. E. Bullard

The conditions in the plant may be made ideal; the light and air may be perfect; the machinery may be installed in such a way that not an unnecessary step or motion is needed from the time the raw material enters until the finished product leaves the plant; every precaution may be taken against accidents, the machines may all have safety guards and the plant made just as safe to life as it is possible to make; all these things may be done, but if the labor morale is not kept up the results are not going to be satisfactory. Unless all the people in the plant are thinking "more production" the best results cannot be obtained.

All these other things are mechanical. It is comparatively easy to determine the best location of machines, the best way to guard against accidents, the best way to lay out the lighting, the best ventilation. The whole thing can be laid out on a drawing board and studied. The drawing board study makes it possible to determine upon the most satisfactory solution because these things that are being treated follow known laws.

When it comes to treating the labor morale, however, it is a different matter. It is more along the line of the problem that the doctor has. Labor may be suffering from a disease and it is not always possible to tell in advance just how it will react to any remedy that is applied.

There is another way in which labor trouble resembles a disease. When anyone is not well all of his friends have remedies that will make him recover immediately. There is scarcely anyone who meets him who has not something to recommend or to advise. If any person followed all the advice that he receives, the chances that he would ever get well would be very small. The only safety depends upon following the advice of the doctor.

In the same way nearly everyone has a sure-fire remedy for any labor troubles and each person has a different remedy to apply to the same trouble. Not only is this true, but each person can quote cases where his remedy has accomplished wonderful results. Some suggest employee magazines, some a council of the employees, some profit sharing, some welfare work, some pension systems, some housing, some selling stock of the company to the employees on easy payments. There is not one in a hundred who ever suggests that any effort be made to find out what the real trouble is.

Now when a man is sick the success of the doctor depends to a very great extent on the proper diagnosis of his case, of finding out exactly what is the matter. A certain man was sure that there was something wrong with his heart. He went to a doctor and told him his symptoms. This doctor did not look into the case with his usual thoroughness because the trouble seemed so apparent. He began treating the patient for heart trouble. The patient, however, showed no improvement. In fact he seemed to be getting worse, and being worried, decided to visit another doctor. This new doctor asked many questions. He could see from the answers that the primary cause was not heart trouble. He gave the patient a thorough examination and pronounced the real trouble indigestion. The indigestion had interfered to a certain extent with the heart action and caused the patient to feel certain that he had heart trouble. This new doctor treated the patient for indigestion and within a short time he began to show improvement. It was not very long before there were no signs at all of heart trouble. The success of the treatment in this case depended upon first finding out the real trouble and then treating the case for that trouble.

Many a plant applies a remedy for its labor troubles that has proved exceptionally successful in some other plant and finds that it does not work. Conditions do not improve. In fact they may become even worse. The remedy seems to aggravate the disease. It is a good deal like giving a sedative rather than a laxative in the case of constipation. The failure lies, not so much in the remedy as in using it for the wrong disease. Before any remedy is used it should be made certain that the remedy has proved successful when used for the same sort of trouble to which it is planned to apply it.

There is no universal remedy for any kind of labor trouble. Each plant must solve its own problems. Even the same disease or trouble in different plants may require different treatments. The Ford Motor Co. has found a certain plan very effective. It is effective because it has been developed to fit the conditions of that particular factory. If it were applied bodily to plants other than those operated by the Ford Co., it might fail completely. In fact it might result in a hard fought strike. It would not be the fault of the plan. It would be due to the mistake of not prescribing the proper remedy for the trouble.

Just as a doctor rarely treats any two individuals in exactly the same way so employers cannot treat labor troubles in the same way. The treatment which the doctor gives a patient depends upon the present condition and the past history of that patient. The way he has lived, the diseases he has had in the past, his present conditions and his constitution all enter into the decision that the doctor makes in regard to the most effective treatment. In the same way, the past history and present condition of the labor morale of a plant will have a very important bearing upon the proper treatment that should be given to labor in that plant. It is bad practice to place too much dependence upon patented remedies. It is better to make a very careful diagnosis of the case and then prescribe special remedies.

When it is decided to improve the ventilation of a building, the wise engineer first finds out what is wrong with the present ventilation. He does so in order to make sure that he will really improve it and not make the same mistakes that were made in the first installation. When it is decided to improve the lighting, it is first decided what is wrong with the lighting then in use. In the same way when instituting any physical or mechanical improvements it is first decided what is wrong with the old installation.

When it is decided to improve the labor morale, however, an investigation of the causes underlying its condition are not always made, and naturally there is far more likelihood of failure. There are certain methods used in efforts to keep up or improve morale that everyone is satisfied will not give permanent and satisfactory results. We have been given to understand that one of these methods was used by the German high command during the war to keep up the morale of the German soldiers. This method was to give the soldiers only the good news and to hold back the bad news, to tell them only those things which would encourage them and to keep them in ignorance of everything that might discourage them. On the face of it this would seem like a good way of keeping up the morale. It would have worked all right in the case of the Germans if the Allies had not made it their business to give the German soldiers all the bad news, all the information that would discourage them.

There is always danger that the employee magazine, unless it is published to a very great extent by the employees themselves, will become propaganda that is very similar to that which the German high command sent out for the consumption of the private soldiers. No one wants to print any discouraging information in the employees' magazine. He wants to make it just as optimistic as possible. The result may be that it goes on so far in this direction as to cause distrust on the part of the employees and fail utterly in its purpose. Hundreds of employee magazines have gone to an early grave because of the fact that they were written for the management rather than for the employee and it was evident to the employee that this was the case. Naturally the employees took little or no interest in these magazines and the cost of getting them out represented just so much money wasted, if not even a greater loss.

Until the true conditions in a plant are thoroughly studied, remedies cannot be applied intelligently nor can improvements be assured. There is no universal remedy for labor morale. The same system cannot be worked equally well by any two men. It is a case of studying men and conditions and applying the remedy that fits the men and the conditions. It is a case of studying mental reactions and the temperaments of the workers and fitting the conditions to meet these reactions and temperaments. What may be perfectly satisfactory for a Latin race, may not serve so well for a Slavic race, or for Anglo-Saxons. Labor remedies cannot be moved bodily from one plant to another and made to work. They must be sufficiently remodeled to fit the conditions existing in the new plant.

National Screw-Thread Commission Report on Coarse and Fine Threads—I*

The advances made by the commission up to date will reduce the variety of screw threads in general use, facilitate manufacture in case of war, make the best use of labor in our industries in time of peace, increase the safety of travel by rail, steamship and airplane, and in general will increase the dependability of all mechanisms.—FROM THE REPORT.

THE National Screw Thread Commission was created by Act of Congress July 18, 1918, for the purpose of ascertaining and establishing standards for screw threads for use of the various branches of the Federal Government and for the use of manufacturers. The commission was to exist for a period of six months. Before the expiration of this time an extension was granted until March 21, 1920. On March 1, 1920, a further extension of two years was granted. The commission is composed of two representatives of the Army, two representatives of the Navy, four from Engineering societies and the Director of the Bureau of Standards, Washington, D. C., who is chairman. The progress report represents the greater part of the work which it was expected would be accomplished by the commission and has been submitted for approval to the Secretaries of War, Navy and Commerce. The law provides that when the report is thus approved it is binding upon the departments in question and must be used by other Federal departments whenever possible. The following is a digest of the report so far as it concerns the fine and coarse thread series recommended.

The aim of the commission in establishing thread systems for adoption and general use was to eliminate all unnecessary sizes and in addition to utilize, so far as possible, present predominating sizes. While from certain standpoints it would have been desirable to make simplifications in the thread systems and to establish more thoroughly consistent standards, it is believed that any radical change at the present time would be out of place and interfere with manufacturing conditions, and would involve great economic loss.

The testimony given at the various hearings held by the commission is very consistent in favoring the maintenance of the present coarse and fine thread series, the coarse thread series being the present United States Standard threads, supplemented in the series below ¼ in. by the standard established by the American Society of Mechanical Engineers (A. S. M. E.), and the fine thread series being substantially standards that have been found necessary, consisting of sizes taken from the standards of the Society of Automotive Engineers (S. A. E.) and the fine thread series of the American Society of Mechanical Engineers (A. S. M. E.). The recommendation of these standards will tend toward their more universal use, and will constitute important gain that is affected by standardization, with a minimum handicap.

*The report also treated of Fire Hose Coupling Threads, Hose Coupling Threads, and Pipe Threads, the data for which have not been included in this extract.

TABLE I. NATIONAL COARSE THREAD SERIES

Identification		Basic Diameters			Thread Data		
1	2	3	4	5	6	7	8
	n	D	E	K			D
Numbered and Fractional Sizes	Number of Threads per Inch	Major Diameter	Pitch Diameter	Minor Diameter	Metric Equivalent of Major Diam.	Pitch	Depth of Thread
		Inches	Inches	Inches	Mm.	Inches	Inches
No. 1	64	0.073	0.0629	0.0527	1.854	0.0156250	0.0101
2	56	0.086	0.0744	0.0628	2.184	0.0178571	0.0116
3	48	0.099	0.0855	0.0719	2.515	0.0208333	0.0135
4	40	0.112	0.0958	0.0795	2.845	0.0250000	0.0162
5	40	0.125	0.1088	0.0925	3.175	0.0250000	0.0162
6	32	0.138	0.1177	0.0974	3.505	0.0312500	0.0203
8	32	0.164	0.1437	0.1234	4.166	0.0312500	0.0203
10	24	0.190	0.1629	0.1359	4.826	0.0416667	0.0271
12	24	0.216	0.1889	0.1619	5.486	0.0416667	0.0271
1/4"	20	0.2500	0.2175	0.1850	6.350	0.0500000	0.0325
5/16	18	0.3125	0.2764	0.2403	7.938	0.0555556	0.0361
3/8	16	0.3750	0.3344	0.2938	9.525	0.0625000	0.0496
7/16	14	0.4375	0.3911	0.3447	11.113	0.0714286	0.0464
1/2	13	0.5000	0.4500	0.4001	12.700	0.0769231	0.0500
9/16	12	0.5625	0.5084	0.4542	14.288	0.0833333	0.0541
5/8	11	0.6250	0.5660	0.5069	15.875	0.0909091	0.0590
3/4	10	0.7500	0.6850	0.6201	19.050	0.1000000	0.0650
7/8	9	0.8750	0.8028	0.7307	22.225	0.1111111	0.0722
1	8	1.0000	0.9188	0.8376	25.400	0.1250000	0.0812
1 1/8	7	1.1250	1.0322	0.9394	28.575	0.1428571	0.0928
1 1/4	7	1.2500	1.1572	1.0644	31.750	0.1428571	0.0928
1 3/8	6	1.3750	1.3917	1.2835	38.100	0.1666667	0.1083
1 1/2	5	1.7500	1.6201	1.4902	44.450	0.2000000	0.1299
2	4 1/2	2.0000	1.8557	1.7113	50.800	0.2222222	0.1443
2 1/4	4 1/2	2.2500	2.1057	1.9613	57.150	0.2222222	0.1443
2 1/2	4	2.5000	2.3376	2.1752	63.500	0.2500000	0.1624
2 3/4	4	2.7500	2.5876	2.4252	69.850	0.2500000	0.1624
3	4	3.0000	2.8376	2.6752	76.200	0.2500000	0.1624

NATIONAL COARSE THREAD SERIES

There is specified in Table I a thread series which will be known as the National Coarse Thread Series. This series contains certain sizes known previously as the United States Standard threads and also certain sizes known as the A. S. M. E. machine-screw threads. There are included in the National Coarse Thread Series only the sizes which are essential. The National Coarse Threads are recommended for general use in engineering work, in machine construction where conditions are favorable to the use of bolts, screws and other threaded components where quick and easy assembly of the parts is desired, and for all work where conditions do not require the use of fine pitch threads.

NATIONAL FINE THREAD SERIES

The threads specified in Table II will be known as the National Fine Thread Series. This series contains certain sizes known previously as the S. A. E. threads, and, also, certain sizes known as the A. S. M. E. machine-screw sizes. There are included in the National Fine Thread Series only the sizes which are essential. The National Fine Threads are recommended for general use in automotive and aircraft work, for use where the design requires both strength and reduction in weight, and where special conditions require a fine thread, such as, for instance, on large sizes where sufficient force can not be secured to set properly a screw or bolt of coarse pitch by exerting on an ordinary wrench the strength of a man.

The notation used throughout the report is shown in

Fig. 1. The standard form of thread profile known previously as the U. S. Standard or Seller's Profile shall be used as shown by Fig. 2, which represents the form of thread for minimum nut and maximum screw. No

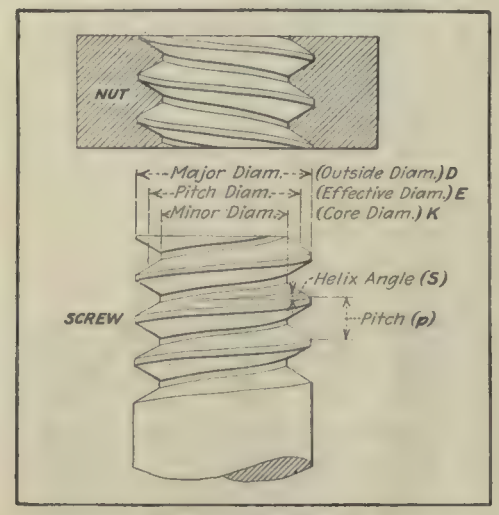


FIG. 1. NOTATION

allowance between nut and screw is shown in Fig. 2, this condition existing in class II, medium-fit, where both the minimum nut and the maximum screw are basic.

Specifications

A clearance shall be provided at the minor diameter of the nut by removing the thread form at the crest by an amount equal to $\frac{1}{8}$ to $\frac{1}{4}$ of the basic thread depth. A clearance at the major diameter of the nut shall be provided by decreasing the depth of the truncation triangle by an amount equal to $\frac{1}{8}$ to $\frac{3}{8}$ of its theoretical value.

The following general specifications will apply to all classes of fits hereinafter specified: In order to conform to the general ideas of standardization the pitch diameter of the minimum threaded hole or nut should correspond to the basic size, the errors due to workmanship being permitted above the basic size. The maximum length of engagement for screw threads manufactured in accordance

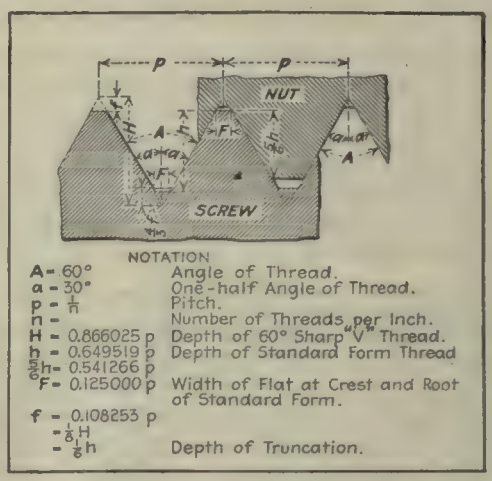


FIG. 2. NATIONAL FORM OF THREAD FOR MINIMUM NUT AND MAXIMUM SCREW

with any of the classes of fit specified herein shall not exceed the quantity as determined in the following formula:

$$L = (1.5)\ D$$

Where L = Length of Engagement

D = Basic Major Diameter of Thread.

The specifications established for the various classes of fit are applicable to the National Coarse Threads and the National Fine Threads.

Classification and Tolerances

The National Coarse and Fine Threads shall be manufactured in accordance with the following "classification and tolerances."

TABLE II. NATIONAL FINE THREAD SERIES

Identification 1	2 n	Basic Diameters 3 D	4 E	5 K	Thread Data 6	7 p	8 h
Numbered and Fractional Sizes	Number of Thread per Inch	Major Diameter	Pitch Diameter	Minor Diameter	Metric Equivalent of Major Diam.	Pitch	Depth of Thread
		Inches	Inches	Inches	Mm.	Inches	Inches
No. 0	80	0.0600	0.0519	0.0438	1.524	0.0125000	0.00812
1	72	0.0730	0.0640	0.0550	1.854	0.0138889	0.00902
2	64	0.0860	0.0759	0.0657	2.184	0.0156250	0.01014
3	56	0.0990	0.0874	0.0758	2.515	0.0178571	0.01160
4	48	0.1120	0.0985	0.0849	2.845	0.0208333	0.01353
5	44	0.1250	0.1102	0.0955	3.175	0.0227273	0.01476
6	40	0.1380	0.1218	0.1055	3.506	0.0250000	0.01624
8	36	0.1640	0.1460	0.1279	4.166	0.0277778	0.01804
10	32	0.1900	0.1697	0.1494	4.826	0.0312500	0.02030
12	28	0.2160	0.1928	0.1696	5.486	0.0357143	0.02319
1/4"	28	0.2500	0.2268	0.2036	6.350	0.0357143	0.02319
5/16	24	0.3125	0.2854	0.2584	7.938	0.0416667	0.02706
3/8	24	0.3750	0.3479	0.3209	9.525	0.0416667	0.02706
7/16	20	0.4375	0.4050	0.3725	11.113	0.0500000	0.03248
1/2	20	0.5000	0.4675	0.4350	12.700	0.0500000	0.03248
9/16	18	0.5625	0.5264	0.4903	14.288	0.0555556	0.03608
5/8	18	0.6250	0.5889	0.5528	15.875	0.0555556	0.03608
3/4	16	0.7500	0.7094	0.6688	19.050	0.0625000	0.04060
7/8	14	0.8750	0.8286	0.7822	22.225	0.0714286	0.04640
1	14	1.0000	0.9536	0.9072	25.400	0.0714286	0.04640
1 1/8	12	1.1250	1.0709	1.0167	28.575	0.0833333	0.05413
1 1/4	12	1.2500	1.1959	1.1417	31.750	0.0833333	0.05413
1 3/8	12	1.5000	1.4459	1.3917	38.100	0.0833333	0.05413
1 1/2	12	1.7500	1.6959	1.6417	44.450	0.0833333	0.05413
2	12	2.0000	1.9459	1.8917	50.800	0.0833333	0.05413
2 1/4	12	2.2500	2.1959	2.1417	57.150	0.0833333	0.05413
2 1/2	12	2.5000	2.4459	2.3917	63.500	0.0833333	0.05413
2 3/4	12	2.7500	2.6959	2.6417	69.850	0.0833333	0.05413
3	10	3.0000	2.9350	2.8701	76.200	0.1000000	0.06495

TABLE III. CLASS I—LOOSE FIT. ALLOWANCES AND TOLERANCES. SCREWS, NUTS AND GAGES

1	2	3	4	5	6	7
			Master Gage Tolerances			
No. Threads per Inch	Allowances	Extreme or Drawing Pitch Dia. Tolerances	Diameter	*Lead	Half Angle	Net Pitch Dia. Tolerances
	Inches	Inches	Inches	Inches	Degrees	Inches
80	0.0007	0.0024	0.0002	±0.0002	±0° 30′	0.0020
72	0.0007	0.0025	0.0002	±0.0002	±0° 30′	0.0021
64	0.0007	0.0026	0.0002	±0.0002	±0° 30′	0.0022
56	0.0008	0.0028	0.0002	±0.0002	±0° 30′	0.0024
48	0.0009	0.0031	0.0002	±0.0002	±0° 30′	0.0027
44	0.0009	0.0032	0.0002	±0.0002	±0° 30′	0.0028
40	0.0010	0.0034	0.0002	±0.0002	±0° 20′	0.0030
36	0.0011	0.0036	0.0002	±0.0002	±0° 20′	0.0032
32	0.0011	0.0038	0.0002	±0.0002	±0° 20′	0.0034
28	0.0012	0.0043	0.0003	±0.0002	±0° 15′	0.0037
24	0.0013	0.0046	0.0003	±0.0002	±0° 15′	0.0040
20	0.0015	0.0051	0.0003	±0.0002	±0° 15′	0.0045
18	0.0016	0.0057	0.0004	±0.0003	±0° 10′	0.0049
16	0.0018	0.0063	0.0004	±0.0003	±0° 10′	0.0055
14	0.0021	0.0070	0.0004	±0.0003	±0° 10′	0.0062
13	0.0022	0.0074	0.0004	±0.0003	±0° 10′	0.0066
12	0.0024	0.0079	0.0004	±0.0003	±0° 10′	0.0071
11	0.0026	0.0085	0.0004	±0.0003	±0° 10′	0.0077
10	0.0028	0.0092	0.0004	±0.0004	±0° 5′	0.0084
9	0.0031	0.0100	0.0004	±0.0004	±0° 5′	0.0092
8	0.0034	0.0111	0.0004	±0.0004	±0° 5′	0.0103
7	0.0039	0.0124	0.0004	±0.0004	±0° 5′	0.0116
6	0.0044	0.0145	0.0006	±0.0005	±0° 5	0.0133
5	0.0052	0.0169	0.0006	±0.0005	±0° 5′	0.0157
4½	0.0057	0.0184	0.0006	±0.0005	±0° 5′	0.0172
4	0.0064	0.0204	0.0006	±0.0005	±0° 5′	0.0192

* Allowable variation in lead between any two threads not farther apart than the length of engagement.

TABLE IV. CLASS II-A—MEDIUM FIT (REGULAR). ALLOWANCES AND TOLERANCES. SCREWS, NUTS AND GAGES

1	2	3	4	5	6	7
			Master Gage Tolerances			
No. Threads per Inch	Allowances	Extreme or Drawing Pitch Dia. Tolerances	Diameter	* Lead	Half Angle	Net Pitch Dia. Tolerances
	Inches	Inches	Inches	Inches	Degrees	Inches
80	0.0000	0.0017	0.0002	±0.0002	±0° 30′	0.0013
72	0.0000	0.0018	0.0002	±0.0002	±0° 30′	0.0014
64	0.0000	0.0019	0.0002	±0.0002	±0° 30′	0.0015
56	0.0000	0.0020	0.0002	±0.0002	±0° 30′	0.0016
48	0.0000	0.0022	0.0002	±0.0002	±0° 30′	0.0018
44	0.0000	0.0023	0.0002	±0.0002	±0° 30′	0.0019
40	0.0000	0.0024	0.0002	±0.0002	±0° 20′	0.0020
36	0.0000	0.0025	0.0002	±0.0002	±0° 20′	0.0021
32	0.0000	0.0027	0.0002	±0.0002	±0° 20′	0.0023
28	0.0000	0.0031	0.0003	±0.0002	±0° 15′	0.0025
24	0.0000	0.0033	0.0003	±0.0002	±0° 15′	0.0027
20	0.0000	0.0036	0.0003	±0.0002	±0° 15′	0.0030
18	0.0000	0.0041	0.0004	±0.0003	±0° 10′	0.0033
16	0.0000	0.0045	0.0004	±0.0003	±0° 10′	0.0037
14	0.0000	0.0049	0.0004	±0.0003	±0° 10′	0.0041
13	0.0000	0.0052	0.0004	±0.0003	±0° 10′	0.0044
12	0.0000	0.0056	0.0004	±0.0003	±0° 10′	0.0048
11	0.0000	0.0059	0.0004	±0.0003	±0° 10′	0.0051
10	0.0000	0.0064	0.0004	±0.0004	±0° 5′	0.0056
9	0.0000	0.0070	0.0004	±0.0004	±0° 5′	0.0062
8	0.0000	0.0076	0.0004	±0.0004	±0° 5′	0.0068
7	0.0000	0.0085	0.0004	±0.0004	±0° 5′	0.0077
6	0.0000	0.0101	0.0006	±0.0005	±0° 5′	0.0089
5	0.0000	0.0116	0.0006	±0.0005	±0° 5′	0.0104
4½	0.0000	0.0127	0.0006	±0.0005	±0° 5′	0.0115
4	0.0000	0.0140	0.0006	±0.0005	±0° 5′	0.0128

* Allowable variation in lead between any two threads not farther apart than the length of engagement.

TABLE V. CLASS II-B—MEDIUM FIT (SPECIAL). ALLOWANCES AND TOLERANCES. SCREWS, NUTS AND GAGES

1	2	3	4	5	6	7
			Master Gage Tolerances			
No. Threads per Inch	Allowances	Extreme or Drawing Pitch Dia. Tolerances	Diameter	* Lead	Half Angle	Net Pitch Dia. Tolerances
	Inches	Inches	Inches	Inches	Degrees	Inches
80	0.0000	0.0013	0.0002	±0.0002	±0° 30′	0.0009
72	0.0000	0.0013	0.0002	±0.0002	±0° 30′	0.0009
64	0.0000	0.0014	0.0002	±0.0002	±0° 30′	0.0010
56	0.0000	0.0015	0.0002	±0.0002	±0° 30′	0.0011
48	0.0000	0.0016	0.0002	±0.0002	±0° 30′	0.0012
44	0.0000	0.0016	0.0002	±0.0002	±0° 30′	0.0012
40	0.0000	0.0017	0.0002	±0.0002	±0° 20′	0.0013
36	0.0000	0.0018	0.0002	±0.0002	±0° 20′	0.0014
32	0.0000	0.0019	0.0002	±0.0002	±0° 20′	0.0015
28	0.0000	0.0022	0.0003	±0.0002	±0° 15′	0.0016
24	0.0000	0.0024	0.0003	±0.0002	±0° 15′	0.0018
20	0.0000	0.0026	0.0003	±0.0002	±0° 15′	0.0020
18	0.0000	0.0030	0.0004	±0.0003	±0° 10′	0.0022
16	0.0000	0.0032	0.0004	±0.0003	±0° 10′	0.0024
14	0.0000	0.0036	0.0004	±0.0003	±0° 10′	0.0028
13	0.0000	0.0037	0.0004	±0.0003	±0° 10′	0.0029
12	0.0000	0.0040	0.0004	±0.0003	±0° 10′	0.0032
11	0.0000	0.0042	0.0004	±0.0003	±0° 10′	0.0034
10	0.0000	0.0045	0.0004	±0.0004	±0° 5′	0.0037
9	0.0000	0.0049	0.0004	±0.0004	±0° 5′	0.0041
8	0.0000	0.0054	0.0004	±0.0004	±0° 5′	0.0046
7	0.0000	0.0059	0.0004	±0.0004	±0° 5′	0.0051
6	0.0000	0.0071	0.0006	±0.0005	±0° 5′	0.0059
5	0.0000	0.0082	0.0006	±0.0005	±0° 5′	0.0070
4½	0.0000	0.0089	0.0006	±0.0005	±0° 5	0.0077
4	0.0000	0.0097	0.0006	±0.0005	±0° 5′	0.0085

* Allowable variation in lead between any two threads not farther apart than the length of engagement.

Class I, Loose Fit

The loose fit class of screw threads is intended to cover the manufacture of strictly interchangeable threaded parts where the work is produced in two or more manufacturing plants. In this class will be included threads for artillery ammunition and rough commercial work, such as stove bolts, carriage bolts, and other threaded work of a similar nature, where quick and easy assembly is necessary and a certain amount of shake or play is not objectionable.

The pitch diameter of the minimum nut of a given diameter and pitch will correspond to the basic pitch diameter as specified in the tables of thread systems given herein, which is computed from the basic major diameter of the thread to be manufactured. The dimensions of the maximum screw of a given pitch and diameter will be below the basic dimensions as specified in the tables of thread systems given herein, which are computed from the basic major diameter of the threads to be manufactured, by the amount of the allowance given in Table III. The tolerance on the nut will be plus; to be applied from the basic size to above basic size. The tolerance on the screw will be minus; to be applied from the maximum screw dimension to below the maximum screw dimension. The allowance provided between the size of the minimum nut, which is basic, and the size of the maximum screw for a screw thread of a given pitch will be as specified in Table III. The tolerance allowed on a screw or nut of a given pitch will be as specified in Table III.

Class II, Medium Fit

The medium fit class, Subdivision A, Regular, is intended to apply to interchangeable manufacture where the threaded members are to assemble nearly, or entirely, with the fingers and where a moderate amount of shake or play between the assembled threaded members is not objectionable. This class will include the great bulk of fastening screws for instruments, small arms and other ordnance material, such as gun carriages, aërial bomb dropping devices and interchangeable accessories mounted on guns; also machine screws, cap-screws, and screws for sewing machines, typewriters and other work of a similar nature.

The pitch diameter of the minimum nut of a given diameter and pitch will correspond to the basic pitch diameter as specified in tables of thread systems given herein, which is computed from the basic major diameter of the thread to be manufactured. The major diameter and pitch diameter of the maximum screw of a given pitch and diameter will correspond to the basic dimensions as specified in tables of thread systems given herein, which are computed from the basic major diameter of the thread to be manufactured. The tolerance on the nut will be plus; to be aplied from the basic size to above basic size. The tolerance on the screw will be minus; to be applied from the basic size to below basic size. The allowance between the size of the maximum screw and the minimum nut will be zero for all pitches and all diameters. The tolerance for a screw or nut of a given pitch will be as specified in Table IV.

The medium fit class, Subdivision B, Special, is intended to apply especially to the higher grade of automobile screw thread work. It is the same in every particular as Class II-A, Medium Fit (Regular), except that the tolerances are smaller. The tolerance for a screw or nut of a given pitch will be as specified in Table V.

Class III, Close Fit

The close fit class of screw is intended for threaded work of the finest commercial quality, where the thread has practically no back lash, and for light screw driver fits. In the manufacture of screw thread products belonging in this class it will be necessary to use precision tools, selected master gages, and many other refinements. This quality of work should, therefore, be used only in cases where requirements of the mechanism being produced are exacting, or where special conditions require screws having a precision fit. In order to secure the fit desired, it may be necessary in some cases to select the parts when the product is being assembled.

The pitch diameter of the minimum nut of a given diameter and pitch will correspond to the basic pitch diameter as specified in tables of thread systems given herein, which is computed from the basic major diameter of the thread to be manufactured. The major diameter and pitch diame-

TABLE VI. CLASS III—CLOSE FIT. ALLOWANCES AND TOLERANCES. SCREWS, NUTS AND GAGES

1	2	3	4	5	6	7
			Master Gage Tolerances			
No. Threads per Inch	Interference or Negative Allowances	Extreme or Drawing Pitch Dia. Tolerances	Diameter	* Lead	Half Angle	Net Pitch Dia. Tolerances
	Inches	Inches	Inches	Inches	Degrees	Inches
80	0.0001	0.0006	0.00010	±0.00010	±15′ 00″	0.0004
72	0.0001	0.0007	0.00010	±0.00010	±15′ 00″	0.0005
64	0.0001	0.0007	0.00010	±0.00010	±15′ 00″	0.0005
56	0.0002	0.0007	0.00010	±0.00010	±15′ 00″	0.0005
48	0.0002	0.0008	0.00010	±0.00010	±15′ 00″	0.0006
44	0.0002	0.0008	0.00010	±0.00010	±15′ 00″	0.0006
40	0.0002	0.0009	0.00010	±0.00010	±10′ 00″	0.0007
36	0.0002	0.0009	0.00010	±0.00010	±10′ 00″	0.0007
32	0.0002	0.0010	0.00010	±0.00010	±10′ 00″	0.0008
28	0.0002	0.0011	0.00015	±0.00010	± 7′ 30″	0.0008
24	0.0003	0.0012	0.00015	±0.00010	± 7′ 30″	0.0009
20	0.0003	0.0013	0.00015	±0.00010	± 7′ 30″	0.0010
18	0.0003	0.0015	0.00020	±0.00015	± 5′ 00″	0.0011
16	0.0004	0.0016	0.00020	±0.00015	± 5′ 00″	0.0012
14	0.0004	0.0018	0.00020	±0.00015	± 5′ 00″	0.0014
13	0.0004	0.0019	0.00020	±0.00015	± 5′ 00″	0.0015
12	0.0005	0.0020	0.00020	±0.00015	± 5′ 00″	0.0016
11	0.0005	0.0021	0.00020	±0.00015	± 5′ 00″	0.0017
10	0.0006	0.0023	0.00020	±0.00020	± 2′ 30″	0.0019
9	0.0006	0.0024	0.00020	±0.00020	± 2′ 30″	0.0020
8	0.0007	0.0027	0.00020	±0.00020	± 2′ 30″	0.0023
7	0.0008	0.0030	0.00020	±0.00020	± 2′ 30″	0.0026
6	0.0009	0.0036	0.00030	±0.00025	± 2′ 30″	0.0030
5	0.0010	0.0041	0.00030	±0.00025	± 2′ 30″	0.0035
4½	0.0011	0.0044	0.00030	±0.00025	± 2′ 30″	0.0038
4	0.0013	0.0048	0.00030	±0.00025	± 2′ 30″	0.0042

* Allowable variation in lead between any two threads not farther apart than the length of engagement.

ter of the maximum screw of a given diameter and pitch will be above the basic dimensions as specified in tables to thread systems given herein, which are computed from the basic major diameter of the thread to be manufactured, by the amount of the allowance (interference) specified in Table VI. The tolerance on the nut will be plus; to be applied from the basic size to above basic size. The tolerance on the screw will be minus; to be applied from the maximum screw dimensions to below the maximum screw dimensions. The allowance (interference) provided between the size of the minimum nut, which is basic, and the size of the maximum screw, which is above basic, will be as specified in Table VI. The tolerance for a screw or nut of a given pitch will be as specified in Table VI.

Class IV, Wrench Fit

The wrench fit class of screw threads is intended to cover the manufacture of threaded parts ¼ in. in diameter or larger which are to be set or assembled permanently with a wrench. Inasmuch as for wrench fits the material is an important factor in determining the fit between the threaded members there are provided herein two subdivisions for this class of work, namely, subdivision "A" and subdivision "B." These two subdivisions differ mainly in the amount of the allowance (interference) values provided for different pitches.

Subdivision "A" of Class IV, Wrench Fit, provides for the production of interchangeable wrench-fit screws or studs used in light sections with moderate stresses, such as for aircraft and automobile engine work.

Subdivision "B" of Class IV, Wrench Fit, provides for the production of interchangeable wrench-fit screws or studs used in heavy sections with heavy stresses, such as for steam engine and heavy hydraulic work.

The pitch diameter of the minimum nut of a given diameter and pitch for threads belonging to either subdivision "A" or subdivision "B" will correspond to the basic pitch diameter as specified in tables of thread systems given herein, which is computed from the basic major diameter of the thread to be manufactured. The major diameter and pitch diameter of the maximum screw of a given diameter and pitch for threads belonging in either subdivision "A" or subdivision "B" will be above the basic dimensions as specified in tables of thread systems given herein, which are computed from the basic major diameter of the thread to be manufactured, by the amount of the allowance (interference) provided. The tolerance on the nut will be plus; to be applied from the basic size to above basic size. The tolerance on the screw will be minus, to be applied from the maximum screw dimensions to below maximum screw dimensions. At the present time the commission does not have sufficient information or data to include in its tentative report values for tolerances and allowances for wrench fits. It is hoped, however, that sufficient information resulting from investigation and research will enable the commission to decide at an early date the allowance and tolerance values for the two classes of wrench fits included herein, which will be applicable to the various materials, and which will meet the requirements found in manufacture of machines or product requiring wrench fits.

Tolerances

There are specified herein for use in connection with the various fits established, three different sets of tolerances, as given in Tables III, IV, V and VI.

The tolerances as hereinafter specified represent the extreme variations allowed on the work.

The tolerance limits established represent, in reality, the sizes of the "Go" and "Not Go" master gages. Errors in lead and angle which occur on the threaded work can be offset by a suitable alteration of the pitch diameter of the work. If the "Go" gage passes the threaded work interchangeability is secured and the thread profile may differ from that of the "Go" gage in either pitch diameter, lead or angle. The "Not Go" gage checks pitch diameter only, and thus insures that the pitch diameter is such that the fit will not be too loose.

The tolerances established for Class I, Loose Fit, and Class II, Medium Fit, permit the use of commercial taps now obtainable from various manufacturers. For Class III, Close Fit, in which it is desired to produce a hole close to the basic size, it is recommended that a selected tap be used.

The pitch diameter tolerances provided for a screw of a given class of fit will be the same as the pitch diameter tolerances provided for a nut corresponding to the same class of fit. The allowable tolerances on the major diameter of screws of a given classification will be twice the tolerance values allowed on the pitch diameters of screws of the same class.

The minimum minor diameter of a screw of a given pitch will be such as to result in a basic flat ($\frac{1}{8}$ x p) at the root when the pitch diameter of the screw is at its minimum value. (Note: When the maximum screw is basic the minimum minor diameter of the screw will be below the *basic* minor diameter by the amount of the specified pitch diameter tolerance.) The maximum minor diameter may be such as results from the use of a worn or rounded threading tool when the pitch diameter is at its maximum value. In no case, however, should the form of the screw as results from tool wear be such as to cause the screw to be rejected on the maximum minor diameter by a "Go" ring gage the minor diameter of which is equal to the minimum minor diameter of the nut.

The maximum major diameter of the nut of a given pitch will be such as to result in a flat ⅛ of the basic flat ($\frac{1}{8}$ x p) when the pitch diameter of the nut is at its maximum value. (Note: When the minimum nut is basic the maximum major diameter will be above the *basic* major diameter by the amount of the specified pitch diameter tolerance plus ⅛ of the basic thread depth.) The nominal minimum major diameter of a nut will be above the basic major diameter by an amount equal to $\frac{1}{16}$ of the basic thread depth plus the neutral space. This results in a clearance which is provided to facilitate manufacture by permitting a slight rounding or wear at the crest of the tap.

In no case, however, should the minimum major diameter of the nut as results from a worn tap or cutting tool be such as to cause the nut to be rejected on the

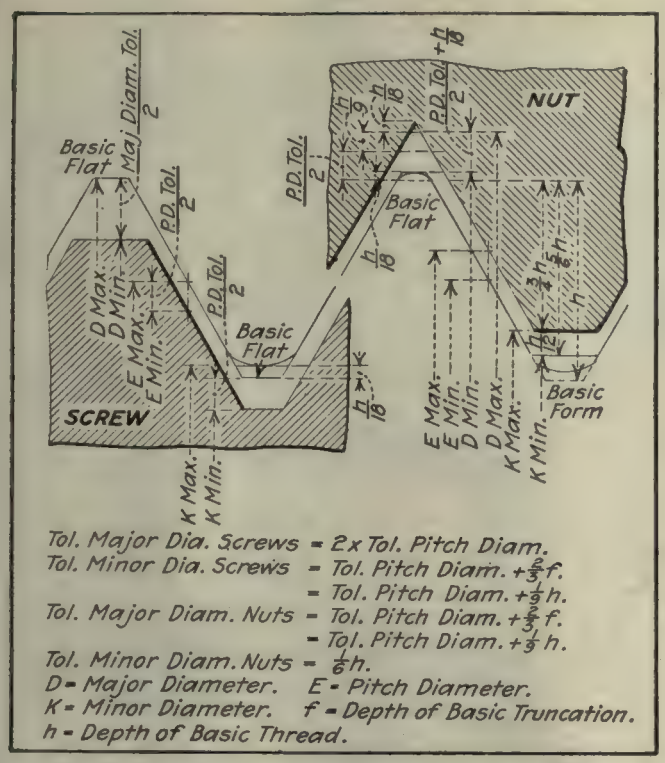


FIG. 3. RELATION BETWEEN PITCH DIAMETER TOLERANCES AND TOLERANCES ON MAJOR AND MINOR DIAMETERS. (DRAWING SHOWS ONE SIDE OF THREAD ONLY AND THEREFORE SPACES INDICATE HALF TOLERANCES OR TOLERANCES ON RADII.)

minimum major diameter by a "Go" plug gage made to the standard form at the crest.

The tolerances on minor diameter of a nut of a given pitch will be ⅛ of the basic thread depth, regardless of the class of fit being produced. In Fig. 3 there are shown the various relations previously specified for tolerances on both the screw and the nut.

The specifications establishing the various sets of tolerances for the different classes of fit specified herein will apply to the manufacture of National Coarse Threads, National Fine Threads, and wherever applicable to the production of all special threads.

Where tolerances are desired for a special thread and the pitch is not listed in the tables given the tolerance values should be chosen corresponding to the number of threads per inch nearest to that of the special thread being produced. Where the number of threads per inch is midway between two of the pitches listed the tolerance corresponding to the coarser pitch should be used. For instance, the tolerance on a screw having 11½ threads per inch would correspond to the tolerances specified for a screw of 11 threads per inch.

With reference to the classification of screw thread fits attention is called to the fact that the minimum threaded hole or nut corresponds to the basic size; that is, the pitch diameter of the minimum nut is basic for all classes of fit. This condition permits the use of taps which when new are oversize and which are discarded when the hole cut is at the basic size. In order to secure the desired fit the screw size is varied; the maximum screw corresponds to the basic size for the Medium Fit Class, is slightly above basic size for Close Fit Class, considerably above the basic size in the Wrench Fit Class, and below the basic size for the Loose Fit Class.

The tolerances specified in column 7 of Tables III, IV, V and VI are the net tolerances, which are in no way reduced by permissible manufacturing tolerances provided for master gages. These master gage tolerances are provided for by being added to the net tolerances. Thus the extreme or drawing tolerances are the net working tolerances increased by the master gage increment or equivalent diametrical space required to provide for the master gage tolerances. The limits established for the extreme tolerances should in no case be exceeded. The application of gage tolerances in relation to tolerances allowed on the work can be best understood by considering that the extreme tolerances represent the absolute limits over which variations of the work must not pass. The manufacturing tolerances required for master gages are then deducted from the extreme working tolerances, producing the figures specified as net tolerances. Further reduction of the extreme tolerances is caused by the manufacturing tolerances required for the inspection gages and working gages.

It is essential that the proportion of the tolerance used by the workmen producing the work at the machine be well within the net tolerance limits. The net tolerance limits as established by the master gages may be considered as the largest circle of the target, the space occupied by the master gage tolerances representing the width of the line establishing the largest circle. The marksman always aims to hit the bull's-eye. Any mark inside of the largest circle or cutting the circle scores. Any mark outside of the largest circle does not score. The same is true in producing work—the careful manufacturer will aim to produce work which is in the center of tolerance limits. The bull's-eye in this case, which is the working tolerance used at the machine, will be considerably less than the net tolerance and the result will be that a very large percentage of the work will be accepted, and spoiled or rejected work will be reduced to practically nothing. If the net tolerance limits are used as working limits at the machine there will be a larger percentage of rejections due to differences in gages and wear of both tools and gages. The application of this principle is illustrated in Fig. 4, which is a diagram showing the relative position of master gage, inspection gage and working gage tolerances with reference to the net tolerance allowed on the work.

Extreme Limits

The extreme limits as shown by the lines at *A* and *a* in Fig. 4 represent the absolute limits within which all variations of the work must be kept, including permissible variations provided for manufacturing tolerances on master gages. The manufacturer of the product should not be concerned with the extreme tolerances but should work within the net tolerance limits. The extreme tolerance limits are included for the manufacturer or inspector of master gages, and in no case should master gages be approved which are outside of the dimensions established by these extreme limits.

The lines at *b* and *B* represent the net working tolerance limits within which all manufactured product must come.

The regions *AB* and *ab* represent the space required to provide for the "Go" and "Not Go" master gage tolerances respectively.

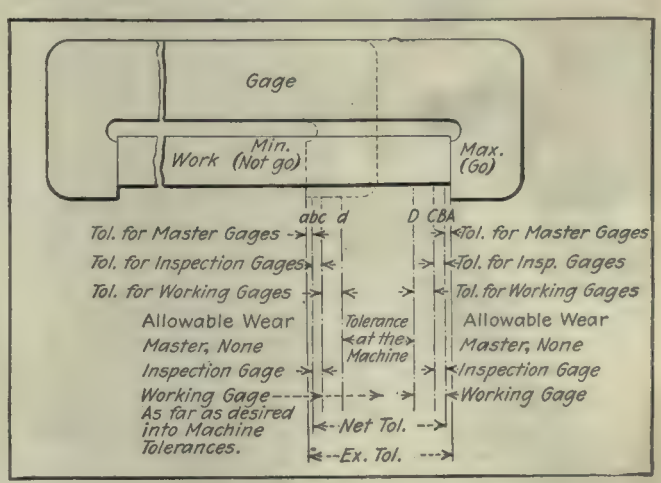


FIG. 4. RELATION OF GAGE SIZES, TOLERANCES AND WEAR LIMITS WITH REFERENCE TO GAGING AN EXTERNAL PART. (FOR GAGING AN INTERNAL PART TOLERANCES AND WEAR ARE PROVIDED FOR IN A SIMILAR MANNER)

Master gages provide physical standards representing the limits placed on the work. The master gage tolerances are placed within the extreme tolerance limits. However, the manufacturer receives the full benefit of the specified net tolerance. So far as the manufacturer is concerned he should in no case permit variations in the work produced to extend beyond the limits established by his master gages.

The regions *BC* and *bc* represent the space required to provide for the "Go" and "Not Go" inspection gage tolerances respectively. The inspection gage tolerances are placed inside the net tolerance limits.

The regions *DC* and *dc* represent the space required to provide for the "Go" and "Not Go" working gage tolerances respectively. These working gage tolerances are placed within the net tolerance limits. This insures that any work accepted by the working gage will be accepted by the inspection gage, and that work accepted by both working gage and inspection gage will be within the net tolerance limits.

The "Go" master gage is not to be used on the product. It serves as a standard for comparative measurements or as a check for verifying the inspection or working gage. It also serves as a standard representing the wear limit for the inspection or working gage. The "Go" master gage is, therefore, not subject to wear.

The "Go" inspection gage may wear until it reaches the size represented by the master gage. As shown in Fig. 4 the wear provided for the inspection gage is that which takes place within its own tolerance region. However, a definite allowance for wear may be provided for the "Go" inspection gage in addition to its tolerance region if desired.

The "Go" working gage wears within its own tolerance limits and through the inspection gage tolerance region and continues to properly accept work until worn to the dimension established by the "Go" master gage. It is good practice to transfer the "Go" working gage to use as an inspection gage when it is worn so that its dimension corresponds to that of the inspection gage.

The "Not Go" master gage is not to be used on the product. It serves as a standard for comparative measurements or as a check to verify the inspection or working gage. It is, therefore, not subject to wear.

The "Not Go" inspection gage wears within its own tolerance region and into the tolerance region established for the "Not Go" working gage. It is good practice to transfer the "Not Go" inspection gage to use as a working gage when it is worn so that its dimension corresponds to that of the "Not Go" working gage.

The "Not Go" working gage wears within its own tolerance region into the working tolerance. It is purely an enonomic question as to when the "Not Go" working gage should be discarded due to wear, inasmuch as continued use reduces the working tolerance, the result of which must be balanced against the cost of a new gage.

(The second part of this article will appear in the next issue.)

An Ancient Planer

By Herbert Fox

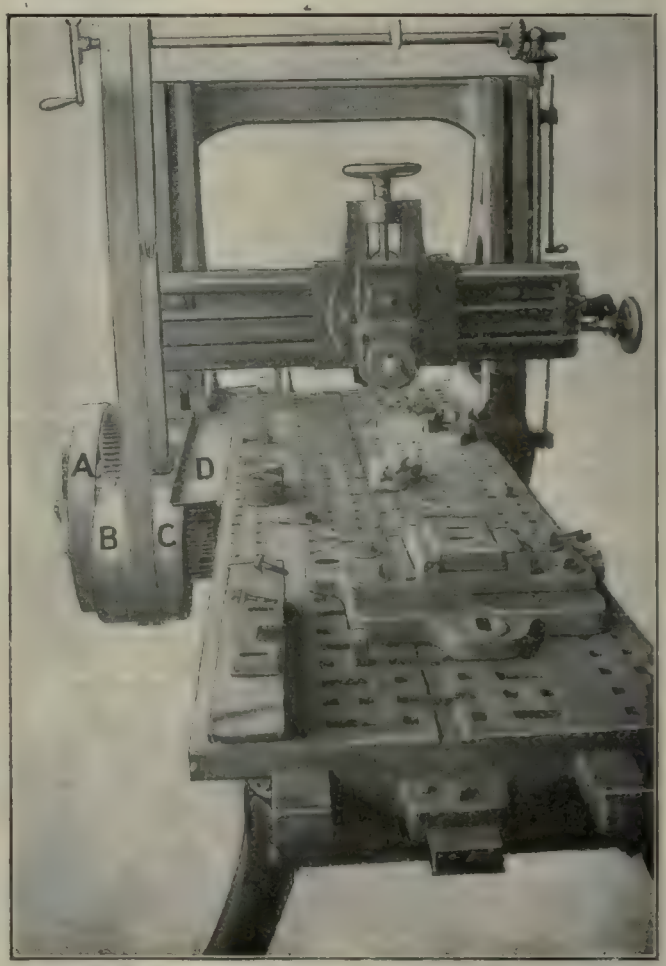
The article on "Examples of Early Machine Design" appearing in *American Machinist* on page 1 of the present volume brought to mind an old planer, still in service, that is different from any of those illustrated and is unique so far as the writer's experience goes.

The machine is located in rather close quarters so that it was impractical to cover it all in a photograph but the picture herewith presented will show the reversing gears, which for simplicity deserve commendation.

All the gears of the table-drive except the bull-wheel are located outside the bed. The drive shaft extends some distance from the bed and on its end is keyed the internal gear *A*. On the same shaft and close to the side of the bed is keyed a regular spur gear of much smaller diameter. Back of the drive shaft a stud, extending from the side of the bed, carries three pulleys that run loosely on the stud.

The outer pulley *B* has upon its outer hub a pinion meshing with the internal gear; the inner hub of the inner pulley *C* is also a pinion and meshes with the spur gear on the shaft drive. The center one of the three pulleys is an idler.

There is but one belt. When this is on the outer pulley the drive is through the pinion on its hub to the internal gear and thus direct to the table with only the one reduction. This is the cutting stroke.



AN EXAMPLE OF EARLY MACHINE DESIGN

When the belt is on the outer pulley the inner pulley is of course being driven in the opposite direction through the gear spur to the pinion on its hub. When the belt is shifted to the inner pulley for the reverse stroke the drive is again direct to the spur gear, and the outer pulley is driven back at a higher rate of speed.

Whether this is an efficient drive or not I do not know; I never used the machine. It is certainly an ingenious arrangement of gearing, and does the work required of it with a less number of gears than is ordinarily used. A disadvantage arises from the fact that the gears are so located as to catch chips that are accidentally brushed off the back side of the bed, and the sheet metal guard *D* has been put on to avoid trouble in this respect.

The planer was built, according to the name on the tie bar, by A. M. Freeland of New York; a name that goes back to the period preceding the Civil War and the machine is therefore from 50 to 70 years old.



Flywheel Starter Ring-Gears

By FRED H. COLVIN
Editor, *American Machinist*

The advent of the geared starter for automobile motors evolved the custom of cutting the geared piece directly in the rim of the cast-iron flywheel, which has not proved altogether satisfactory. Profiting by the experience of others, the Ford Motor Co. makes a steel ring gear that bolts to the flywheel and which obviates broken teeth, as well as undue wear.

THESE rings are made from the straight bar, the first operation being to cut the stock to length at the rate of 240 per hr. on a Ferracute punch press. The ends of the bar are then bent as shown in the transformation sheet, Fig. 1, the bending being done on the Ajax forging machine shown in Fig. 2.

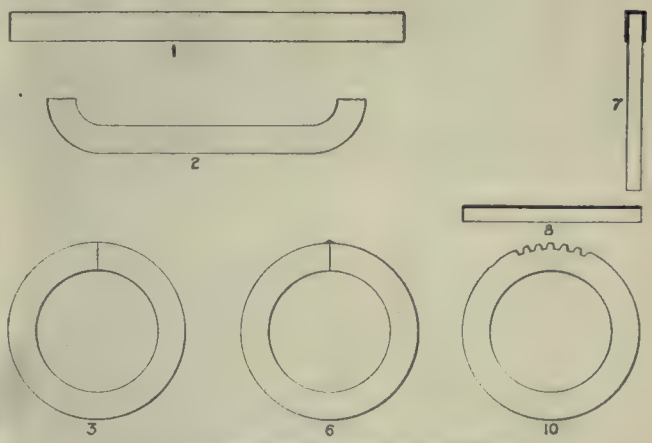


FIG. 1. TRANSFORMATION SHEET

The first and second forming operations are done on the large Bliss press shown at the right of the forging machine, the bars going directly from one to the other. This picture also shows a method of holding an anvil on a cast-iron pedestal. The threaded bolts allow of ready takeup and an anvil so mounted allows any sort of a pad to be interposed between it and the pedestal.

The next forming operations are done on the press

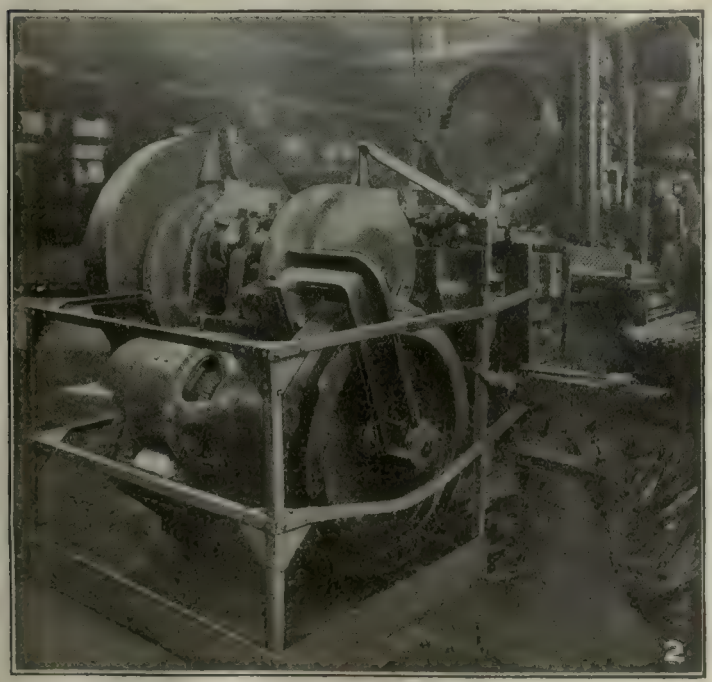


FIG. 2. THE FIRST BENDING OPERATIONS



FIG. 3. THE FINAL BEND

AUTOMOTIVE CONSTRUCTION

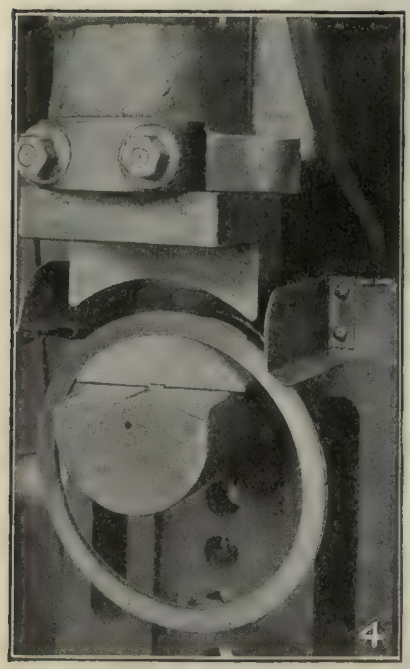


FIG. 4. THE FINAL FORMING

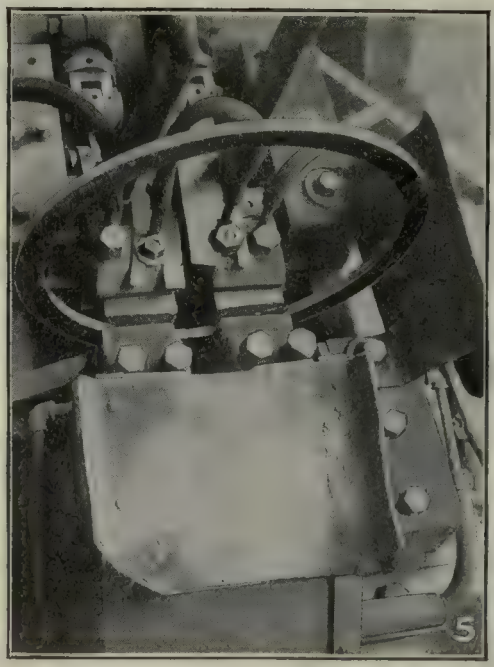


FIG. 5. WELDING THE ENDS

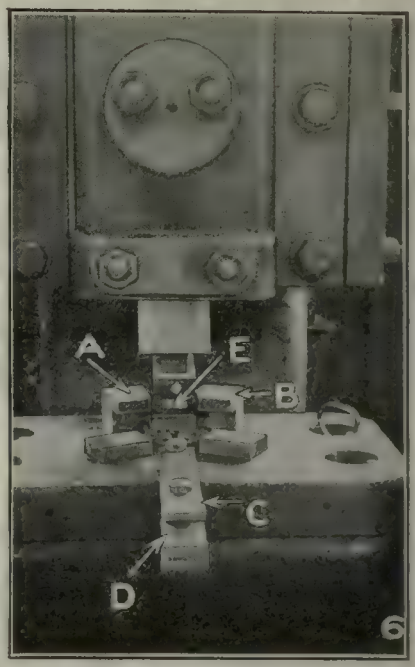


FIG. 6. TRIMMING OUTSIDE FLASH

shown in Fig. 3, which carries double slides *A* and *B*. The ring as it comes to this machine is bent, as shown at *C*, and, after being placed centrally in position, is forced down by the form *D* into the die which is similar to *E* on the other slide. This die closes the ring, which is then taken off the form, and after final forming is ready for the welding machine. The final forming of the ring is done on the horn press shown in Fig. 4, which works out irregularities and brings the points together.

The Welding Operation

The welding is done on a Winfield resistance welder, as shown in Fig. 5, the ring being shown in place and the ends butted together. This machine handles 60 rings per hr., or one per minute.

The flash or surplus metal from the welding must be trimmed on all sides, and the press on which the outside trimming is done is shown in Fig. 6. The ring rests in the blocks *A* and *B*, being held in position by the block *C*, which is on the outer support *D*. The knife or cutter *E* is guided as close to the work as possible to counteract the tendency of springing away from the cut.

Trimming

The sides are trimmed in the press shown in Fig. 7, the ring being supported on a horn and held in position by the lugs *A* and *B*. The trimming knives *C* and *D* come down each side of the ring and trim the flash. Both of these trimming operations are done at the rate of 500 rings per hr.

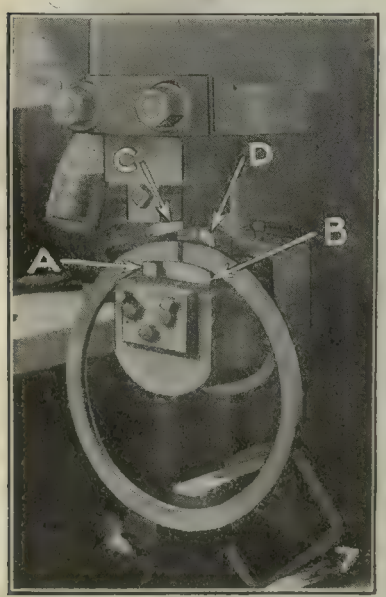


FIG. 7. TRIMMING THE SIDES

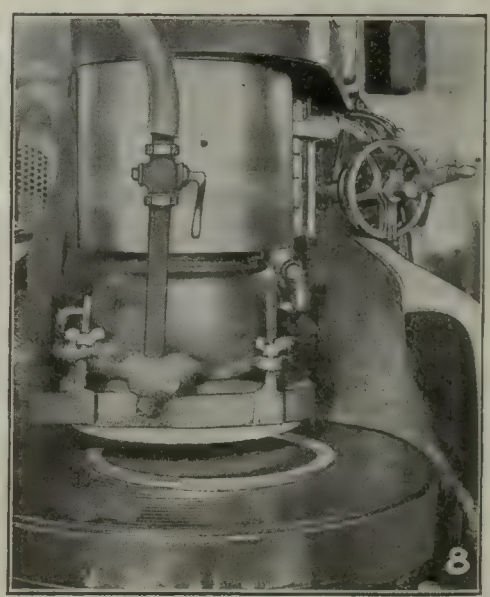


FIG. 8. GRINDING THE SIDES

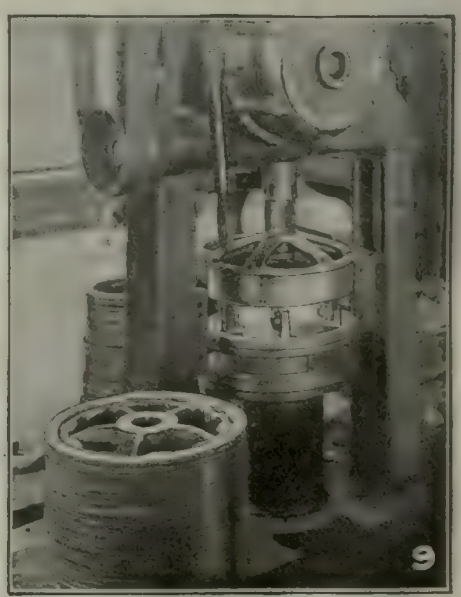


FIG. 9. PRESSING 8 RINGS ON MANDREL

AUTOMOTIVE CONSTRUCTION

The rings are then snagged, after which they are heated and quenched, then restruck under a heavy Erie hammer. They then are tested for hardness on Brinell machines, straightened if necessary, and one face ground on the Blanchard vertical grinding machine shown in Fig. 8, using a magnetic chuck. This machine handles 60 rings per hr., one wheel lasting for about 200 rings.

The rings are then turned on the inside on 24-in. Bullard vertical lathes at the rate of 30 per hr. per machine, after which they are loaded on a mandrel in batches of eight by means of the Atlas power press shown in Fig. 9. The outside diameter is then turned on Reed-Prentice lathes at the rate of 48 per hr., after

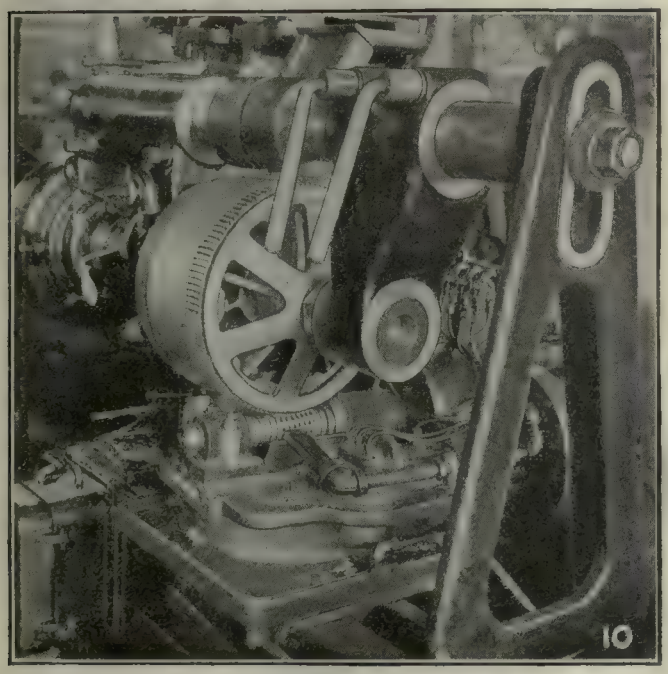


FIG. 10. HOBBING THE GEAR TEETH

which the teeth are rough and finished hobbed on Barber-Colman machines, the finishing operation being shown in Fig. 10. Flooded lubrication is provided by the large piping shown.

The Finishing Operations

The cut gears are then pressed off the mandrel, and the teeth chamfered by various processes. The method shown in Fig. 11 utilizes a Pratt & Whitney milling machine with the simple fixture shown. The gear is held on the plate *A* by means of the three clamps shown, and the teeth spaced with the aid of the spring *B*. Other tooth-rounding methods include the use of Becker hand milling machines and also the Rochester gear tooth rounding machines. The sixteen bolt holes are then drilled, countersunk and tapped, after which the rings are filed on a special Ford made filing machine, and then cleaned on a polishing lathe. This is simply a heavy buffing stand with a substantial work rest bolted across the front. The buffing wheels are carefully protected by heavy guards, so as to avoid all likelihood of accident.

The final operation is the cleansing with a hot bath in a Blakeslee washer, after which they are ready for the assembling department.

A Simple Roll Feed

By Otto Vogetzer

The device shown in the illustration is very useful when making small punchings in quantity. The length of feed may be easily adjusted from ¼ in. to 2½ in. It was made primarily for the purpose of feeding 1½ x 0.020-in. brass to a combination blanking and drawing die.

The punch descends ¾ in. into the die, so that the feed cannot take place until about half of the upstroke has been completed and the stock has been stripped clear of the punch.

The arm which operates the pawl lever is secured to

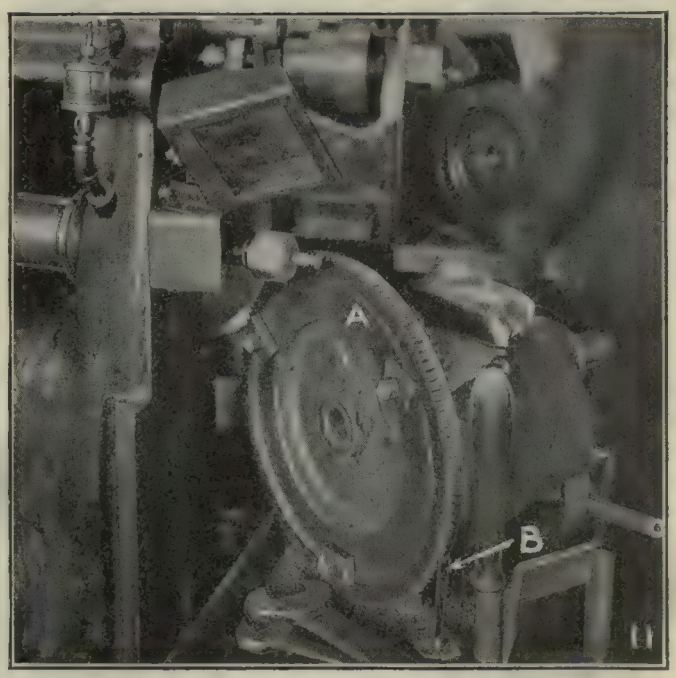
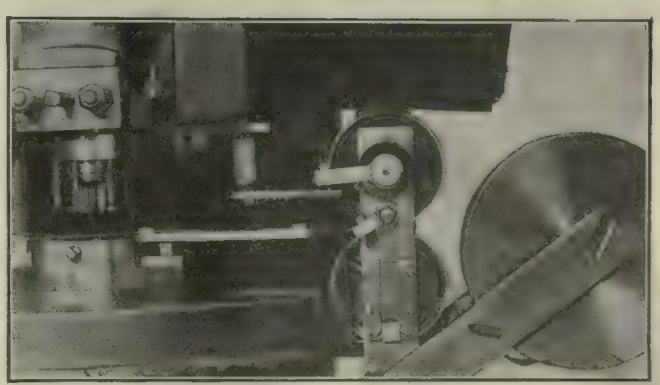


FIG. 11. ROUNDING TOOTH CORNERS

the press ram. On the downstroke the pawl lever is pulled down by a spring until it strikes the lower adjusting screw, which movement determines the number of teeth that the pawl is allowed to turn the ratchet on the upstroke of the ram. The feed is positive and the amount of material fed at each stroke is under control of the operator by turning the adjustment screw.

The output is about 4,000 pieces per hour.



A SIMPLE ROLL FEED



Efficient Pattern Making

By E. A. Dixie

The foreman of our pattern shop is, I believe, one of the most resourceful patternmakers in the United States. Where he shines most I have not yet been able to discover. Sometimes I think it is where but a single casting is required and to judge from the drawings a most elaborate pattern must be made; at other times he seems to excel when making some simple little change in a pattern so that the molders' output is doubled or quadrupled. I have already given you instances of the latter, so this article will serve to show how he simplified a job and reduced the pattern-making time by at least five-sixths.

In Fig. 1 is shown the bottom of the casting, which is approximately 50 in. in diameter by 10 in. deep. The top is flat with an 8-in. diameter hole in the center. The cored under side of the casting was to be in the cope so that the face would be clean metal.

I went to the patternmaker with rough sketches of the piece to get an idea of the time necessary to make the pattern and coreboxes. After going over them carefully he gave me an estimate of six or seven days for pattern work; "but," said he, "how many castings do you want?" "Only one," I replied, "If that is the case," he said, "we can do all the patternwork in not more than a day" and this is how it was done.

A in Fig. 2 is a cast-iron stock pulley ring. *B* is a filling piece to fit the large pulley ring as shown in Fig. 3. The face of *B* was laid out to show where the cores and webs were to go, the webs being left white as shown. Simple core boxes *C* and *D* were provided. The corebox *E* was a small pulley ring which was in

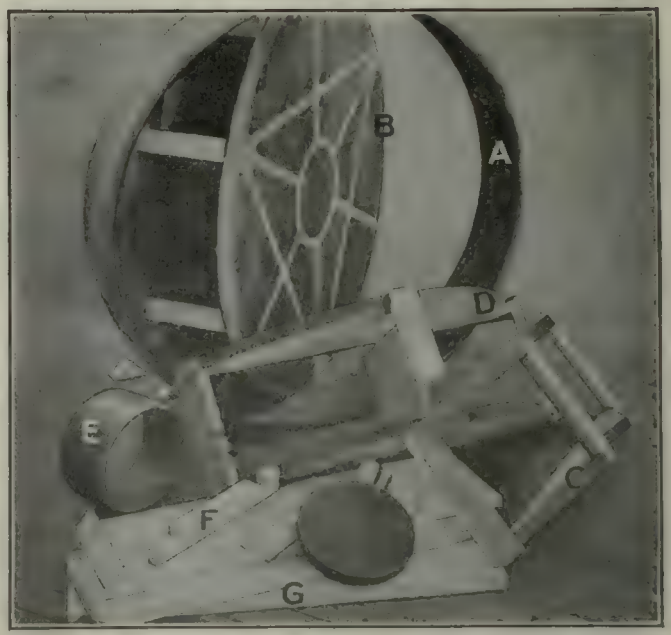


FIG. 2. THE PATTERN AND COREBOXES



FIG. 1. THE BOTTOM SIDE OF THE CASTING, SHOWING THE RIBS



FIG. 3. FILLING PIECE ASSEMBLED IN THE PULLEY RING

stock in the patternloft but *C* and *D* had to be made, as also had the sweeps, one of which is at *F*. The plain pieces of board *G* were wooden dries on which the cores were made up and on which they were baked in the core oven. With the exception of the core from corebox *E*, three cores were made from each of the other coreboxes. Sweeps were made to produce the channel around the bottom.

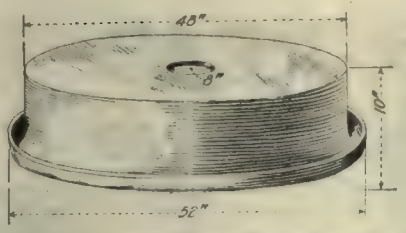


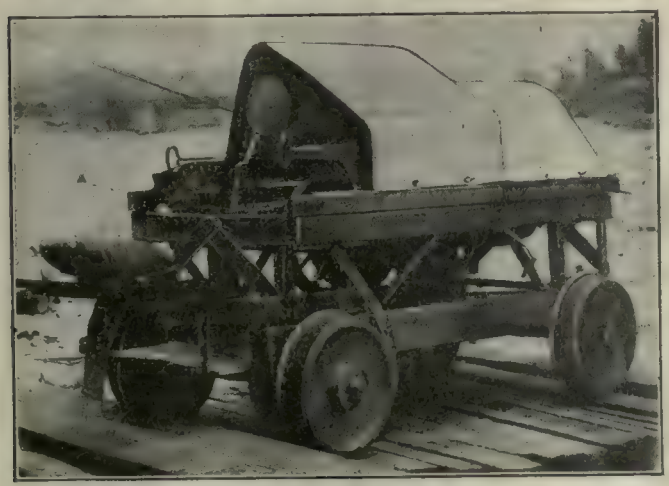
FIG. 4. PERSPECTIVE VIEW OF THE CASTING RIGHT SIDE UP

With the patterns shown the molding was a simple matter and need not be gone into except to mention that the cores were hung by the usual hooks from the cope. Fig. 4 shows a perspective view of the casting.

Motor Car Built by Municipal Machine Shops

By C. W. Geiger

The illustration shows a railway motor car for construction work built by the Municipal Machine Shops, Los Angeles. It was originally used for hauling cars



RAILWAY MOTOR CAR FOR CONSTRUCTION-WORK USE

in the construction of the new outfall sewer at Hyperion, and it was made so that it could be operated within the sewer in drawing the cars from the concrete mixer to points along the outfall. When this work was completed, the car was taken to the municipal rock crushing plant in the bed of the Los Angeles River, and it is now used for hauling the two-yard dump cars.

The car is provided with flanged wheels for the narrow-gage tracks, and it is equipped with a 22-hp. motor taken from an old automobile. The top of the machine is covered with sheet metal.

A Clever Unloading Scheme

By I. B. Rich

A simple yet effective device for saving the time of one man in unloading ore from the bucket is shown in Figs. 1 and 2. The bucket *A* is of the usual type of ore bucket but has a few links of chain with a cross piece at the end, dangling from the bottom. The

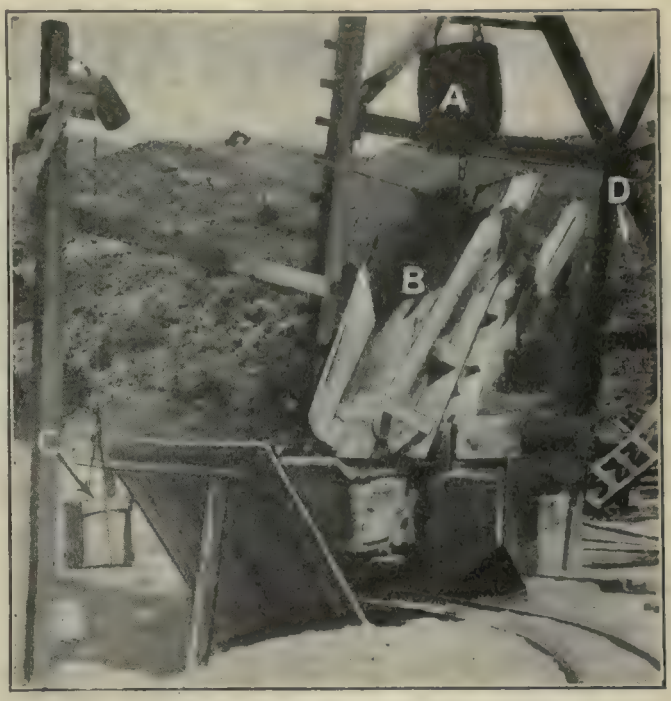


FIG. 1. BUCKET IN UPPER POSITION

ore chute *B* is hinged at the front or lower end and has a V-notch cut in the upper end. The chute is normally held in a vertical position, clear of the mine shaft, by the counterweight *C*.

The engineer or hoist man raises the ore bucket to the position shown in Fig. 1. Then a pull on rope *D*, which runs back into the engine house, tips the chute *B* back under the bucket as shown in both views. This brings the V-notch around the dangling chain so that, when the bucket is lowered, the cross piece catches in the bottom of the V and capsizes the bucket and spills the contents down the chute into the small car shown. This arrangement is in use at the Dardanelles Mine, Chloride, Ariz.

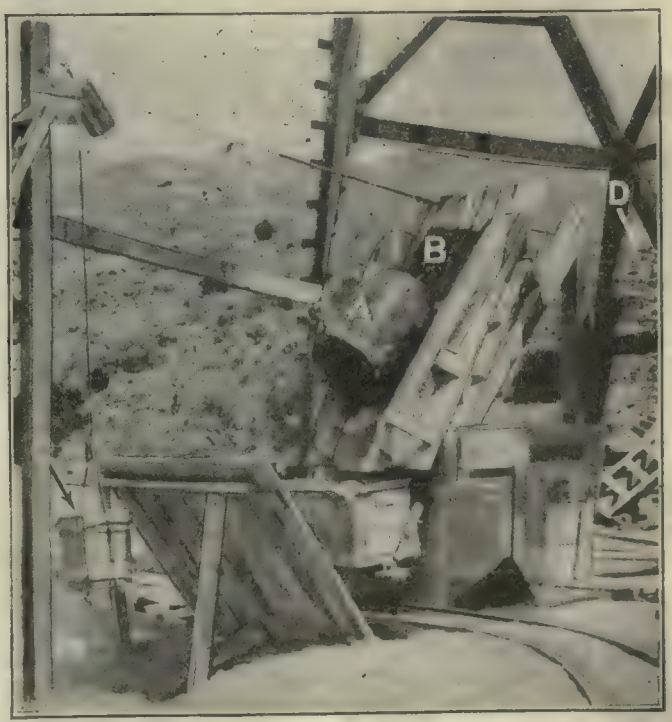


FIG. 2. DUMPING THE BUCKET

WHAT to READ —for the man in a hurry



Suggested by the Managing Editor

THE Millholland Geared-Head Turret Lathe furnishes the material for the opening article. One of the special features of this machine is that there are only four geared spindle speed changes.

E. L. Bowman in his short article "Using the Trade Magazine to Capacity" tells of a very convenient way to get the most good from the *American Machinist* and other trade papers. All of us have been up against the task of going to some amount of trouble to properly benefit from our magazines with the result that many have eventually thrown them away. The indexing and filing system advocated is one way of profitably hanging on to your valuable magazines. Page 489. An original method of obtaining extreme accuracy is delineated in the article by Simeon Colley, "Making a Hobbing Machine for Precision Work," page 491. Mr. Colley tells in detail of the construction of a machine to hob the wormwheels of a precision instrument called the azimuth head, used extensively by our Army.

What to read was not a difficult matter to decide two hundred years ago when books were few and magazines unheard of. It is far different now when so much reading matter is offered to pass the time pleasantly or profitably as the reader chooses. We are doing our utmost to make the "American Machinist" not only profitable but indispensable as a clearing house of ideas and news of the machinery world. This page is the editors' advertisement of their section of the paper. It gives the high spots.

"Western Automobile Repair Shops" and "Instruction Sheets That Instruct" are the titles of two short articles by a Special Correspondent, who, we assure you, is a technical writer of some note. Page 494.

The twenty-fifth article of Ethan Viall's series on "Modern Welding and Cutting" begins on page 497. It deals with the evolution of electric arc and resistance welding. The Viall article is immediately followed (page 499) by another Welding and Cutting article—"Carbon Electrode Arc Welding and Cutting," by O. H. Eschholz, research engineer, Westinghouse Electric and Manufacturing Co., Pittsburgh. It may be considered a companion article to "Training Arc Welders" which appeared on page 837, Vol. 52, of *American Machinist*.

Frank A. Stanley tells of the making of a milling cutter ten and one-half inches in diameter and about two feet in length. This mammoth cutter was used on such work as slabbing off connecting rods under heavy cuts with coarse feeds. "Making a Milling Cutter in a Railroad Shop," page 504.

There was created by Act of Congress July 18, 1918, a commission known as the Screw Thread Commission, its duties being to ascertain and establish standards for screw threads for use of the various branches of the Federal Government and for the use of manufacturers. In its work the Commission aimed to eliminate all unnecessary sizes and to utilize so far as possible, present predominating sizes. The result of the work of the Commission is set forth in a voluminous report. Our extract of the report begins on page 507. It considers coarse and fine threads only and on account of its necessary length has been divided into two parts, the second of which will appear in a subsequent issue. The Commission has submitted the complete report for approval to the Secretaries of War, Navy and Commerce. The law provides that when the report is thus approved, it is binding upon the departments in question and must be used by other Federal departments whenever possible.

The Automotive Section contains another Colvin article—"Flywheel Starter Ring Gears"—page 513. It describes the making of the steel ring gear used on the Ford.

An article of merit is that on heat treatments for alloy steel by A. H. Miller of the research department of the Midvale Steel and Ordnance Co., Philadelphia. The paper is confined to a discussion of steels for structural purposes and is limited to their heat treatment. This begins on page 519.

"American Contractors and Labor Conditions in France," by E. J. Mehren, page 524b, gives some pertinent facts relative to the absence of participation by American contractors in rebuilding the devastated regions of France.

Among the shorter articles of note are "Building Up Subordinates" by Entropy, page 488; "Aids to the Construction of Logarithmic Charts" by John L. Alden, page 496; "Keeping Up the Labor Morale" by J. E. Bullard, page 505, and "How to Get Safe Production" by A. V. Reschar, page 522.

Some Commercial Heat Treatments for Alloy Steels*

By A. H. MILLER
Research Dept., Midvale Steel and Ordnance Co., Philadelphia, Pa.

The object of alloy-steel heat treatment, and indeed with a very few exceptions all heat treatment, is to produce a grain size as small as possible, with a degree of hardness suitable for the purpose intended. The three variables which must be controlled for a successful heat treatment are temperature, time and rate of cooling, and together with these the influence of mass must not be neglected. The author of this paper deals with the heat treatment of alloy steels used for structural purposes, especially of nickel and nickel-chrome steel. He describes a series of tests which were conducted to determine the effects of the various heat treatments on samples of the same chemical composition, and the varied results are illustrated by a series of photomicrographs which show the effect of different adjustments of the above-mentioned variables.

ALLOY steels, both for tool and structural purposes, have had an increasing application for a number of years. This paper is confined to a discussion of steels for structural purposes, and will further limit itself to their heat treatment. It will apply directly to the two alloy steels which are probably used to a greater extent than all others combined; namely, nickel and nickel-chrome steels. It is to be borne in mind, however, that the statements to be made in regard to these two alloys are almost equally applicable to all of the structural alloy steels, provided temperature changes are made which correspond to the changes in the critical temperature of other alloys.

In speaking of heat treatments, a fundamental thought must always be kept in mind: All fabricated steels are submitted to a heat treatment. The differences between steels known as heat-treated and others commonly spoken of as untreated is merely that the treated steels have supposedly received a preconceived, carefully-carried-out treatment, whereas the so-called untreated steels have received a variable and generally unknown treatment which is the result of casting, forging, and cooling at an unknown and variable rate from the casting or forging temperature.

The Time Element in Heat Treatment

In the heat treatment of alloy steels the three variables which must be controlled for a successful heat treatment are temperature, time, and rate of cooling. The influence of mass on these three variables must never be neglected; moreover, it must be borne in mind that an increase in mass may increase the treatment temperature, should increase the length of time held at temperature, and will inevitably alter the rate of cooling.

Too little attention is generally paid to the time element of the heat treatment, whereas it actually is of great importance. The illustrations, Figs. 1-7, are a series of photomicrographs of a nickel-chrome steel of the following composition: carbon, 0.35-0.40 per cent; nickel, 3 per cent; and chromium, 0.75 per cent; and show the microstructure in a typical forged condition, and after annealing at a proper annealing heat for varying periods of time. It will be noted that this series gives the time held at the annealing temperature from zero (meaning that the piece was brought to temperature and the furnace was immediately shut down) to 10 hr. A study of the photomicrographs shows that the ferrite as contained in the cell outlines of the forged specimen was not dissolved and uniformly diffused until the piece had been held at the annealed temperature for ½ hr. Fig. 7 shows that there had been a slight growth of the austenite crystals between the time of completed uniform solution at ½ hr. and the end of the run, 10 hr.

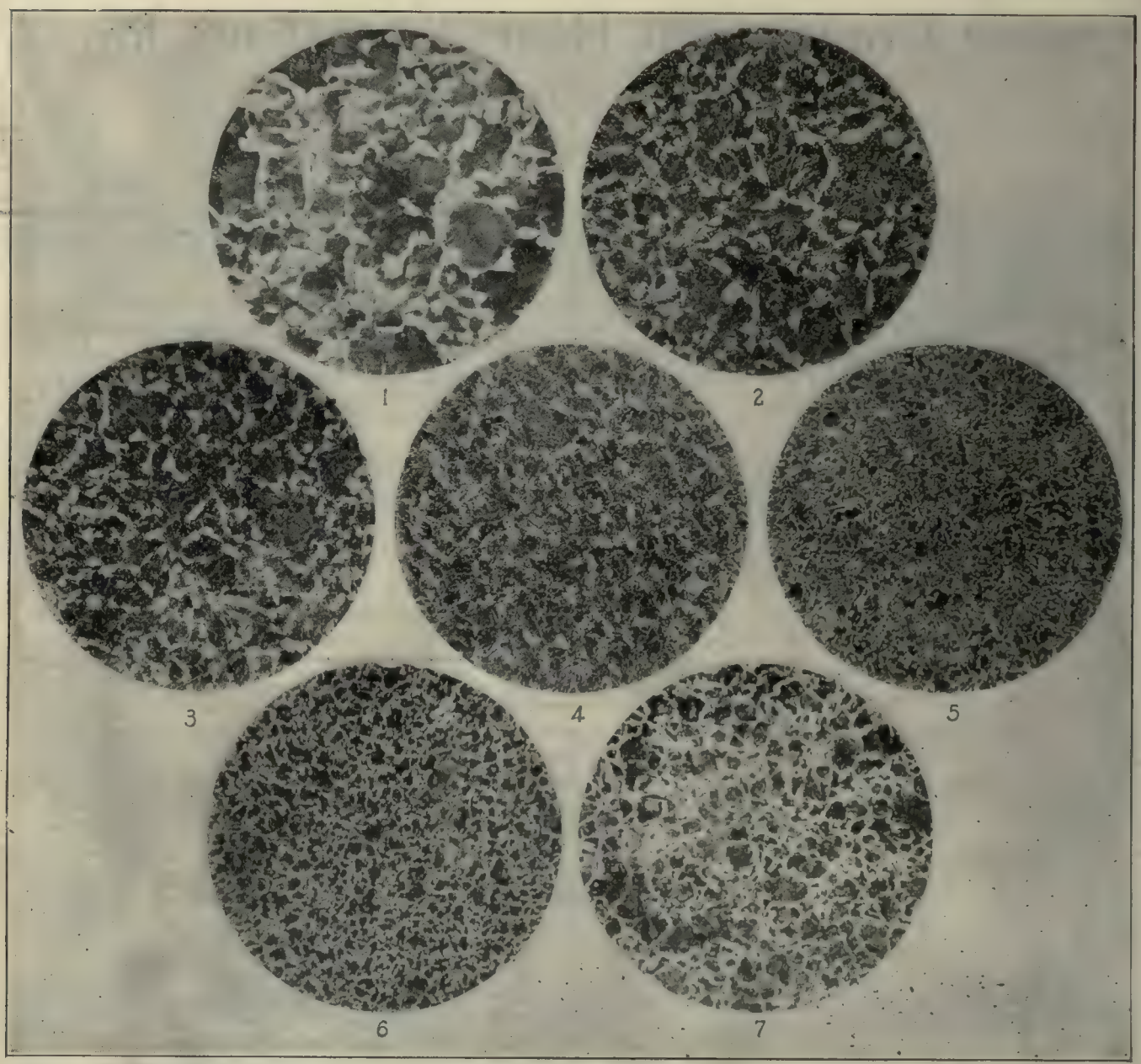
This series also shows that a new cell system may grow in steel simultaneously with the breaking up of the previously existent system. The pieces, representative micrographs of which are shown, were all cut from the same bar, and were treated by placing them together in a furnace controlled by a thermocouple, withdrawing them one by one at the end of the specified time and plunging each immediately into a box of well-aerated lime.

The reason that a considerable length of time is required to produce a uniform structure is probably as follows: After the steel is raised to a temperature above the critical temperature, the iron is in the gamma form, in which iron carbide is soluble. There is, however, a certain length of time required for this solution, and, more than that, a certain added length of time is necessary to allow the solution to become homogeneous, just as, in dissolving a lump of sugar in water, a certain length of time is required to complete the solution, and a certain further length of time for the water to become uniformly sweet. Analogously, if the iron carbide be dissolved in the gamma iron and this solution does not have time to become homogeneous before it be recooled the ferrite will naturally separate out on cooling at the point where the greatest concentration existed in the solution.

Procedure in Alloy-Steel Heat Treatment

The object of alloy-steel heat treatment, and indeed, with a very few exceptions, all heat treatment, is to produce a grain size as small as possible, with a degree of hardness suitable for the purposes intended, by the simplest possible means. Thus the ill-controlled and generally very poorly forged structure must first be broken up and a fine uniform structure established. In steels which are sensitive to heat treatment, of which the nickel and nickel-chrome steels are excellent examples, this object is best achieved in several steps, each of which is designed to break up the structure resulting from the previous step and bring the material into a more nearly ideal condition.

*Presented at a meeting of the Washington Section of the American Society of Mechanical Engineers. Reprinted from *Mechanical Engineering*, September, 1920.



FIGS. 1 TO 7. EFFECT OF TIME AT NORMALIZING HEAT (1,450 DEG. FAHR.) FOLLOWED BY SLOW COOLING
Fig. 1—As forged. Fig. 2—Not held, cooled in lime. Fig. 3—Held 5 min. Fig. 4—Held 10 min. Fig. 5—Held 15 min. Fig. 6—Held 30 min. Fig. 7—Held 10 hr. × 80.

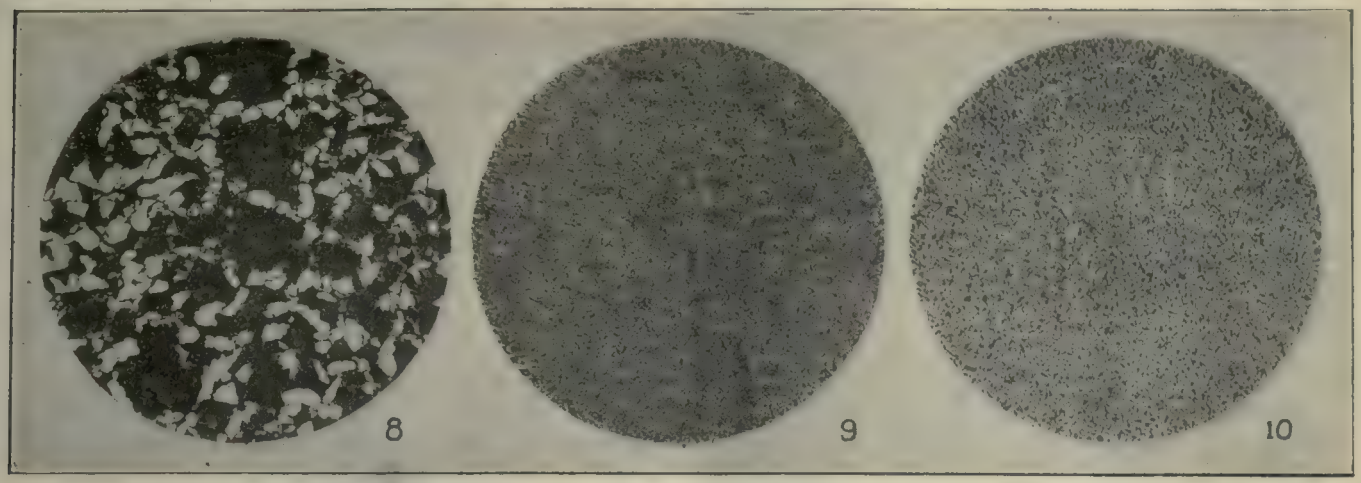
If the forging conditions are bad, as is the case in most forging processes, especially that of drop forging, a treatment of numerous steps may be necessary. As an example of the most drastic the following is given:

1. Anneal from approximately 1,450 deg. F.
2. Quench from 1,600 deg. F.
3. Quench from 1,400 deg. F.
4. Draw at 1,250 deg. F.
5. Quench from 1,400 deg. F.
6. Draw at such a temperature as will give the desired hardness.

This heat treatment is not of unheard length, as it is quite conceivably necessary in many cases. As a matter of fact, in manufacturing pieces which will not subsequently be forged by the purchaser, steel companies very frequently give all of the preliminary steps of this treatment to their regular product. It must be well understood, however, that this number of steps is necessary only to guard against lack of uniformity, due to one piece out of a great number having possibly been subject to a poor forging heat. If the forging temperature can be accurately regulated, however, many of the steps in this treatment can be eliminated.

In much commercial work, with good forging practice, a simple anneal at 1,450 deg. F., followed by a quench just above the critical temperature and a draw, will put the steel in excellent preliminary condition, at which point the steel can be machined to its final shape. If conditions are such that the steel must be extraordinarily hard (as, for instance, in automobile gears), a final quench with a draw at about 400 to 600 deg. F. is then given.

It must be borne in mind when laying out treatments that the time at which the steel is held at temperature during any treatment, whether it be an anneal or a quench, is of quite as great importance as the temperature. This is illustrated by photomicrographs, Figs. 8-10, of two pieces cut from the same bar as those previously shown, both of which were placed in the furnace together. One of these pieces was drawn from the fur-



FIGS. 8 TO 10. EFFECT OF HOLDING AT TEMPERATURE DURING TREATMENT

Fig. 8—Heated to 1,400 deg. Fahr.; not held, quenched in oil; reheated to 1,150 deg. Fahr.; held 30 min.; cooled slowly. × 100. Fig. 9—Heated to 1,400 deg. Fahr.; held 30 min.; quenched in oil. × 100. Fig. 10—Heated to 1,450 deg. Fahr. for 30 min.; cooled slowly. Heated to 1,600 deg. Fahr. for 30 min.; cooled slowly. Heated to 1,400 deg. Fahr. for 30 min.; cooled slowly. Heated to 1,150 deg. Fahr. for 30 min.; cooled slowly. × 100.

nace and quenched immediately it had reached the quenching temperature (in this case 1,400 deg. F.). The other was allowed to remain in the furnace for ½ hr. and was then quenched. It will be seen that the ferrite areas in the first case had been slightly or incompletely broken up, whereas in the second case they were very completely dissolved.

These photomicrographs differ from a corresponding one in the first series of annealed samples in that there is shown no new grain growth within the old partly broken-up system. This, of course, is due to the fact that in the second case the time element necessary for the separation of the ferrite during cooling was not sufficient.

From results obtained in the careful heat treatment of nickel-chrome steels, a series of curves, Fig. 11, has been prepared which show the physical properties of a nickel-chrome steel resulting from proper preliminary treatment and varying drawing temperatures.

The type composition only is given in this figure, because it is a mean of the results of about twenty bars from several heats of slightly varying compositions. The nickel steels of the same approximate carbon content give results which are somewhat inferior to this nickel-chrome curve, whereas the results of another type of nickel-chrome steel, of 3½ per cent nickel and 1½ per cent chromium, would be slightly superior.

Starting from the extended heat treatment just described, the development of the cheapest and simplest treatment which will give good results is a matter of intelligently eliminating or altering steps of the ideal heat treatment as conditions permit. For instance, in a certain case where important drop forgings were manufactured from the grade of nickel-chrome steel shown on the curve, the actual treatment to which pieces were subjected is as follows: The pieces were forged under a drop hammer, and were dipped immediately afterward into a tank of oil which was maintained close to the forge. The pieces were kept in this oil for about four minutes, removed at a temperature between 700 to 900 deg. F., and were buried in ashes as a precaution against cracking. Then the pieces were subjected to a single quench at 1,400 deg. F. and were drawn at 1,200 deg. F., in which condition they were machined and received no further treatment. The uniformly excellent results obtained (each of the pieces was separately tested) showed that this very simple treatment had been entirely effective. A little thought will show that the reason for this was that the drop forging was not excessively high, and that the growth of large-cell outline was prevented by the quench after forging was completed. The single quench and draw were sufficient to completely refine the steel from the

C	Mn	P	S	Si	Ni	Cr	V
.40					3.00	.75	

CRITICAL POINTS
Ac_1 1325° Ac_2 —— Ac_3 1360°
Ar_1 —— Ar_2 —— Ar_3 ——
CURVES AVERAGE OF 20 TESTS
SUBMITTED BY MIDVALE S. & O. CO. NICETOWN
TEST PIECE 2" x .505" DIAM.
DATE AUGUST, 1914

OPERATION	SIZE TREATED	TEMPERATURE	TIME AT HEAT	HOW COOLED	REMARKS
1 QUENCHED	1" ROUND	1600°	½ HOUR	OIL	
2 QUENCHED	1" ROUND	1400°	½ HOUR	OIL	
3 DRAWN	1" ROUND	1250°	½ HOUR	LIME	
4 MACHINED	TO .505" ROUND				
5 QUENCHED	.505 ROUND	1400°	½ HOUR	OIL	
DRAWN OR ANNEALED AS INDICATED ON CURVE			1 HOUR	AIR	

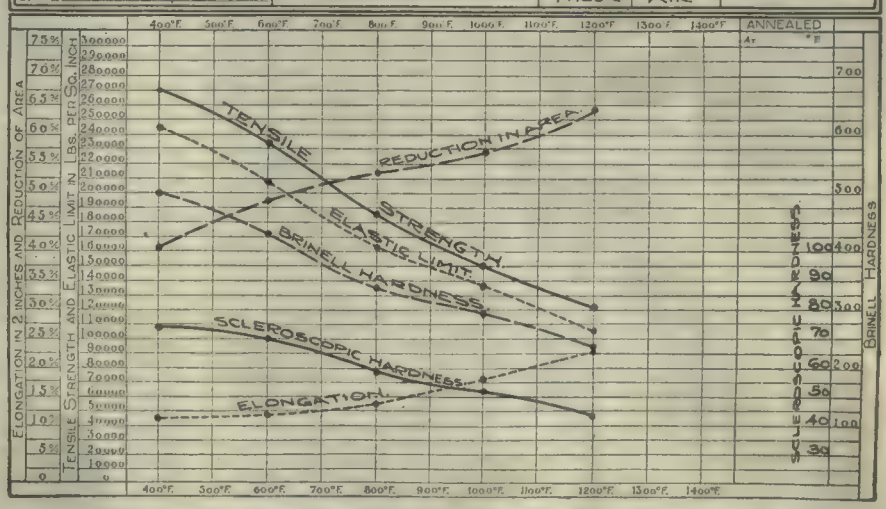


FIG. 11. PHYSICAL PROPERTIES OF A NICKEL-CHROMIUM STEEL RESULTING FROM PROPER PRELIMINARY TREATMENT AND VARYING DRAWING TEMPERATURES

fair condition which was thus produced. There is this to be observed in all cases of quenching of alloy or indeed any other steels: Following the quench, the piece quenched is in a condition of great strain and is liable to crack. This liability to crack persists until the piece has been drawn, and it is therefore wise to draw the piece as soon as possible after the quenching.

In cases where a drastic quench is advisable it is better to remove the piece from the quenching medium before it becomes entirely cold. By this procedure the great proportion of the condemnations due to cracking are avoided.

Fiber Fractures a Criterion of Proper Treatment

One of the significant effects of a correct heat treatment on alloy steels, which is indeed a criterion as to the efficiency of the treatment, is the production of a peculiar type of fracture in a broken piece, known as "fiber." This fiber fracture is absolutely distinctive, and cannot be mistaken by one who is even slightly skilled in inspection. It is produced in all of the well-melted, shock-resisting alloy steels by proper heat treatments, and is so closely related to impact test values that failing impact tests can almost invariably be selected from broken impact test bars by the absence of this type of fracture. The ease of producing fiber by heat treatment is a criterion of the value of an alloy for shock-resisting properties. So important is the presence of this feature that armor plate, which must withstand shock test of the more severe character, is never knowingly shipped without it.

How To Get Safe Production

By A. V. Reschar

The matter of safe production is consuming a lot of time and getting lots of attention among industrial leaders. The essentials of a Safety Organization must necessarily be the first subject given consideration, when laying out and putting into effect, for practical operation, methods that will produce the result desired—production increased and accidents reduced.

We must eliminate existing hazards and improve working conditions. This will require executive, administrative and practical ability equally efficient with those shown in productive channels. In the handling of safety the same quality of initiative and good judgment are required as in any of the other departments in the plant. To direct safety activities, making it a result getter, is no soft job. Therefore you must realize this one point—that it is a man-sized job and the essentials mean much or little according to whether or not you intend to carry the activity to a successful finish. Know your work. Keep your fingers on the details. Don't overlook opportunities and use them to make the work interesting and effective—get your employees interested.

Essentials of a Safety Organization

There are three elements in the essentials of a Safety Organization. They are simple and basic in their scope. They are necessarily important as they form the foundation for the continuance of safety work. They are the elements of support—analysis and action. The safety engineer is the man around whom the proper functioning of Safety Division activities center.

First—He should have the unqualified support of the management, and, furthermore, it must be known throughout the plant that the management stands for the new movement at all times.

Second—The foremen should let it be known, by word and action, that safety is considered part of their duty to the employee, as well as to the employer. In this work the foreman's support is of vital importance to the outcome of the issue.

Third—You must obtain the employees' interest and support and then maintain it through practical and common-sense methods. Scientific, theoretical or dreamy practices will not appeal to them. Good judgment and common sense will keep them interested. It is an acknowledged truth that the safe production is always assured and your organization successful, once the management and foremen give their unqualified support, as the employee always shows himself willing to give his support and do his bit.

Program of Action

To develop the plan, the most important is the element of analysis. The details of the work resulting from an analysis of the efforts to be applied in various lines make it simple to understand when the energies of the organization are expended. Of what shall our work consist? It might be said in a general visualizing statement, it covers three fundamental and vitally important phases of activity—Supervision, Plant Inspection and Safety Education. These three subdivisions are in reality the product of the Safety Department and are applicable to any size of plant, irrespective of number of employees.

The first of the items mentioned, Supervision, may be carried on by a general committee, comprised of a few persons in positions of authority and meeting once a week, or may be delegated to a safety engineer with a corps of assistants who work under the supervision of the general committee. The size of the industry and hazard of operations should decide the size and personnel of this committee. A careful inspection of like industries will be of great assistance in solving the problem.

Plant Inspection—From weekly or periodical inspection, in any industry, the work may be broadened to daily and almost constant scrutinizing of working conditions by a real co-operating organization. It is necessary to make a close inspection of accidents that have happened, learning their causes and locations and then outline a system of guard construction, institute an educational campaign that will arouse the interest and insure complete co-operation of employees at all times.

Safety education is the most important activity that you have to deal with as the great majority of accidents are caused by carelessness and many times the operators are guilty of criminal carelessness, which results in serious injury or even loss of life. The real point to be made is to educate the employee to *think*. How many have said—"Why didn't I think of this or that?"

Action needed is known as sincerity of operation. It means to carry out details to a finish. Real safety must be a live issue. The pep and energy that is shown by the management and safety division must be of such real quality that work never lags but is always full of crisp refreshing messages. Let's make our plant ideal to work in and a place where accidents are unknown *now* instead of waiting years to do it.

SHOP EQUIPMENT NEWS

-Edited By-
S. A. HAND

SHOP EQUIPMENT • NEWS •
A weekly review of modern designs and equipment

Descriptions of shop equipment in this section constitute editorial service for which there is no charge. To be eligible for presentation, the article must not have been on the market more than six months and must not have been advertised in this or any previous issue. Owing to the news character of these descriptions it will be impossible to submit them to the manufacturer for approval.

• CONDENSED • CLIPPING INDEX
A continuous record of modern designs and equipment

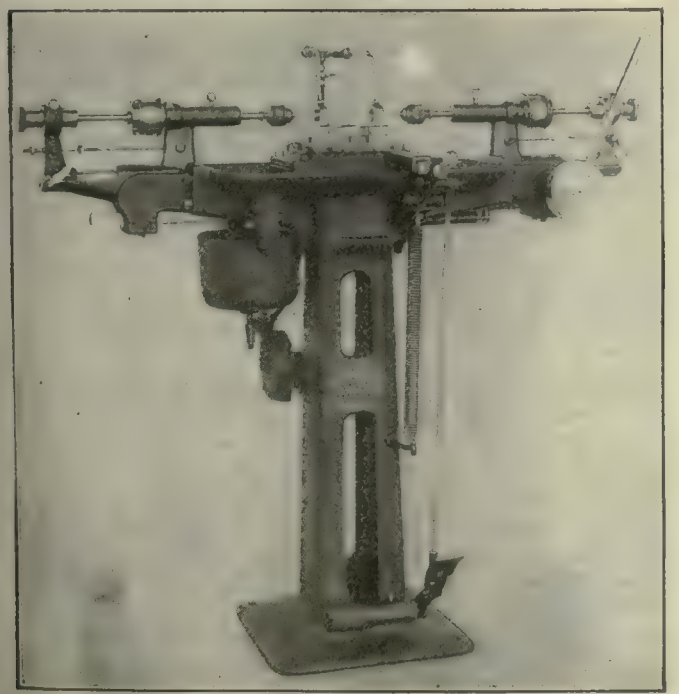
Langelier Opposed-Spindle Countersinking Machine

The opposed-spindle countersinking machine shown in the illustration has recently been placed on the market by the Langelier Manufacturing Co., Arlington, Cranston, R. I. It is intended for countersinking or centering both ends of pins simultaneously. Pins from 1⅛ to 4½ in. long and from ⅛ to ⅛ in. in diameter can be handled, the production being eight pins per minute.

Each drilling head contains a hardened spindle running in phosphor-bronze bearings, the drilling speed being 2,000 r.p.m. The pulleys driving the spindles run on ball bearings on stationary sleeves on the drill heads, so that no bending strain comes on the spindles. Each spindle carries a No. 2A Jacobs chuck having a maximum capacity of ⅜ in. The spindles can be fed simultaneously by a hand lever, which acts through racks and a pinion. The feeding yokes are so attached to the spindles by clamps that the positions of the tools may be adjusted to suit the work. The depth of the feed is controlled by means of adjustable stops.

The work-holding fixture is adjustable for different sizes of work, the pins to be countersunk being held between beveled bushings in the two jig-heads. The jig-heads are actuated by a locking cam, which can be operated by both a hand lever and a pedal so as to release the work. A spring causes the die-heads to move together and to hold the work rigidly.

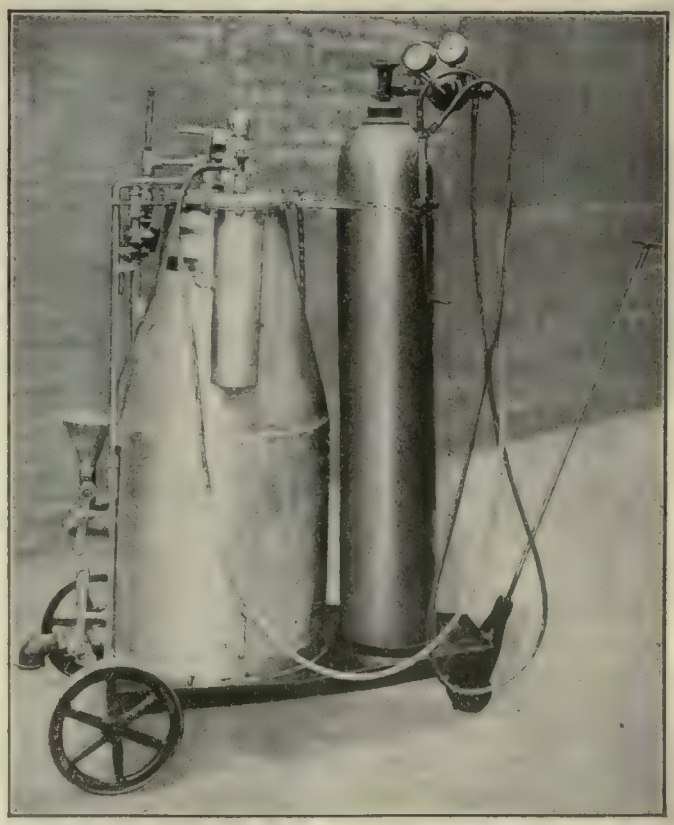
The machine is equipped with a coolant system. The cutting lubricant is supplied to the tools by a rotary pump through flexible tubing which leads into the jig-heads. The coolant is automatically controlled so as to flow only when the tools are cutting and it is strained before being returned to the coolant tank.



LANGELIER OPPOSED-SPINDLE COUNTERSINKING MACHINE

Imperial Automatic Acetylene Generator

The Imperial Brass Manufacturing Co., 1200 West Harrison St., Chicago, Ill., is now manufacturing an automatic acetylene generator. The machine is intended primarily for use in oxy-acetylene welding, cutting and lead burning. The machine shown in the illus-



IMPERIAL AUTOMATIC ACETYLENE GENERATOR IN PORTABLE WELDING OUTFIT

tration is mounted on a portable truck with an oxygen cylinder and torch, so as to form a complete outfit.

The generator is of the medium-pressure, carbide-to-water type. The carbide is fed into the water by a simple vibrator of the dashpot type, having but one moving part and being operated automatically by the gas flowing through it from the generator to the torch. Thus, turning on the torch starts the feeding of the carbide and shutting off the torch stops it. The pressure in the generator is controlled by a spring in a diaphragm governor. It is claimed that the governor, operating in conjunction with the automatic feed, maintains a uniform pressure and that no acetylene regulator is required in the service line unless a number of torches are being fed from it.

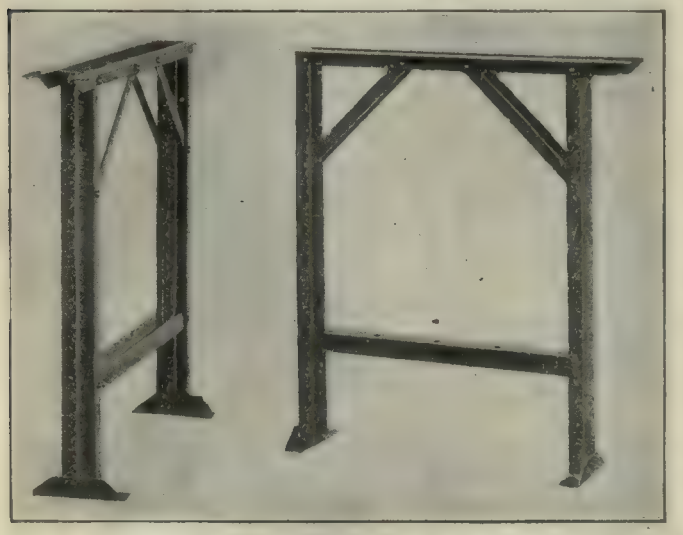
A blowoff is provided so that the pressure cannot rise above 15 lb. per square inch. The levers for operating are interlocked so that it is necessary to follow the proper sequence of operations when filling, starting, or shutting off the generator. The gas, when leaving the generator, is passed through a purifier having a water seal, thus cooling the gas and preventing a backflash.

The machine will run for five hours on one filling of carbide. It is made in four sizes, having carbide capacities of 15, 25, 50 and 100 lb. respectively. The generating capacities are, respectively, 15, 25, 50 and 100 cu.ft. of gas per hour. The largest size will supply eight torches on medium-duty work, being adapted to stationary use. The over-all heights vary from 38½ to 67½ in., the diameters from 16 to 28 in., and the weights from 140 to 350 lb. The weight of the truck is 40 lb.

Ot-Steel Bench Legs

Bench legs made of steel angles have recently been placed on the market by the Angle Steel Stool Co., Otsego, Mich. The legs are made in various heights and styles, style 5-26 being shown in the illustration.

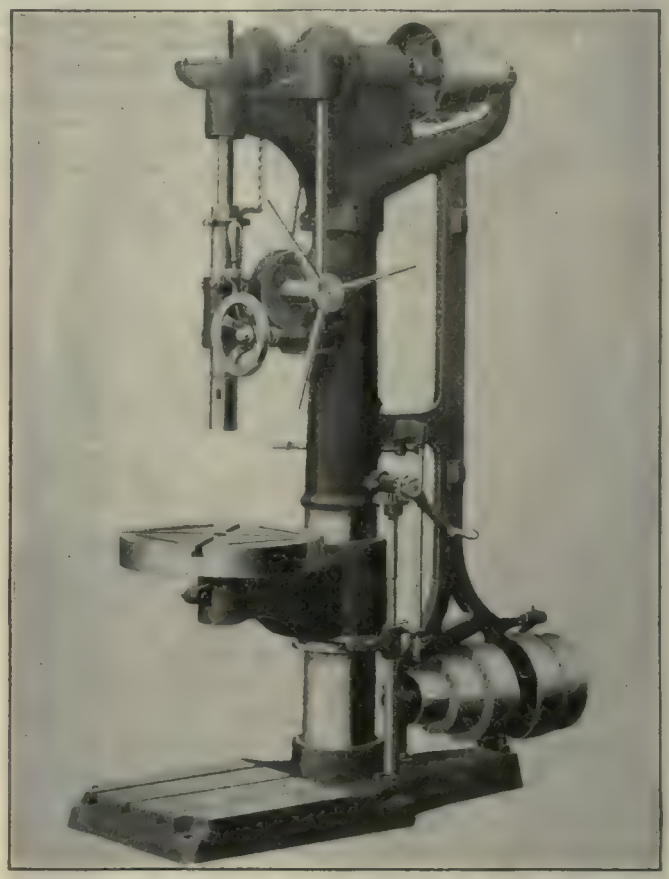
The tops of the legs are flat, so that boards of any width may be laid on them. If desired, heavy planks can be used along the front edge with light ones in the rear where the wear is less severe. The top member and shelf support are furnished with from three to five holes for bolting on the planks. To form a wider table, two legs may be used back to back. All legs are finished with a baked-on green enamel.



OT-STEEL BENCH LEGS MADE OF STEEL ANGLES

Sibley 24-, 26-, and 28-in. Stationary Head Drilling Machines

The stationary-head, heavy-pattern drilling machine shown in the illustration has recently been placed on the market by the Sibley Machine Co., South Bend, Ind. It is intended for production work, and, with the exception of the head, is very similar to the sliding-head drilling machines made by the same concern and described in these columns on May 6, 1920, and Nov. 13, 1919.



SIBLEY STATIONARY-HEAD DRILLING MACHINE, 24-, 26-, AND 28-IN. SIZES

Specifications: Height, top of cone pulley, 86 in. Spindle to base, maximum, 44½ in. Spindle to table, maximum, 27½ in. Traverse of table, 13 in. Travel of spindle, 12 in. Feed per rev. of spindle, 0.006, 0.010, 0.015 and 0.020 in. for 24-in. machine; 0.008, 0.012, 0.016 and 0.024 in. for 26- and 28-in. machines. Diameter of table, 21, 23 and 25 in. for 24-, 26-, and 28-in. machines, respectively. Diameter of column, 8 in. Hole in spindle, No. 4 Morse taper. Ratio of back gears, 4½ to 1. Speed of countershaft, 500 r.p.m. Spindle speeds, 29 to 495 r.p.m. for 24-in. machine; 26 x 403 r.p.m. for 26- and 28-in. machines. Floor space, 23 x 63 in. Weight: net, 1,600 lb. for 24-in. machine, 1,650 lb. for 26-in., and 1,700 lb. for 28-in.; boxed for export, 2,000, 2,050 and 2,100 lb., respectively. Size, boxed for export, 76 cu.ft.

All drive-shaft bearings are fitted with interchangeable die-cast split bushings of anti-friction metal and all bearings are provided with oil cups. The back gears are of the sliding type and are operated by a lever. The spindle is counterbalanced by a weight inside the column. The feed is driven through gears, four changes, controlled by a knob in the center of the handwheel, being available. An adjustable automatic stop is provided. The gears in the feed-change box run in oil, and all gears on the machine are completely inclosed.

Geared tapping attachment, individual motor drive, square table, oil-pump outfit, belt guards, and quarter-turn countershaft can be furnished as special equipment.

EDITORIALS

More Pay for Railroad Mechanical Executives

ONE of the great weaknesses of the usual method of railroad management is the shortsighted and wholly indefensible policy of under-paying the mechanical executives, from superintendents of motive power down to roundhouse foremen. This underpayment has been so marked as to compel the resignation of good men, men capable of giving most valuable service, in order to secure a living salary in other lines.

There is no more important question before the financial managers of the railroads today than to see that these men are adequately paid. In no other line of work are executives responsible for the satisfactory performance of such huge investments in machinery so poorly compensated for their years of experience and service.

The wages of railway workers as a whole have been raised materially by the strength of their organizations. Is it good policy to make it plain to all that this is the only way in which just compensation can be secured by those who work for the railways of this great country?

The economical operation of railways depends on keeping their invested capital, in the shape of rolling stock, in operation as large a percentage of the time as possible. Five years ago N. D. Ballantine stated before the Western Railway Club that the locomotives were in the hands of the mechanical department for repairs 58.5 per cent of the time. And further that only 36 per cent of the remaining time was spent in actual running over the roads.

Can we expect executives who are so underpaid that living expenses are uppermost in their mind to greatly increase this percentage?

The mechanical executive, whether he be roundhouse foreman or shop superintendent, must be aided and encouraged to increase the revenue obtained from the capital invested in rolling stock. New machinery and new methods, often new shops themselves, are necessary in many places. The first step, however, is to pay an adequate salary. This, with a proper tool equipment, will tend greatly to reduce the cost of operation by keeping locomotives more continually on the job.

F. H. C.

Human Engineering

THE personal element in management is, of course, receiving increasing attention everywhere, and deservedly so. The idea that all human effort can be measured by a stop-watch and calculated in terms of percentage efficiency is no longer generally believed to be wholly correct. Of course, the American attitude is far from that easy Oriental policy of maximum current enjoyment of life and minimum thought of efficiency or progress. However, the maintenance of cordial personal relations from the executive to the lowliest apprentice is being recognized as of great importance.

The engineer is taking an increasing responsibility in these affairs, commanding the respect of all parties concerned in most industrial controversies and maintaining a fair and respected, yet vigorous and determined attitude toward both parties. We venture to say that not the least of the problems of the Federated American Engineering Societies will be found in the field of relations between management and employees. It is a public service that deserves the very best thought and if the engineers can solve some of the problems involved they will certainly command the thanks and support of the entire public, including the two parties at issue.

E. V.

American Labor and Immigration

A RECENT report from the Bureau of Immigration states that 56,106 immigrants entered the United States in July.

Newspaper accounts commenting on this report state that "Labor is thoroughly alarmed at the ever growing foreign immigration" and that "Federation officials will ask Congress to place drastic restrictions upon it."

On April 7, of this year, the Inter-Racial council held its annual convention in New York. This conference of men, all prominent in our industrial life, went on record as unanimously in favor of a modification of our immigration laws, so as to encourage European emigration of unskilled labor. Every one of the speakers, who took part in the discussion, urged a policy of moderation. The critical need for unskilled labor in our growing industries, and especially on the farms and plantations of the South and West, was very forcibly brought out. We quote from the opening speech of the conference delivered by William H. Barr: " . . . our permanent national prosperity depends upon sound production, and one of its essential features is a sufficient supply of unskilled workers. We need such labor on the farm, in industry and in the home."

During the war munition making centers "drafted" thousands of farm laborers from the fields to the cities, high wages and more diversified living conditions proving a big attraction. This caused a shortage of farm products—and a shortage of any thing means a high price for it.

Now that labor has firmly established itself in Industry, with the highest wage rate and shortest working period it has ever known, why should it attempt to block the rehabilitation of other lines of trade?

The men who left the farm for the factory will not go back. The farmer needs labor, and needs it badly, if this great country is to continue as the "commissary of the world."

And the one way to get it is by encouraging immigration of Europe's unskilled labor.

If American labor will live up to its productive capacity and give a fair day's works for a fair day's pay —it need fear no competition from foreign elements, skilled or unskilled.

H. V. D.

American Contractors and Labor Conditions in France

By E. J. MEHREN
Editor, *Engineering News-Record*

PARIS, June 15.

WHY have not American contractors participated in the rebuilding of the devastated regions of France? There were predictions at the time of the Armistice of great opportunities for them. Few of these opportunities have been realized. There are a number of reasons:

(1) The French want to rebuild according to French ideas, having regard also for the traditions of the ruined cities. These ideas are incompatible with the mass production proposed by some American contractors.

(2) The French have a pride in their ability to carry on construction. They resent the suggestion that they need help. There is, so far as I can learn, only one construction company here that represents American capital—and it is, in reality, a French company manned by French engineers and contractors. There are only three Americans in a responsible force of probably 50.

(3) Construction can be taken in hand only as fast as the damages can be determined. This is an enormous task and necessarily can proceed only as rapidly as the relatively limited number of commissions of qualified men, familiar with local conditions, can work. With the fluctuations in wages and material prices, too, these damage credits are subject to frequent change. Under the law, an owner who rebuilds within 50 km. of the original site is paid the reproduction value as of the present date. Necessarily the estimate must be revised if wages and material costs change. A 20 per cent credit is wanted as soon as the damages are determined, and other advances made as the work proceeds. If an owner chooses not to rebuild, or to rebuild at a distant point, he receives damages based on values in 1914.

(4) The French government wisely decided to concentrate on work in the order of its economic importance: First, the reclamation of the land, and the erection of temporary dwellings, then the restoration of the building-material industry, followed by the reconstruction of factories and the construction of permanent dwellings. The last feature has hardly yet been taken in hand. Therefore, plans for rebuilding whole towns in permanent construction were not in order early in 1919 and are scarcely in order today.

(5) Building materials are scarce and must be distributed so that in all districts and towns progress may be at about the same rate.

There are other reasons, but these are the really important ones.

It is worth noting that the financing of work was not referred to until the question was raised by the visitor. In other words, the various factors above mentioned have always disposed of the American contractor before the question of finance was reached. The traditional position that all flows to the man with money did not hold here. Of course, France would still like to have American credits, but only to allow them to pay for raw material when the exchange has returned to normal or materially improved.

The financing of contracts is, nevertheless, a matter of grave importance, not due to failure to get estimates promptly, but to the necessity of carrying a large material supply. This applies to the relatively large operations—not to the building of one or two small dwellings, for which material is secured from the government material depots. The root of the trouble is a combination of inadequate transportation facilities and material shortage. One must wait three months for deliveries. Consequently, the larger contractors are following the practice of taking work only in a given locality and carrying there large stocks, which are delivered to the building sites with their own truck fleets. The capital required is about 50 per cent of the amount of work done in a year. Sub-contracting, with the upset conditions, is very unsafe. For that reason most contractors do all the work themselves, and even go as far as to make the window frames, doors and trim in their own shops.

Material, it should be said, is paid for only after it has been built into the job.

Contracts are all on a unit-price basis, the bid price being considered a base price which is adjusted every three months in accordance with the fluctuations in labor and material prices. The contracts are made with individual owners or, for dwellings, with co-operative building societies, the membership of which is composed of those whose damages have been determined by the government commissions. One may get a contract to build a whole village but, unless one wishes to carry the risk, only if the appraisal work has been finished and the owners have all joined the co-operative society. The government advances go into the treasury of the society, which, in turn, pays the contractor.

There is still much work to be done. In fact, only a beginning has been made, but the work is not likely to be done by American contractors. If they have capital to be employed they may use it in France if they want to lose their identity, and organize as a French company with French officials. Even then they will not get work, or succeed in what they get, unless they are willing to respect French customs and acquire some of that French tact to which we are largely strangers.

The last remark is made advisedly. Many who come here carry a superior air. It is naturally and rightfully resented. "I will bring a hundred Americans over here and show you how to do construction work," was said by the representatives of a strong American company to a French official. What chance would that organization have to get work, no matter how heavily its arms were laden with gold? I could cite other cases of boorish assertion of superiority—but this case will suffice. Our help will be welcome; but we must come here to help only. The French must do the work in their way.

That does not mean that American construction methods cannot be used; they can be, if tactfully proposed and where conditions are suitable.

With reference to the reconstruction it is to be noted

that it is proceeding much more rapidly than the work in Belgium. In commenting on conditions around Ypres, it was pointed out that only work in the cities and towns was proceeding. Such is not the case in France. Work of every kind is going forward and the progress is rapid.

Labor Conditions

A previous article also pointed out that labor conditions in the devastated regions are good. Wages are high, but the men are working hard.

In the other part of France conditions are not so favorable, but the recent improvement has been such that a decidedly optimistic tone has developed among the manufacturers, just as it has in Belgium. This optimism has developed largely because of the failure of the May-day strike.

The Confederation Generale du Travail, the French organization corresponding to our American Federation of Labor, had, previous to the war, been quite radical. During the war heavy responsibilities were imposed on the leaders, and, as usual, caused them to modify their program. At the same time, the war was a breeder of radicalism among the younger men. So strong did they become that the leaders were obliged, finally, to condone radicalism (just as Gompers did with us) or lose their jobs. The radical group felt they were ready for the test in May. The plan was nothing short of a social revolution, the establishment of the "Fourth Republic," with the workers in control. The strategy, so the radicals thought, was carefully worked out. There were to be successive "waves" of strikes until the government capitulated—first the railroad men were to strike, then in succession the steel workers, the stevedores, etc. The strategy got no farther than the third wave, the stevedores. Very shortly it became apparent that the radicals were wrong in their calculations, that they did not have the majority of French workmen with them. Even on the railroads, the critical industry, the strike was not popular, except possibly on the government railway system, the *État*. The proposed steel strike was a flat failure, the stevedores' strike somewhat more successful. For three weeks the losing fight was kept up, and when the C.G.T. called it off it was in hopeless defeat.

This it is that has produced the optimistic tone in France. It has been clearly demonstrated that the French worker proposes to stick to a sane economic system, that he will not turn Bolshevistic.

Since the strike, too, efficiency has increased materially. The workers show a better spirit. Evidently they have concluded that their own best interests are served by doing a good day's work.

The French workers, by the way, probably have less cause to complain than those in any other country. Wages have gone up in the same proportion as living costs—about 3½ times. Nevertheless, here as elsewhere, there has been a decrease in efficiency. In fact the 8-hour day is now required by law, though it is by common consent not observed in the devastated regions.

Employers' Attitude

As indicative of the liberalizing of the views of employers, formerly quite conservative, one movement gaining strength here may be noted—a plan whereby married men are paid more for the same work than unmarried men. The plan is administered through associations, each embracing all the industries of one kind in a given district. Each employer pays into the association's treasury weekly a given sum per employee. Out of this fund the married men are paid the extra wage. The amount varies somewhat in different districts, but is approximately 200 francs on the birth of a child and 20 francs per week for each child in the family. The plan is administered through associations not merely to give it greater stability but to insure the payment of the same extra ratio through the given industry in the given district.

Remarking upon the unusual character of the scheme and its negation of the "uniform pay for uniform work" slogan, I was met with the rejoinder, "We apply the differential in income taxation; why not in business? If the differential is sound in taxation, it is so in business."

Incidentally the plan does not find favor with the C.G.T., for it tends to make the married man even more steady and unsusceptible to radical propaganda than he is today. What the radicals in the C.G.T. want is a large following of unattached men who will follow wherever the leaders wish to go.

American Construction Plant

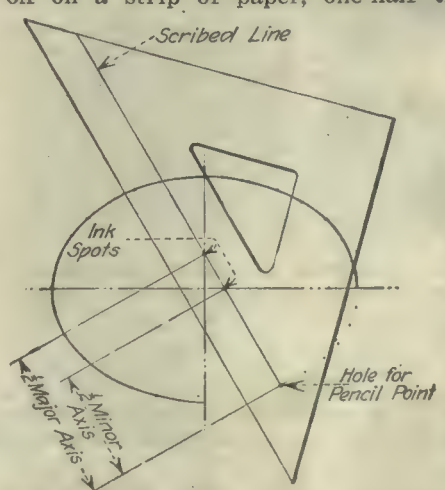
Reference to industrial conditions naturally tempts one to inquire as to the prospects for the use here of American construction machinery. The situation is much the same in this respect as it is in Belgium: the present rate of exchange makes the purchase of American equipment prohibitive. Moreover, the attitude of the French contractor is rather less favorable to such equipment than is that of the Belgian.

If the labor costs stay up, there may be a change in this attitude. Around Paris common labor received before the war about 0.60 franc per hour (60 centimes or about 11½ cents at normal exchange). Now it receives 2 francs, about 3½ times as much. In the provinces the comparative rates are about 40 centimes and 2.35 francs, respectively. Skilled labor that received 1 franc before the war gets about 3.50 francs now. The French contractor is shrewd and able. He did not use machinery before because hand labor was more economical. If machinery can effect economies he will come to its use, though he will make sure of every step.

Drawing an Ellipse

By Chester E. Josselyn

Having reason to draw an ellipse recently, I marked off on a strip of paper, one-half the axes according to the well-known method. After this was done it occurred to me to arrange the 45-deg. triangle as shown; this I found to be an improvement over the strip of paper. The ink spots are easily removed and others placed as needed. The method requires keeping the two spots on the center lines.



METHOD OF DRAWING THE ELLIPSE

Business Conditions in England

FROM OUR LONDON CORRESPONDENT

LONDON, Aug. 19, 1920.

REGARDING only money values the figures for British overseas trading for July must be considered generally as satisfactory, for although both imports and re-exports declined considerably a much more marked increase in exports was shown. The value of imports reached £163,342,351, a decline of more than seven millions compared with the previous month. Re-exports were valued at £17,848,479, or two and one-quarter millions less than last month. On the other hand, exports of British goods reached in value the total of £137,451,904, an increase in the month of twenty-one millions, most of the increase being in goods wholly or partly manufactured. The adverse trade balance was therefore only slightly above eight millions. A semi-official estimate has indeed been prepared which suggests that by the end of the year Great Britain will have a credit balance of exports of about £180,000,000, this of course, allowing for the value of invisible exports. For the year the net income from investments abroad is estimated at £120,000,000 and the net shipping earnings at £440,000,000, with other services at £40,000,000, making a total of £600,000,000; while the excess of imports as shown by the monthly figures is estimated for the year at £420,000,000, giving a balance of £180,000,000. Whether these figures prove true or not, it is clear at the moment that Great Britain is returning rapidly to general pre-war conditions as regards the balance of overseas trading.

The government has passed its bill in connection with credits and insurance for overseas trading, and some £26,000,000 will be available for these purposes. The bill has been severely criticised in the city of London—not always it would seem with adequate knowledge. Apparently an alternative scheme was submitted, to be worked by bankers and underwriters rather than a government department, something more in the nature of "celerity and despatch" being then probable, it was thought. Indeed the sign of absolute want of knowledge of ordinary commercial methods is alleged against the scheme as proposed. Yet the overseas trade department has its advisory council—all business men and including its fair proportion of bankers. The scheme when operating will take risks refused by bankers in the ordinary way, exporters being advanced about four-fifths the cost of goods they propose to supply. The importer must cover the value of the goods with a bank and allow, too, for any detrimental variation in the rate of exchange.

The Effect of High Prices

While figures relating to British overseas trading are satisfactory when money values alone are considered, the effect of high prices must not be overlooked. This consideration, incidentally, shows the futility of comparisons, published in Great Britain in earlier days, between the money values of the output per workman here and in countries where prices were higher. Reports are still somewhat conflicting, but in general it is clear that a lull in trade is being experienced. While, officially, employment last month was estimated as good, as a whole, slackness was recorded in the cotton-weaving, linen, lace, and boot and shoe industries, and declines in other branches are noted. Generally it is being felt, for various reasons which need not be specified, that unemployment will increase as winter develops. Despite storekeepers' advertisements, the cost of living steadily rises, the average level of retail prices as officially estimated at the end of last month being about 155 per cent above the level for the immediate pre-war days. Taking food alone, the increase was rather higher. The machine-tool industry has for quite a period now experienced a declining demand and privately the possibilities of price reductions are discussed. It is felt that there is room even in present circumstances.

The conditions in the coal industry affect everybody, as these columns have recorded. The poor quality of fuel available is proving a handicap to industry, while every householder in the kingdom complains. The Federation of British Industries is setting up an expert department to advise members on the economic running of steam-raising plants. Trade organizations can also arrange for reports, having in view the particular requirements of the trade as a whole, and a questionnaire on industrial coal and coke supplies is being circulated regarding the fuel requirements of British industrial centers and for the various industries. Problems of smoke abatement, periodical inspection of sources of fuel, control and use of fuels, and even the training of pupils and workmen may also be taken up by the federation which, in emphasizing the importance of the scheme, notes that the output of coal available has been reduced from 15 to 20 per cent, while the cost of industrial coal has increased from 300 to 400 per cent, and the quality has depreciated markedly.

In another direction the federation is endeavoring to help British manufacturers; namely, by undertaking the direct representation in Great Britain and the dominions of the Paris Marché du Monde. As regards this, the site is being cleared and contracts for a building have been placed. The federation mentions that a considerable number of American, French, Italian and other continental firms, besides British, have reserved space. The federation, too, will have a stall at the Lyons Fair to be held from Oct. 1 to 15, where trade literature, catalogs, etc., will be displayed and distributed and trade inquiries collected and forwarded. The sections of the exhibition include metallurgy, electrical engineering, general engineering, industrial supplies, hardware, and a new feature—research and invention. But it is fairly generally recognized that, if only owing to the exhibition at Olympia, W., the British machine-tool industry will probably not be well represented.

Child Labor Laws

From the beginning of January next it will probably be illegal to grant exemption from full-time attendance at schools for any British child between the age of 5 years and 14. In fact, it will be possible for the local authorities to compel school attendance until 15 years of age. The half-time system of working will therefore be abolished. At the same time employers will be faced with the necessity, in London at any rate, of arranging for continued education during ordinary working hours of youths, eventually up to 18 years of age.

Such particulars as are available relating to the machine-tool and engineering exhibition being held at Olympia, London, W., from Sept. 4 to 25, suggest that it will be fairly representative of the British machine-tool industry, at any rate up to medium-sized products. Some American tools will be shown, some Swiss, and a few French.

Several of the firms who specialize in heavier tools are not exhibiting, not being members of the association. To take Manchester alone, the Whitworth firm, Craven Bros., and Hetherington & Sons will not be present, while from Leeds the firms of Campbells & Hunter, J. Buckton & Co., Rice & Co., and the firm best known as Scriven & Co. are not directly represented. The hall of Olympia, W., is in fact hardly suited to the installation of heavy machinery as exhibits.

For the most part the exhibits will be of the accepted British types. But some real additions to workshop facilities will be shown, and the rather numerous Herbert stands may be particularized in this direction. The following notes are of course written in advance and can make no claim to order or completeness, as at the moment the writer has not either seen or heard from all the firms showing.

New Equipment To Be Exhibited

A new spiral bevel-gear planer based essentially on the Robey-Smith machine will be on the stand of Smith & Coventry, Ltd., Manchester. Simplicity of operation has

been aimed at, this applying to construction, operation, and even cutting tools employed. Cunliffe & Croom, Ltd., Manchester, has a somewhat improved planing machine to plane 6 ft. x 2 ft. 6 in. x 2 ft. 6 in., the belt-striking gear here being of the rotary type.

The horizontal boring, etc., machine by the Dickinson Co., Keighley, has a new facing head by which it is possible to face from maximum diameter to the center and then reverse and face outward again, tripping the feed at any desired point on the surface of the work. The facing head and spindle can be run at different speeds and the head can be stopped while the spindle revolves at drilling speeds.

Lathes, Planers and Drilling Machines

A 7-in. (14-in. swing) toolroom lathe by Holbrook & Sons, Stratford, has automatic stops which, set for screw-cutting, enable the threading tool to run up a blind hole without fear of breakage. A 6-in. (12-in. swing) lathe has four stops for turning, but by using a trigger the saddle can, if necessary, be passed over the stops, the trigger being lifted automatically when the lathe is screw-cutting.

J. Stirk & Sons, Ltd., Halifax, exhibit planers with their split-field electric drive.

In certain of the radial drills by J. Archdale & Co., Ltd., Birmingham, centralized control has been highly developed. Thus, in machines by the firm, eighteen speed changes, the arm and sleeve locking lever, and the stopping, starting and reversing lever are all carried on the saddle, with increased production and, it is claimed, reduction of fatigue to the operator due to avoidance of wasteful movements; while again the operator can concentrate his mind better on the work to be done rather than on the manipulation of the machine.

A. Butterworth & Co., Rochdale, will be showing its turning machines, with automatic changes of feed by means of gear box to the turret slide, each machine having a safety shearing clutch and an automatic knock-off motion to stop the machine when the turret has completed a cycle. Also the feed motion can be disengaged so that it cannot be automatically engaged with danger to the operator, while the machine is being set up. In addition, the feed can be stopped by hand while the spindle is still running.

Grinding Machines and Gear Planers

The Lumsden Machine Co., Gateshead, is showing a line of new grinding machines, including a vertical surface grinding machine with a 16-in. diameter segmental wheel in eight blocks held by taper dogs. The feed to the work is either by hand or automatic, the maximum being 0.008 in. and the minimum 0.0005 in.

Among the exhibits of J. Parkinson & Son, Shipley, will be a Sunderland gear planer to take 4-ft. diameters and cut up to 2-in. circular pitch. It is arranged for double-cutting and will be direct motor-driven. Another machine, with a capacity of 12-in. diameter x 4-in. face x 5 d.p. will be cutting small spiral gears in steel. Another of the same size will be double-cutting spur gears in steel, two cutters in this operation being employed, one on each stroke, each cutting a different wheel. A third machine of the same size will be cutting steel pinions with seven teeth, also double-cutting, the wheels being mounted in pairs.

Alfred Herbert, Ltd., Machines

Alfred Herbert, Ltd., Coventry, has a really considerable number of new machines, some made by itself, some designed by itself but made by other firms. A 4-ft. radial drilling machine, for example, is of Herbert design but manufactured by Tangye, Ltd., Birmingham. For one thing this machine will actually drill at the center of a circle of 4 ft. radius; this is perhaps not uncommon with German machines, but usually in Great Britain allowance has to be made for the column, so that the actual maximum radius is some inches less than the nominal radius.

A Herbert circular cold-sawing machine has as its special feature a chip remover, in which a toothed disk meshes with the saw, and can be reversed to allow for wear on one side. The disk is fixed at right angles to the saw and is of case-hardened steel, its teeth being driven by the teeth of the saw itself, giving a pushing action across the teeth and removing the chips, which are thus caused to fly out.

Herbert's New Automatic Lathe

The firm's new auto lathe is of single-pulley drive and, excepting chucking, all operations are automatic, the machine itself stopping automatically at the conclusion of work. Other features include: No changing of cams for any work that can be done; automatic speed and feed changes while the tools are cutting; head adjustable longitudinally to allow for variations of thickness of work; the turret rotates at back end of stroke and is clamped automatically, and the turret operating drum makes three revolutions for each forward and backward motion and is driven direct by worm-wheel without torsion. The front and back cross-slides are independent and can work separately or simultaneously, and a back-facing attachment can be supplied.

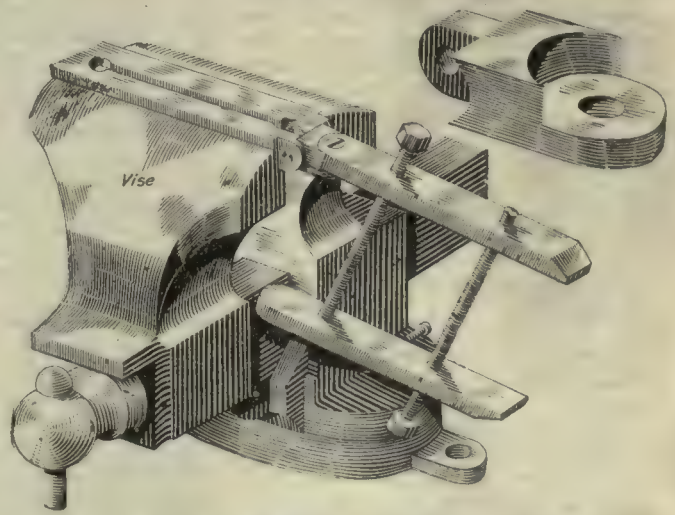
Other Herbert Machines

The Herbert firm will also be showing the Tangye axle-turning lathe, the new features of which include diameter and longitudinal stops, the compound rest being dispensed with. An axle ending and centering machine of the same make will have a constant quick power traverse for heads and saddles along the bed and an additional tool rest at the back of the saddle, with independent automatic feed for turning collars of axles, while the tool at the front rest faces the ends. The drilling spindles will be driven by separate motor and higher productivity is predicted for the machine. The Coventry firm is showing a large quantity of gaging apparatus and also small tools. Its various stands include quite a number of American machine tools and also Swiss and French tools. In fact, with the associated French, Italian and Belgian companies, the Herbert firm occupies nine stands, seven on the ground floor and two in the gallery.

Parallel Clamp Attachment

By Chas. H. Willey

A handy little tool to enable toolmakers to hold work at a convenient angle in the bench vise is shown in the picture. It can be made from scrap material with very little time and trouble, and should prove a valuable addition to the kit of a toolmaker not already provided with means for accomplishing the same result.



HOLDING PARALLEL CLAMP IN VISE

No description is needed, as anyone who would have use for the device would be quite capable of understanding the sketch without further instructions.

SPARKS FROM THE WORK

Valentine Francis

Remaining Government Surplus Machine Tools To Be Disposed of by 1921

In all probability all of the surplus machine tools in the possession of the Government will have been disposed of by the end of the year. Practically all of the Air Service surplus already has been sold. The supplies at district offices of the Ordnance Department are being sold rapidly at the series of auctions now in progress. Large lots of machine tools will be offered at auction at Chicago on Sept. 9; at Scituate, Mass., Sept. 15; at Buffalo, Sept. 24; at Hoboken, Sept. 28, 29, 30 and Oct. 1, and at Rochester, N. Y., on Oct. 11.

The Belgian machine-tool contract practically has been filled. The invoices have not been made up as yet, but the total purchases by the Belgian government aggregate $3,000,000. Reports to the machine-tool section of the Office of Director of Sales for the War Department are that the Belgians are very much pleased with American-made machine tools. Taking the orders which have been booked by American manufacturers recently as an indication, it is the belief at the War Department that these machine tools which went abroad are proving valuable advertisements for the American product.

To date, the French government has purchased in this country less than $1,000,000 worth of machine tools. When the French first considered the purchase of machine tools, $25,000,000 worth was the basis of negotiations. Afterward the French government purchased the entire expeditionary force surplus in France, which included a large number of standard machines. Then surpluses began to develop in their own country. French machine tools were available in larger numbers than was known when negotiations were opened. As a result, the French purchases were confined almost entirely to special-purpose machines. Due to the fact that there was a brisk demand at home for many of the tools which the French wanted, the aggregate of their purchases fell far below their original estimates.

Colonel Alfred Lamar, the chief of the Machine Tools Section, will return from Belgium on Sept. 8.

New Departure Holds Another Safety Contest

Chairman E. B. Case of the New Departure Co., Bristol, Conn., safety committee, announces the start of another safety contest, this time for the month of September, and for special prizes to the foremen of departments.

Six prizes will be offered to the foremen whose departments make the best showing during this thirty-day period. There will be two prizes in gold, a first prize of a $10 gold piece, and a second prize of a $5 gold piece. Four cash prizes of $4, $3, $2 and $1, respectively, will also be offered.

F. A. E. S. Membership Growing

The annual convention of the American Society of Civil Engineers, held in Portland, Ore., Aug. 10, 1920, adopted resolutions which provided:

"That the Board of Direction of the American Society of Civil Engineers be directed to submit at once the question of the American Society of Civil Engineers becoming a charter member of The Federated American Engineering Societies to referendum vote to the Corporate Membership of the American Society of Civil Engineers as recommended by the Joint Conference Committee, said ballot to be accompanied by a copy of the Constitution and By-laws of said Federation;" and

"that the Board of Direction of the American Society of Civil Engineers be further instructed in event of a favorable vote on said referendum to proceed at once to take such steps as may be necessary for the A. S. C. E. to become affiliated with said Federation."

The Cleveland Engineering Society, at its meeting on Aug. 10, voted to become a charter member of The Federated American Engineering Societies.

Ordnance Tool Co. Adds to Factory Space

For the purpose of expanding its facilities to manufacture large and small tools, jigs and fixtures, the Ordnance Tool Manufacturing Co. of St. Louis, Mo., has recently completed an addition to its plant which now comprises 13,000 sq.ft. of floor space. Additional equipment has been ordered and it is being contemplated to increase the present force of toolmakers. In addition to the tool design division, installed some time ago, a thoroughly equipped pattern shop has been added.

John H. VanDeventer Now Editor of "Industrial Management"

John H. VanDeventer, formerly Editor of the *American Machinist*, has accepted the Editorship of *Industrial Management*. Coming to this paper on Sept. 14, 1914, as associate editor, Mr. VanDeventer's ability soon became apparent and he became successively managing editor and then editor-in-chief. Called into the Ordnance Department in September, 1917, he served a year as Major, being engaged in organization work in the gun division on both guns and shells.

Returning to the *American Machinist* he wrote the story of the Ordnance Department, which showed what was really accomplished, and was also instrumental in organizing the Army Ordnance Association. He undertakes his new work with the best wishes of his former associates.

Outing of Cincinnati-Bickford Tool Co.

A well attended outing was held on Saturday, Aug. 21, by the Cincinnati-Bickford Tool Co. Highland Grove, a beautiful picnic ground, was the setting for the affair, which occupied the entire day. A special train took the picnickers both to and from the grove. The day was started with singing and was taken up largely by games and athletic and novelty contests. Entertainments, such as a merry-go-round, were provided for the children. Dancing, of course, was one of the most popular features.

The outing was declared to be a great success by August H. Tuechter, president of the company, who said that all of the 1,500 people who attended the outing seemed to have had a very enjoyable day. Judging from the success of the affair, it would appear that there is considerable harmony in some of the machine-tool plants of Cincinnati despite the strike.

Bullard Plant Bought by Underwood Typewriter Co.

The Underwood Typewriter Co. has purchased the plant of the Bullard Machine Tool Co. at Broad St. and Railroad Ave., Bridgeport, Conn. The place is listed on the tax list for half a million dollars.

According to Mr. Rossiter, vice-president of the typewriter company, the Bridgeport plant will be known as factory No. 2, and will employ between 1,500 and 2,000 people. The company does not expect to occupy it before October.

LD'S INDUSTRIAL FORGE
News Editor

Westinghouse Awards Engineering Scholarships

The War Memorial Scholarship Committee of the Westinghouse Electric and Manufacturing Co. has announced as the winners of the four scholarships for the coming college year, 1920-21, Alva C. Corrao, small motor drafting department; Henry Gardiner Symonds, son of N. G. Symonds, manager industrial sales division, Chicago office; J. Dale Seabert, transformer engineering department, and Herbert R. Hillman, son of William A. Hillman, who has been a machinist in the works of the R. D. Nuttall Co. for 27 years.

These War Memorial Scholarships were established in 1919 as a means for perpetuating the memory of those employees of the Westinghouse and its subsidiary companies, who took part in the World War. Each scholarship carries with it the annual payment of $500 for a period not to exceed four years. The payment is to be applied toward an engineering education in any technical school or college selected by the successful candidate and approved by the scholarship committee. Scholarships are granted for one year only, but are continued for the full course provided the scholar maintains the academic and other standards as required by the institution.

Two classes of scholarships are provided: (a) for sons of employees of the company or its subsidiary companies, who have been employed for five years or longer, and (b) for employees who have been continuously employed at least two years and who shall not, on Sept. 1, have exceeded the age of 23. The four awards for the coming school year are in addition to the four scholarships awarded last year, all of which have been continued for the coming year. Four new scholarships will be awarded and eventually Westinghouse will be maintaining 16 scholarships in the leading schools of the United States.

Three of the winners have selected for his college Carnegie Institute of Technology, Pittsburgh, and Mr. Symonds has selected Leland Stanford, Jr., University of California. The awarding of the scholarships is based upon the personal character of the applicants and grades in examinations.

It has been announced that 450 exhibitors have enrolled for the Sixth National Exposition of Chemical Industries, which will open in New York Sept. 20. The number of exhibitors breaks the former record of 358, made at the Chicago exhibition last year.

First International "Plattsburg" for Pan-American Commerce

The organization of the Pan American College of Commerce at Panama, which will open in January, 1921, will be the most progressive and up-to-date step yet taken of an educational character to promote that kind of Pan American trade and intercourse which will be of equal benefit alike to all of the American republics, and hence worthy of the support of their representative commercial and economic interests.

It will be the first "Plattsburg" or intensive training camp for foreign commerce that has been organized on a large scale in the Western Hemisphere, and should have the same beneficial effect on all the countries concerned that the "Plattsburgs" or intensive training camps for the world war had upon the United States.

The Panama Government, which gives its enthusiastic patronage and practical support to the project, feels assured of its success. Honorable John Barrett, who retired Sept. 1, 1920, from the position of Director General of the Pan American Union after fourteen years of service at the head of that international institution, and who had previously served as United States Minister to the Argentine Republic, to Panama and to Colombia, has accepted the responsible post of President of the Administrative Council. Dr. Clarence J. Owens, Director General of the Southern Commercial Congress, and formerly Economic Commissioner of the Panama Government, will be the Executive Director, assisted by an eminent Dean and faculty of experts presently to be chosen.

For further information address Dr. Clarence J. Owens, Executive Director, Pan American College of Commerce, 1000 Vermont Ave., N. W., Washington, D. C.

Stanley Works Leases Large Tenement House

The Stanley Works, New Britain, Conn., has leased a three-story tenement house, consisting of six apartments. The premises are to be used as a boarding and rooming establishment, the lease states. The lease is for one year with a monthly rental of $144.

It was announced on Aug. 30 that a report had reached Secretary Daniels from the New York Navy Yard of a successful preliminary test in electrically piloting vessels into harbor by means of a submerged cable.

Iron and Steel Engineers Announce Program for Annual Convention

The Association of Iron and Steel Electrical Engineers announces the following program for its fourteenth annual convention, to be held at the Hotel Pennsylvania, New York, Sept. 20 to 24.

MONDAY, SEPT. 20

9 a. m.—Registration.

10:30 a. m.—Business Session (for members only.)

Reports of Committees.

Election of Officers.

2 p. m.—Papers: "Practical Education of Steel Mill Electricians," by W. A. Cornwell; "Relation of Standardization in Electrical Equipment to Safety," by Walter Greenwood.

TUESDAY, SEPT. 21

10 a. m.—Papers: "Power Transmission for Industrial Plants," by D. M. Petty; "Underground Transmission," by A. L. Freret.

2 p. m.—Excursion.

WEDNESDAY, SEPT. 22

10 a. m.—Papers: "Some Considerations in the Determination of Auxiliary Drives," by Gordon Fox; "Report of Electrical Development Committee for 1920," by E. S. Jefferies, chairman.

2 p. m.—Papers: "The Reversing Electric Mill Considered from the Standpoint of Tonnage," by K. A. Fauly.

7 p. m.—Annual Banquet. Arrangements have been made to accommodate 1,000 guests. Ladies are especially invited.

THURSDAY, SEPT. 23

10 a. m.—Papers: "Centralized Turbine Generating Stations for Steel Mills," by T. E. Keating; "Current Limit Reactance," by R. H. Keil.

2 p. m.—Papers: "Report of Electric Furnace Committee for 1920," by E. T. Moore, chairman.

FRIDAY, SEPT. 24

10 a. m.—Papers: "Standardization Committee Report," by W. T. Snyder, chairman.

2 p. m.—Excursion.

Machinery Will Double Philippine Sugar Output

The sugar output of the Philippine Islands will be more than doubled next year by the installation of modern machinery, according to a statement made public by the Bureau of Foreign Commerce.

In 1919 the Philippines sent $3,566,000 worth of cane sugar to the United States.

U. S. Shipping Board to Sell Machinery and Equipment

United States Shipping Board Emergency Fleet Corporation offers for sale machinery, equipment and materials at the yard formerly operated by National Shipbuilding and Dry Dock Co., Savannah, Ga.

Sealed bids will be received until 11 o'clock a.m., Sept. 16, by the United States Shipping Board Emergency Fleet Corporation at the office of the director, Division of Supply and Sales, 6th and B Sts., S. W., Washington, D. C., for the purchase of the interest of the United States Shipping Board Emergency Fleet Corporation in plant machinery, equipment, and shipbuilding materials—excepting treenails and lumber—located at the yard of the National Shipbuilding and Dry Dock Co., Savannah, Ga. The use of certain equipment and facilities for loading, sawing, dressing, and remanufacturing lumber is reserved until the lumber has been removed from the yard.

Bids must be submitted in duplicate on standard proposal forms and inclosed in a sealed envelope marked "Proposal 4002 to be opened at 11 a.m., Sept. 16, 1920."

The property to be sold consists of:

Buildings, track, fire apparatus, water, steam and air lines, lighting equipment, air and small tools, scaffolding, cypress poles, building material, electric supplies, hospital supplies, pipe and fittings, machine parts, tool steel, machinery, yard equipment, launch and boats, hospital equipment, hardware, masts and booms, iron.

Property is to be removed from yard within six months of signing of contract. Bids must be accompanied by a certified check on a national bank, payable to the United States Shipping Board Emergency Fleet Corporation, for 10 per cent of the amount bid.

Proposal forms and further information may be obtained by addressing the Director, Division of Supply and Sales, United States Shipping Board Emergency Fleet Corporation, 6th and B Sts., S. W., Washington, D. C.

Exports and Imports

The Bureau of Foreign and Domestic Commerce issued a report on the total values of imports and exports of the United States for July, 1920. This shows that the total value of imports for July were $537,000,000, against $343,746,070 in July, 1919. Exports for July, 1920, amounted to $654,000,000, against $568,687,515 in July, 1919.

Cigarette Machinery Sought

The increasing local demand for cigarettes in southern India has encouraged the opening of a number of factories for the manufacture of cigarettes for this trade, as well as for exporting. In view of the growing labor difficulties, it is said, there are excellent opportunities for the sale of automatic machinery for use in making both cigars and cigarettes.

Old Hickory Powder Plant Sale Postponed

The Director of Sales announces that the date for receiving bids for the Old Hickory Powder Plant, near Nashville, Tenn., has been postponed from Sept. 2 to Sept. 30.

This postponement was found necessary because of the large number of inquiries received and the magnitude of the proposition. Investigation demonstrated the great task of the manufacturers, bankers and financiers in general who are interested in the commercial development of this plant in working out such proposals. Many varied interests are involved in this development.

Old Hickory, which is a great modern plant and industrial town, has been called "the magic city of the war." It is recognized as the greatest industrial achievement of the war, either in America or abroad. While constructed for the manufacture of smokeless powder and explosives, the several units of the plant are readily adaptable to many industries, including chemical; rubber goods, such as auto tires; pulp and paper mills; sugar refinery; coking and coke by-products; food, both evaporated and concentrated; iron and steel foundries; fibrated products, such as asphaltum shingles; aluminum; wood box or refrigerator manufacture; cellulose and photographic film manufacturing; and a number of other minor industries, such as an ice plant or cold-storage warehouse.

American capital has displayed a great interest in the sale of this plant. Sealed bids for the entire property will be received now and up to 10 a.m., Eastern time, Sept. 30, 1920. Requests for information, proposals to purchase a part, and sealed bids for the entire property should be addressed to the Chairman, Ordnance Salvage Board, War Trade Building, Washington, D. C.

Gray Iron Foundry to Open New Plant

A machine molding section will be added to the plant of the Gray Iron Foundry Co. at Reading, Pa. A portion of the foundry now under construction will be put in operation within the next few days. The building is of steel and reinforced concrete, and when completed will be 60 x 200 ft., and will cost $40,000.

A working force of sixty men will be required to operate an equipment of Tabor molding machines with a daily capacity of 6,000 to 8,000 castings. Articles weighing from one-half ounce to ten pounds each will be turned out.

The new department will enable the foundry to keep pace with the machine shop, plating, assembling and other sections of the plant, where in part or wholly the concern manufactures to order lawn mowers, hardware specialties, small machines, household appliances, lamp stands, sadirons, toys, novelties, and many other articles in which cast iron is used.

Kempsmith Employees Enjoy Great Picnic

The Kempsmith Manufacturing Co. of Milwaukee, Wis., celebrated its fifth annual outing at one of Milwaukee's suburban lakes on Saturday, Aug. 21. Kempsmith's outings have always been marked by exceptionally fine weather. This year, however a cold drizzle greeted the picnickers, but even so, they were not daunted and turned out in even larger numbers than in past years. The weather soon cleared up and the greater part of the day was ideal in every respect.

There were all sorts of contests and events for men, women and children, and the picnic did not lack action at any time during the entire day. Community singing was one of the features of the day, the music being furnished by the Kempsmith Band, which not only plays once a week in the shop, but at many functions throughout the city of Milwaukee.

Everyone missed Paul E. Thomas, president and treasurer of the company, who is abroad at the present time studying trade conditions. John Goetz, vice president and works manager of the company, proved a very capable leader of all the games and contests, which, under his guidance, were all run off smoothly. Dancing was the principal feature of the evening, several contests being held.

Machinery Exports to Japan Increasing—Kobe District Growing Fast

That Kobe is fast growing as an industrial center in western Japan is evidenced by the fact that the 2,000 factories and mills, employing 70,000 workpeople, produced various industrial products worth approximately $20,000,000 in 1919, states the *Japan Advertiser*. Mechanical engineering represented the greatest output, with the chemical industry second. With the object of studying various after-war trade problems, leading merchants and manufacturers have organized the Kobe Commercial Club, proposing, with this end in view, to send abroad expert trade commissioners.

With the imports of textile machinery into Japan increasing in value from $2,000,000 to $8,000,000 in the last three years, Consul Frazer believes the present financial depression is only a temporary check to the general demand for all varieties of this machinery in the Kobe district. It is of interest to note that before the war the United States supplied less than 1 per cent of the spinning and weaving machinery brought into Japan, while in 1918 and 1919 more than half of the imports of textile machinery came from the United States.

The arrival in New York of 18,691 aliens during the week ended Aug. 28 broke all immigration records at Ellis Island since before the World War.

Simonds Steel Mills Laboratory Completed

Following out special plans for general advancement in research work, the Simonds Manufacturing Co., Fitchburg, Mass., has just completed an addition, 40 x 50, to its research laboratory connected with its steel mills at Lockport, N. Y. Additional equipment, consisting of a 300 to 500 lb. capacity special type electrical melting furnace, several electric heating furnaces, and other tools and equipment have been installed, with a view of greatly extending facilities for carrying on development and research work. New formulas and methods for making special steels will be worked out at the enlarged laboratory under the direction of an expert metallurgical staff.

Business Items

The New England Wire Die, Inc., of Waterbury, Conn., has been organized to deal in diamond dies, machinery repairs, etc., with a plant at Waterbury. The capital stock is $50,000.

The new three-story addition to the plant of the Butterfield Co., at Derby Line, Vermont, is nearing completion, and when finished will add over 35,000 sq.ft. to the present floor space.

The New Britain Machine Co. and Union Manufacturing Co. of New Britain, have taken out building permits. The former will build a coal hopper and the latter a warehouse.

A consolidation was effected on Aug. 10 between the Zahner Metal Sash and Door Co. of Canto, Ohio, and the Empire Art Metal Co. of New York, under the name of the Central Metal Products Corporation.

The Carroll Foundry and Machine Co., Bucyrus, Ohio, has bought the Lambert horizontal boring machine, formerly made by the Lambert Machine Engineering Co., Cleveland, Ohio, and will manufacture and market it on a large scale.

The Herberts Machinery and Supply Co., Los Angeles, Cal., announces that its new San Francisco store is located at 140 East First St. The firm deals in machine tools and woodworking machinery.

Owing to advanced stage of construction of the new plant of the Eastern Potash Corporation, near New Brunswick, N. J., the engineering office has been removed from 120 Broadway, New York City, to the new building. Olin H. Landreth has resigned as chief engineer of the company but will be connected in an advisory capacity as consulting engineer.

The Billings & Spencer Co. of Hartford, Conn., manufacturer of machine tools and drop forgings, etc., has increased its capital stock from $1,000,000 to $3,000,000.

The Mesta Machine Co., West Homestead, Pa., has opened an office in the Singer Building, New York, from which point all its foreign business will be handled. All foreign correspondence should be addressed to New York. The New York office will also be the sales office for the New York and Eastern states territory. M. M. Moore, the export sales manager, who has just returned from a several months' European trip, will be in charge.

The plant of the Dillon Crucible Alloys, Ltd., Welland, has been purchased by the Canadian Atlas Crucible Steel Co., Ltd., and Canadian interests will be strongly represented in the company as well as on the board of directors. The general sales office of the company will be located at 133 Eastern Ave., Toronto, Ont., with a warehouse in conjunction, and branch warehouses and sales offices at 326 Craig St., W., Montreal, also at Winnipeg, Man.

Personals

MESSRS. ENGLE and DORRINGTON, salesmen, and MR. MERZBACHER, of the Disston steel products laboratory, will be in charge of the booths of Henry Disston & Sons, Inc., Philadelphia, Pa., at the American Steel Treaters' Society convention at the Philadelphia Commercial Museum on Sept. 14 to 18.

L. L. WATHER, manager of the Cincinnati and Chicago branches of Henry Disston & Sons, Inc., Philadelphia, will have charge of the firm's exhibit at the American Foundrymen's Association, at Columbus, Ohio, Oct. 4 to 8.

IRA SMITH has been appointed division manager of Plant B of the New Departure Manufacturing Co. of Bristol, Conn. Mr. Smith has been superintendent of this plant for the past several years, and has been with the company for over fifteen years, starting in as an office boy and working himself up to the present position as manager of Division B.

A. B. WAY, recently secretary and general manager of the Bridgeport Chain Co., has become affiliated with the Chain Products Co. of Cleveland, Ohio, in the capacity of district sales manager for New England, with headquarters at the company's New York office, 150-152 Chambers St.

EDWARD D. ROCKWELL has resigned as division manager of Plant B of the New Departure Manufacturing Co. of Bristol, Conn., having purchased a hardware business in Bristol, which he will take over immediately. Mr. Rockwell has been with the New Departure Co. for the past twenty-two years.

H. W. NORRIS, secretary of the Cincinnati-Bickford Tool Co., sailed Aug. 21 for a two months' business trip to Great Britain and the Continent.

F. P. JENKINS, for some years with the Brown & Sharpe Manufacturing Co. of Providence, R. I., and more recently with the Screw Machine Products Corp. of the same city, has become associated with the Advance Tool Co. of Cincinnati, Ohio, as superintendent. The latter concern manufactures reamers, cutters, jigs, fixtures, etc.

C. B. LORD, formerly with the Wagner Electric Co., St. Louis, is now works manager of the Advance-Rumely Co., Battle Creek, Mich.

JULIUS JANES, formerly president of the Standard Steel Castings Co., Cleveland, Ohio, has recently concluded an arrangement with the Farrell-Cheek Steel Foundry Co. of Sandusky, Ohio, by which he will be the sales representative of this organization in Cleveland and Cuyahoga County.

OLIN H. LANDRETH, formerly chief engineer and now consulting engineer of the Eastern Potash Corporation, has opened offices at 156 Fifth Ave., New York City, where he will be available for engagements in power development, industrial engineering, hydraulic engineering and valuation work.

CHARLES WHITING BAKER, for many years editor-in-chief of *Engineering News*, and since 1917 consulting engineer of *Engineering News-Record*, announces his resignation and the establishment of the Engineering Business Exchange, New York, an agency to bring together those desiring to sell any sound engineering or technical business and those seeking opportunities to purchase.

JOEL F. TROUTMAN, who for seven years has been manager and vice-president of the H. A. Smith Machinery Co. of this city, has resigned to become junior partner of the newly organized firm of Cornwell & Troutman, 701 to 705 South Salina St. The company will be local distributors for the silent Alamo farm electric and power lights.

Obituary

GEORGE F. MARCHANT, president and founder of the George F. Marchant Co., Chicago, Ill., died Aug. 4.

HENRY BOWEN MILLER, for 50 years superintendent of the Luke H. Miller Co., safe and iron works, died on Aug. 24 at the home of his daughter in Baltimore. He was 91 years old and a native of Pawtucket, R. I. He retired from business about eight years ago.

WILLIAM E. SESSIONS, president of the Sessions Foundry Co., Bristol, Conn., died suddenly at his home in Bristol, Aug. 27, of heart disease. Mr. Sessions was 63 years old and was one of the best known manufacturers of the state.

FRANK E. HARTHAN died recently at his home, West Boylston, Mass., after a lingering illness. Mr. Harthan left Worcester, Mass., in 1898 to become superintendent of the Reeves Engine Co., Trenton, N. J., and in 1902 accepted a similar position with the McFarland Foundry and Machine Co. He retired from active work in 1916 on account of failing health.

New Publications

Case Carbonizing. One hundred twelve 5 x 7¾-in. pages, 21 illustrations and several tables. Bound in paper covers. Issued by the Driver-Harris Co., Harrison, N. J.

This is one of the most compact little books yet issued for the use of those interested in case-hardening or carbonizing. While primarily gotten up to call attention to the use of nichrome boxes and pots, it is not a mere advertising booklet, as the information is of general use to all those having to do with carbonizing or heat treatment of low-carbon steels.

The book starts out with a chapter on case-carbonizing divided into sections on the definition of case-carbonizing, its history, mechanics, oil tempering vs. case-hardening, requirements for case-hardening, quality of steel used, effect of temperature and time, pack-hardening, carbonizing compounds, containers, packing, soft spots, vertical pack-hardening. Chapter II, Cyanide-Hardening, gives details of the practice and formulas used for cyanide work and outlines its limitations. Chapter III, Gas-Hardening, covers the theory and use of various gases for case-hardening. Chapter IV, Lead-Hardening, tells of the use of the lead bath in connection with case-hardened work. The temperature range of the lead bath is given also. Chapter V, Carbonizing Containers, mentions and discusses the various kinds of containers and their merits or demerits. Chapter VI, Nichrome-Commercial and Technical Data, gives the strength of nichrome, its acid-resisting properties and other features. Chapter VII, Cast Nichrome Containers, takes up cast nichrome for cyanide hardening, cast nichrome for lead-hardening, cast nichrome for pyrometer protection tubes, dipping baskets, additional uses of nichrome castings. Chapter VIII, Commercial Methods of Using Cast Nichrome, describes its uses for treating automobile starting and lighting equipment, studs, setscrews, small bolts, nuts, etc., ring gears for automobile differentials, roller bearings. The appendix is filled with tables of stock patterns and special container sizes. The latter is especially valuable for the man wanting containers to suit his particular needs.

Electro-Deposition of Metals, by Dr. George Langbein, translated and enlarged by William T. Braunt. 8th Edition, revised and enlarged. 863 pp., 6 x 9, illustrated. Published by Henry Carey Baird & Co., Inc., 2 West 45th St., New York City. Price $7.50.

This voluminous treatise is an eminently practical work on the arts of electro-plating, galvanizing, metal coloring, lacquering and electrotyping. The original work is probably so well known to the trade that little need be said about its general contents. This edition pays particular attention to the practical innovations adopted since the publication of the previous one and presents the most recent machinery and apparatus such as the new plating machines, grinding and polishing lathes, sand blast and lacquering apparatus, etc. The book is divided into four sections as follows: I—Historical; II—Theoretical; III—Sources of Current; IV—Practical. The last part is of course the most useful and is replete with practical working formulas for every conceivable kind of electro-deposition and metal finishing.

The Design of Screw Propellers for Aircraft, by Henry C. Watts, M.B.E., B.Sc., Fellow of the Royal Aeronautical Society. 340 pp., 6 x 9, with illustrations and diagrams. Published by Longmans, Green & Co., Fourth Ave. and 30th St., New York City. Price $8.

This exhaustive treatise on the design of airplane propellers goes into the subject with true British thoroughness. It is based on the author's work for the British Air Ministry during the period of the war and includes not only the complete theoretical analyses of the various problems taken up but the results of practical tests as well. Many charts and tables of propeller tests made by the Royal Air Force engineers and test pilots are used to illustrate the principles involved. The more important chapter headings follow: The Aerofoil; The Simple Drzewiecki Theory; Aerodynamic Analysis and Design; Inflow and Outflow; The Combined Theory; Overall Efficiency; The Flow of Air Through a Propeller and the Effect of Placing a Body in the Ship Stream; The Strength of a Propeller; Tandem Propellers; The Variable Pitch Propeller; The Hub; The Design of Windmills. Three Appendices on Drawing, The Construction of Propellers and the Works of M. Drzewiecki, together with a list of symbols, complete the book.

Metallography—Part I, Principle of Metallography, by Samuel L. Hoyt, E.M., Ph.D., Metallurgical Engineer, National Lamp Works of General Electric Co., and formerly Associate Professor of Metallography at the University of Minnesota. 256 pp., 6 x 9, illustrated by diagrams, photographs and drawings. Published by the McGraw-Hill Book Co., Inc., 239 West 39th St., New York City.

This is the first of a three-volume series on Metallography by Professor Hoyt. Part II, The Metals and Common Alloys, is in press and Part III, Technical Practice, in preparation. Part I deals with fundamental principles and is largely the outgrowth of the author's university work and notes. It is very well written and makes a refreshingly economical use of words, something that cannot be said of all technical books, unfortunately. The elements of metallographic theory are well handled and considerable information on the apparatus and laboratory methods is included. The chapter headings are: I—Constitution Diagrams; II—The Preparation of Metallic Alloys; III—Metallic Microscopy; IV—The Misconstructure of Metals and Alloys; V—Pyrometry and Thermal Analysis; VI—Physical Properties; VII—Mechanical Properties.

Shop Practice for Home Mechanics. By Raymond Francis Yates. Three hundred and fourteen 5½ x 8¼ in. pages, 309 illustrations and tables, bound in dark green cloth boards. Published by the Norman W. Henley Publishing Co., 2 West 45th St., New York City. Price $3.

A good practical book prepared for home mechanics. It is written in a way to make clear to the youth or man who knows little or nothing of mechanics how to use hand tools and the simple measuring tools and how to operate the lathe. There are also introduced instructions on pattern making, hardening and tempering steel, soldering and brazing and the construction of a small power driven drill press and a small grinding head.

The book begins with a chapter on the introduction to the study of elementary mechanics. This is followed by chapters on the use of miscellaneous tools measuring instruments and their use, drilling and reaming, introduction to lathe work, advanced lathe work, special lathe work, grinding operations and pattern making, etc., as previously mentioned. The closing chapter is on general information and includes some valuable tables.

Trade Catalogs

Gages, Measuring Machines, Etc. The Golden Co., 405 Lexington Ave., New York City, has announced the list of apparatus that it is handling: Universal measuring machines for checking and controlling gages and standards of every description; high precision micrometer, range 0 to 4 in., gaging to an accuracy of 0.000005 in.; comparators for gaging interchangeable parts of all forms, to an accuracy of 0.00005 in. and other special gages. These appliances can be furnished to English or metric dimensions.

Wetmore Cylinder Reamer Sets. Wetmore Reamer Co., Milwaukee, Wis. Bulletin No. 14, is the designation of a new four-page publication describing the Wetmore set, consisting of a roughing reamer, a semi-finishing reamer, and a floating finishing reamer, particularly suited to the reaming of engine cylinders. The details of construction and the reason why round, straight and smooth holes are obtained, are pointed out. Illustrations of all the tools as well as a phantom of the floating finishing reamer are included. The new construction of the latter, with its float-in-the-head design is shown in the phantom view. Reference is also made to the adaptation of the semi-finishing reamer of the cylinder set for line and pilot reaming.

New "Eveready" Catalog. Issued by the Oxweld Acetylene Co. of 3640 Jasper Place, Chicago, Ill., is now ready for the public. The catalog is issued in sections, each devoted to a particular phase of "Eveready" equipment—welding and cutting blowpipes, regulators, accesories, etc.

The "Eveready" line was formerly manufactured under the name of "Prest-o-Lite" apparatus by the Prest-o-Lite Co., and was extensively used in the metal trades. The Oxweld Co. took over the production and sales under the present name—"Eveready"—early in 1920, incorporating certain improvements in design lately developed in oxy-acetylene engineering.

Geyser Electric Water Heater. The Bridgeport Machine and Tool Manufacturing Co., Bridgeport, Conn. Circular describing the latest in electric water heaters. Covers construction, operation, and average efficiency of the "Geyser" machine.

Tools, Dies, Jigs and Fixtures. The City Engineering Co., 35 S. St. Clair St., Dayton, Ohio. A single page circular showing three illustrations of its Brehm trimming die which was built for an engineering company.

Sandblasts. J. M. Betton, 59 Pearl St., New York. Catalog, pp. 16, 3¾ x 6 in. This catalog describes the Injector sand blast and gives general directions for installing and operating this machine.

Imperial Automatic Acetylene Generator. The Imperial Brass Manufacturing Co., 1200 West Harrison St., Chicago, Ill. Catalog pp. 7, 6 x 9 in. A short but complete summary of Imperial acetylene products, covering the several sizes and types of generators and trucks for their mounting.

Status Oil Hardening, Non-Shrinkable Tool Steel. The Hammond Steel Co., Inc., Syracuse, N. Y. Catalog, pp. 12, 4 x 8½ in. A short survey of Hammond steel products including punching and embossing dies, and a variety of cutting tools.

Benjamin Convert-A-Cap. Benjamin Electric Manufacturing Co., Chicago, Ill. A four-page circular describing this latest electrical device, the Benjamin Convert-A-Cap (No. 937). Full specifications of the work covered by this cap are given and also a list of prices and shipping weights.

Tanks. The Youngstown Boiler and Tank Co., Youngstown, Ohio. Catalog, pp. 8, 8 x 10 in., covering the production of steel tanks for storage of liquids or gases, steel stocks and supports; steel bins, flumes and hoppers. A table of standard specifications for Y-B-T tanks is also included.

Forthcoming Meetings

The American Steel Treaters' Society and the Steel Treating Research Society will hold their second annual convention and exhibition at the Commercial Museum, Philadelphia, Pa., on Sept. 14 to 18, inclusive. J. A. Pollak, of the Pollak Steel Co., Cincinnati, Ohio, is secretary of the former society.

The Sixth National Exposition of Chemical Industries will be held in New York on Sept. 20 at the Grand Central Palace.

The Association of Iron and Steel Electrical Engineers will hold its fourteenth annual convention at the Hotel Pennsylvania, New York, Sept. 20 to 24.

The National Safety Council, 168 North Michigan Ave., Chicago, Ill., will hold its ninth annual safety congress in Milwaukee on Sept. 27 to Oct. 1.

The American Foundrymen's Association will hold its annual convention and exhibit at Columbus, Ohio, on Oct. 4 to 9. C. E. Hoyt, 1401 Harris Trust Building, Chicago, Ill., is secretary.

An exposition of U. S. manufacturers at Buenos Aires, Argentine Republic, S. A., has been arranged for the month beginning Nov. 15. Information can be obtained from the American National Exhibition, Inc., Bush Terminal Sales Building, 132 West 42nd St., New York.

The National Machine Tool Builders' Association will hold its 19th annual Fall convention at the Hotel Astor, New York City, on Thursday and Friday, Dec. 2 and 3, 1920. C. Wood Walter, care of the association at Worcester, Mass., is secretary.

The 1920 annual meeting of the American Society of Mechanical Engineers will be held in the Engineering Societies Building, 29 West 39th Street, New York City, from Dec. 7 to Dec. 10.

September 16, 1920 American Machinist Vol. 53, No. 12

Testing Machines as Related to the Foundry*

By THORSTEN Y. OLSEN
Tinius Olsen Testing Machine Co.

In the constant search for positive knowledge of the qualities of materials, it is becoming more and more the practice of manufacturing plants to establish their own testing laboratories. New tests and new testing machines which have been devised to fill the needs of the expanded testing field, as they were brought up in the foundry, are recounted and explained by the author.

TESTING machines in general are today well known to the engineer and foundryman. Such machinery has developed so greatly in later years, that whereas thirty to forty years ago such machines were only occasionally used, today they are considered indispensable and a requisite for any up-to-date foundry.

Testing machines are installed in foundries for two general purposes: either to improve the product and thus promote reputation by having a name for supplying the best that is made; or to meet specifications set by the purchaser. There are some manufacturers who go a step further, enter the research or experimental field of testing and equip laboratories with special testing machines, in order not only to test material for tensile or transverse strength, but to test with regard to the particular use to which it is put and also to demonstrate its value in other fields and thereby create a new market by demonstrating its value under prescribed conditions. This class of testers is naturally the one on which the progress in any industry largely depends and from which the industry at large derives a benefit, although possibly not taking advantage of it until driven to do so by competition.

Testing in years gone by was, to a greater or lesser extent, considered a luxury and, by some, foolish and unnecessary; but today it is one of the best assets and greatest instruments of production because it promotes higher grade materials selling at higher prices. The first commercial testing machines in this country were designed about fifty years ago and the first so-called universal screw power testing machine over forty years ago, by Tinius Olsen. Today such machines are made in many sizes to test any material.

In addition to universal testing machines for tension, compression and transverse testing, several hundred other types and sizes of testing machines have

*Address, illustrated by lantern slides, delivered at a meeting of the Foundrymen's Association.

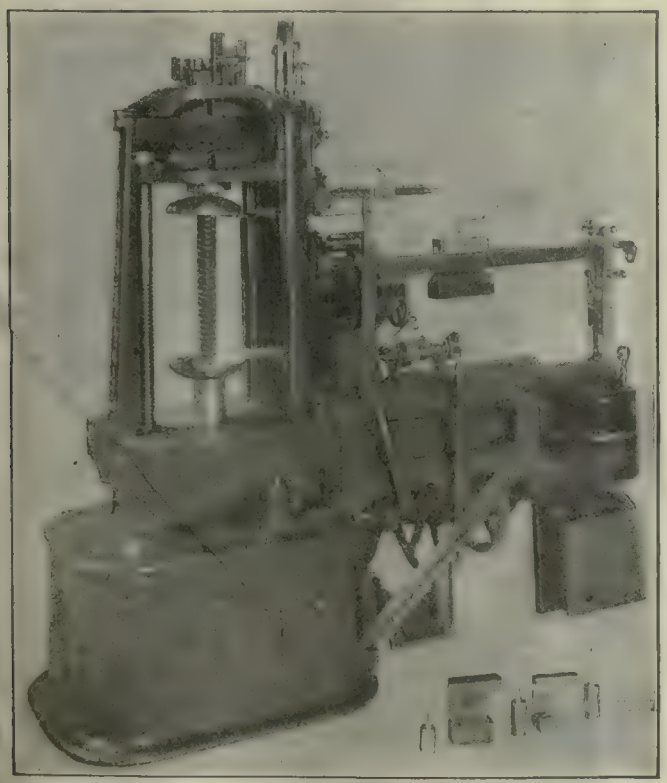


FIG. 1. THREE-SCREW UNIVERSAL TESTING MACHINE WITH AUTOMATIC RECORDING DEVICE



FIG. 2. AUTOGRAPHIC TRANSVERSE TESTING MACHINE

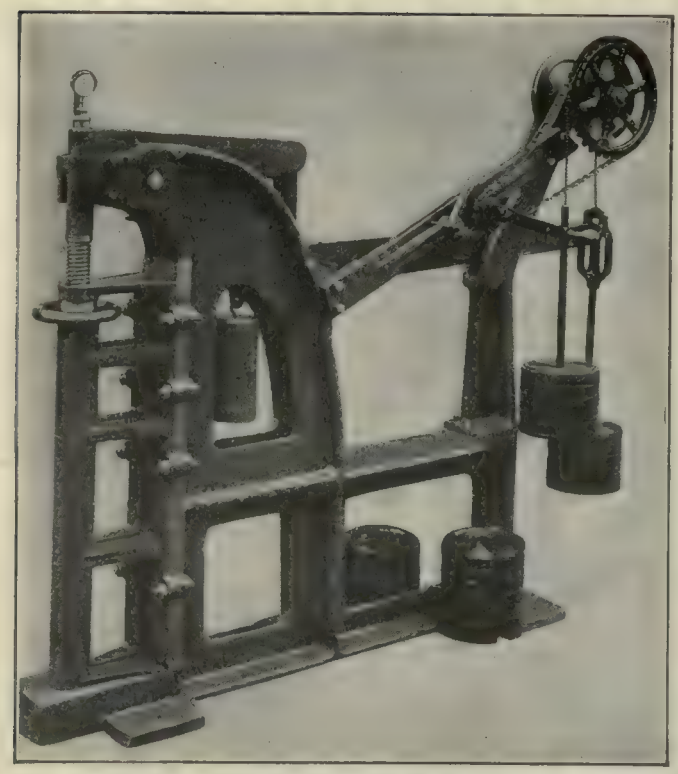


FIG. 3. STANDARD LEVER TYPE BRINELL HARDNESS TESTING MACHINE

been developed and built. Such of these as bear on the quality of foundry products are treated of in this article.

The machine used mostly by large foundries, which are required to make both tensile and transverse tests, is what is known as the universal testing machine, and depending on the size of specimen to be tested, a machine of from 30,000 to 100,000 lb. capacity is selected. This machine is designed on a four-screw principle of gearing, with a direct-connected motor drive. The tensile test specimen is placed between the two crossheads and the lower head driven down by screw gearing, thus pulling the specimen apart, the load being transmitted to the scale beam through the medium of the upper head and weighing levers.

Transverse test specimens may be broken by placing them on suitable supports on the weighing table, with specified distances between supports, and then running the crosshead down. The load is recorded on the scale beam and the deflection is read from an indicator which measures the motion of the specimen at its central point. The scale beam, in order to take care of both tensile and transverse test specimens, is, for foundry use, generally supplied with two poises, one reading to capacity for the tensile test and the other to one-tenth capacity for the transverse test.

Universal testing machines are also built on a three-screw principle of gearing which is an improved design for such machines. This type gives a greater clearance for the operator, which is a very desirable feature, causing, however, a machine of considerably greater weight and also greater cost.

There are various types of beams for the universal testing machine. On the automatic beam the load is automatically weighed, while on the dial vernier screw beam the poise is operated by hand. The very latest type of machine (shown by Fig. 1) is equipped with an automatic and autographic attachment, which records the relation between stress and strain for tension, compression or transverse test, for any point in the travel of the crosshead, up to the rupture point of the test specimen. The stress may be recorded in three or more magnitudes, as may be desired, while the strain is magnified, in this particular machine, ten times. Highly magnified diagrams may be secured for a light wire as well as for the heaviest specimen within the capacity of the machine.

The universal testing machines described cover all requirements for specimen tests. It is often desired to test full size, completed members, especially in railroad work, such as couplers, bolsters, side frames, etc., and machines of this type are built which will weigh up to 1,000,000 lb. Many steel foundries build ship anchors which must be proof-tested and this work is accomplished on an anchor tester designed for the purpose. Such machines are generally installed with capacities ranging from 200,000 to 400,000 lb., although Olsen machines have been built, arranged for anchor testing, up to 2,000,000 lb. capacity.

The transverse test for foundry products is such a valuable one, and one so greatly used, that many sizes and designs of such machines are available, depending on specifications for such tests. The standard machine for making small standard transverse tests is of the lever type. The test bars are either 1 in. square or round with an area of 1 square inch. They are placed on supports 12 in. between centers; the load is applied by handwheel and weighed on a scale beam, while a suitable device measures the deflection of the bar, correcting for the motion of the lever.

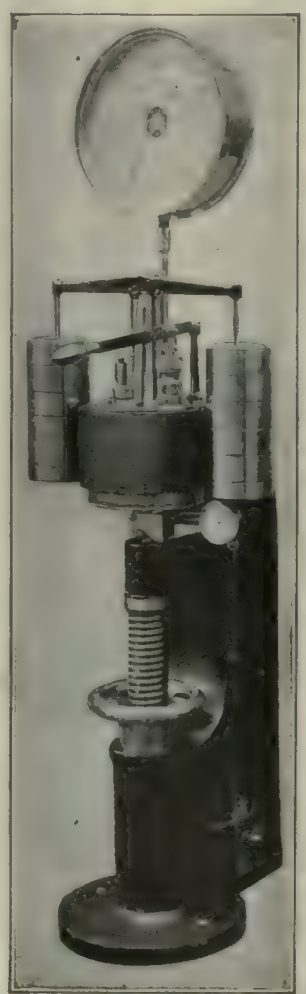


FIG. 4. HYDRAULIC TYPE BRINELL HARDNESS TESTING MACHINE

This type of machine is a good one, but in the light of modern practice a more complete test is demanded, and to cover such a demand the autographic transverse testing machine, as shown by Fig. 2, has been developed. This machine, merely by the turning of a handwheel, will scribe on the recording drum a highly magnified stress-strain diagram for a transverse test and give the operator a permanent record (which may be filed away) in less time than it takes to make an ordinary test in a lever type of machine. It is designed on a combined lever-pendulum basis of weighing. The rotation of the recording drum accurately records the load on square cross-section paper, correcting for the sine angle of the pendulum, while the motion of the pen measures the deflection of the bar.

Among the special tests to which foundry iron, steel, bronze or aluminum may be

subjected are hardness, impact, alternate stress, endurance, wear or abrasion torsion and cutting quality. For hardness the Brinell test is generally used. It consists of causing a standard Brinell ball of 10 mm. diameter to penetrate the metal under a load of 3,000 kg. for a period of 15 sec. and measuring the width of imprint with a special microscope, referring the readings so obtained to a table which will at a glance give the Brinell hardness number. The depth of imprint also can be measured by an additional attachment. This is done in routine work to procure comparative readings.

In Fig. 3 is shown a standard lever type Brinell hardness testing machine in which the load is applied very easily and quickly by a hand crank. The weights that apply the load to the lever system are counterbalanced and it is thus only necessary to raise the counter-balancing weights momentarily when a ratchet is applied, holding them in place until the time limit expires and the load is again released. This type of machine is very rugged and not liable to get out of order and is thus an ideal one for a foundry. Such machines are in use by the Pennsylvania railroad and various brake-shoe manufacturers, as all brake shoes must be subjected to such a test. Similar machines are arranged to be operated either by water or air pressure nd controlled by a foot-valve. They are largely used by automobile manufacturers and parts makers who test all their material for hardness.

The hydraulic type of Brinell hardness testing machine is of the bench type. The load is applied by hand pump and is weighed by a gage. The raising of calibrated weights insures accuracy and prevents an overload. This type of machine is the one most frequently used at present and is made in several sizes and types, including a portable type for store or stockroom use. Fig. 4 shows an Olsen hydraulic Brinell hardness testing machine with an automatic gage, which measures the depth of penetration to one one-hundredth of a millimeter.

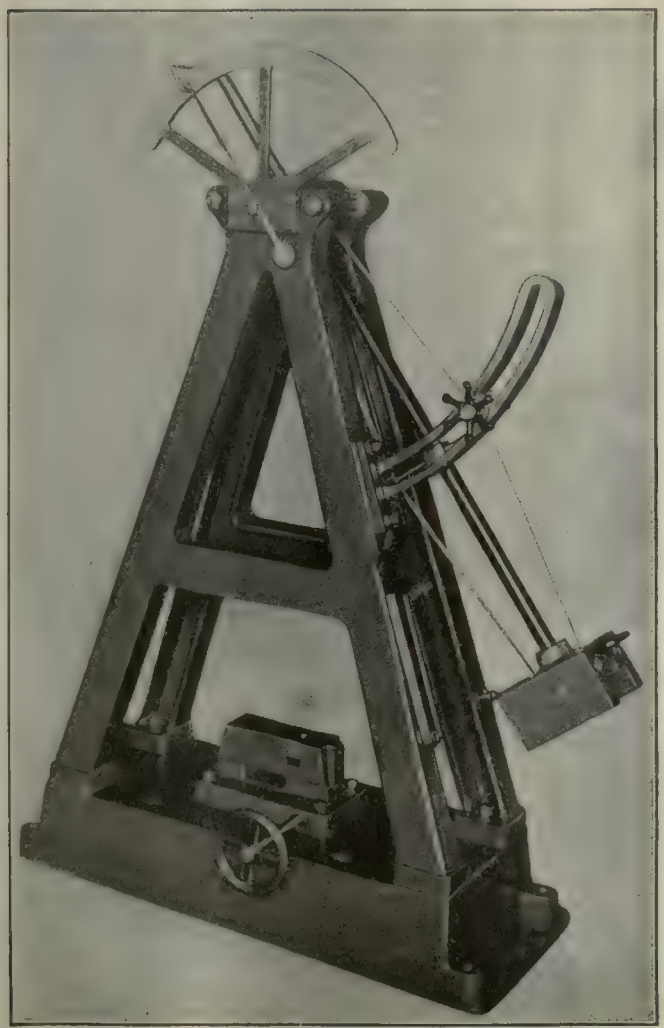


FIG. 5. IMPACT TESTING MACHINE

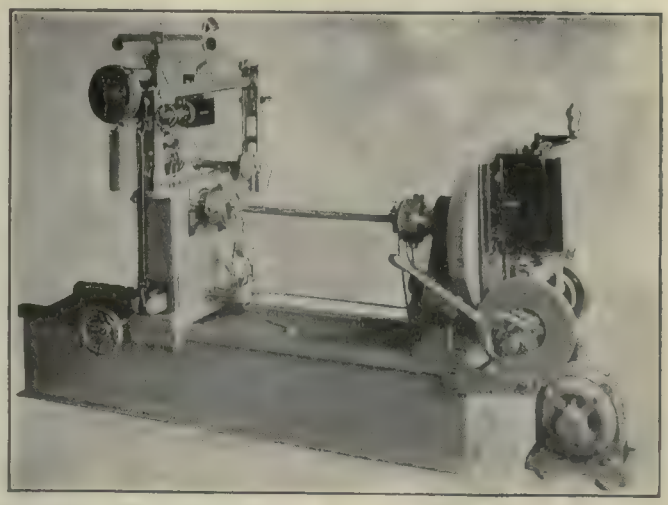


FIG. 6. AUTOMATIC AND AUTOGRAPHIC TORSION TESTING MACHINE

Impact tests are made in various ways, either on a small notched specimen, broken in the form of a cantilever, or in the form of a beam, or without notching, by shear or by impact tension. Cast iron and semi-steel are also often broken by either repeated blows from the hammer falling from a specified height, the number of drops being proportional to the strength of the test piece, or by increasing the height of fall per drop until rupture of specimen. Fig. 5 shows the most improved type of 120 ft.-lb. capacity impact testing machine, which tests a small notched specimen, either rectangular or round in section, breaking it as a cantilever. The pendulum is raised to the extreme top position and dropped. It strikes the specimen, breaking it off. The work to cause rupture is indicated by the amplitude of the continued motion of the pendulum over the scale. The specimen is held in a special clamping device operated by handwheel. This machine is adapted to testing small specimens by impact tension, indicating the work to cause rupture on the same scale.

Tension tests are now beginning to show their value in testing cast products, although more in connection with bronzes and aluminum alloys, than with steel and malleable iron. Machines for such tests are made in various sizes, not only to test samples, but full-size members, so that the strength of the design as well as of the material may be tested. Fig. 6 shows a small automatic and autographic torsion testing machine of 60,000 in.-lb. capacity which is very largely used at present. In this particular machine an autographic record may be taken in three magnitudes as to the load, and in two magnitudes as to measurement of the angular distorsion, so that highly magnified curves may be taken depending upon the characteristics of the material under test. These machines are also made with capacities ranging up to 1,500,000 in.-lb.

In the following paragraphs there are briefly

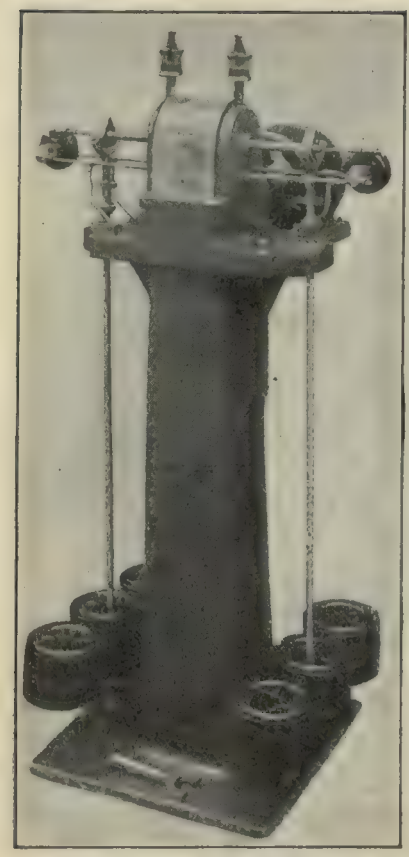


FIG. 7. WHITE-SOUTHER ENDURANCE TESTING MACHINE

described some of the latest types of alternate stress, endurance, repeated impact, wear and binding testing machines which are used in testing foundry products. The Upton-Lewis toughness and endurance testing machine No. 2, is arranged to test specimens either $\frac{1}{4}$ x 1 in. or $\frac{3}{8}$ x 2 in. in cross-section (or other sizes by adjustment) by bending them forward and backward under a known fiber stress. The amount of this fiber stress and the number of alterations are recorded by means of a pencil shown at the top of the machine. The fiber stress is set by an adjustable eccentric and weighed through the action of two springs. This machine has been largely used for testing malleable iron and steel castings, as well as bronze and aluminum alloys and much valuable information has been secured from these tests.

The Olsen-Foster alternate torsion testing machine No. 2, takes a standard tensile test specimen of 0.505 in. in diameter and subjects it to an alternate torsion test under a known fiber stress. The fiber stress in this machine is kept constant by a mechanism operated through a handwheel. The angular distorsion consequent to keeping the fiber stress a constant, the fiber stress and the number of alternations are recorded on a continuous diagram sheet. This machine is of value in testing materials for automobile and aëroplane construction.

The White-Souther endurance testing machine, Fig. 7, has been very largely used for testing steel, copper and aluminum alloys for fatigue. The test consists primarily of rotating a specimen, loaded at the end by weights to transmit an alternate stress. The specimen may be single or double ended and is held in place by taper liners. The rotation is at the rate of 1,300 r.p.m. Revolutions are recorded by speed counters, which are automatically cut off when the specimen breaks.

The Matsumura repeated impact testing machine illustrated in Fig. 8 was developed by Prof. Tsuruzo Matsumura, of Kiota, Japan. In this machine a specimen is placed loosely on two anvils at a specified distance apart and the hammer permitted to fall repeatedly on the specimen, which is rotated through 180 deg. between blows. The number of blows is counted and is taken as a measure of resistance to shock. The force of the blow may be regulated within the limits of the machine. The specimen, when struck, resting as it does, freely on the supports, experiences an unconstrained deformation and the shock is transmitted to the supports and not to the other machine parts. This type of test is now receiving considerable thought and attention and will no doubt be a large factor in determining the quality of material in the future.

Iron and steel as well as other metals are very often used where they are subjected to considerable wear and under such conditions a wear test should be prescribed. Fig. 9 shows the Norris slip abrasion testing machine in which the specimen rotates between three rollers. The two lower rollers operate at different rates of speed, producing a slip on the specimen, and the load is applied through the upper or third roller. The specimen is accurately weighed before and after the test, and a measure of the wear thus obtained. In Fig. 10 is shown the Olsen universal efficiency testing machine, in which may be tested tools, such as drills, taps, dies, reamers, milling cutters, files, and hacksaw blades;

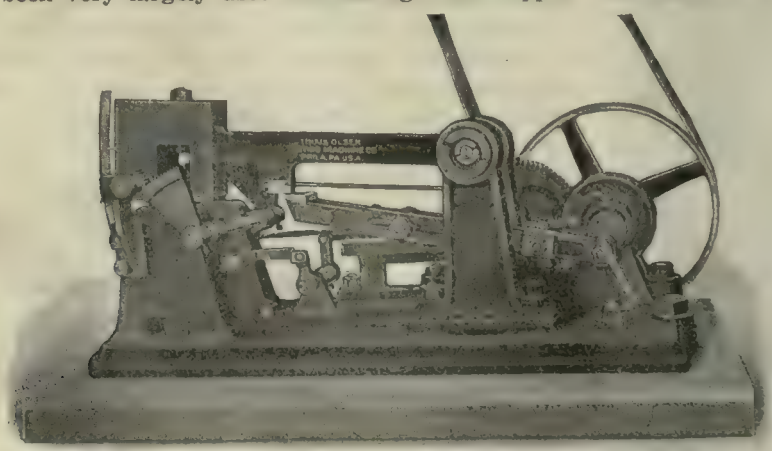


FIG. 8. MATSUMURA REPEAT-IMPACT TESTING MACHINE

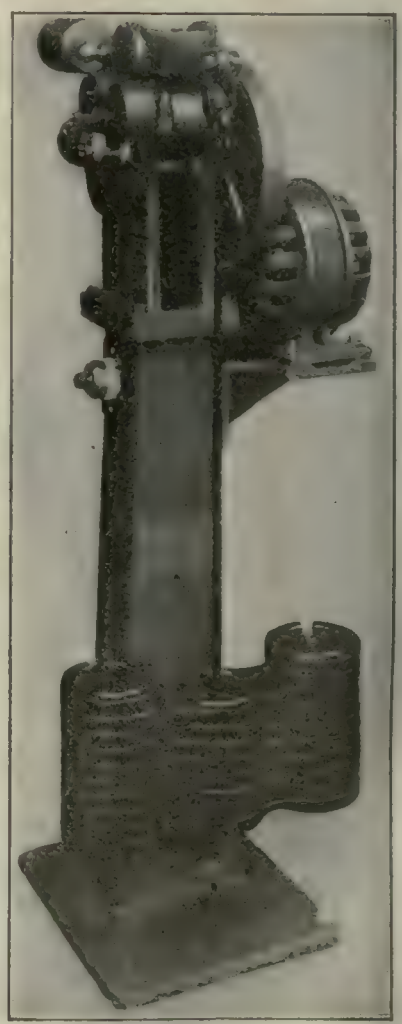


FIG. 9. NORRIS SLIP-ABRASION TESTING MACHINE

cutting compounds; the cutting property of tool steel; and the properties of various metals to be cut. The machine consists of a bed, at one end of which is a weighing and recording mechanism, and at the other a driving mechanism. The weighing end of the machine is a pendulum mounted on ball bearings so that the torque may be weighed. The pendulum is fitted with change weights to give various capacities, a scale for measuring torque and a recording mechanism. A hydraulic support in the pendulum head enables the pressure at the point of tool to be registered continuously on a gage. The uses of the machine are best explained by describing some of the tests made on it. Drills are tested to show the relation between torque, penetration and pressure at the point. In this test the drill, which is rotated, is placed in the line head, as shown in the illustration, and material of known properties to be drilled, is held in the weighing head. The feed is either positive, ranging in a geometric ratio, or by gravity. The relation between the torque and penetration or number of revolutions may be recorded on the diagram drum and the pressure at the point of the drill may be read from the gage.

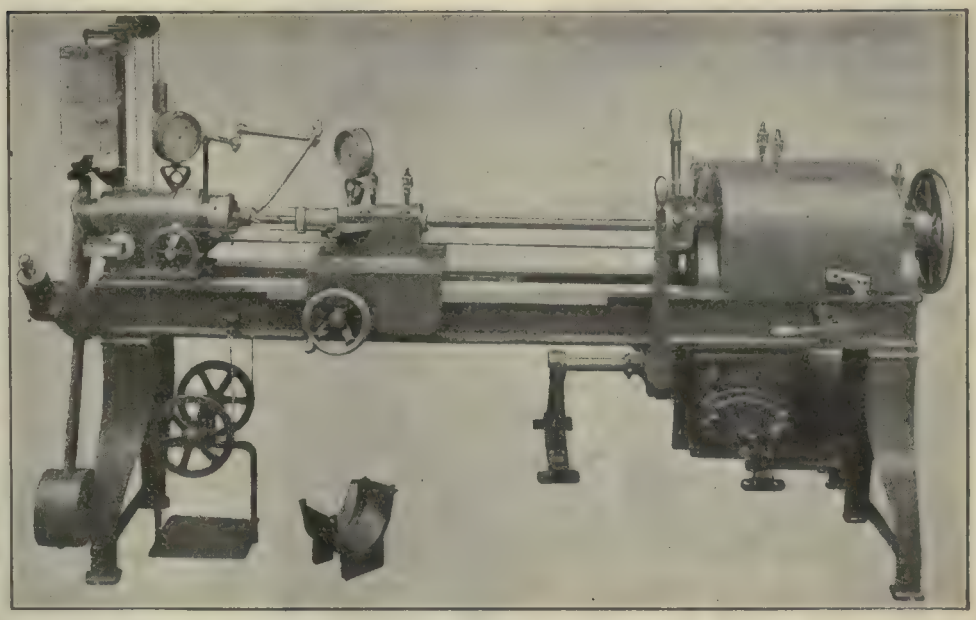


FIG. 10. UNIVERSAL EFFICIENCY TESTING MACHINE

Fig. 11 shows a hacksaw blade in the necessary attachment. The object of the test is to determine the relation between the number of revolutions and the depth of cut under prescribed conditions. Fig. 12 shows a milling cutter under test, using a single tooth and measuring the wear of this tooth by a special indicating instrument.

In similar manner files are tested to determine the relation between the revolutions and the material filed. Tool steel or metal to be machined is tested, the conditions of the one being the reverse of the other,. Fig. 13 shows a number of test curves. *A* is the result of the test of a file, *B* and *C* of ¾-in. drills, *D* of a hacksaw blade, *E* of a machine die, *F* of a trap, and *G* of a small drill.

Curve *B* is that of a ¾-in. high-speed drill running at 360 r.p.m., with a point pressure of 1,100 lb., while curve *C* is that of a ¾-in. carbon drill running at 90 r.p.m. with a point pressure of 1,350 lb. The feed and the class of material being drilled were the same in both. It is readily seen that the high-speed drill, cutting four times as fast, shows less torque as well as less pressure at the point of the drill.

Curve *G* is that of a small drill which readily shows that the torque required to penetrate is over twice that required to cut the material. It is often this excess torque required to penetrate that breaks the drill and the test shows that great care should be taken in the proper sharpening of such small drills.

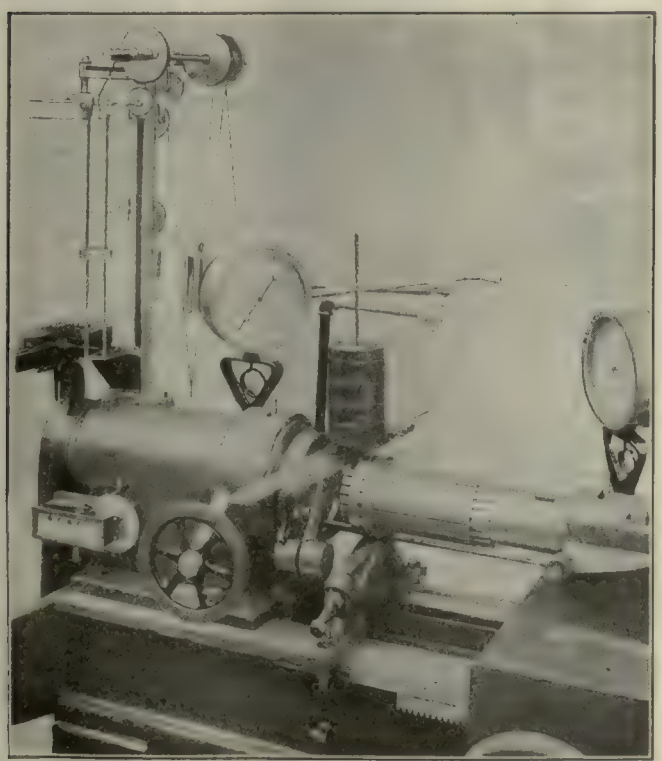


FIG. 11. HACKSAW BLADE TESTING ATTACHMENT

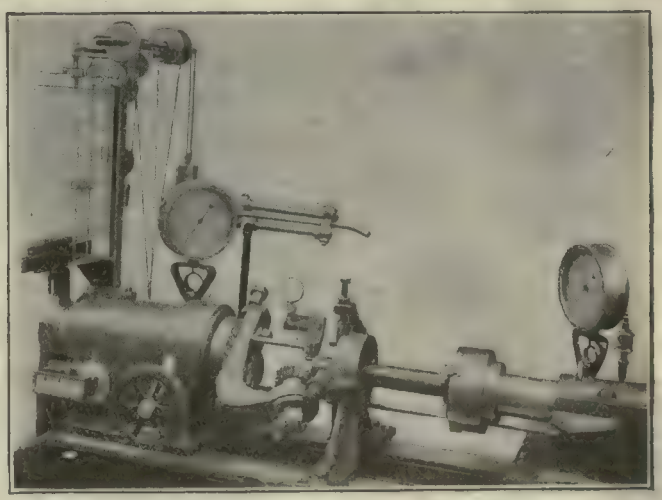


FIG. 12. MILLING CUTTER-TESTING ATTACHMENT

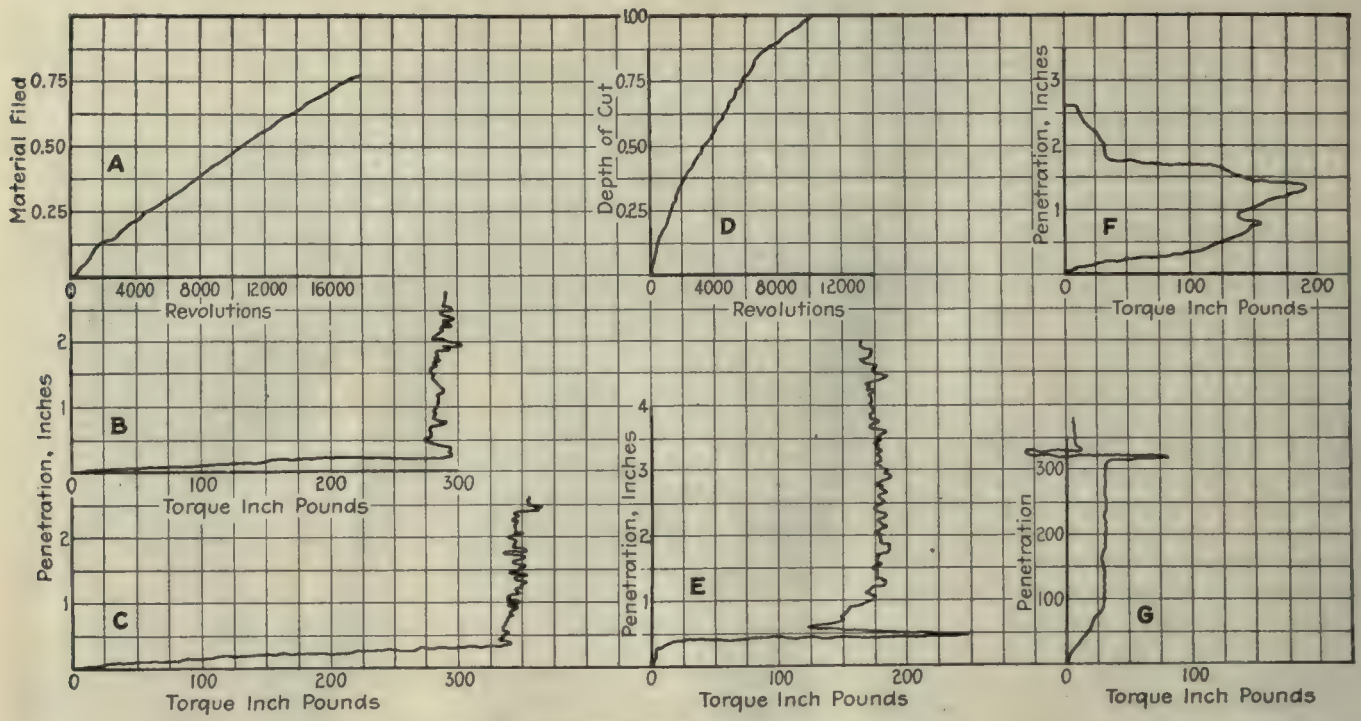


FIG. 13. DIAGRAMS OF EFFICIENCY TESTS

Curve *F* is that of tapping the hole drilled by curve *G* and the area of this diagram represents the work of tapping.

The very large range of testing machines applicable to the foundry is indicated by the action of one of the largest foundries in this country which is even now equipping a central testing laboratory which will be equipped with practically all of the various types herein described, including the universal efficiency testing machine.

Speed Table for Lathe Men

By I. B. Rich

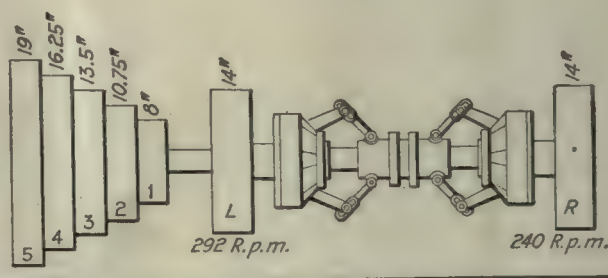
The Meese & Goddfried Co., San Francisco, Cal. is securing increased production from its lathes by the use of speed and feed tables which are framed and hung in convenient places for all lathe operators to see. The one illustrated herewith is for a 36-in. Niles pulley lathe.

The standard time for turning cast-iron pulleys is based on a cutting speed, with two tools cutting, of 25 ft. per minute. This may seem low but on account of the rims being quite thin, the iron has been found too hard to permit of a speed much above the figure given. One roughing cut is taken with a feed of $\frac{1}{16}$ in. per revolution and a minimum speed of 25 feet. There is one finishing cut with a feed of $\frac{1}{4}$ in. per revolution and a speed of not less than 40 ft. per minute.

The table shown in the blueprint is so arranged that the operator need only refer to the column representing the diameter of the pulley he is about to turn. If, for example, he has a 28-in. pulley he looks under the 28-in. column in the list headed "Diameter of Pulley" and finds that a cutting speed of 23 ft. per minute will be secured when the clutch lever is thrown to the left and the belt is on the second step of the cone. The operator starts with this combination (which gives him the nearest to the 25 ft. desired) and will increase his speed as much as the hardness of the casting will allow.

In the lower portion of the chart is a similar table to be used as a guide in obtaining the desired feed. This shows that thirteen per inch is the nearest to the $\frac{1}{16}$-in. feed wanted, the other feeds and the way in which they are secured being plainly shown.

These were designed by Horace P. Philips, superintendent of the Meese & Gottfried shops.



POSITION OF COUNTERSHAFT		SPINDLE	DIAMETERS OF PULLEYS										
CLUTCH	CONE	R.p.m.	16"	18"	20"	22"	24"	26"	28"	30"	32"	34"	36"
R	1	1.63	7	8	9	9	10	11	12	13	14	15	15
L	1	2.03	8	9	10	12	13	14	15	16	17	18	19
R	2	2.55	11	12	13	15	16	17	19	20	22	23	24
L	2	3.19	13	15	17	18	20	22	23	25	27	28	30
R	3	3.88	16	18	20	22	24	26	29	31	33	35	37
L	3	4.84	20	23	25	28	30	33	35	38	41	43	46
R	4	5.85	24	28	31	33	36	40	43	46	49	52	55
L	4	7.31	30	34	38	42	45	50	53	57	60	65	69
R	5	9.19	38	44	48	53	58	63	67	72	77	82	86
L	5	11.48	47	54	60	66	72	79	84	90	97	102	108

Cutting Speeds are shown in Feet per Minute.
Roughing Cut
Minimum Speed, 25 Ft. per Min. Feed $\frac{1}{16}$".
Finishing Cut
Minimum Speed, 40 Ft. per Min. Feed $\frac{1}{4}$".



FEED TABLE

CONE	B.G.	FEED PER IN.
1	IN	62
1	OUT	21
2	IN	33
2	OUT	12
3	IN	22
3	OUT	7
4	IN	13
4	OUT	4

SPEED TABLE FOR PULLEY LATHES

Laying the Cards on the Table

By FRED H. COLVIN
Editor, *American Machinist*

It is generally conceded that co-operation can only be secured when mutual confidence prevails. And confidence, according to some of our best thinkers on industrial matters, is best secured by what is generally termed "laying the cards on the table." A very complete example of this method —one where facts and figures are laid open for the inspection of all—is shown herewith.

AFTER five years of practical experience with a plan that is based primarily on "laying all the cards on the table," and that uses the shop committee system as a means of contact between the management and the workers, the White Motor Co., of Cleveland, Ohio, is now ready to state its belief in the advantages of such methods as a step in the solution of the problems which are today confronting industrial managers everywhere.

The main features of this method have been brought out in previous articles, but it is well not to forget a few of the salient points in considering all questions of the kind. Wages have increased 110 per cent since 1914, output per man has nearly doubled, there is no piece work, nothing but straight day wages, and no arbitrary efficiency standards or practices are used—and the price of trucks has advanced only 10 per cent.

The following figures as to production, wages, costs, etc., show how thoroughly the old policy of secrecy has been abandoned and the freedom with which the facts of the business are discussed with the men. Nor are they hidden from others, as can be seen. The tables shown, as well as the "maxims," are taken from large blueprints which are posted in conspicuous places where all who run may read. To those who fear to let too much be known, the answer of those who believe in publicity is that imagination usually pictures profits at a much higher figure than they really are. When someone tells the men that enormous dividends are being paid, and the actual figures are not shown, the men naturally assume all statements as true—that "silence gives consent."

The figures in Table I show interesting facts as to the plant and production value, which is something of an education to most men in the shop, and show that with a plant investment only twice as large as in 1914, the output is nearly four times as great. And this with a price advance of only 10 per cent. The ratio between direct and indirect labor remains approximately the same, while the total labor cost has increased from 18.71 per cent to 24.99 per cent of the product.

Table II is a real lesson in shop finance as it shows just what is meant by factory value of trucks produced, the output per man, the increase

Maxims

Capital is only production minus consumption. Business originally was founded on service. The customer pays all. The public suffers all. Absentee ownership may or may not be a curse. Absentee management is always a curse.

Declaration of Principles

No Entangling Alliances.
Free Speech, and Free Press.
Recognition of Individual Rights.
No Discrimination Against Nationality, Political Belief or Creed.
No Discrimination Against Any Organization.
Base Wage, Based on Buying Power.
Craftsmen's Wages Adjusted to the Above.
Production of a Necessity.

Speaking for the White Motor Co. alone, our policy has been in the past and is now to limit payment of dividends to 8 per cent on capital stock. Through opinion, in the factory, in the community, and in the home, the soundness of the above will be checked. THE WHITE MOTOR CO.

Year	Factory Value of Product	Average No. Men	Estimated Buying Power of $1	Average Weekly Earnings Based on 51 W'ks Work	Hours Work	Hours Pay	Total Wages	Trucks Per Man Per Year	Factory Value of Trucks Produced Per Man * Per Year
1910	$ 3,836,290	1,072		$14.04	60	60	$ 767,496	2.290	$3,578.63
1911	$ 5,097,523	1,419		$12.82	59	60¼	$ 927,696	1.985	$3.592.33
1912	$ 6,739,756	1,852		$13.53		61½	$1,278,426	1.785	$3.639.17
1913	$ 6,795,196	1,964		$13.45			$1,347,064	1.785	$3,459.87
1914	$ 9,023,172	2,202	$1.00	$15.03			$1,688,467	1.924	$4,097.72
1915	$21,040,078	3,758	90c.	$16.51	54½	59½	$3,163,857	2.460	$5,598.72
1916	$17,053,311	3,611	86c.	$17.34			$3,186,921	2.082	$4,722.60
1917	$22,448,927	4,341	72c.	$20.94			$4,637,105	2.040	$5,171.33
1918	$30,952,748	4,844	55c.	$27.07			$6,688,051	2.720	$6,389.91
1919	$35,356,000	5,475	50c.	$31.64	49½	52	$8,835,000	2.751	$6,456.62

*THE FACTORY VALUE OF OUR TRUCKS PRODUCED INCLUDES:

MERCHANDISE & SUPPLIES, ETC.
LABOR
POWER & FUEL
MAINTENANCE & REPAIRS
FACTORY SALARIES & GENERAL ADMINISTRATIVE EXPENSE
INSURANCE
FEDERAL, STATE & CITY TAXES
PLANT EXTENSION, ETC.
DIVIDENDS

Note — Trucks Per Man 2.751; Value $6,456.62; Average Value $2,347.00

THE RESULTS SHOWN BY THE TABLES ARE DUE TO THREE REASONS:

One-Third Due to Ample Capital & Plant & Methods of Manufacture
" " " Management
" " " the Men Voluntarily Giving an Honest Day's Work.

Note — Average Truck Price Increased Approximately 10 Per Cent Since 1914

TABLE I. OUTPUT AND LABOR COSTS SINCE 1914

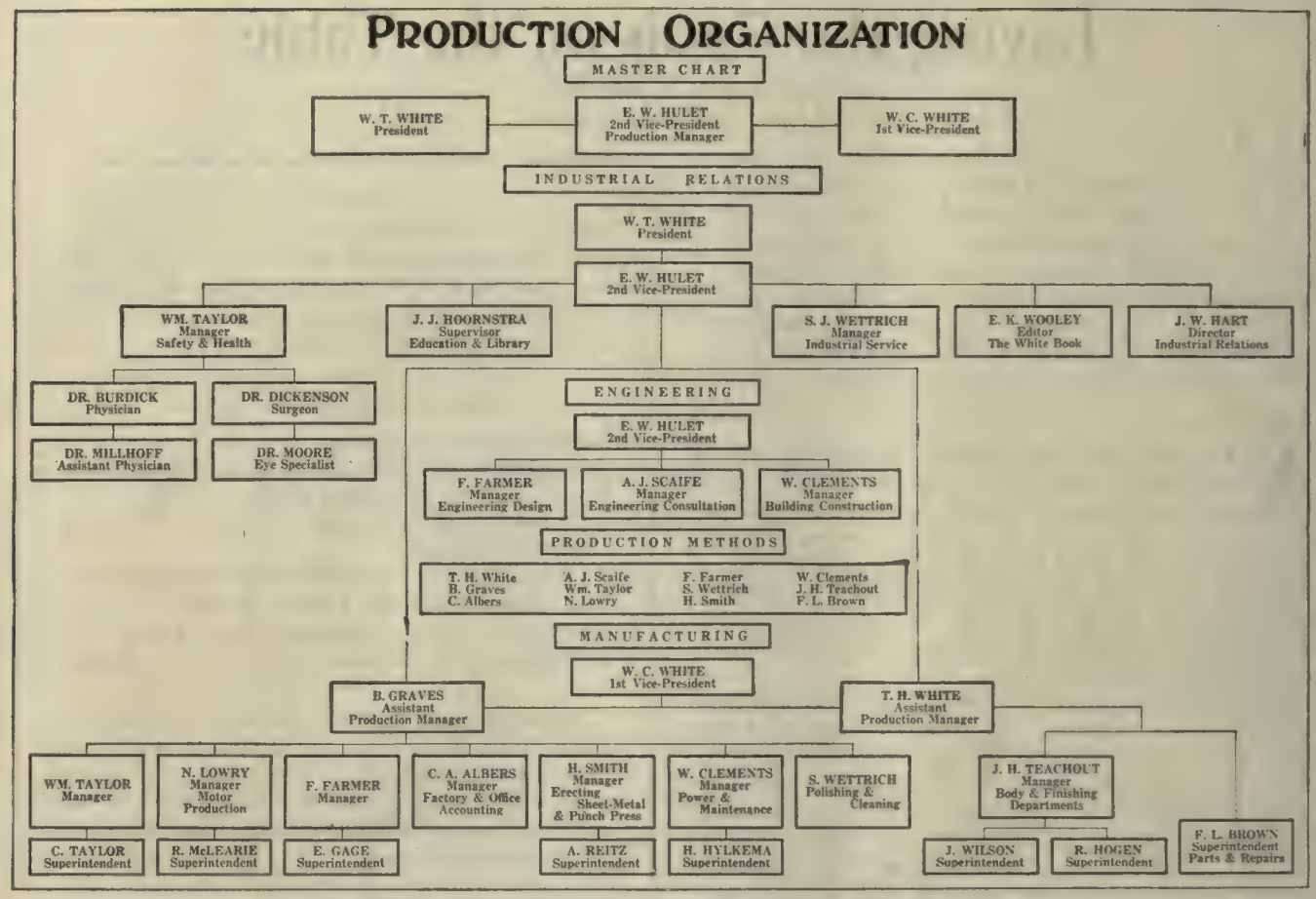


FIG. 1. ORGANIZATION OF THE WHITE MOTOR CO.

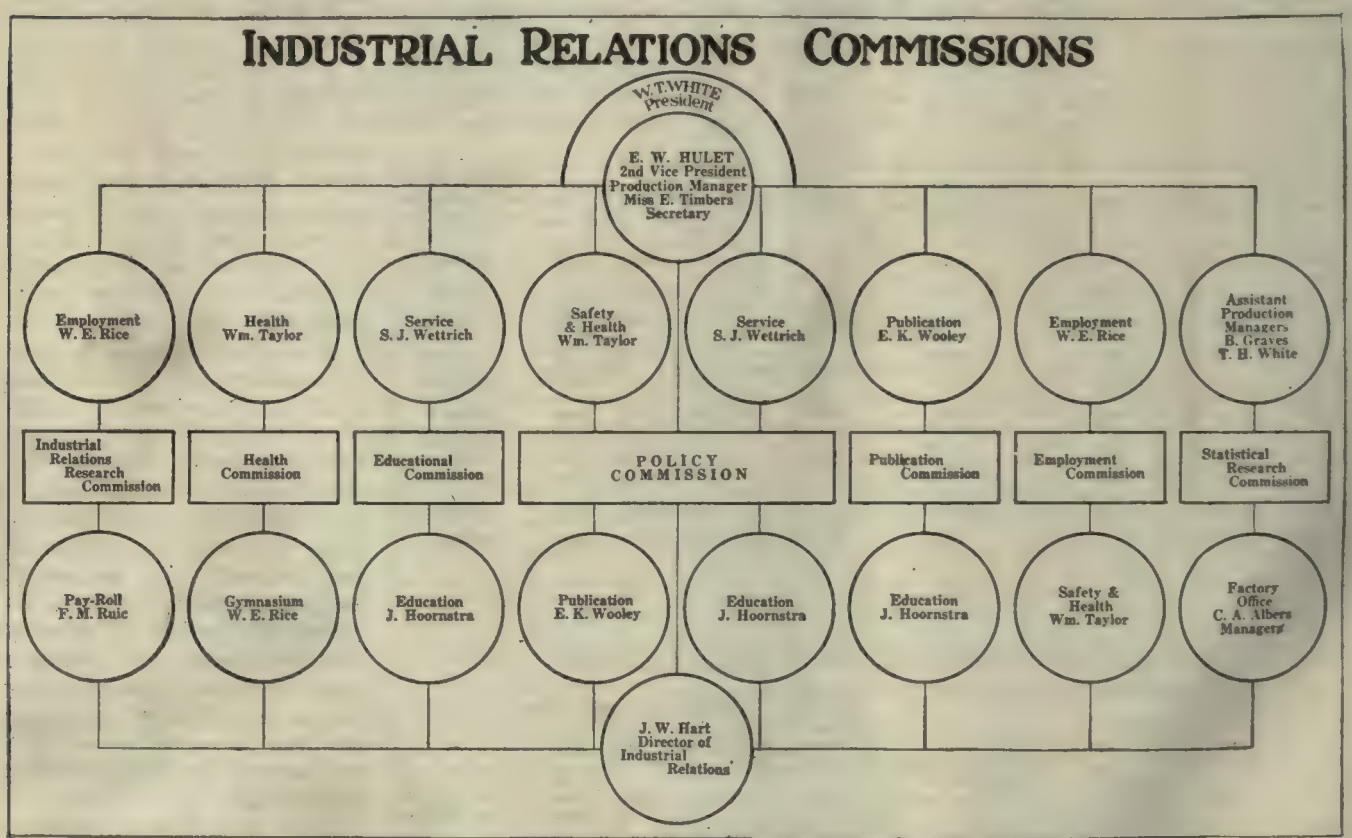


FIG. 2. ORGANIZATION OF INDUSTRIAL RELATIONS COMMISSION

in men, wages and, best of all, output, since 1910. It also shows the decrease in number of working hours as well as a much greater decrease in the purchasing power of the dollar. The success is credited to three sources: capital, management and an honest day's work, in equal measure.

THE WHITE MOTOR COMPANY				
COMPARATIVE FIGURES		12 MONTHS 1914	12 MONTHS 1918	12 MONTHS 1919 (December Estimated)
PRODUCTION VALUE		$9,023,172	$30,952,748	$35,356,000
PLANT VALUE		$1,879,000	$ 3,200,000	$ 3,650,000
RATIO, PRODUCT-PLANT		4.8 to 1	9.7 to 1	9.6 to 1
TOTAL PRODUCT (Parts Included)		4,255	13,163	15,064
AVERAGE NUMBER OF MEN		2,202	4,844	5,475
AVERAGE WEEKLY EARNINGS (51 Weeks)		$15.03	$27.07	$31.64
TOTAL WAGES, Factory Employees		$1,688,467	$6,688,051	$8,835,000
RATIO, WAGES-PRODUCT	Direct	13.81%	15.84%	18.35%
	Indirect	4.90%	5.81%	6.63%
	Total	18.71%	21.65%	24.99%

TABLE II. DETAILS OF COSTS AND DISTRIBUTION OF CREDITS

The organization of the White Motor Co. is shown in Fig. 1. Perhaps the most striking feature is that the production manager is a vice president and has a voice in the management and policy of the company. There is a growing belief that, unless this is done, unless the engineering or technical end of the business has its voice in the entire management best results cannot be secured. Financial men are necessary but it is believed that they should not dominate all the policies of management. Nor do the financial men have a monopoly of the ability to pick good men, even though some of them seem to feel that this is the case. We need only to look back at the many fiascos in plant management, where bankers picked the executives in the munition factories to bear this out. It must be remembered that the White Motor Co. has a system of representative committees, one man being chosen to represent every ten men in the shop. Figs. 1 and 2, however, show how little machinery there is about the whole thing and how the production manager ties up closely and directly with all the different activities. In Table II, it will be seen how the policy commission ties together the production, safety and health, service, publication, education and industrial relations. Education also plays a big part in the plan of industrial work of the company, as can be seen. The plans are so simple, the actions so direct, that they get as near to the old personal contact as seems possible in a large shop. The plan works remarkably well and can be studied carefully to advantage. But as with all successful plans, it must be remembered that success depends more on mutual confidence, on the spirit behind it, than on the plan itself.

Reminiscences of an Old School Machinist

By R. THOMAS HUNTINGTON

During the last half-century the growth and development of the machine shop in the way of improved machinery, advanced ideas and methods, hitherto unheard-of materials both for working with and to be worked—though swift and at times bewildering — has been so consistent and so engrossing that the full scope of its progress is apparent to us who are within its influence only when we step aside from ourselves and, through the rearward mental vision of our older associates, recall conditions of the earlier days when machines of precision were but dreams and many of the jobs today considered elementary called for the highest degree of skill. To those of us whose hair has grown gray in the service, the reminiscences of our fellow tradesman, himself 73 years old, bring back as in a dream the pleasures and the triumphs of the golden days of our own apprenticeships.

THE modern bench lathe with all its attachments, including milling and grinding devices as well as provision for accurate thread cutting, is almost a machine shop in itself. How different was the lathe of my boyhood when I entered the shop as an apprentice 57 years ago I will leave to the reader to judge. The bed of the lathe upon which I worked in those early days consisted of two stringers of wood (hard pine, I think it was) 4 by 8 inches in size, separated by three pieces of wood ¾ in. thick, 3½ in. wide, and about 4 in. long; one of these pieces being at each end of the clear space of the bed—about 3 ft. apart, and the third piece at the outer end of the headstock. These five pieces of wood were raised from the bench on blocks 3 or 4 in. thick placed practically under the separating blocks. The bed of the lathe was firmly bolted to the bench by six bolts with heads let in a little below the surface so as not to interfere with the movement of the tailstock or "tee" rest. There was no countershaft; the driving cone was on the main line, or a jackshaft according to the location of the lathe, and the workman started and stopped the lathe by throwing on or off the belt by hand. The head- and tailstocks were held firmly in position by a wedge passing through a wrought iron stirrup or strap cast into the metal of the stocks. The headstock remained stationary and was held in line by a key, or feather, about ¾ in. wide fitting into the space between the two stringers of wood that formed the bed. If there were a number of lathes in line, the stringers were made long enough to accommodate all the headstocks with room enough between them to allow ample movement to their respective tailstocks. There was no real standard then in existence; each shop having its own designer, and the designs were many and varied. The tailstocks were similar ir principle to those with which the present-day workman is familiar, but they were held in position by the wedge before mentioned. There was not as much movement

to the tailspindle as is now the practice as there were no deep holes to drill.

The T-rest was held to the bed by a wedge passing through a stirrup bolt which had at its upper end a square head fitting a corresponding slot in the base of the rest. There was adjustment up and down of the rest the same as now, but the rest was broader on the top to accommodate the hook-tools then in use; of which more will be said later. Some of the lathes had two T's; one for the hook-tool and one for hand tooling, chasing threads, etc.

The live center had usually a square taper shank; the hole in the spindle being shaped during the forging operation by driving in a swage of the desired shape. The shank of the tail center was round with very slight taper. The cone pulley was generally made of wood and was keyed to the spindle.

Only Hand Tools Were Used

All work was accomplished on these old lathes by means of hand tools. There were no slide rests. All drills were made of flat steel forged nearly to size and finished with a file as required. The blacksmith or tooldresser of the old days was an artist. He took particular pride and exercised a deal of patience in making good clean forgings that required but little fitting.

There were no dogs as we have them now. In drilling a hole in a piece attached to the faceplate of the lathe there would be a T- or L-shaped piece of stock, with a slot in it of somewhere about the right size for the drill to pass through, to hold the drill from turning; the drill being held back against the tail-center by hand or with a monkey wrench.

In preparing to turn round work, such as studs, bolts, etc., we did not drill center holes then as we do now Each man had three center punches: a round one of about 60 deg. included angle and a round, and a square one of about 90 deg. included angle. The sharper one would be used as a starter, followed on one end of the work by the blunt round one and on the other end by the square one.

There would be two live centers for the lathe: one round pointed one and one with a square point; both about 90 deg. included angle. The square pointed one used in conjunction with the square center-punch mark was depended upon to drive small round work, while a bent strap bolted to the faceplate and having a hole of suitable size and shape in it was used to drive square or hexagon stock.

Work was rough turned with a "hook-tool" ground on top something like a diamond point but having at the bottom a sharp point or heel to keep it from slipping on the rest. The tool was made of rectangular section stock, usually ⅜ by ½ in. and about a foot long, being held in a wooden holder about two feet long. The steel shank of the tool was fitted to a groove in the top of the wooden holder, and held by an eye bolt the eye of which was fitted to the tool shank. The threaded portion of the eyebolt, passing through a hole in the wooden holder, entered a square nut set in a handle, like a large file handle, that projected downward at a right angle from the holder. Thus the steel part of the tool could be moved in and out with relation to the wooden holder and tightened in any desired position by turning the handle.

To use the hook-tool the workman grasped the downwardly projecting handle with his left hand, rested the outer end of the holder on his right shoulder and held it down firmly with his right hand, while the pointed spur above referred to rested on the T rest immediately before the revolving work. By a peculiar twisting motion, impossible of description but imparted by both hands and a movement of the body at the same time, the tool could be made to advance along the work, taking off the stock as neatly if not as rapidly as a tool held in a modern slide-rest. The amount of work that could be accomplished in a day by this crude tool would surprise some of the present day mechanics.

In using the hook-tool a workman not only knew his business but attended strictly to it all the time; if his judgment erred or his attention wandered he would get a sudden crack behind the ear that would bring him to his senses—if it didn't deprive him of them altogether.

I remember seeing one young man, who thought he could turn a brass gong with a diamond point instead of a flat tool, laid out unconscious for half an hour. He was warned against using the diamond point, but like many another young man was self-sufficient in his own ignorance and scorned to accept the instructions of his elders. Experience is a dear teacher but leaves no doubt as to point of its teaching.

Finishing was usually done with a square graver. For starting a thread we used a diamond shaped graver and we obtained the proper pitch by a slight twist of the wrist which took some time to acquire.

After a thread was started a chaser was used to finish it. The chaser was a flat tool with six or more teeth of the shape, size, and pitch of the thread it was intended to cut. The chasers were usually made by cutting in the teeth with a hob of the same pitch as the tap that was to be used to thread the corresponding nut, but some expert workmen could file these chasers; using the tap as a templet and gage.

The apprentice of those days was given a lathe to work on only after having been in the shop for six months. I am working today, in my seventy-third year, on a modern bench lathe with all its up-to-date accessories, and as I cast back in my mind to my own apprenticeship in those far off days I wonder what some of the fellows who have learned their trade in recent years would do if they were to be put up against the conditions of fifty seven years ago.

Twist Drills and Drill Rod Unknown

Twist drills were unknown; there was no bright drawn stock, the diameter and roundness of which could be trusted to an infinitesimal fraction of an inch; the only grinding wheels in existence were made of wood and covered with leather to which emery was attached by covering the leather with glue and rolling the wheel in a trough of loose emery.

Most of the larger lathes had a chain feed, the chain passing over a sprocket wheel under the headstock and operated by a large wooden-rimmed handwheel. There were a few geared lathes for cutting threads on large work.

In 1868 I worked on my first screw-cutting lathe in the shop of William Sellers & Co. of Philadelphia, which shop was equipped with the most improved machinery then in use. Here, also, I first made the acquaintance of snap and thread limit gages. Here for the first time I found a full set of dogs for turning work of all sizes, and the old square center with which I had become so

familiar, became but a memory. All lathe centers were ground to an angle of 60 degrees.

There was a machine in the Sellers shop the like of which I have not seen in recent years. It was called a "cotter drill" and was made in Manchester, England. It was a very heavy machine and was semi-automatic in its action. The tool from which it received its name was a sort of two-lipped milling cutter instead of a drill and was sometimes called a "fish-tail" because of its resemblance to that well known appendage. Its work was the cutting of slots in flat bars of steel. Two such bars, 6 in. wide, 2 in. thick, and 10 or 12 ft. long would be mounted on the machine and a slot 2 in. wide by 6 in. long cut in one end and a series of shorter slots were cut in the other end.

How the Machine Worked

The workman would feed the drill down into the work to the proper depth of cut—determined by his judgment as to what the tool would stand—and then throw in a clutch which would cause the table to travel the desired distance to where a properly adjusted dog would disengage the feed. At this end the drill would be fed down some more and the clutch reversed, causing the table to travel back to the starting point.

These movements would be repeated until the tool was half through the work, when the latter would be turned over and the same operations gone through on the other side.

These pieces served as tie bars on the hydraulic wheel-presses used for pressing locomotive driving and car wheels on their axles. The reason for slotting them in pairs was to keep each pair exactly alike so that when the movable head of the wheel press was altered to suit different gages the draft would be evenly divided between the bars.

Got Tips From Apprentice Boy

As I stated above I first encountered the screw-cutting lathe in this shop, and I am indebted to an apprentice-boy who was running a similar lathe alongside me for many tips concerning its operation. We were both making bolts to be used on some parts of the firm's product and we were using, for the first time, the new snap gages

The bolts were to act as dowels and in consequence must be smooth and accurately to size. The boy seemed to be getting on finely; his bolts were smooth and apparently fitted his snap gage perfectly, while mine were not so smooth; causing the foreman, a very fussy individual, to give me quite a lecture on the desirability of perfect workmanship

The work did not pass through a separate inspection department as it would now, but each foreman was depended upon to keep the work from his department right. When the machines were assembled it was found that the bolts turned by my neighbor were too small.

Upon investigation it was found that the apprentice boy had turned his first bolt too small and in order to avoid explaining to the foreman, had squeezed the gage in a vise until it fitted the bolt. After that all gages were inspected after each man was through with them. The boy, who was an indentured apprentice, served out his time and in due course became a full-fledged mechanic. I have never seen him since but have seen many like him.

It was at the Sellers shop that I first saw hardened-steel bushings. These bushings were quite large, with holes in their walls for oil and dowels, and were ground inside and out. As the bushings were to go on a shaft between two solid collars, I wondered how they were ever going to get them to place. I was told that they were sawed in halves by a plain steel disk running at high rate of speed.

I did not see this operation and consequently know nothing of it but hearsay, but it was said that the disk went through the hardened bushings like a circular saw through wood. I do not know whether a lubricant was used or not. The disk was a trifle thicker at the periphery, thinning toward the center, and was run between two collars that were of such diameter as to allow only enough of the disk to project to reach through the wall of the bushings.

Closing Gates When Whistle Blows

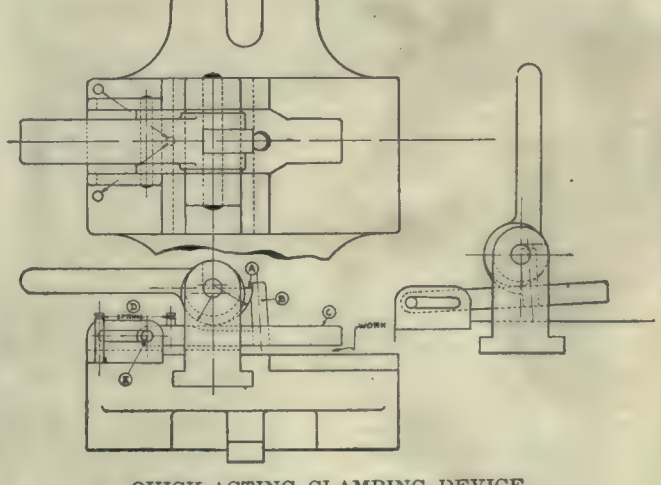
The Sellers company were very particular about promptitude in reporting for work, the gates being closed when the whistle blew, and any one coming after that was obliged to pass through the time-keeper's office; losing two and one-half hours from his pay.

The firm did not put any small change in the pay envelope. A running balance was kept on the books and the change paid to the workman each time it amounted to one dollar.

Double-Acting Clamping Device

By W. A. Anderson

The clamping device herewith illustrated provides a quick method of bringing the clamp over the work and clamping it simultaneously with one movement of the operating lever. The cam *A*, which is part of the eccentric cam for tightening, actuates the pin *B*, thus moving the clamping leaf forward. As the leaf *C* moves forward the eccentric cam presses it downward. The pin *E* acts as a pivot for the clamp leaf and also



QUICK-ACTING CLAMPING DEVICE

guides it in its sliding movement. The springs *D* always hold the clamp leaf against the eccentric cam so that the clamp clears the work freely when moving forward. The view at the side shows the clamp back out of the way and illustrates how the pin enters the eccentric, thus providing the throw necessary to free it from the work.

FOR SMALL SHOPS *and* ALL SHOPS

By J. A. Lucas





Arc Welding Equipment*—XXVI†

ELECTRIC Arc Welding is the transformation of electrical energy into heat through the medium of an arc for the purpose of melting and fusing together two metals, allowing them to melt, unite, and then cool. The fusion is accomplished entirely without pressure. The heat is produced by the passage of an electric current from one conductor to another through air which is a poor conductor of electricity, and offers a high resistance to its passage. The heat of the arc is the hottest flame that is obtainable, carrying in temperature estimated to be between 3,500 and 4,000 deg C. (6,332 to 7,232 deg. F.).

The metal to be welded is made one terminal of the circuit, the other terminal being the electrode. By bringing the electrode into contact with the metal and instantly withdrawing it a short distance, an arc is established between the two. Through the medium of the heat thus produced, metal may be entirely melted away or cut, added to or built up, or fused to another piece of metal as desired.

A particularly advantageous feature of the electric arc weld is afforded through the concentration of this intense heat in a small area, enabling it to be applied just where it is needed.

Direct-current is now more generally used for arc welding than alternating-current.

When using direct-current, the metal to be welded is made the positive terminal of the circuit, and the electrode is made the negative terminal.

Regarding alternating-current it is obvious that an equal amount of heat will be developed at the work and at the electrode, while with direct-current welding we have considerably more heat developed at the positive terminal. Also in arc welding the negative electrode determines the character of the arc, which permits of making additions to the weld in a way that is not possible with alternating-current. Inasmuch as the work always has considerably greater heat-absorbing capacity than the electrode, it would seem only reasonable that the direct-current arc is inherently better suited for this work.

Two systems of electric arc welding, based on the type of electrode employed, are in general use, known as the carbon (or graphite) and the metallic electrode processes. The latter process is also sub-divided into those using the bare and the covered metallic electrodes.

A simple schematic layout for an arc-welding outfit is shown in Fig. 311.

The Carbon Electrode Process

In this process, the negative terminal or electrode is a carbon pencil from 6 to 12 in. in length and from ¼ to 1½ in. in diameter. This was the original process devised by Bernados and has been in more or less general use for more than thirty years. The metal is made the positive terminal as in the metallic electrode process in order that the greater heat developed in this terminal may be applied just where it is needed. Also, if the carbon were positive, the tendency would be for the carbon particles to flow into the weld and thereby make it hard and more difficult to machine.

The current used in this process is usually between 300 and 450 amp. For some special applications as high as from 600 to 800 may be required, especially if considerable speed is desired. The arc supplies the heat and the filler metal must be fed into the weld by hand from a metallic bar.

*For the author's forthcoming book, Welding and Cutting. All rights reserved.

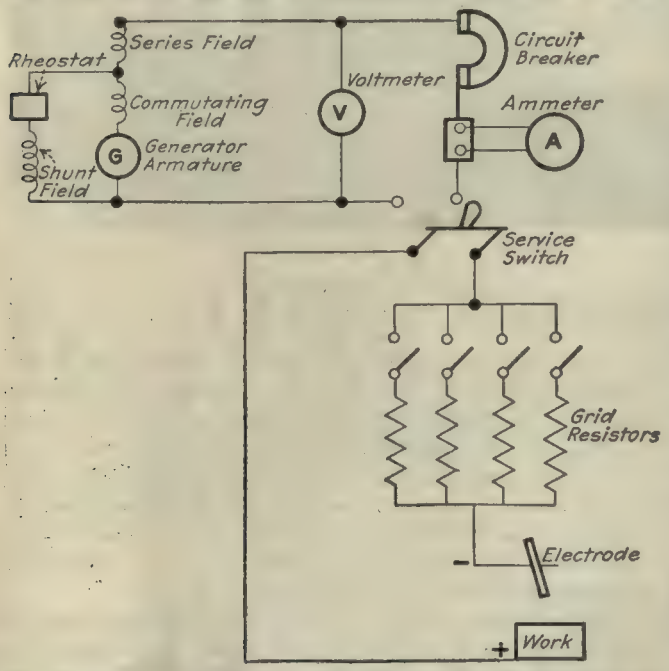
†Part XXV appeared in last week's issue.

The class of work to which the carbon process may be applied includes cutting or melting of metals, repairing broken parts and building up materials, but it is not especially adapted to work where strength is of prime importance unless the operator is trained in the use of the carbon electrode. It is not practical to weld with it overhead or on a vertical surface but there are many classes of work which can be profitably done by this process. It can be used very advantageously for improving the finished surface of welds made by metal electrodes. The carbon electrode process is very often useful for cutting cast iron and nonferrous metals, and for filling up blowholes.

The Metallic Electrode Process

In the metallic electrode process, a metal rod or pencil is made the negative terminal, and the metal to be welded becomes the positive terminal.

When the arc is drawn, the metal rod melts at the end and is automatically deposited in a molten state



Courtesy of the Westinghouse Co.

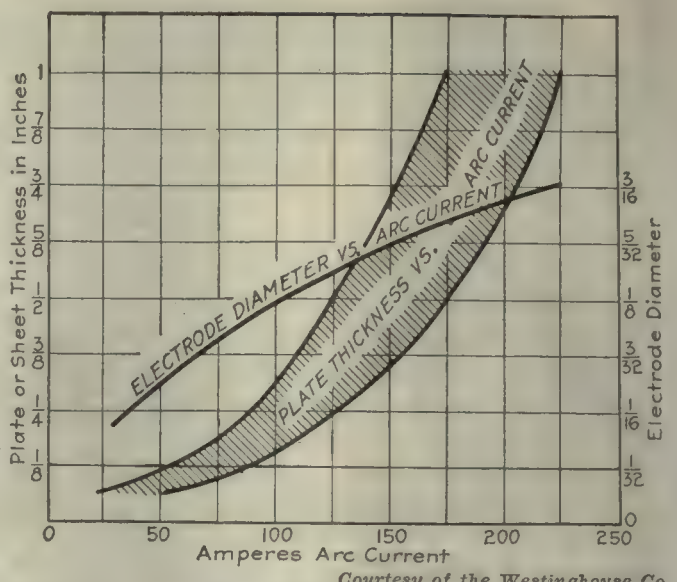
FIG. 311. SIMPLE SCHEMATIC WELDING CIRCUIT

in the hottest portion of the weld surface. Since the filler is carried directly to the weld, this process is particularly well adapted to work on vertical surfaces and to overhead work.

If the proper length of arc is uniformly maintained on clean work, the voltage across the arc will never greatly exceed 22 volts for bare electrodes and 35 volts for coated electrodes. The arc length will vary to a certain degree however, owing to the physical impossibility of an operator being able to hold the electrode at an absolutely uniform distance from the metal throughout the time required to make the weld.

It is very essential that the surfaces be absolutely clean and free from oxides and dirt, as any foreign matter present will materially affect the success of the weld.

When using a metallic electrode, the arc which is formed by withdrawing it from the work, consists of a highly luminous central core of iron vapor surrounded by a flame composed largely of oxide vapors. At the temperature prevailing in the arc stream and at the



Courtesy of the Westinghouse Co.

FIG. 312. RELATION OF APPROXIMATE ARC CURRENTS AND ELECTRODE DIAMETERS

electrode terminals, chemical combinations occur instantaneously between the vaporized metals and the atmospheric gases. These reactions continue until a flame of incandescent gaseous compounds is formed which completely envelopes the arc core. However, drafts created by the high temperature of the vapors and by local air currents tend to remove this protecting screen as fast as it is formed, making it necessary for the welder to manipulate the electrode so that the maximum protective flame for both arc stream and electrode deposit is continuously secured. This can be obtained automatically by the maintenance of a short arc and the proper inclination of the electrode towards the work in order to compensate for draft currents.

Selection of Electrodes

The use of a metallic electrode for arc welding has proved more satisfactory than the use of a carbon or graphite electrode which necessitates feeding the new metal or filler into the arc by means of a rod or wire. The chief reason for this is that, when the metallic electrode process is used, the end of the electrode is melted and the molten metal is carried through the arc to be deposited on the material being welded at the point where the material is in a molten state produced by the heat of the arc. Thus a perfect union or fusion is produced with the newly deposited metal.

Wire for metallic arc welding must be of uniform, homogeneous structure, free from segregation, oxides, pipes, seams, etc. The commercial weldability of electrodes should be determined by means of tests per-

PLATE THICKNESS IN INCHES	CURRENT IN AMPERES	ELECTRODE DIAMETER IN INCHES
1/16	20 to 50	1/16
1/8	50 to 85	3/32
3/16	75 to 110	1/8
1/4	90 to 125	1/8
3/8	110 to 150	5/32
1/2	125 to 170	5/32
5/8	140 to 185	5/32
3/4	150 to 200	3/16
7/8	165 to 215	3/16
1	175 to 225	3/16

TABLE XXIV. APPROXIMATE CURRENT VALUES FOR PLATES OF DIFFERENT THICKNESS

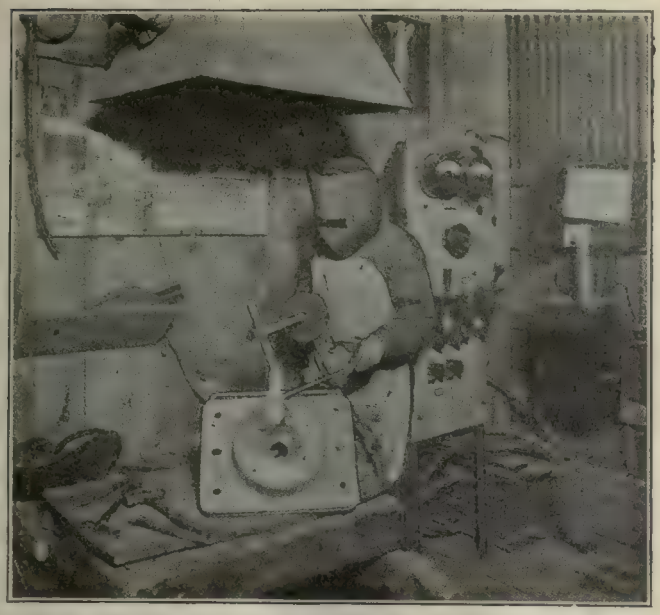


FIG. 313. CARBON-ARC WELDING, USING KING MASK

formed by an experienced operator, who can ascertain whether the wire flows smoothly and evenly through the arc without any detrimental phenomena.

The following table indicates the maximum range of the chemical composition of bare electrodes for welding mild steel:

Carbon trace up to	0.25%
Manganese trace up to	0.99%
Phosphorous not to exceed	0.05%
Sulphur not to exceed	0.05%
Silicon not to exceed	0.08%

The composition of the mild steel electrodes, commonly used, is around 0.18 per cent carbon, and manganese not exceeding 0.5 per cent, with only a trace of phosphorus, sulphur and silicon.

The size, in diameter, ordinarily required will be $\frac{1}{8}$ in., $\frac{5}{32}$ in., and $\frac{3}{16}$ in. and only occasionally the $\frac{3}{32}$ in.

These electrodes are furnished by a number of firms, among whom are John A. Roebling's Sons Co., Trenton, N. J.; American Rolling Mills Co., Middletown, Ohio; American Steel and Wire Co., Pittsburgh, and Ferride Electric Welding Wire Co., New York City; Page Woven Wire Co., Monessen, Pa.; John Potts Co., Philadelphia.

A coated electrode is one which has had a coating of some kind applied to its surface for the purpose of totally or partially excluding the atmosphere from the metal while in a molten state when passing through the arc and after it has been deposited.

The proper size of electrode may be determined from Fig. 312 from which it will be seen that the class of work, and current used are both factors determining the size of the electrode for welding steel plates of various thicknesses. To find the diameter of the metallic electrode required, select, for example, a three-eighths plate, and follow horizontally to the "Thickness of the Plate Curve." The vertical line through this intersection represents about 110 amp. as the most suitable current to be used with this size of plate. Then follow this vertical line to its intersection with the "Diameter of Electrode" curve which locates a horizontal line representing approximately an electrode $\frac{5}{32}$ in. in diameter. In a similar manner, a $\frac{1}{2}$-in. plate requires about 125 amp. and a $\frac{5}{32}$-in. electrode.

The amount of current to be used is dependent on the thickness of the plate to be welded when this value is $\frac{3}{4}$ in. or less. Average values for welding mild steel plates with direct current are indicated by the curve referred to above in connection with the selection of the electrode of proper size. This data is also shown in table XXIV.

It should be borne in mind, however, that these values are only approximate as the amount of current to be used is dependent on the temperature of the plate and also upon the type of joint. For example, when making a lap weld between two $\frac{1}{2}$-in. steel plates at ordinary air temperature of about 65 deg. F. it has been found that the extra good results were obtained by using a current of about 225 amp. and a $\frac{5}{16}$-in. diameter electrode. The explanation for the high current permissible is the tremendous heat storage and dissipation capacity of the lapped plates which makes the combination practically equivalent to that of a butt weld of two 1-in. plates. For that reason the above values will be very greatly increased in the case of lap welds which require practically twice the amount of current taken by the butt welds.

When the proper current value is used there will be a crater, or depression, formed when the arc is interrupted. This shows that the newly deposited metal is penetrating or "biting into" the work.

The difference between the carbon and the metallic electrode processes can be seen in Figs. 313 and 314. In Fig. 313 the welder is using a carbon electrode and feeding metal into the weld from a metal rod held in his left hand. In Fig. 314 the metal rod is held in a special holder and not only carries the current but metal from it is deposited on the work.

Electrode holders should be simple, mechanically strong, and so designed as to hold the electrode firmly. It should be practically impossible to burn or damage the holder by accidental contact so that it will not work. Small, flimsy or light projecting parts are almost sure to be broken off or bent. Fig. 315 shows one of these holders that answers the requirements. However, any of the companies selling arc welding apparatus will be able to supply dependable holders.

A holder made by the Arc Welding Machine Co., New York, is shown in Fig. 316 and in detail in Fig. 317. The metal rod is clamped in by means of an eccentric segment operated by a thumb lever. If the rod should freeze to the work it will not pull out of the holder, but

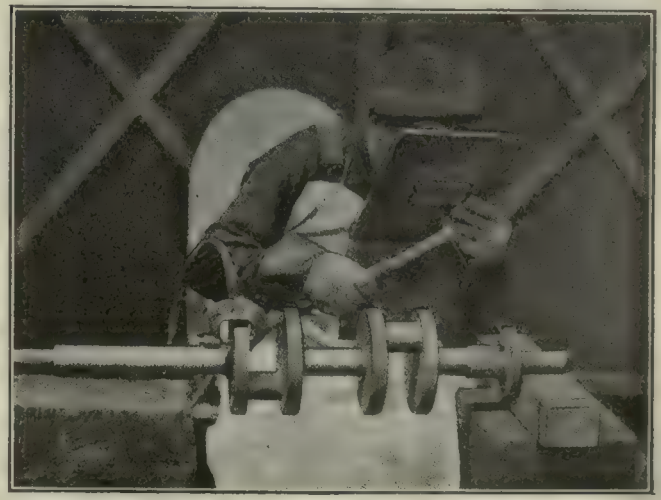


FIG. 314. METALLIC-ARC WELDING, USING A HAND SHIELD

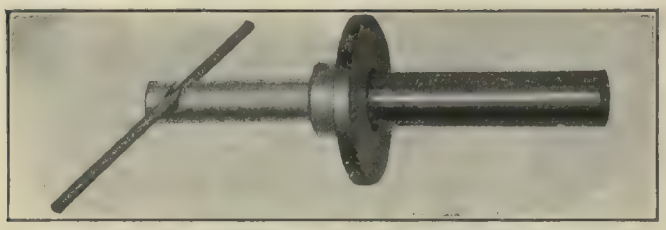


FIG. 315. SIMPLE FORM OF ELECTRODE HOLDER

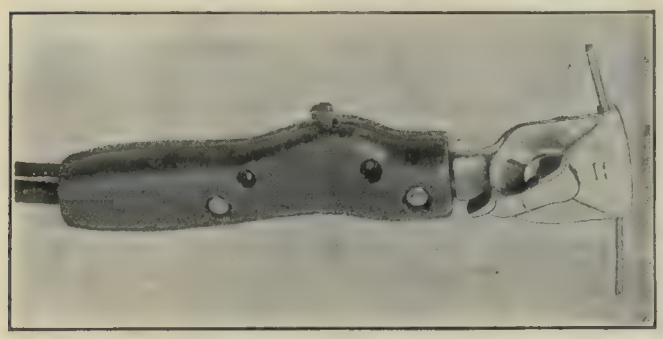


FIG. 316. SPECIAL MAKE OF ELECTRODE HOLDER

will be gripped all the tighter. The welding current enters at the rear end of the composition shank, passes along the shank to the head of the tool, and from there directly into the electrode. It will be noted, that there are no joints in this tool except where the cable is soldered into the shank. There is a relatively large contact surface between the electrode and the holding head, which precludes any possible heating at this point. The trigger is intended for remote control employed with the closed-circuit system. Whenever this holder is used on other systems, the trigger is omitted.

Cable

For arc welding service the cables leading to the electrode holder should be very flexible in order to allow the operator full control of the arc.

The following sizes of cable have been found by the General Electric Co., suitable for this service, due account being taken of the intermittent character of the work.

It is extra flexible stranded dynamo cable, insulated for 75-v. circuit, with varnished cambric insulation, covered with weatherproof braid.

Amperes	Size of Cable	Circular Mills
Up to 200	225/24	90,000
Over 200 Up to 500	375/24	150,000
Over 500 Up to 1,000	650/24	260,000

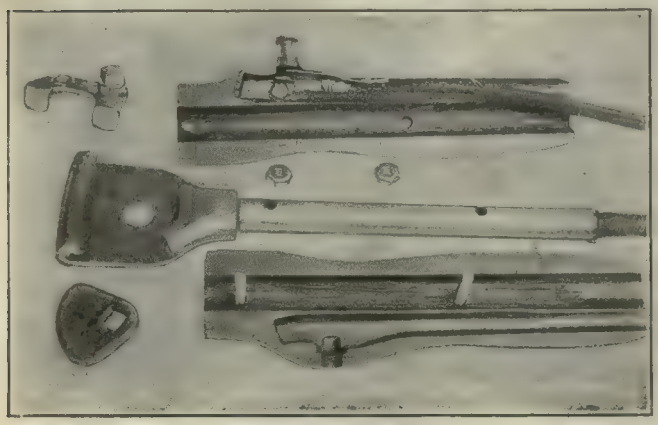


FIG. 317. DETAILS OF SPECIAL ELECTRODE HOLDER



FIG. 318. KING FACE MASKS WITH AND WITHOUT SIDE SCREENS

It will be noted in Figs. 313 and 314, that two different ways of protecting the eyes are shown. One man has a helmet and the other uses a shield held in the hand. Conditions under which the welders work, and their personal preferences, largely dictate which type is to be used. However, no welder should ever attempt arc welding without a protecting screen fitted with the right kind of glass. Cheap glass is dear at any price, for the light rays thrown off from the arc are very dangerous to the eyesight. The guard should be so made as to not only protect the eyes from dangerous light rays, but should also protect the face and neck from flying sparks of metal.

A very good face mask made by Julius King Optical Co., New York, is shown in Fig. 318. These masks are made of fiber and provision is made for a free circulation of air between the front and the face, not only keeping the operator cool, but preventing the tendency of the lenses to fog. The masks are supported by bands over the head and it is said that weight is not apparent and that they are as comfortable to wear as a cap. Two styles are made—with and without side screens. The one without screens may be had with combination lenses tinted for acetylene or electric welding or with any other tint for specific work. The one with side screens, providing side vision, is fitted either with combination lenses or with clear Saniglass lenses. A hand shield is shown in Fig. 319.

In arc welding in the open, other workmen or onlookers are liable to injury as well as the welders, so screens should be placed around the work to conceal the light rays from the view of others besides the welder. Such an arrangement is shown in Fig. 320.

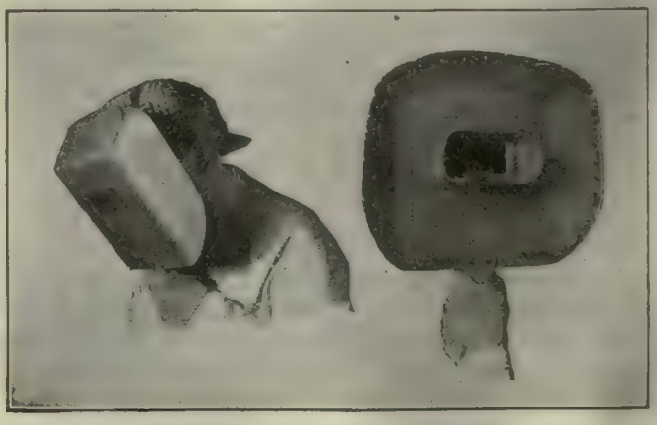


FIG. 319. KING HAND SHIELDS

Where repetition work is to be done, it is well to provide individual stalls or booths, somewhat similar to the one shown in Fig. 321. These were designed for use in the welding schools under the supervision of the Lincoln Electric Co. For actual shop work, curtains or screens should be provided back of the welders.

It must be remembered also, that owing to the presence of ultra-violet rays, severe flesh burns may result with some people if proper gloves and clothing are not worn—especially when using the carbon arc.

Selecting a Welding Outfit

Welding outfits may be of the stationary or the portable type. These may also be divided into motor-generator sets and the "transformer" types. Both d.c. and a.c. current may be used primarily, depending on the apparatus employed and the source of current available.

Regarding the selection of any particular outfit J. M. Ham, writing in the *General Electric Review* for December, 1918, says:

"Few things electrical have in so short a period of time created such wide-spread interest as that of arc welding. Engineers having to do with steel products, in whatever form produced or in whatever way employed, have investigated its uses not only as a building agent when applied to new material but as a reclaiming agent for worn or broken parts. In both cases its possibilities as a means of greatly increasing output and in saving otherwise useless parts at a small fraction of their original or replacement value has proved astounding.

Out of these investigations have grown several systems of arc welding that may be designated as, constant potential, constant energy and alternating current.

To exploit these is the duty of the sales department and the measure of its success depends upon the quality of service rendered.

The difficulties of giving service are perhaps not fully appreciated. Where so many systems have been called for and where so many individual ideas have to be met, the problems of the manufacturer become multiplied.



FIG. 320. METHOD OF USING SCREENS TO PROTECT OTHERS

During a period of freight congestion when locomotives were in unprecendented demand, an engine was run into the repair shop with slid flat spots on each of the eight driving wheels, and orders were issued to return it ready for service in record time. In three hours repairs had been completed by means of the electric arc (to have put on new tires would have required three to four days) and the locomotive was out on the road. Many other achievements as remarkable as these have been obtained.

It would seem that having demonstrated the success of arc welding for a given line of work, others similarly engaged would be keen to take advantage of it; but that is true only in part, possibly because this is a "show me" age.

When it becomes apparent to the investigator of arc welding possibilities that the process fulfills his require-



FIG. 321. INDIVIDUAL STALLS FOR INSTRUCTION WORK

ments, the question of what system to employ confronts him; salesmen are on the job to tell him about their particular specialties. He is informed that the real secret of welding is having the proper electrode (the salesman's special kind); it must be covered or bare, as the case may be, and contain certain unnamed ingredients. The merits of the direct-current system are extolled. Alternating-current outfits are advocated by others, it being claimed that they bite deeper and weld if the arc is held. The prospective buyer retires with a headache to think it over.

There is no mystery about arc welding. It is being done with all sorts of outfits and many varieties of electrodes. It can even be done from power lines with resistance in series with the arc. But these systems differ widely in essentials, just as in the case of automobiles. We can buy a cheap car or an expensive car, and in either event we get just about what we pay for.

The arc-welding set must pay its way. It must earn dividends and conserve materials, and when properly selected and applied does both of these things to a degree quite gratifying. To the discriminating purchaser it is not sufficient merely to know that an outfit will make a weld, he wants to know if it is the best weld that can be made, if it can be made in the shortest possible time, and whether the ratio between cost of the entire system to the savings effected is the lowest obtainable. He doubtless will, if the work is of sufficient magnitude to warrant, establish a welding department with a trained arc welding man in charge, and see that this department stands on its own feet. By so doing he places responsibility on a man who knows what to do and how to do it—a friend rather than a foe of the system. He will, other things being anything like equal, respect the opinion of the operator in the selection of the system to be employed, because it is better to provide a man with tools he is familiar with and prefers to use, rather than to force him to use something with which he is unfamiliar or which he regards with disfavor.

Obviously, the purchaser wishes to know that the companies he is dealing with are reliable and responsible, that the experience back of the salesmen is sufficient to warrant faith in his product. It is important to know the amount of power required per operator and whether drawing the needed amount from his own lines or from those of the power company will interfere with the system, and if so to what extent, and what, if any, additional apparatus will be needed to correct the trouble. Having determined these things to his satisfaction, he can install his arc-welding system with a considerable degree of assurance that there will be a decided saving in time, men, and money, and a genuine conservation of materials.

Checking Up On Accidents

By H. P. Heyne
Safety Inspector, United Alloy Steel Corporation, Canton, Ohio

When it is found that injuries are more frequent in one department than in others where similar work is performed, the correction of this situation may require special examination into the conditions and the manner in which the work is performed, careful study of the employees engaged in the work, and the introduction of special safety requirements. These may result in change in the method of handling the material; special precautionary measures; closer observance by foremen over the men; better maintenance of tools, etc. Departmental and occupational injury statements and charts visualize existing conditions and show up the "high spots" or peaks to be investigated.

The foremen should be able to give enthusiastic assistance in securing the support of the workmen in accident prevention. The prevention itself can be accomplished by the safety engineer, but he must win to his viewpoint the foremen and working force. The enthusiasm should be contagious, from the officials and department heads down to the workmen, joining them in accident-prevention activities.

Safety work is a business proposition, to both employer and employee. The employer is benefited through increased production and decreases in spoilage, hospital expense and compensation. The employee and his family are spared hardships, misery and suffering, through his not being incapacitated, and he is able to maintain a livelihood through non-interruption of employment, and increase in his earning power due to increased efficiency. Safety Engineering might well be considered a producing unit in an establishment, for its activities have a direct bearing on production and efficiency.

Classification of Injuries

A monthly report showing the classification by departments, as to causes of injuries, acts as a stimulus, among the department heads, to reduce the number on the subsequent reports. The causes for injuries would vary in accordance with the class of work in the establishment. There are, however, general causes which are applicable to most industries, such as: 1. Foreign bodies in eye (from grinding wheels from chipping; hot material; sparks). 2. Burns (from hot metal, slag, water, steam, acid, electricity, babbitt). 3. Handling material (loading; unloading; piling; removing from piles; conveying). 4. Objects falling (over; falling from overhead; falling into pits). 5. Hand tools (hammers; sledges; picks; crow bars). 6. Machinery (gears; machines; machinery tools; winches). 7. Transmission (pulleys; belts; shafting; setscrews). 8. Persons falling (slipping or tripping; falling into openings, pits or stairways; from ladders; over material on floors and in yards). 9. Stepping on or striking against objects (sharp objects; slivers; scrap; glass; protruding nails). This list is by no means complete, but it shows how injuries may be classified for analytical purposes, which is a necessary procedure to successfully attack the causes for injuries.

Inquiries Reported to Employment Department

A monthly compilation of lost-time injuries, showing the employee's name, check number, nature of injury, days lost, etc., may be furnished the employment department, so that injuries may be recorded in the employment files. In this manner, the records will show how often an employee has suffered injuries and when it is observed that he has sustained a number of injuries involving loss of time, it will be a cue for a further investigation. Such an employee may not be competent for the place he is filling, and it may be better to transfer him to another position, resulting in a saving to the company and benefitting the worker.

National Screw Thread Commission Reports on Coarse and Fine Threads—Part II

Part I defined and classified the coarse and fine threads recommended by the commission, specified the tolerances for nut and screw and outlined the gages to be used. Part II, which concludes the article, specifies the gages in detail, supplies tables of manufacturing tolerances for them and includes typical specifications for screw-thread productions.

(Part I appeared last week.)

THE general subject of gaging screws is too extensive to be fully covered in this report. Reference is made, however, to bulletins published by the Bureau of Standards covering various inspection methods, including the standard ring and plug gages, and the optical projection method of gage inspection; also, to an article in the *Journal* of American Society of Mechanical Engineers of February, 1919, with reference to the use of the projection lantern for gaging work.

Inasmuch as the threaded plug and ring limit gage is the most universally used scheme of gaging, and one that has been brought to the highest state of refinement, there is set forth herein what is considered the best practice used in the production and use of such gages. It is understood, however, that it is not the intention of this commission to confine manufacturers to any particular method of gaging, as that would tend to hinder progress.

It has been the practice of many manufacturers, including Government shops, to work with "Go" gages only and to depend upon the judgment of a good workman to keep within proper limits by the amount of "shake" or difference between the work and the gage. With a highly skilled and trained force working on but one kind of work and also referring the working gage to but one master gage, a fair degree of interchangeability can be maintained under these conditions.

In the recent military preparations, the Government required munitions in such vast quantities and in such a short period of time that this method of insuring interchangeability failed, and a method of gaging had to be established which did not rely entirely upon the skill and judgment of the workmen or inspectors. One reason for the necessity of a complete gaging system was that it was not possible to obtain a sufficient number of skilled workmen or inspectors. Furthermore, one master gage could not be used all over the country and consequently discrepancies in measurement between different shops had to be guarded against by the use of properly tested standards and by approved methods of measuring.

It is believed that the experience gained by manufacturers producing war material will result in a much more extensive use of gages than was ever thought practicable during pre-war times. The gage specifications which are given herein cover the manufacture, use and application of a system of gaging which has been thoroughly demonstrated in the execution of war contracts as being adequate for the production in large quantities of strictly interchangeable screw-thread product. It is not the intention of this report to limit manufacturers to any particular methods of test in checking either the manufactured product or in measuring gages, for the reason that any specification which would tend to limit the development of new and improved methods of measuring would be very undesirable. However, when the ordinary forms of thread gages are used, the specifications given herein will apply.

Gages and Methods of Test

The specifications for gages given herein are built upon the following fundamental assumptions:

Approved limit master gages do not reduce the net working tolerance. Permissible errors in *angle of thread* specified for "Go" gages tend to reduce the net working tolerance, while similar permissible errors on the "Not Go" gage tend to increase the net working tolerance. These two factors, therefore, balance each other. Permissible *lead errors* specified for the "Go" gage reduce the net working tolerance, while permissible lead errors on the "Not Go" gage tend to increase the net working tolerance. In order to realize the full net working tolerance, the permissible diametrical variation specified for both "Go" and "Not Go" gages (gage increment) is placed outside of the net tolerance limits. The extreme tolerance equals the net tolerance plus gage increment. The "Go" gage should check simultaneously all elements of the thread (all diameters, lead, angle, etc.) The "Not Go" gage should check separately the elements of the thread.

The following general specifications refer in particular to gaging systems which have been found satisfactory by the Army and Navy for the production of interchangeable parts as specified under the subject of "Classification and Tolerances." These specifications are included for the use of manufacturers where definite information is lacking. They are not to be considered mandatory.

Thread gages may be included in one of four classes, namely, Standard Master Gages, Limit Master Gages, Inspection Gages, and Working Gages.

The Standard Master Gage is a threaded plug representing as exactly as possible all physical dimensions of the nominal or basic size of the threaded component. In order that the Standard Master Gage be authentic, the deviations of this gage from the exact standard should be ascertained by the National Bureau of Standards and the gage should be used with knowledge of these deviations or corrections.

Limit Master Gages are for reference only. They represent the extreme upper and lower tolerance limits allowed on the dimensions of the part being produced. They are often of the same design as inspection gages. In many cases, however, the design of the master gage is that of a check which can be used to verify the inspection or working gage.

Inspection Gages are for the use of the purchaser in accepting the product. They are generally of the same design as the working gages and the dimensions are such that they represent nearly the net tolerance limits on the parts being produced. Inasmuch as a certain amount of wear must be provided on an inspection gage, it can not represent the net tolerance limit until it is worn to master gage size.

Working Gages are those used by the manufacturer to check the parts produced as they are machined. It is recommended that the working gages be made to represent limits considerably inside of the net limits in order that sufficient wear will be provided for the working gages, and in order that the product accepted by the working gages will be accepted by the inspection gages.

The following list enumerates the inspection and working gages required for producing strictly interchangeable

screws as specified for National Coarse Threads, National Fine Threads, or other straight threads.

a. A maximum or "Go" ring thread gage, preferably adjustable, having the required pitch diameter and minor diameter. The major diameter may be cleared to facilitate grinding and lapping.

b. A minimum or "Not Go" ring thread gage, preferably adjustable, to check only the pitch diameter of the threaded work.

c. A maximum or "Go" plain ring gage to check the major diameter of the threaded work.

d. A minimum or "Not Go" snap gage to check the major diameter of the threaded work.

The following list enumerates the inspection and working gages required for producing strictly interchangeable nuts, as specified for National Coarse Threads, National Fine Threads, or other straight threads.

a. A minimum or "Go" thread plug gage of the required pitch diameter and major diameter. The minor diameter of the thread plug gage may be cleared to facilitate grinding and lapping.

b. A maximum or "Not Go" thread plug gage to check only the pitch diameter of the threaded work.

c. A "Go" plain plug gage to check the minor diameter of the threaded work.

d. A "Not Go" plain plug gage to check the minor diameter of the threaded work.

The following list enumerates the limit master gages required for the verification of the working or inspection gages as previously listed for verifying the screw.

a. A set plug or check for the maximum "Go" thread ring gage, having the same dimensions as the largest permissible screw.

b. A set plug or check for the minimum or "Not Go" thread ring gage having the same dimensions as the smallest permissible screw.

c. A maximum plain plug for checking the minor diameter of both the "Go" and "Not Go" inspection thread ring gage.

The following list enumerates the limit master gages required for the verification of the working or inspection gages as previously listed for verifying the nut.

a. A minimum or "Go" threaded plug to be used as a reference for comparative measurements, corresponding to the basic dimension, or standard master gage.

b. A maximum or "Not Go" threaded plug to be used as a reference for comparative measurements, corresponding to the largest permissible threaded hole.

c. A minimum plain ring gage to check the major diameter of the "Go" and "Not Go" master threaded plug unless suitable measuring facilities are available for this purpose.

Gages may be made of a good grade of machinery steel pack-hardened, or of straight carbon steel of not less than 1 per cent carbon; or preferably of an oil hardening steel of approximately 1.10 per cent carbon and 1.40 per cent chromium.

Handles should be made of a good grade of machinery steel plainly marked to identify the gage.

The following specifications will be helpful in the design and construction of gages used for producing threaded work.

All plain plug gages should be single-ended. Plain plug gages of 2 in. and less in diameter should be made with a plug inserted in the handle and fastened thereto by means of a pin. Plain plug gages of more than 2 in. in diameter should have the gaging blank so made as to be reversible. This can be accomplished by having a finished hole in the gage blank fitting a shouldered projection on the end of the handle, the gage blank being held on with a nut.

The "Go" plain plug gage should be noticeably longer than the "Not Go" plain plug gage, or some distinguishing feature in the design of the handle should be used to serve as a ready means of identification, such as a chamfer on the handle of the "Go" gage.

Both the "Go" and the "Not Go" gages should have their outside diameters knurled if made circular.

The "Go" gage should have a decided chamfer in order to provide a ready means of identification for distinguishing the "Go" from the "Not Go" gage.

Snap gages may be either adjustable or non-adjustable. It is recommended that all snap gages up to and including $\frac{1}{8}$ in. be of the built-up type. For larger snap gages, forged blanks, flat plate stock or other suitable construction may be used.

Sufficient clearance beyond the mouth of the gage should be provided to permit the gaging of cylindrical work.

Snap gages for measuring lengths and diameters may have one gaging dimension only, or may have a maximum and minimum gaging dimension, both on one end, or maximum and minimum gaging dimensions on opposite ends of the gage. When the maximum and minimum gaging dimensions are placed on opposite ends of the gage, the maximum or "Go" end of the snap gage will be distinguished from the minimum or "Not Go" end by having the corners of the gage on the "Go" end decidedly chamfered.

All plug thread gages should be single-ended. Thread plug gages 2 in. and less in diameter should be made with a plug inserted in a handle and fastened thereto by means of a pin.

Plug gages of more than 2 in. in diameter, unless otherwise specified, should have the gaging blank so made as to be reversible. This can be accomplished by having the finished hole in the gage blank fitting a shouldered projection on the end of the handle, the gage blank being keyed on and held with a nut.

"Not Go" thread plug gages should be noticeably shorter than the "Go" thread plug gages, in order to provide a ready means of identification, or the handle of the "Go" gage should be chamfered.

End threads on plug thread gages should not be chamfered, but the first half turn of the end thread should be flattened to avoid a feather edge.

Inspection and working thread plug gages should be provided with dirt grooves which extend into the gage for a depth of from one to four threads.

The length of thread parallel to the axis of the gage should, for all standard "Go" thread plug gages, be at least as much as the quantity expressed in the following formula:

$$L = (1.5)\ D$$

Where L = Length of thread

D = Basic major diameter of thread.

For threaded work of shorter length of engagement than (1.5) D, the length of thread on the "Go" gage may be correspondingly shorter.

"Not Go" Thread Gage for Pitch Diameter Only: All "Not Go" thread plug gages should be made to check the pitch diameter only. This necessitates removal of the crest of the thread so that the dimension of the major diameter is never greater than that specified for the "Go" gage, and also removing the portion of the thread at the root of the standard thread form.

All ring thread gages should be made adjustable.

The "Go" gage should be distinguished from the "Not Go" gage by having a decided chamfer and both gages are to have their outside diameter knurled if made circular.

The end threads on ring thread gages should not be chamfered but the first half turn of the end thread should be flattened to avoid a feather edge.

The length of thread parallel to the axis of the gage should, for all standard "Go" ring thread gages, be at least as great as the quantity determined in the formula previously given. For threaded work of shorter length of engagement than (1.5) D, the length of thread on the "Go" gage may be correspondingly shorter.

"Not Go" ring thread gages should be made to check the pitch diameter only. This necessitates removal of the crest of the thread so that the dimension of the minor diameter is never less than that specified for the maximum or "Go" gage and also removing the portion of the thread at the root of the standard form. There are specified herein for use in the production of National Coarse Threads and National Fine Threads, and for other straight threads, several tables of gage manufacturing tolerances.

TABLE VII. MANUFACTURING TOLERANCES ON PLAIN GAGES

Manufacturing Tolerance Allowed on Work	Allowable Tolerance for Master Gages		Allowable Tolerance for Inspection Gages		Suggested Tolerance for Working Gages	
	Minimum Gage	Maximum Gage	Minimum Gage	Maximum Gage	Minimum Gage	Maximum Gage
0.002.....	+0.0000 +0.0001	—0.0000 —0.0001	+0.0001 +0.0003	—0.0001 —0.0003	+0.0003 +0.0005	—0.0003 —0.0005
0.002 to 0.004	+0.0000 +0.0002	—0.0000 —0.0002	+0.0002 +0.0004	—0.0002 —0.0004	+0.0004 +0.0007	—0.0004 —0.0007
0.004 to 0.006	+0.0000 +0.0003	—0.0000 —0.0003	+0.0004 +0.0007	—0.0004 —0.0007	+0.0007 +0.0011	—0.0007 —0.0011
0.006 to 0.010	+0.0000 +0.0004	—0.0000 —0.0004	+0.0006 +0.0010	—0.0006 —0.0010	+0.0010 +0.0015	—0.0010 —0.0015
0.010 to 0.020	+0.0000 +0.0005	—0.0000 —0.0005	+0.0010 +0.0015	—0.0010 —0.0015	+0.0015 +0.0021	—0.0015 —0.0021
0.020 to 0.050	+0.0000 +0.0006	—0.0000 —0.0006	+0.0020 +0.0026	—0.0020 —0.0026	+0.0026 +0.0033	—0.0026 —0.0033

TABLE VIII. TOLERANCES ON MASTER THREAD GAGES FOR LOOSE FIT AND MEDIUM FIT WORK

(This applies to both Standard and Limit Master Gages)

Number of Threads per Inch	Allowable Variation in Lead Between Any Two Threads Not Farther Apart than Length of Engagement	Allowable Variation in One-half Angle of Thread Gages	Allowable Tolerances on Diameters of Minimum Thread Gages	Allowable Tolerances on Diameters of Maximum Thread Gages
4 to 6	±0.0005	±0° 5′	+0.0000 +0.0006	—0.0000 —0.0006
7 to 10	±0.0004	±0° 5′	+0.0000 +0.0004	—0.0000 —0.0004
11 to 18	±0.0003	±0° 10′	+0.0000 +0.0004	—0.0000 —0.0004
20 to 28	±0.0002	±0° 15′	+0.0000 +0.0003	—0.0000 —0.0003
30 to 40	±0.0002	±0° 20′	+0.0000 +0.0002	—0.0000 —0.0002
44 to 80	±0.0002	±0° 30′	+0.0000 +0.0002	—0.0000 —0.0002

TABLE IX. SUGGESTED MANUFACTURING TOLERANCES FOR INSPECTION GAGES FOR LOOSE FIT AND MEDIUM FIT WORK

Number of Threads per Inch	Allowable Variation in Lead Between Any Two Threads Not Farther Apart than Length of Engagement	Allowable Variation in One-half Angle of Thread Gages	Allowable Tolerances on Diameters of Minimum Thread Gages	Allowable Tolerances on Diameters of Maximum Thread Gages
4 to 6	±0.0006	±0° 5′	+0.0006 +0.0015	—0.0006 —0.0015
7 to 10	±0.0005	±0° 10′	+0.0004 +0.0010	—0.0004 —0.0010
11 to 18	±0.0004	±0° 15′	+0.0004 +0.0008	—0.0004 —0.0008
20 to 28	±0.0003	±0° 20′	+0.0003 +0.0006	—0.0003 —0.0006
30 to 40	±0.0002	±0° 30′	+0.0002 +0.0005	—0.0002 —0.0005
44 to 80	±0.0002	±0° 45′	+0.0002 +0.0004	—0.0002 —0.0004

Table VII will be found practicable for all plain plug, ring and snap gages used in connection with a measurement of screw thread diameters. In addition to the master gage tolerances, suggested tolerances for inspection and working gages are also given in Table VII.

Table VIII will be found practicable for both standard and limit master thread gages for thread work designed in accordance with the manufacturing tolerances for Class I, Loose Fit, and Class II, Medium Fit, made to Tables III, IV and V.

Table IX contains suggested manufacturing tolerances for inspection thread gages with a small allowance for wear for use in quantity production of Class I, Loose Fit, and Class II, Medium Fit thread work, made to Tables III, IV and V.

TABLE X. SUGGESTED MANUFACTURING TOLERANCES FOR WORKING GAGES FOR LOOSE FIT AND MEDIUM FIT WORK

Number of Threads per Inch	Allowable Variation in Lead Between Any Two Threads Not Farther Apart than Length of Engagement	Allowable Variation in One-half Angle of Thread Gages	Allowable Tolerances on Diameters of Minimum Thread Gages	Allowable Tolerances on Diameters of Maximum Thread Gages
4 to 6	±0.0006	±0° 5′	+0.0015 +0.0025	—0.0015 —0.0025
7 to 10	±0.0005	±0° 10′	+0.0010 +0.0020	—0.0010 —0.0020
11 to 18	±0.0004	±0° 15′	+0.0008 +0.0015	—0.0008 —0.0015
20 to 28	±0.0003	±0° 20′	+0.0006 +0.0012	—0.0006 —0.0012
30 to 40	±0.0002	±0° 30′	+0.0005 +0.0010	—0.0005 —0.0010
44 to 80	±0.0002	±0° 45′	+0.0004 +0.0006	—0.0004 —0.0006

TABLE XI. MASTER GAGE TOLERANCES FOR CLASS III, CLOSE FIT WORK

(This applies to both Standard and Limit Master Gages)

Number of Threads per Inch	Allowable Variation in Lead Between Any Two Threads Not Farther Apart than Length of Engagement	Allowable Variation in One-half Angle of Thread Gages	Allowable Tolerances on Diameters of Minimum Thread Gages	Allowable Tolerances on Diameters of Maximum Thread Gages
4 to 6	±0.00025	± 2′ 30″	+0.00000 +0.00030	—0.00000 —0.00030
7 to 10	±0.00020	± 2′ 30″	+0.00000 +0.00020	—0.00000 —0.00020
11 to 18	±0.00015	± 5′ 00″	+0.00000 +0.00020	—0.00000 —0.00020
20 to 28	±0.00010	± 7′ 30″	+0.00000 +0.00015	—0.00000 —0.00015
30 to 40	±0.00010	±10′ 00″	+0.00000 +0.00010	—0.00000 —0.00010
44 to 80	±0.00010	±15′ 00″	+0.00000 +0.00010	—0.00000 —0.00010

Table X contains suggested manufacturing tolerances for working thread gages with a small allowance for wear for use in quantity production of Class I, Loose Fit, and Class II, Medium Fit thread work, made to Tables III, IV and V.

Table XI contains the tolerances suggested for both standard and limit master thread gages for work designed in accordance with manufacturing tolerances for Class III, Close Fit thread work, made to Table VI. As the component tolerances for this class are relatively small, it is believed that the working gages will be required to be held within the gage tolerances shown in Table XI.

For plain plug gages, plain ring gages and plain snap gages required for measuring diameters of screw thread work, the gage tolerances specified in Tables VIII, IX, X and XI should be used. Attention is called to the fact that the tolerances on thread diameters vary in accordance with the number of threads per inch on the screw or nut being manufactured. In manufacturing a plain plug, ring or snap gage, in the absence of information as to the number of threads per inch of the screw to be made, or for gage dimensions other than thread diameters, the tolerances for plain gages given in Table VII may be used.

The tolerances on lead are specified as an allowable variation between any two threads not farther apart than the length of thread engagement as determined by the following formula:

$$L = (1.5)\ D$$

Where L = Length of thread engagement

D = Basic major diameter of thread.

TABLE XII. TOLERANCES AND LIMITS ON MAXIMUM AND MINIMUM MASTER, INSPECTION AND WORKING GAGES FOR SHAFT AND HOLE

Work to be gaged:

Hole,	1.250 + 0.004	1.254	max.
	— 0.000	1.250	min.
Shaft,	1.248 + 0.000	1.248	max.
	— 0.004	1.244	min.

Gages for hole:

Maximum Gages

	Dimension of Part	Gage Tolerances	Gage Limits
Limit master gage	1.254	—0.0000	1.2540
		—0.0003	1.2537
Inspection gage	1.254	—0.0004	1.2536
		—0.0007	1.2533
Working gage	1.254	—0.0008	1.2532
		—0.0013	1.2527
Minimum Gages			
Limit master gage	1.250	+0.0000	1.2500
		+0.0003	1.2503
Inspection gage	1.250	+0.0004	1.2504
		+0.0007	1.2507
Working gage	1.250	+0.0008	1.2508
		+0.0013	1.2513

Gages for shaft:

Maximum Gages			
Limit master gage	1.248	—0.0000	1.2480
		—0.0003	1.2477
nspection gage	1.248	—0.0004	1.2476
		—0.0007	1.2473
Working gage	1.248	—0.0008	1.2472
		—0.0013	1.2467
Minimum Gages			
Limit master gage	1.244	+0.0000	1.2440
		+0.0003	1.2443
Inspection gage	1.244	+0.0004	1.2444
		+0.0007	1.2447
Working gage	1.244	+0.0008	1.2448
		+0.0013	1.2453

By comparison of the above figures, it will be seen that it is not possible for the master, inspection or working gage dimensions to overlap.

The tolerances on angle of thread as specified herein for the various pitches are tolerances on one-half of the included angle. This insures that the bisector of the included angle will be perpendicular to the axis of the thread within proper limits. The equivalent deviation from the true thread form caused by such irregularities as convex or concave sides of thread, rounded crests, or slight projections on the thread form, should not exceed the tolerances allowable on angle of thread.

The tolerances given for thread diameters in Tables VIII, IX, X and XI, are applied in such a manner that the tolerances permitted on the inspection and working gages occupy part of the extreme tolerance. This insures that all work passed by the gages will be within the tolerance limits specified on the part drawing as represented by the limit master gages. The tolerances given also permit the classification and selection of gages so that if a gage is not suitable for a master gage it may be classified and used as an inspection or working gage provided that the errors do not pass outside of the net tolerance limits. The application of the tolerances on diameters of thread gages is exactly the same as explained herein for plain gages. For an example of this application see Table XII.

Typical Specifications for Screw Thread Products

Material: The material used shall be cold-drawn bessemer steel automatic screw stock.

Composition:

Carbon, 0.08 to 0.16 per cent
Manganese, 0.50 to 0.80 per cent
Phosphorus, 0.09 to 0.13 per cent
Sulphur, 0.075 to 0.13 per cent.

Method of Manufacture: Bolts and nuts may be either rolled, milled, or machine cut, so long as they meet the specifications herein provided. Bolts and nuts to be left soft.

Workmanship: All bolts and nuts must be of good workmanship and free from all defects which may affect their serviceability.

Finish: All bolts and nuts to be semi-finished; that is, the bodies to be machined, under side of head and nut faced, upper face of head and nut to be chamfered at an agle of 30 deg., leaving a circle equal in diameter to the width of the nut.

Form of Thread: The form of thread shall be the "national form," as specified herein, and formerly known as the United States Standard or Sellers Thread.

Thread Series: The pitches and diameters shall be as specified in Table I, herein, and known as the National Coarse Thread Series.

Class of Fit: Class II-A, medium fit (regular).

Dimensions: Nominal size: ½ inch. Number of threads per inch: 13. Length under head: 3 ±0.05 inches. Minimum length of usable thread: 1 inch. Diameters: (Specified in table XI of complete report.)

Tolerances and Allowances: See Table IV.

Nuts: Form: Hexagonal. Thickness: ½ ±0.01 inch. Short diameter (across flats): ⅞ ±0.01 inch.

Heads: Form: Hexagonal. Thickness: 7/16 ±0.01 inch. Short diameter (across flats): ⅞ ±0.01 inch.

Gages: The gages used shall be such as to insure that the product falls within the tolerances as specified herein for Class II, Medium Fit (Regular).

The following gages are suggested and will be used by the purchaser:

For the Screw:

- A maximum or "Go" ring thread gage.
- A minimum or "Not Go" ring thread gage to check only the pitch diameter of the thread.
- A maximum or "Go" plain ring to check the major diameter of the thread.
- A minimum or "Not Go" snap gage to check the major diameter of the thread.

For the Nut:

- A minimum "Go" thread plug gage.
- A maximum or "Not Go" thread plug gage to check only the pitch diameter.
- A "Go" plain plug gage to check the minor diameter.
- A "Not Go" plain plug gage to check the minor diameter of the thread.

Inspection and Test: Screws and nuts shall be inspected and tested as follows:

At least three bolts and nuts shall be taken at random from each lot of 100, or fraction thereof, and carefully tested. If the errors in dimensions of the screws or nuts tested exceed the tolerance specified for this class; the lot represented by these samples shall be rejected.

Delivery: Unless otherwise specified the assembled bolts and nuts are to be delivered in substantial wooden containers, properly marked, and each containing 100 pounds.

The commission, in formulating this progress report, has acted largely in the capacity of a judiciary, basing its decisions upon evidence received from authorities on screw-thread subjects and upon the conclusions drawn by other organizations having to do with standardization of screw threads. In addition, the various subjects dealt with have been considered with a knowledge of present manufacturing conditions and with anticipation of further development in the production of screw-thread products. Above all, it is the intention of the commission to facilitate and promote progress in manufacture.

In the time provided the commission has devoted its attention to the standardization of only those threads, sizes, types and systems which are of paramount importance by reason of their extensive use and utility. There remains much to be accomplished along the lines of standardization of special but important threads, and of maintaining progress in our standardization work in keeping with the developments of manufacturing conditions.

The Hardening of Screw Gages With the Least Distortion in Pitch*

By Wilfrid J. Lineham†
Goldsmith's College, London

In the hardening of screw gages at Goldsmith's College it was required to find a means of quenching the steel after heating so that the distortion along the pitch line should be reduced to a minimum. The work was being done under the scheme inaugurated and supported by the London Council Education Department for war purposes.

I. Water Hardening

THE first law of hardening (known for many years) asserts that sudden quenching after heating retains the steel in the condition that prevailed at the quenching temperature.

The second law of hardening (of much more recent discovery) states that quenching, while crossing an arrest or recalescence point, produces the least amount of distortion, and it is one of the purposes of this paper to endeavor to prove the truth of this law. A second reason for the paper is to offer the author's results to other screw-gage manufacturers for their immediate assistance.

The second law had already been used by other investigators and practically applied with material success, but the author was unaware of the exact researches that have led to the adoption of fixed temperatures. The Wild-Barfield process he believed to be the first practical example, the principle of which is to use the change in magnetic properties of wrought iron or steel when passing from the β to the α state to indicate the temperature at which to quench. Reference to the Roberts-Austen diagram, Fig. 1, shows this to occur along the Ar2 line, temperature 765 to 770 deg. C. (1,409 to 1,418 deg. F.).

The Horstmann Brothers arrived at a similar result by quenching at 700 deg. C. (1,292 deg. F.), which is the temperature of the eutectoidal line Ar1. The screw gages they manufactured were produced, they said, with no alteration in pitch, but a slight swelling always occurred in diameter, which was lapped down afterward. They kindly communicated their method to the author, who thereupon decided to make his own investigations, the results of which are now set forth.

The author's first-sought ideal was a quenching temperature which would produce no distortion whatever, but it will be seen that this has not been achieved, nor does it seem likely that anything more than a minimum distortion can be arrived at. The Ar1 line for the use of the second law appeared to have manifest advantages over that at Ar2 because of its constancy of temperature over a large range of carbon percentages; and it seems reasonable to expect that steels of any carbon content will act in the same manner when cooling across this line, if all are free from impurities.

Before the war the manufacture of screw gages was confined to the use of high-carbon steel, say, from 0.85 to 1.2 per cent carbon, which was usually left unhardened, on account of the difficulties caused by distortion on quenching. The making of hardened screw gages had been practiced to a very limited extent before 1914, the correction after hardening being obtained by the use of laps of cast-iron or boxwood. The method taken generally has now been revived and extended, and is the only one followed at the present time, so a short description will be useful in order that the author's intentions may be understood.

Assuming that the gage can be hardened with so little change that the pitch tolerance, plus or minus, is not exceeded, which it will be shown can be done, the process of making a gage involves, first, the accurate screwing of the blank, and then hardening the screwed piece.

The first was carried out in a lathe accurately corrected in pitch by a cam bar. The screwing tool, known as a form tool, was of disk shape and supplied with chasing teeth on its circumference. Two of these "form chasers" were used, both being quite accurate in pitch and of perfect sectional contour for the thread to be cut. One was used to rough out the gage screw to about half or two-thirds the thread depth; and the

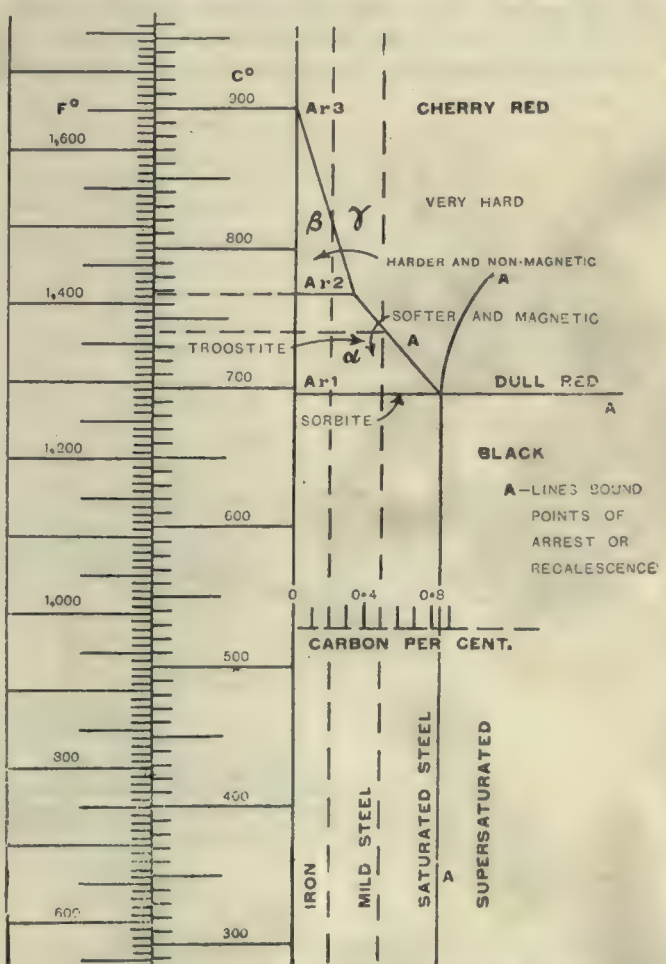


FIG. 1. PORTION OF THE IRON-CARBON DIAGRAM

*Read at a meeting of the Institution of Mechanical Engineers.
†Deceased.

other, very carefully adjusted in position, to finish the thread correct on core, crest and effective diameters and full form. Constant measurement was, of course, necessary, but as the lathe slides were provided with micrometer disks, rapid and almost automatic manufacture was soon secured. The intention of the author at

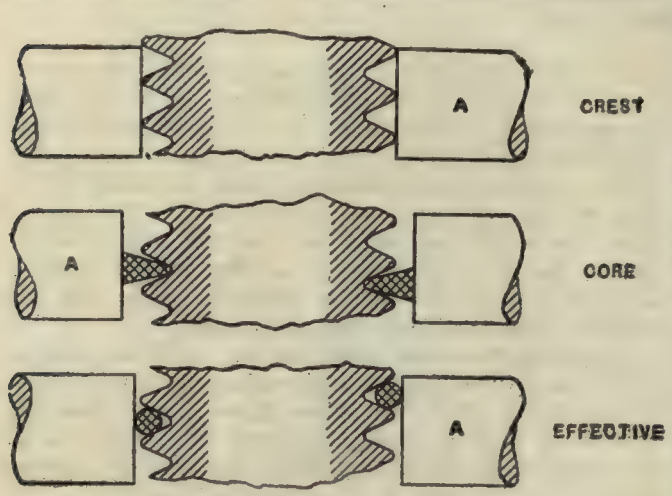


FIG. 2. MEASUREMENT FOR DIAMETER. AAA—MICROMETER-ANVILS

this stage of the work was to just clean up the gage with a full-form cast-iron lap, accurately made from a tap cut in the before-mentioned lathe. This method of lapping proved a failure, the abrasive clinging to the soft gage and causing "scoring," so he fell back on the cutting tool itself for the accuracy demanded, assisted by the use of a very mild steel of 0.14 per cent carbon for the blanks that cut with a polish. The object of the screwing operation was to produce a gage that was *perfect* in all dimensions while yet in the *soft* state.

The next step was to harden. The hardening of screw gages, and, indeed, some others, was performed in a cyanide furnace, made by John Wright, of Birmingham, which consisted of a rectangular cast-iron bath, covered and ventilated to remove the fumes, filled with sodium cyanide, and heated by coal gas and air, the latter being fed at a pressure of 3 lb. per square inch. The cyanide, which melted at about 600 deg. C. (1,112 deg. F.) and boiled at or near 800 deg. C. (1,472 deg. F.), was maintained at 750 to 770 deg. C. (1,382 to 1,418 deg. F.) when in use, the temperature being indicated by a thermo-couple pyrometer. The gages (of mild steel) were placed on trays suspended clear of the bottom of the bath and soaked from ten minutes to one hour, according to size, or until they had acquired the requisite depth of case.

The Cyanide Bath

If a greater depth of case than 0.005 in. be required, packing the gages with barium carbonate and bone black in closed boxes and soaking in a muffle furnace at about 850 deg. C. (1,562 deg. F.) must be resorted to, but the final heating should be completed in the cyanide bath.

It is possible to allow the cyanide bath to cool to the quenching temperature (supposing that to be exactly known) after the requisite soaking of the gage, but the process absorbs much time and increases expense, and is not to be advised for continuous working. Also the temperature may be ascertained by the color of the gage, which may be taken as a very dull red, but this is not advisable. The author therefore installed, in addition to the cyanide bath, a Brayshaw salt-bath furnace, using "pyromelt," and kept that fur-

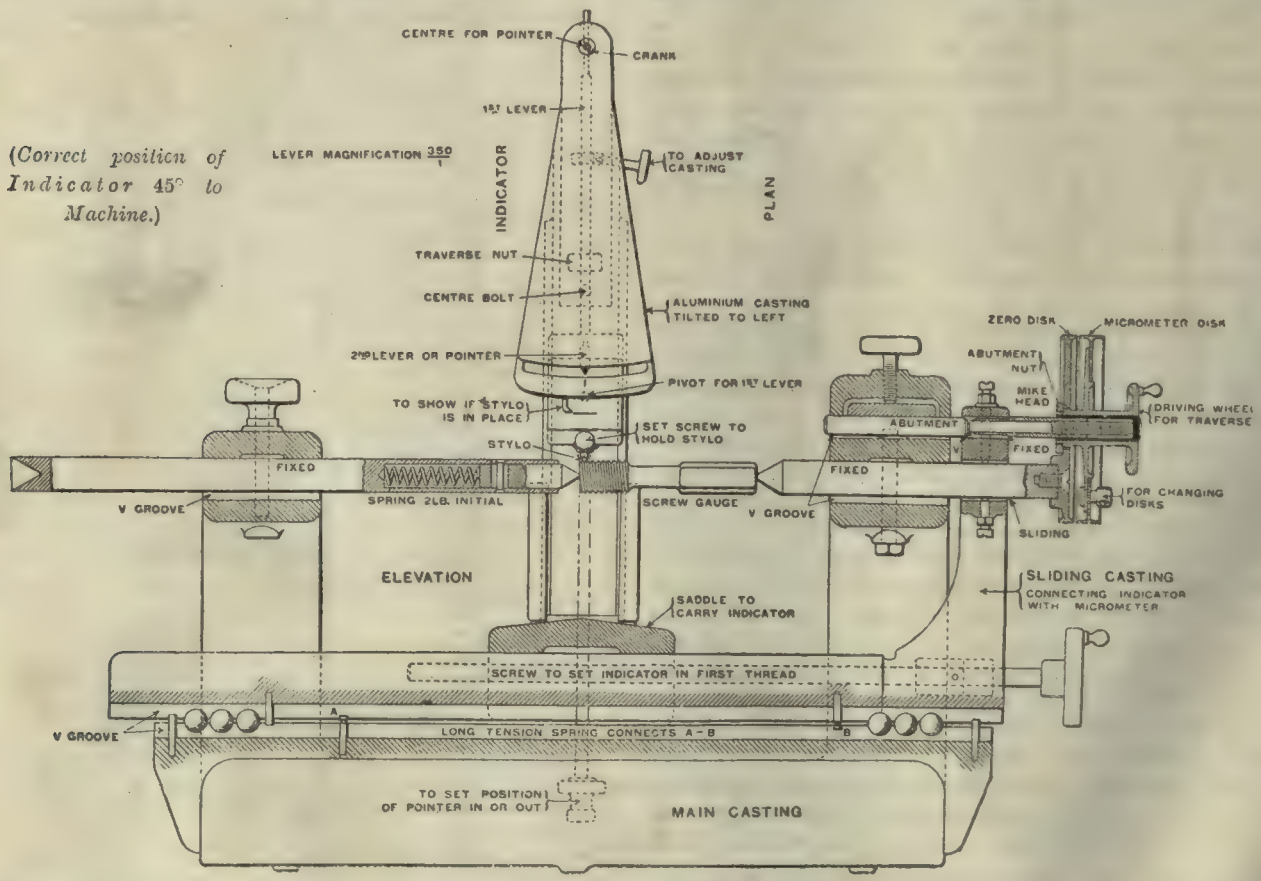


FIG. 3. PITCH MEASURING MACHINE

nace at the constant quenching temperature. This furnace was called the "store furnace," for when a gage had had its full time in the cyanide it was stored here at quenching temperature until its heat had evened up; and it was afterward quenched at leisure. The quenching tank was close to the store furnace and of ample capacity, with inflow and outflow cocks.

The screw gage was next measured for pitch and diameters. The diameter measuring machine has already been illustrated in the *Proceedings*, 1917, page 54, and Fig. 4, page 55, and the mode of its use is merely suggested in Fig. 2 (page 5), which shows the micrometer anvils at the moment of measurement.

The Pitch-Measuring Machine

The pitch-measuring machine, Fig. 3, was designed by the National Physical Laboratory and constructed at Goldsmith's College. The drawing is somewhat diagrammatic in order to show the principle clearly. The gage is supported between centers on the main or fixed casting. A movable carriage supports an indicator on the left and a micrometer on the right, being always pressed leftward by means of a weight. The indicator carries a stylo, which engages with the screw thread, and a pointer in connection therewith, whose reading is multiplied so as to be in the region of one-millionth of an inch of sensitiveness. The micrometer abuts

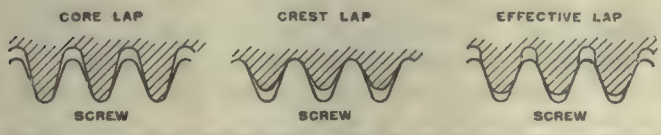


FIG. 4. LAPPING THE SEPARATE ELEMENTS OF A SCREW

against the main casting and can be read to 0.00001 of an inch, and very rapid charting of screw errors can be obtained.

After hardening, it was found that the screw pitch had not distorted beyond the tolerance, plus or minus, if precautions had been taken such as suggested later. The diameters, however, had increased, at least the core and crest were larger, but the effective surface was often unchanged. The operation of lapping followed, three laps, Fig. 4, being used; but the enlargement being only about 0.0001 to 0.0003 in. in diameter, the amount of lapping was very little. Naturally the operation was of a delicate character, and was the particular part of the whole process that most held up delivery; many gages were spoiled in its exercise; but it is believed that the whole hardening process will yet be so perfected that only a full-form cleaning lap will be necessary.

Gages Examined by Optical Lanterns

Finally each gage was examined by an optical lantern magnification of exactly fifty to one, as already described in previous papers; and of course the pitch and the diameters at all three elements of section were thoroughly tested during the stages of manufacture and just before delivery, by a competent staff of examiners. It will be said that if only a screw gage could be made to travel through its various manufacturing steps in such a simple and well-oiled manner, the difficulties of screw gage making would be completely overcome. It is one intention of this paper to show that the difficulties of manufacture are being overcome by the adoption of definite scientific method, and there are strong and practically certain hopes of doing away with lapping altogether.

The crucial point of the manufacture is the hardening. Lathes have been specially built that will produce accurate pitch, and mild steel is being used that can be finished in those lathes with a polish. It will be shown

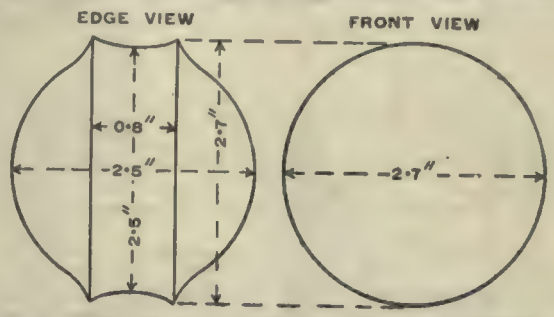


FIG. 5. A DISK OF MILD STEEL 4¼ IN. IN DIAMETER AND 1½ IN. THICK ORIGINALLY, WAS SWOLLEN AS SHOWN BY MEANS OF 1,000 SUCCESSIVE HEATINGS AND QUENCHINGS. ORIGINAL VOLUME 21.28 CU.IN. FINAL VOLUME 21.60 CU.IN.

that a quenching temperature can be found that only lengthens the pitch by 0.0002 in. over 0.7 in. of length, which is within the pitch tolerance, 0.0003 in., on such a length for inspection gages of correct effective diameter.

Two remarkable examples of distortion are shown. The first, Fig. 5, was, before treatment, a cheese-shaped disk of 4¼ in. diameter by 1½ in. thickness, of common mild steel. It was heated in a coke fire and quenched in water, the operation being repeated about a thousand times. The continued distortion has swelled the disk into an approximate spherical form, but that the volume is unchanged was ascertained by displacement measurement.

The second specimen, Fig. 6, was at first a rectangular disk, and here again the spherical form is attempted, the treatment being the same as in the first example.

These two specimens came to the author as a piece of exceptional good fortune, being presented by F. A. Thompson. Their history is: A garage boy required buckets of hot water at meal times and kept three of

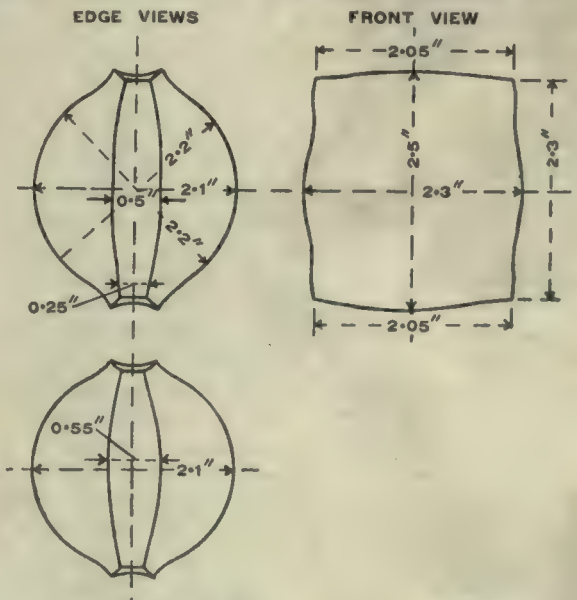
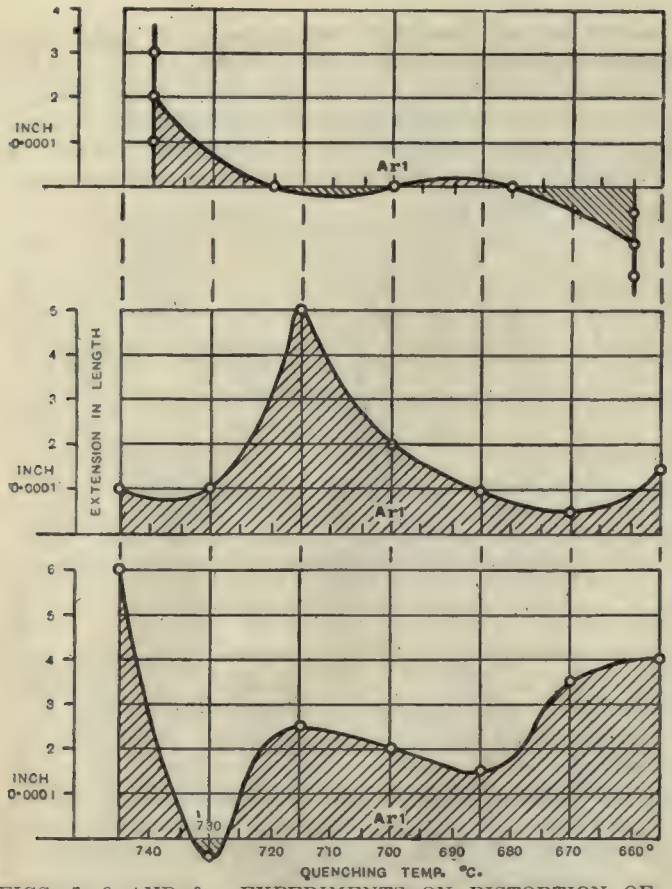


FIG. 6. RECTANGULAR DISK OF MILD STEEL WAS SWOLLEN AS SHOWN BY MEANS OF 1,000 SUCCESSIVE HEATINGS AND QUENCHINGS



FIGS. 7, 8 AND 9. EXPERIMENTS ON DISTORTION OF SCREW GAGES IN LENGTH ONLY: VIZ.: ON PITCH LINE. J AND L MILD STEEL 0.14 PER CENT CARBON. CASED IN SODIUM CYANIDE FOR 30 MIN. AT 750 DEG. C. SPECIMENS $\frac{3}{16}$ IN. IN DIAMETER BY 0.7 IN. LONG

Fig. 7—Average change of length (measured over the end surfaces). Fig. 8 — Distortions all extensions. Fig. 9 — Curve which seemed to indicate no fixed law.

these pieces hot on coke fires, using which he pleased to heat the water by immersion, and continuing his unintentional experiments over a period of about a year.

The author commenced his experiments in April, 1918, by providing seven specimens for each experiment, the material being J and L steel of 0.14 per cent carbon. Each specimen was ground and carefully surfaced by stoning the ends, and the dimensions were about $\frac{3}{16}$ in. in diameter by 0.7 in. long. Previous experiments upon pieces of full gage shape showed the wisdom of using simple cylinders for the temperature tests so as to obtain symmetrical distortions.

One form of distortion resulting from hardening a cylindrical piece of steel was found to be a swelling or bulging at the ends, but the length, measured at the edges, remained very little changed indeed.

The experiments were begun without any clear notion of the form the distortions were likely to assume, and axial measurements were at first made, which proved to be wrong for the purpose required. Also the ends of the cylinders were not parallel to less than 0.0001 in., and the average dimension was taken in the hard and in the soft states respectively. When, however, the circumference was divided into three or four parts and marked, and the change of length taken at the marked positions only and afterward averaged, quite consistent results were obtained, the figures fairly representing pitch line distortions on a screw gage.

Figs. 7 to 12 show, for six sets of experiments, changes of length in units of 0.0001 in. plotted on a base of quenching temperature.

Fig. 7 (April 5, 1918) is a record of the average change of length measured over the end surfaces, and contains the axial bulging. It was on this set that the bulge was first noticed, and from this time onward measurements were made on the edges only. The temperature of 700 deg. C. (1,292 deg. F.), however, is indicated as that of no distortion.

Fig. 8 (April 24, 1918). The distortions are all extensions, and 670 deg. C. (1,238 deg. F.) indicates least distortion. Several screws were hardened at this figure with success.

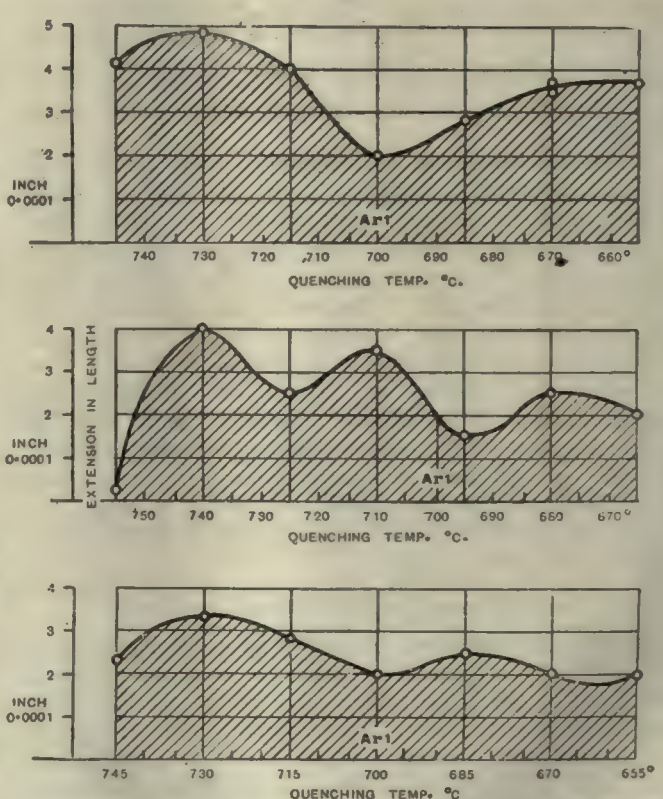
Fig. 9 (April 27, 1918). This curve was distressing. It seemed to show that there was no fixed law and that nothing would result from the labor. The figure 685 deg. C. (1,265 deg. F.) was taken as best, for the drop at 730 deg. C. (1,346 deg. F.) might not be trustworthy.

Fig. 10 (May 4, 1918). A good curve showing 700 deg. C. (1,292 deg. F.) to be decidedly the best temperature. Two specimens were quenched at 670 deg. C. (1,238 deg. F.) and are shown to fairly agree.

Fig. 11 (May 9, 1918). Another wavy curve, with minimum at 695 deg. C. (1,283 deg. F.).

Fig. 12 (May 11, 1918). There is here a minimum at 700 deg. C. (1,292 deg. F.), but also at three other temperatures.

The problem, which now appeared hopeless, suddenly cleared itself. It occurred to the author to plot all the curves on one sheet by superposition, as in Fig. 13, and this operation was at once fruitful in showing that



FIGS. 10, 11 AND 12. EXPERIMENTS ON DISTORTION OF SCREW GAGES IN LENGTH ONLY: VIZ.: ON PITCH LINE. J AND L MILD STEEL 0.14 PER CENT CARBON. CASED IN SODIUM CYANIDE FOR 30 MIN. AT 750 DEG. C. SPECIMENS $\frac{3}{16}$ IN. IN DIAMETER BY 0.7 IN. LONG

Fig. 10.—Curve which indicates that 700 deg. C. (1,292 deg. F.) is the best hardening temperature. Fig. 11—Wavy curve with minimum at 795 deg. C. (1,283 deg. F.). Fig. 12—Minimum at 700 deg. C., but also at three other temperatures

the distortion, or, as it may now be called, *extension*, had definite laws and was not the result of mere chance. Disregarding the first curve shown dotted, all cross at exactly one point, namely, 700 deg. C. (1,292 deg. F.), the recalescent point Ar1 of the equilibrium diagram. The extension is, unfortunately, not obliterated, but it has a fixed and definite value of 0.0002 in., and is within the tolerance limits. It indicates a condition of stability, and if 700 deg. C. (1,292 deg. F.) be made the quenching temperature, this extension can be allowed for when cutting the screw.

Other parts of the curves show nothing but instability. The use of the position 700 deg. C. (1,292 deg. F.) therefore is calculated to assist correct manufacture, while all the other temperatures are unreliable. On that account, an attempt to find a stable temperature of maximum extension, for use when needed, was practically unsuccessful; for gages quenched at 715 deg. C. (1,319 deg. F.) did not always extend well. A very important point is that the temperature must be found with accuracy, the range of stability being so very limited.

In Fig. 14 the distortion scale has been magnified and plotted for a range of 15 deg. ± of 700 deg. C. Maximum instability occurs at 715 deg. C. as well as maximum distortion, and in all cases temperatures below 700 deg. C. are safer than those above. A fair and safe latitude for quenching lies between 690 deg. C. (1,274 deg. F.) and 700 deg. C. (1,292 deg. F.).

The author found no difficulty in making sure of 700 deg. C. with the use of a platinum-rhodium thermocouple, a thermometer within the galvanometer-case giving warning of any change of temperature of the cold junction. Upon retesting the thermocouple after about six months' use it was found by the makers to be quite accurate.

It now appears that the second law of hardening proposed at the commencement of this paper is proved so far as the line at Ar1 is concerned, and could no doubt be proved for other arrest points.

In the early stages of this research measurements of distortion on diameter were made, which always showed an increase of about 0.0001 to 0.0003 in., but the purposes of the research being the measurement of length distortion in screw gages, and time being pressing, diameter measurements were not proceeded with.

Before obtaining the pyrometers, which were not in use before April 5, some experiments were made on a color scale extending through

Bright red
Gray just appearing (due to freezing of the cyanide)
Full gray
Dull red
Black just appearing
Mid black
Full black

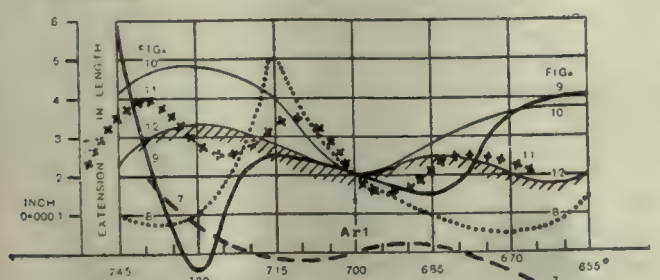


FIG. 13. SUPERPOSED CURVES OF FIGS. 7 TO 12

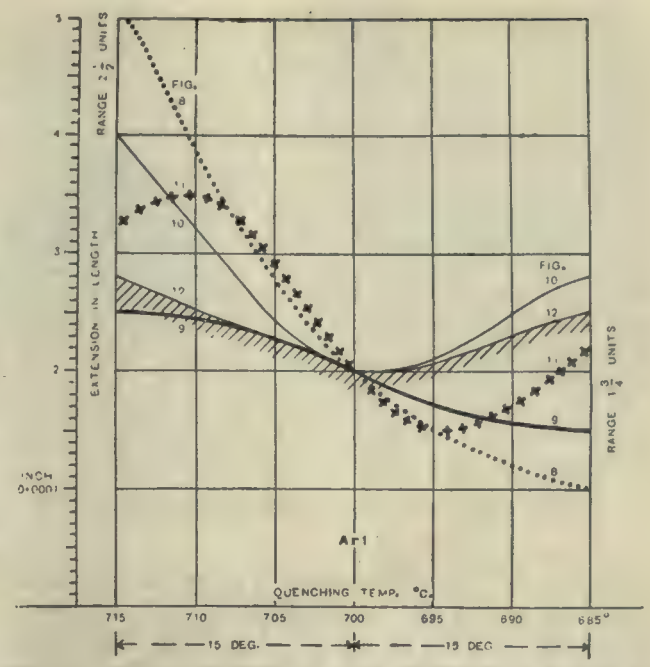


FIG. 14. ENLARGEMENT OF THE DISTORTION SCALE TO 15 DEG. ABOVE OR BELOW Ar1

—the specimen being held in a half light. The results pointed to a best temperature between dull red and black just appearing. Some experimenters have further perfected the color test, but the author considered the pyrometer method undoubtedly superior, and with his system of two furnaces could be practiced by a somewhat unskilled operator.

Further experiments are needed on ring gages, which have laws of their own as regards diametric distortion, and the author had hoped to make experiments on other gage shapes.

It has not been exactly discovered what the first stages of distortion assume, for in the boy's experiments the diameters are all decreased, though it is certain they increased at first. It was believed that a barrel shape was first produced, coupled with end swelling, but careful test has shown a festoon shape on the rim, and it must be always remembered that Nature insists on keeping the volume constant.

Instead, however, of waiting till all these facts could be obtained, it appeared wiser to make known the results that had already been acquired, in order that screw gages might be produced more easily and accurately by every manufacturer in a time of need.

The fact of the emulsive constitution of steel at Ar1 led the author to believe that gages quenched on this line would not be thoroughly hard. He was glad to say that, on the contrary, he had found them in every case to be glass hard. It must not be forgotten that the process of hardening by casing in cyanide produces a high-carbon steel at the surface, while the interior remains in the mild state, and this may have something to do with it.

The most important of the conclusions arrived at in this paper are:

(*a*) The second law of hardening is proved.

(*b*) A temperature of minimum distortion that can be relied upon is 700 deg. C. (1,292 deg. F.).

(*c*) No variation is allowable *above* 700 deg. C.

(*d*) An allowance of 10 deg. below 700 deg. C. is practically permissible.

Frivolous Stuff in the Plant Paper

By Frank H. Williams

Once upon a time, when I was editing an internal house organ or plant paper as we called it, the manager of the corporation said:

"Now, don't put any frivolous stuff in the paper. Put in all the inspirational, uplift stuff you want, but cut out all slang and all frivolous material. We're paying a lot of money to get this paper out and we've got to make it boost our business, not a sort of funny paper for our employees. I want it to be a constant source of inspiration and uplift for the people who work for us. Don't forget this when you're editing it."

At first, hearing that sounded like a very fine and commendable attitude to assume toward the plant paper, but how did it work out?

How the Manager's Ideas Worked Out

It worked out like this:

We spent a lot of money for fine paper and we spent a lot of money for cuts and we spent an infinite amount of time and thought in making the paper everything that the manager wanted it to be, and as the result of this expense and effort *the employees simply wouldn't read it!*

All of which is very pertinent to a discussion of "frivolous stuff" in the plant paper. Will employees read such a publication unless there is a certain amount of "jazz" or kidding in it? Will they pay much attention to a publication which does nothing but preach and nag and suggest improvements, all in a deadly, dull, heavy manner?

As long as employees are human it does seem as though the human-interest stuff has the most chance of registering with them. It does seem as though no regular folks will ever take very avidly to the perusal of preachments from those "higher up." And, for this reason, it does seem as though a certain amount of lively material is essential to the success of a plant paper.

But what form shall this liveliness take? How shall it be injected into the plant paper so as to liven the sheet up without letting it degenerate wholly into a funny sheet?

How to Use "Jazz" in a Plant Paper

Plant paper editors solve this problem in various ways, their solutions frequently being governed almost entirely by local conditions. But whatever the local conditions are it is always interesting to note what is being done along this line by the editors of other successful internal house organs. For this reason we should find it interesting to consider the question of "frivolous stuff" in the *Bowser Booster*, a very successful plant paper issued by S. F. Bowser & Co., Inc., of Fort Wayne, Indiana.

At the first inspection of this publication it is seen that there is always present a sprightliness and a good nature about the way things are written up which tend to make the items readable because of the way in which they are written and not alone for the things that are said. For instance, in a department headed "Who's Who in Bowserdom" appear sprightly items about the employees of the works written in such snappy, invigorating style as this:

"This, ladies and gentlemen, is the right honorable Homer Irven, Foreman of the Light Tank Shop. Under his direction are built flocks of type B, C, D and E tanks. And after finishing his day's task with so much of the alphabet he hies him home and looks after guinea pigs galore and thoroughbred rabbits. As a tank-builder he's right there—having had some twelve years' Bowser experience, and when not making tanks his delight is to make eight rabbits grow where one grew before."

Such a write-up is certainly a lot more interesting than the usual dry-as-dust "Who's Who" biographical sketch. And when accompanied by a thumb-nail photo, as each biography in this department is, the writeup is interesting to people outside the plant as well as those in the factory. And when a plant paper is written so entertainingly as to interest folks outside the plant as well as the employees, then it is certainly functioning at pretty close to 100 per cent. But such a write-up as this can hardly be called "frivolous stuff." It is written with a light touch, of course, but it is not exactly frivolous.

A Little Nonsense Now and Then Relished

A little nonsense now and then is relished by the most serious of employees. And if this nonsense or frivolity comes to them through the plant paper it is inclined to make them feel that the plant is a lively human, interesting entertaining place in which to work. It is inclined to make them feel that there's a lot of life and good spirits about the bosses even if they are rather somber-faced and always anxious for a greater production.

Frivolity is a great thing for the dissipation of the fumes of wrong thinking and of "bad" acting. It is a great thing for getting employees into a comfortable frame of mind. And for that reason, if for no other, it has a very definite reason for its existence in plant papers.

This thing of everlastingly preaching at employees by means of house organs, bulletins and plant meetings is enough to get the goat of any employee who feels that he is doing all that he's got in him and who has the normal human's healthy dislike for too much "goody-goody" stuff. Uplift and inspiration are all right in their way but the very fact that employees consistently avoid plant papers which harp too heavily on these topics should be an indication that such topics are in mighty bad order when they are given too much prominence.

Too Much Frivolity Better Than Not Enough

Of course, as has been indicated in the preceding, there is a chance of getting too much frivolity into the plant paper. That, of course, is a mighty bad thing. But isn't it a lot better to have too much frivolity and have the employees up and shouting for the regular appearance of the plant paper than it is to have too little frivolity and to watch the papers dropped carelessly from their hands within an appreciable number of seconds after receiving the copies?

Get frivolous once in a while in the plant paper and watch how quickly the employees respond by showing an increased interest in the publication.

Forget the uplift stuff for a while and be human and humorous and entertaining.

Give the employees the sort of stuff they want to read.

That, in the final analysis, is what makes or breaks a plant paper. If it contains the sort of stuff the employees like to read, then it will be a success. If it doesn't contain such stuff—*GOOD NIGHT!*



Machining Front Axles

By FRED H. COLVIN
Editor, *American Machinist*

Without going into extreme details concerning the manufacture of front axles, there is shown herein some of the principal operations applied by the Columbia Axle Co., Cleveland, Ohio. The illustrations suggest methods which cannot fail to be helpful in any similar work.

THE first operation is to inspect the forgings for straightness and to correct any inequality. This is done in the fixture shown in Fig. 1. Here the two substantial blocks *A* and *B* are mounted on the massive plate *C*, and are so designed that no stresses which may be imposed in straightening the forgings will materially affect their alignment. The front axle is laid in the position shown and held by the wedges *D* and *E*, which are quickly handled and at the same time hold the axle firmly in place. Then the gages *F* and *G* are applied and if straightening is necessary, it can be easily and quickly accomplished by using the bar *H*. After straightening, the first operation is milling the ends in the very interesting fixture shown in Fig. 2. Here the axle *A* is laid on its side, the end being supported by block *B* and *C* and clamped firmly in place by the toggles operated by the screw *D* and handwheel *E*. This fixture has compensating connections so as to equalize the pressure to make up for inequalities in the forging. Gangs of inserted tooth cutters are used on each end of the axle, there being four cutters in each gang. The cutters are substantially supported and gear driven, allowing the eight surfaces to be finished at one cut. Spindles *F* and *G* are designed to carry milling cutters for facing the spring pads when this is considered desirable. Next comes the drilling of the spindle holes, the novelty here being the use of spring pressure for holding the work, which allows rapid manipulation in clamping the forging firmly in position during

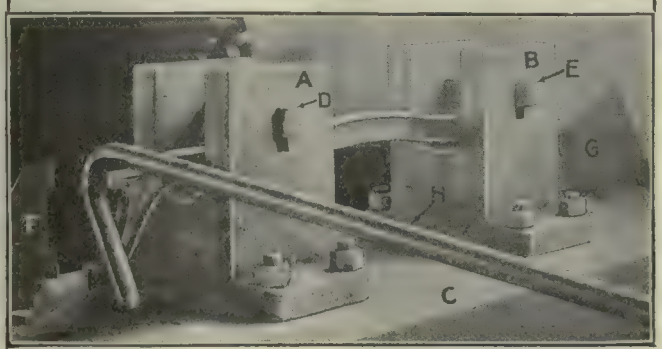


FIG. 1. STRAIGHTENING THE FORGINGS

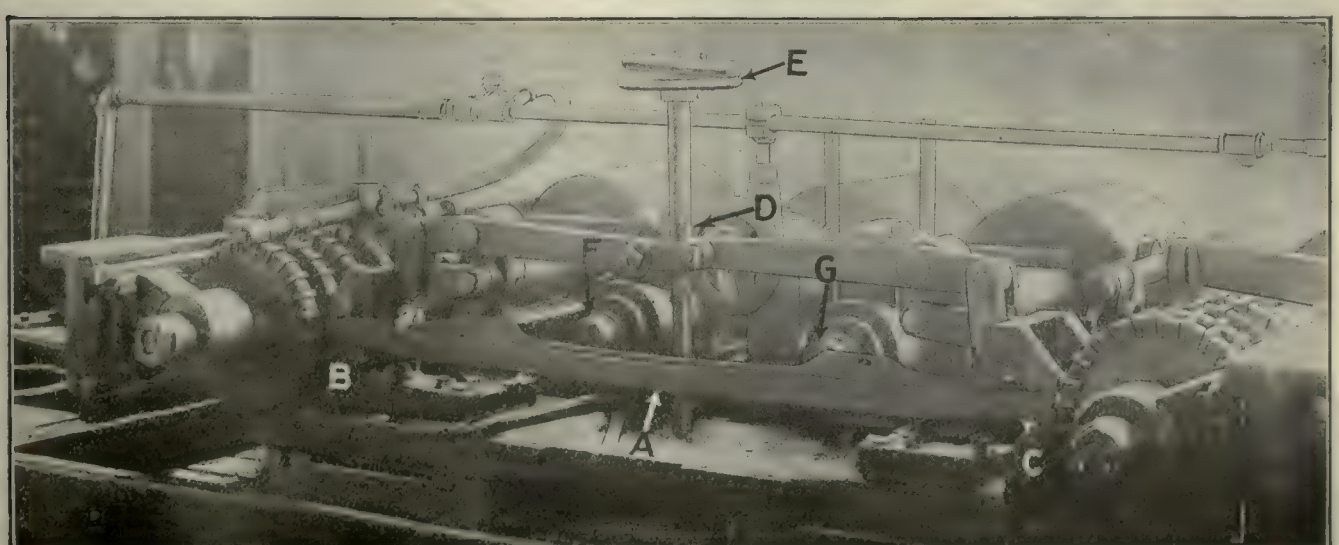


FIG. 2. MILLING BOTH ENDS

AUTOMOTIVE CONSTRUCTION



FIG. 3. DRILLING THE SPINDLE HOLES

the drilling operation. The lower ears of the axle fit into suitable guides beneath the lower bushing plate and by the lever *A*, Fig. 3, both bushing plates are raised so as to allow the easy insertion of the work. By strapping the right-hand fixture *B* to the table of the machine and allowing the other drilling fixture to move slightly on the table of its machine, compensation can be readily made for slight inequalities in the forgings. The heavy compression springs hold the drilling fixture firmly in place during the drilling operation.

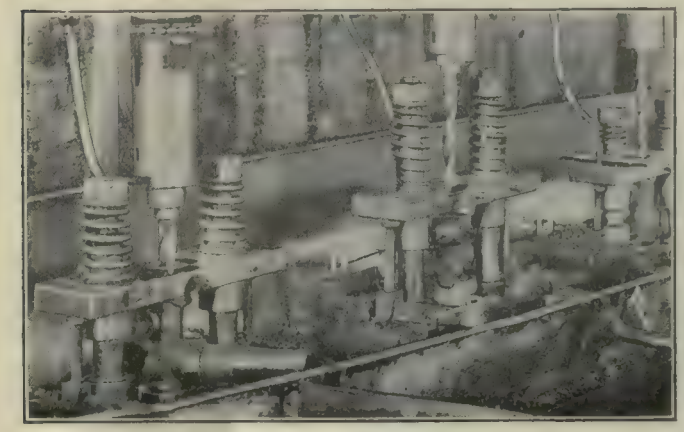


FIG. 4. DRILLING THE STEERING KNUCKLES

Leaving the axle for a moment and taking up the steering knuckle, Fig. 4, we find the same type of drilling fixture as shown in Fig. 3. This illustration makes the operation more understandable as it can readily be seen that the lever *A*, with its forked ends fulcrumed in *B*, enables the operator to compress the springs *C* by means of the rods *D* which impart the upward motion of the forked ends of the lever to the plate carrying the drill bushings. Centering cups are provided for each end of the spindle portion of the steering knuckles so that it is only necessary to raise the bushing plates by means of the lever *A*, insert the knuckle, release the lever and begin drilling at once. On a hole of this length a single operator easily handles four spindles. The side hole for the steering arm is drilled and reamed in the simple fixture shown in Fig. 5. The mandrel *A* slips through the hole which has been previously drilled for the spindle and rests in a pair of V-blocks which form part of the fixture *B*. The end which forms the stub axle rests on the wedge *C* while the strap *D* holds the knuckle firmly in place while it is being drilled and taper-reamed. The main steering arm is an awkward piece to machine on account of its irregular shape, as can be seen in Fig. 6. Fig. 7 shows the methods of drilling both ends in the same kind of drilling fixtures. The arm *A*, Fig. 6, is held in the jaws *A* and *B* in the drilling fixture shown in Fig. 7, the jaws being operated by a right- and left-hand screw, controlled by the hand-

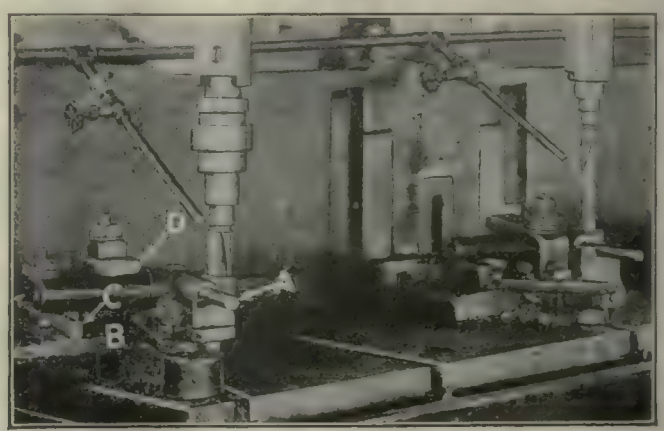


FIG. 5. DRILLING AND REAMING FOR STEERING ARMS

wheel *C*. The jaws center the boss *A*, Fig. 6, and the hole is drilled and reamed in the usual way by the

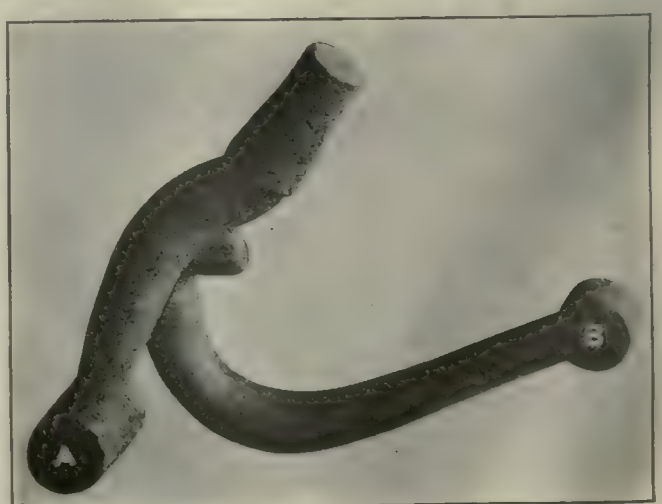


FIG. 6. THE MAIN STEERING ARM

AUTOMOTIVE CONSTRUCTION

aid of suitable bushings. The hole in the boss *B* is drilled in a similar fixture shown at the right in Fig. 7, the same kind of jaws holding the other end with equal facility. The final drilling of the axle, Fig. 8, takes place after the steering buckle and the connecting bar are in place. The axle is held in the jaws *A* and *B* which are operated by the handwheels shown. The stub axles slip in the slides *C* and *D* and the drill bushings are located in the plates *E* and *F*, which are connected by the rods shown, and swing



FIG. 7. DRILLING THE MAIN ARM

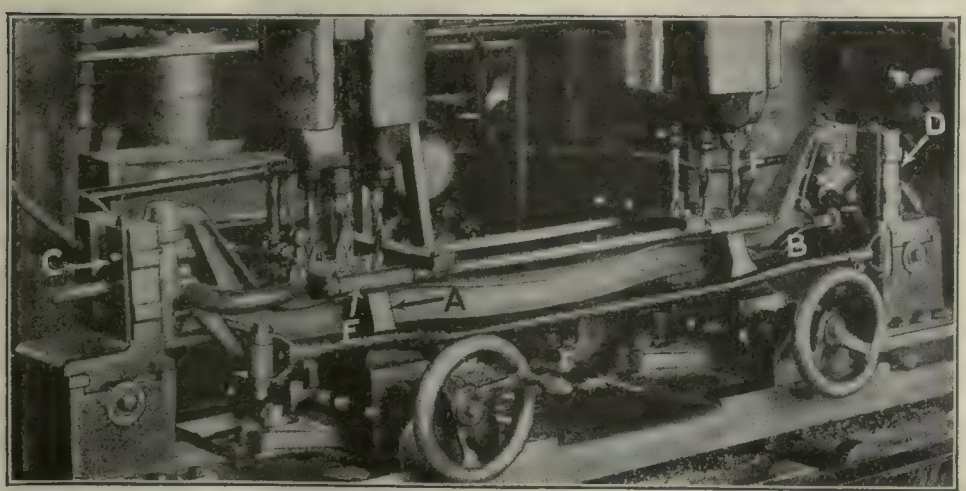


FIG. 8. DRILLING SPRING PADS ON COMPLETED AXLE

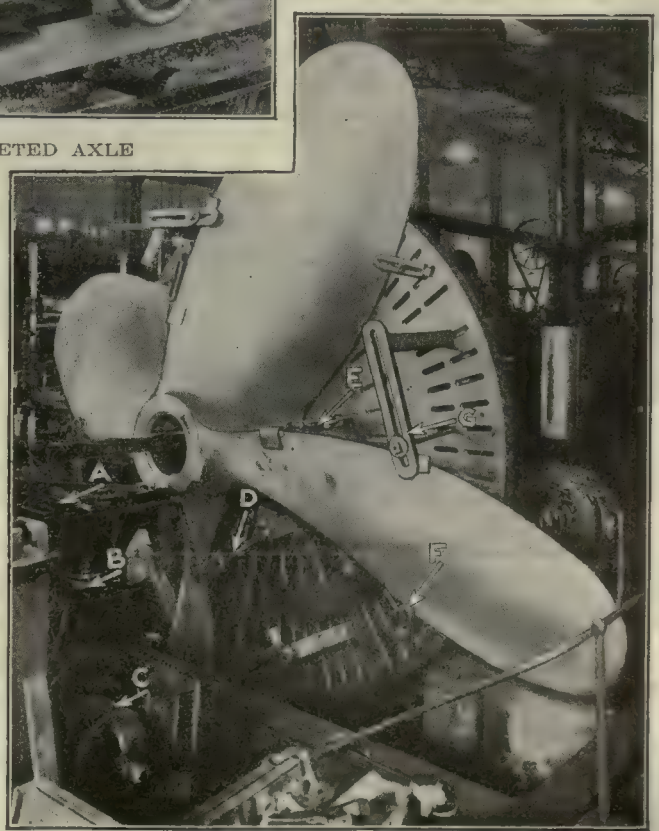
over the axle from the rear. The eight holes are drilled at once, four drills being driven by each spindle. This fixture centers the location of the springs and through them, the whole chassis, from the stub axles, so as to avoid the car body being out of center.

Boring an 11-ton Propeller

The boring of a large propeller is an awkward job, and requires considerable care and ingenuity in handling, as well as in machining. The propeller shown in the illustration is a solid bronze casting 18 ft. in diameter, weighing 22,420 lb. and is in the shop of the Union Plant of the Bethlehem Shipbuilding Corporation. This plant was formerly known as the Union Iron Works, and built the battleship "Oregon".

It is rather unusual practice for a propeller of this size to be cast in one piece, and it is doubtful whether any other plant on the Pacific Coast could have handled this job without special machinery being set up or built. The Union Plant cast and bored this propeller for the Moore Shipbuilding Co., which was doing the repair work on the S. S. "Howick Hall."

It will be noted that the boring tool is carried in the slide *A*, mounted on the swiveling stand *B*, and that the feed is provided by the small motor *C* through the proper gearing. The swiveling base allows the tool slide to be swung at the proper angle, so as to secure the desired taper for the hub fit on the tail shaft. The combination hooks and turnbuckles at *D* and *E*, together with the clamps *F* and *G*, hold the work firmly in place.



BORING A LARGE PROPELLER HUB



An Indicating Attachment for Locating and Boring Holes on the Milling Machine

By R. H. Kasper

When locating and boring holes in work on the milling machine, by use of an indicator and locating buttons, it is inconvenient to take a reading of the dial during a complete revolution of the indicator. It is sometimes impossible to see the dial even with the aid of mirrors.

To overcome this difficulty, the attachment shown in the sketch was designed. By the use of this attachment, the indicator remains stationary and therefore the dial is always in plain view of the operator. Fig. 1 shows a general view of the attachment and the method of using. It will be noted that the attachment is composed of two parts, which are dove-tailed together so as to produce a sliding fit with a minimum of lost motion. The outer part (Fig. 2) is carefully ground on the outside and carries a round-pointed screw which comes in contact with the locating button. The screw is located on the same diameter as the dove-tail. A coil spring holds the screw always in contact with the button. The shank may be cylindrical or tapered, to fit either the spindle or the chuck. Fig. 3 shows the shank which is dove-tailed to carry the outer portion. Fig. 4 is a cross-sectional view of the attachment assembled.

The contact screw must be carefully adjusted to suit the size of button being used. After once being set, the screw needs no further attention, until a different diameter of button is to be used. Adjustment of the screw is easily made. From the outside diameter of the attachment, subtract the diameter of the button and divide the remainder by two. The result obtained should be the dimension *A* in Fig. 4.

When using the attachment, the screw is brought in contact with the button. The table is then set so that the two cylindrical parts of the attachment come practically in line. The indicator is then brought into contact. On revolving the spindle, there will be no movement of the indicator needle if the button is located centrally with the spindle. If the button is not located centrally, the outer portion of the attachment will run eccentric. This is caused by the fact that the shank revolves on the same center as the spindle, while the outer portion is prevented from doing so by the contact screw bearing on the button.

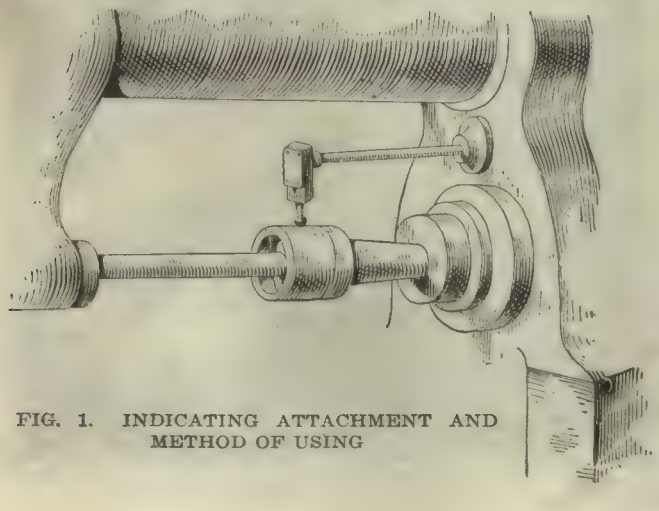
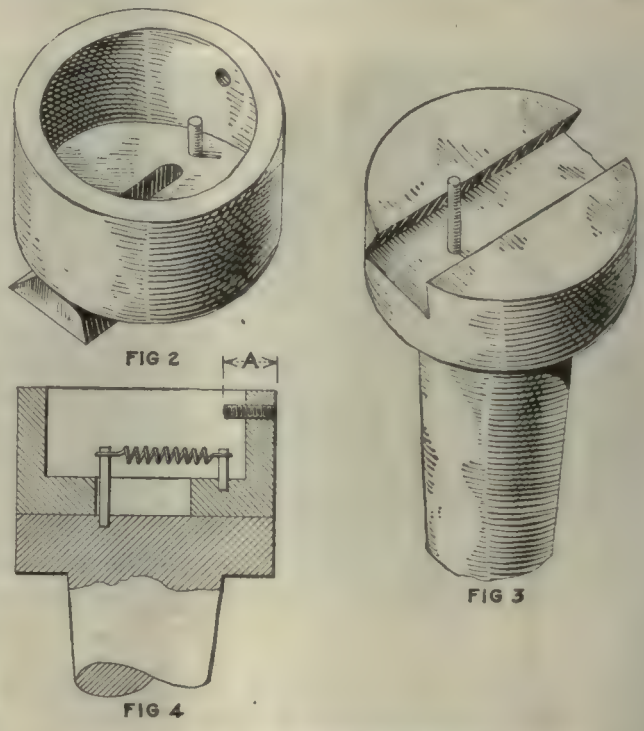


FIG. 1. INDICATING ATTACHMENT AND METHOD OF USING



FIGS. 2 TO 4. PARTS OF ATTACHMENT AND CROSS-SECTION

Fig. 2—Outer part of attachment which carries contact screw. Fig. 3—Shank of indicating attachment. Fig. 4—Cross-section of assembled attachment.

A Turret Tool for Ball Turning

By Harold Mohay

The arrangement of a fixture and turret tool, which is used for turning the ball handle on the end of the lever illustrated in Fig. 1, is shown complete in Fig. 2. As will be noted in Fig. 1, the ball end has a hole *B* drilled in it, this being used for locating purposes, while advantage is also taken of the beveled ribs, shown in section at *A-A*, for clamping and driving the work.

Considering first the fixture portion in Fig. 2, the work *X* is slipped over the pin *A* and also over the spring pin *B*, the latter being turned so as to bring the flats into the correct position for passing between the beveled ribs. The spring pin is then given a quarter turn, following which it is caused to clamp the work by tightening screw *C* against the beveled portion of it in the manner shown. It can be seen that the screw does not project above the surface of the plate, this construction being used for the sake of safety. The fixture is made to screw on the spindle nose, and it is provided with a flange at *D* so that the end of the work will not revolve unprotected in a manner dangerous to the machine operator.

Referring to the turning-tool mechanism, the body of it *E* is made from a steel forging, it being machined at *Y* to fit the turret hole of the lathe. The turning cutter *F*, shown in Figs. 2 and 3, is secured in its holder *G*, which is mounted in the body of the tool in such a manner that it pivots about a center (common to the center of the work) on the hinge pin *H* and the long hinge stud *J*. The cutter is held in place by the clamp *K* and screw *L*, the stud *J* carries a collar *M*, which is pinned in place to prevent the tool from moving up, and a pin *N* holds the hinge stud to the tool holder. In the upper end of this stud *J* a pin 10 in. long is used as a handle for revolving the tool about the center. Another pin *P* in the stud, in connection with a pin *Q* in the body of the tool, limits the movement of the cutter to the portion of the circle which is to be formed. In operation, the turret containing this tool is fed forward against a stop, and the operator then revolves the cutter by hand by means of the operating pin, thus forming the ball handle and the bevel as shown in Fig. 1.

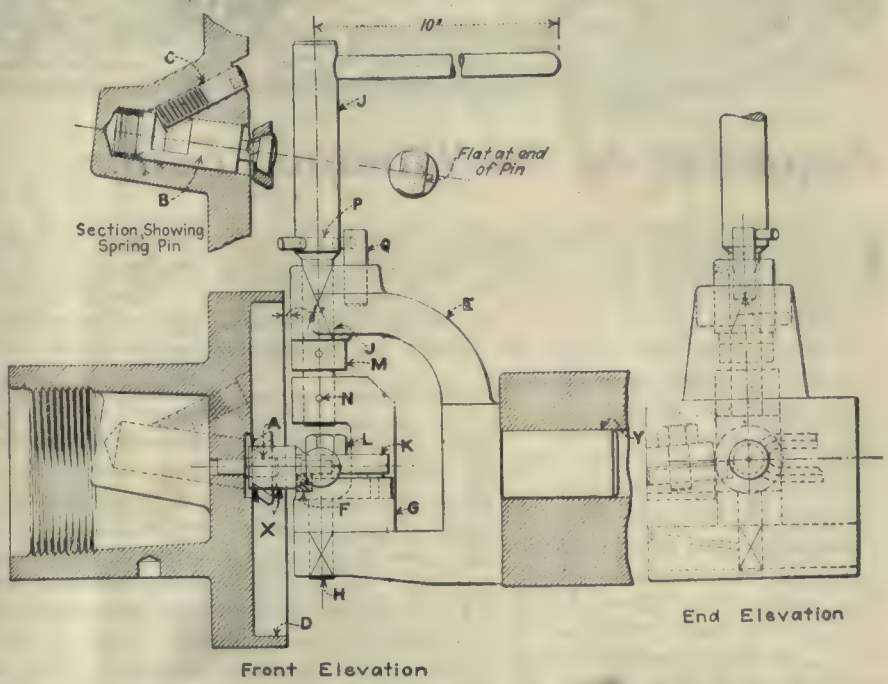


FIG. 2. TOOL ARRANGEMENT USED FOR TURNING THE BALL

For grinding the cutter and setting it on center in the tool, the gage shown in Fig. 4 is used. The end of the cutter is shaped to fit the form. To set the cutter in the holder, the edge *B* of the gage is held against the back edge of the cutter holder *G* and the cutter is moved forward until it reaches the formed edge *A* of the gage. This positively locates the cutter so that it will cut the correct diameter, this being a very important consideration where work of a reasonably uniform character is desired.

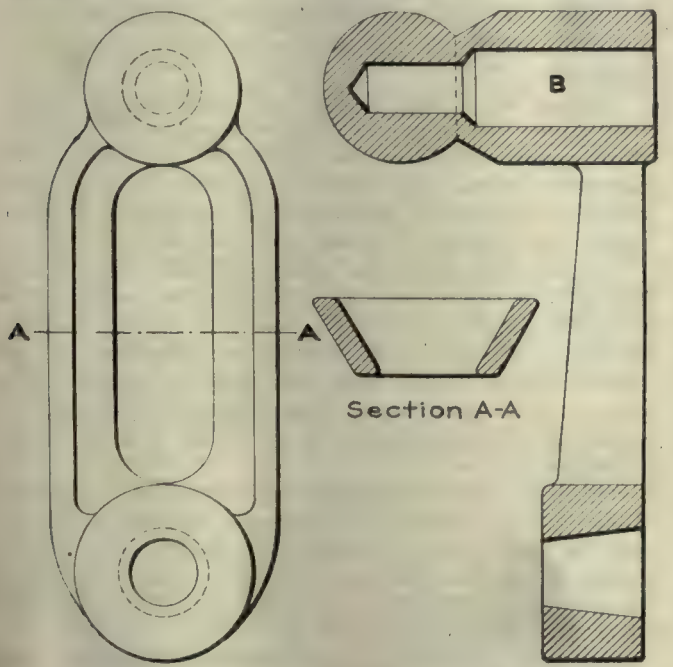


FIG. 1. HANDLE ON WHICH BALL IS TURNED

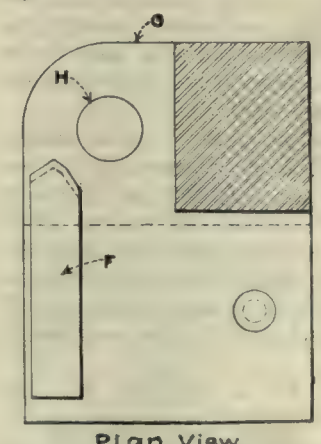


FIG. 3

FIG. 3. CUTTING TOOL IN POSITION IN THE HOLDER

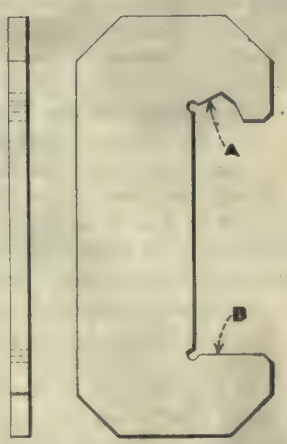


FIG. 4

FIG. 4. GAGE USED IN SHAPING AND SETTING TOOL

WHAT to READ —for the man in a hurry



Suggested by the Managing Editor

IN DEFERENCE to the American Steel Treaters' Society we are leading off this week with an article on material-testing machines by one of the big men in that field. The testing of the materials of construction, and particularly the metals, has grown in importance with the advances made in machine design, metallurgy and shop practice. And, fortunately, the improvement in the machines and devices for performing such tests has kept pace with the requirements of the tester. Mr. Olsen is probably as well fitted as any one to tell what has been done in the design and construction of testing machines. His article is illustrated by cuts of the important types.

What to read was not a difficult matter to decide two hundred years ago when books were few and magazines unheard of. It is far different now when so much reading matter is offered to pass the time pleasantly or profitably as the reader chooses. We are doing our utmost to make the "American Machinist" not only profitable but indispensable as a clearing house of ideas and news of the machinery world. This page is the editors' advertisement of their section of the paper. It gives the high spots.

Another article of particular interest to steel treaters is the one on page 547 by the late Wilfrid Lineham of Goldsmith's College, London. It concerns the control of the hardening of screw gages in such a way as to minimize the distortion along the pitch line. The author started with the intention of discovering a quenching temperature at which distortion would be eliminated but he admits that his ideal was not attained although he got a long way on the road to it. His measuring apparatus is illustrated as are also the rather remarkable results of repeated heating and quenching of steel disks. (As this has been given wide circulation abroad we are omitting it from the European edition.)

Fred Colvin has had several discussions of successful management experiments in previous issues and he has mentioned the White Motor Co., of Cleveland, before. On page 531 he decribes their scheme of posting actual cost figures where the men can see them and also the organization of the company and of the representative committees. Results count in a system of this kind. You can judge for yourself whether it has been worth while.

If you are one of those who like to look back and yarn about the "good old days" which will never come again, R. Thomas Huntington's reminiscences on page 533 will call to mind experiences you hadn't thought of for years.

Viall's welding article this week takes up the equipment used for electric arc welding as well as a short statement of the two commonly employed methods. It starts on page 537.

The rest of the National Screw Thread Commission's Report on coarse and fine threads which was begun last week appears on page 543, and succeeding pages. Here the gage specifications are given in detail, tables of manufacturing tolerances are set forth and typical specifications for screw thread products are outlined.

Automotively speaking we are finding practical difficulties in being entirely logical in the presentation of our series on automobile practice. We still have some more of the comparative engine parts articles coming along but as we are still adding to our supply or data we find it convenient occasionally to slip in something on some other part of the mechanism even if it does seem to be out of its regular order. This is what has happened this week and we are consequently giving you something on front axles. Page 553.

On page 552, Frank H. Williams concludes very sagely that giving the employees what they want to read in a plant paper makes for the success of the paper. His particular theme this week is "frivolity" and his suggestions are pointed, not only for the editors of plant papers but possibly for other editors as well.

On page 564a under the heading "What Other Editors Think" are two unusually interesting editorials. One calls attention to the false economy of trying to make obsolete, inadequate or patched-up equipment in the railroad shops do the work that could be handled more cheaply by modern tools. It recommends a judicial balancing of the opposing policies of "make it do" and "get something better."

The other editorial comments on the results of a questionnaire sent out by the Merchants Association to find out the present status of labor efficiency. It is encouraging to note that the concensus of opinion indicates an improvement and a closer approach to "a fair day's work for a fair day's pay."

Our own editorials on page 559 will give you something to think about.

EDITORIALS

Preparation—Not Pessimism

THE curtailment of automobile production is doubtless the forerunner of other readjustments from the abnormal conditions of the past six years. But, while all readjustments disturb existing conditions to some extent, there should be no pessimistic fears as to the outcome.

The people of the United States are going to continue doing business. Not in the same old way, but in some other way which will be better for all concerned. We are going on; there can be no turning back, no giving up of our ideals or rights to "life, liberty and the pursuit of happiness" as has been our motto in the past.

Far-sighted business men accept a letting up of abnormal demand as an opportunity to put their plants in better order; to substitute more efficient methods for those which are known to be wasteful but which the press of business has made it impossible to change. They also have the opportunity to study ways and means of improving quality or of reducing manufacturing costs, or both.

Now is the time to look ahead and to plan for the future as well as for the present. Now is the time to ask ourselves if there are not ways of making our shop really more efficient.

New machinery has been developed which will cut costs tremendously in many lines of work. Now is the time to see if this is not just what we need to bring our methods up where they belong. Can we not adopt some of the automotive shop methods to other lines of work? Can not the textile field and the newly developed field of washing machines and other household appliances improve their methods so as to reduce the prices of their product and so widen their markets?

The one thing to be avoided is the feeling of pessimism or panic. Let us abandon all talk of "getting back to the good old times," for we never shall nor do we want to. But we can and must go forward to better times, with many of the inequalities of the war period ironed out or eliminated.

Neither wages nor standards of living are going back to the pre-war period. But we can and must come to some equitable basis both as to production and profits. In too many cases neither wages nor selling prices now bear a direct relation to production, or to production costs. Both these conditions are uneconomic, both are closely related and both are unjust. We cannot cure one without the other.

We have a right to demand a fair production per dollar of wage or per hour of shop operation. And the worker has the same right to demand that the cost of his shoes, clothes and all that go to make up his living expenses, shall be based on the cost of labor, material and a *fair* profit. Prices set to secure "all the traffic will bear" in the language of the old railroad freight agent, are especially dangerous during a period of readjustment.

Almost equally bad, however, is a panicky cutting of prices in the hope of keeping the plant going full time. If prices are too high, they should be placed at a fair figure. If they already allow only a reasonable margin of profit, reducing them is not good business. It may be a good time to increase production by laying the case squarely before the men something like this: "Our costs do not allow us to sell in competition with other shops. If we can increase production 10 per cent, we can secure orders enough to keep the plant in operation. We believe this can be done with your co-operation, without disturbing either bonus or wages. It's up to you."

Whatever the way, we are going forward. The machine-building industry is more necessary than ever before, and now is the time to prepare it for the days which lie ahead. F. H. C.

"Labor Also Is On Trial"

THE return of the railroads to private control coupled with the recent rate award of the Interstate Commerce Commission has given birth to the popular idea that it is now 'up to the railroad manager.' . . . Equally true, however, is the fact that another great element in our national life is also on trial. Not only must the railroad managers show their ability, but the men and women they employ must demonstrate their willingness to work and their right to the wages recently awarded them by the United States Railroad Labor Board." This is the beginning of a statement by E. E. Loomis, president of the Lehigh Valley Railroad, that appeared in *Railway Age*. It contains an idea that is worthy of close attention.

In the hectic times during and after the war the expression "What does he get?" has too completely suppressed the older, homelier term "How much does he earn?" We fear that there is little connection between the two terms at present and that if the amount many a man gets was reduced to the amount he earns there would be a break in the silk-shirt market. And the fault is not all with the workman.

This is not an argument to reduce wages—far from it. We believe in high wages, but we also believe that they should be earned. And we agree with Mr. Loomis that the average American workman is too ambitious and has too much sense to remain indefinitely on the same basis as the time-server.

But there remains much difficult missionary work to be done to persuade the American workman, or for that matter the average citizen, that it is impossible to get something for nothing for very long without bankrupting the community. It would seem that the horrible example of Soviet Russia should be sufficient to bring people to their senses but unfortunately this is not the case for it is not difficult to find many who are unconvinced.

The article on another page describing the system in vogue at the White Motor Co., gives an example of a plant where high wages are earned and indicates an attitude that might profitably be adopted in other plants and other industries. K. H. C.

A Chart for Lengths of Keys

By JOHN S. WATTS

There appears to be a certain degree of haphazardness among some designers when the question arises of the length of hub required on a gear or pulley to give a sufficient area of key to transmit the desired torsion. It seems to be the common method to make the hub project slightly on each side past the face of the gear.

ALL the text books give the width and thickness of keys to be used for various diameters of shafts, but give no data on which to base the length of the key, which condition of affairs is probably what has led so many to jump to the conclusion that almost any length of key will do.

Making the size of the key proportional to the diameter of the shaft is certainly desirable for the sake of uniformity, but except in those rare cases where the gear or pulley to be keyed transmits the whole power of the shaft, the diameter of the shaft is no criterion of the size of the key required. In fact, owing to the greater lever arm of the key, the larger the diameter of the shaft the smaller will be the section of key required to transmit a given turning moment.

It is clearly most desirable to have a standard width and thickness of key for each diameter of shaft, and I have therefore, in making up the accompanying chart, kept the width and thickness of key to a standard, and made it to show the length of the standard size key that will transmit the required torque at each diameter of shaft.

To use the chart, Fig. 1, follow along the horizontal line for the turning moment or torque, in inch pounds, to its intersection with the vertical line for the shaft diameter, and read the length of key required from the next higher diagonal line.

For example, a gear to transmit 400,000 in.-lb. on a 6½ in. dia. shaft will require a key 6½ in. long, or, what is the same thing, the hub of the gear should be 6½ in. wide.

The standard upon which the chart is based is a width of key equal to one-quarter of the diameter of the shaft and an allowable shearing stress on the key of 12,000 lb. per square inch.

The curved line indicates the torque which the shaft itself will transmit at a stress of 12,000 lb. per sq.in., and also shows the length of a key that will be equal in strength to the shaft. For instance, a key 10½ in. long in a shaft 6½ in. dia. will be equal in strength to the shaft, both being of the same material.

The depth of keyway is usually made one-third of the width of the key, which in the above case gives a compressive stress on the side of the key of three times the shearing stress, or 36,000 lb. per sq.in., which is allowable where the key fits on all four sides, and therefore the material in the key cannot deform under the pressure. If the key is fitted on the side only the depth of the keyway should be one-half of its width, thus reducing the bearing stress to 24,000 lb. per sq.in., or the length should be increased to keep the bearing stress down to that amount. If the gear is pressed tightly onto the shaft and the friction between the gear bore and the shaft can be depended upon to take part of the turning moment, then the key may be made to project only one-third of its width as before.

In all the above it is assumed that the key is a tight fit and the gear or clutch is immovable. The design of keys for sliding gears or clutches is a different proposition entirely. These should have a surface sufficient to reduce the bearing pressure on the side of the key projecting out of the shaft of not over 3,000 lb. per sq. in. The depth of the keyway in the shaft need not be increased over that required for fixed gears. This will usually involve fitting at least two keys which can be narrower than the standard as the shearing stress need not be reduced.

The chart is constructed as follows: draw the vertical line at the right and lay off on it to scale, the points representing the torgue in inch-pounds, and draw horizontal lines through each of these points.

We now locate upon this vertical line the points corresponding to the shearing strength of the standard size of key in an 8-in. shaft, expressed in inch-pounds for each inch and half-inch of length. That is, a key 2 in. wide and 1 in. long will have a resistance in shear at 12,000 pounds stress of $2 \times 1 \times 12{,}000 = 24{,}000$ lb., and at the lever arm of 4 in., due to the radius of the 8-in. shaft, this gives a torque of $24{,}000 \times 4 = 96{,}000$ in.-lb. for each inch of length of key.

The formula for the moment of resistance of a key one inch long is:

$$\text{Moment of resistance} = M_r = W \times \frac{D}{2} \times f \times 1$$

where W = width of key in inches
D = diameter of shaft in inches
f = allowable shearing stress

But as $W = \frac{D}{4}$ substituting in the formula, we get

$$M_r = \frac{D}{4} \times \frac{D}{2} \times f = \frac{D}{8} \times f$$

As the resistance of the key varies with the square of the diameter of the shaft, we therefore make the base line of the chart, equal to $8^2 = 64$, in length to any convenient scale, because we have taken the vertical line to represent the resistance of the keys in an 8-in. shaft. To the same scale we lay off points for the other diameters of shafts, making the lengths equal to the squares of the diameters and erecting vertical lines at each point.

Now we join the points in the 8-in. vertical line to the zero end of the base line, and it follows from the law of similar triangles that the height of any diameter line to any diagonal line is equal to the moment of resistance of a standard size key of that length indicated by the diagonal line, in a shaft of the diameter indicated by the vertical line.

The curved line is arrived at by scaling up on each diameter vertical line, the torsional strength of that diameter of shaft in inch pounds at a stress of 12,000

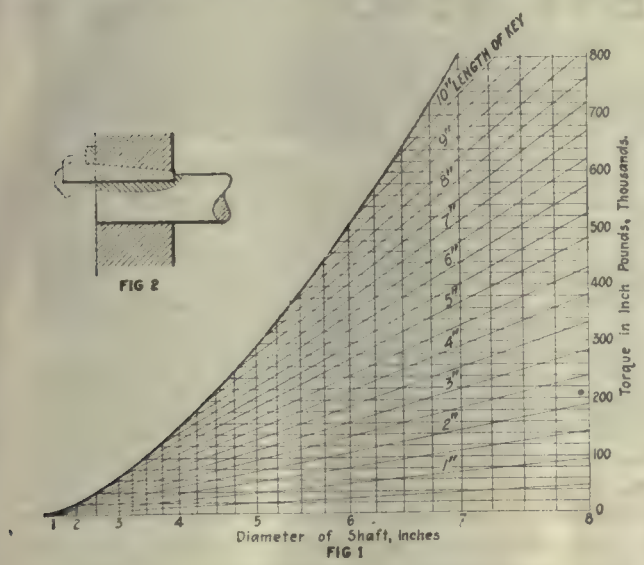


FIG. 1. CHART FOR LENGTHS OF KEYS
FIG. 2. HOW AN UNSUPPORTED GIB KEY CAN BE BROKEN IN REMOVAL

pounds, and drawing the line through the points so acquired.

In passing it may be noted that a key having a width of one quarter of the diameter of the shaft and a length of 1.5708 times the shaft diameter will develop the full strength of the shaft, both shaft and key being under the same stress and being of the same material.

There is another point in fitting keys that is worthy of more attention than is usually given to it. This is making provision for driving out the keys when repairs render it necessary to dismantle the gears.

Where it is impossible to provide space to enable the key to be driven out by means of a key drift against the small end of the key, the large end of the key should have a gib head so that it can be extracted by wedges driven between the gib head of the key and the hub of the gear.

These gib heads are the cause of considerable profanity in the repair shop when they are fitted in a shaft cut off flush with the face of the hub of the gear (which is the way they are nine times out of ten). Under these conditions a key that has been well fitted originally and driven tightly home, especially if it has been in place a long time, will almost every time break off at the head when the wedges are being driven in to extract it.

This can be seen by reference to Fig. 2 which shows that the strain on the head must be severe before much pull can be got on the key.

This trouble can be easily prevented by extending the shaft out about one inch to provide a support underneath the key when being wedged out.

Is This a Punch-Press Job?

BY WILLIAM J. BECKER

Referring to Mr. Hudson's article, "Is This A Punch-Press Job?" on page 1,267, Vol. 52, of the *American Machinist*, the accompanying sketches should be of interest. I designed this fixture, shown in Fig. 1, a year ago for just the kind of a job about which Mr. Hudson inquires. It is made of angle iron and cold-rolled steel and used on a 24-in. shaper. Two screws at the end of the fixture will securely clamp a whole row of bars or wires. Care must be taken to put the proper taper on the clamps, so that they will force the wires down, but not too tightly. The clamping arrangement is shown separately in Fig. 2.

A fixture like this can be made to hold two $\frac{1}{16}$-in. wires per in. of fixture length, so that 48 wires can be machined at one setting on a 24-in. shaper. For a wire smaller than $\frac{1}{2}$-in. in diameter the clamps must be made sufficiently wide and close together to prevent springing while machining. A straight-edge can be clamped to the fixture to act as a stop against the ends of the wires.

Referring to the illustrations, *A* is an angle iron bolted to the shaper table, and the pieces *B* are bars of cold-rolled steel. The case-hardened clamps *C* swing between the bars *B*, and they are set just low enough to clear the cutting tool. Small pins *D* prevent the clamps from falling down into the slots. The heavy setscrew *E* clamps all bars at once. It is necessary that the work be supported as much as possible under the part being machined.

This fixture has been in constant use in the plant, and after doing duty for a year is still turning out work as rapidly and accurately as the day it was first used. It can be unloaded and reloaded in less than one minute and is easily kept clean.

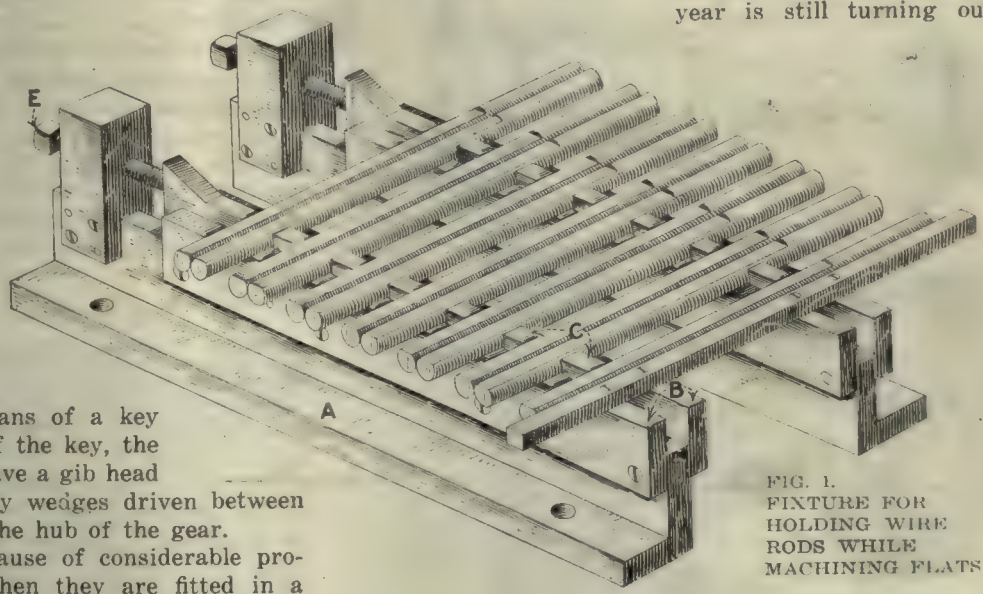


FIG. 1. FIXTURE FOR HOLDING WIRE RODS WHILE MACHINING FLATS

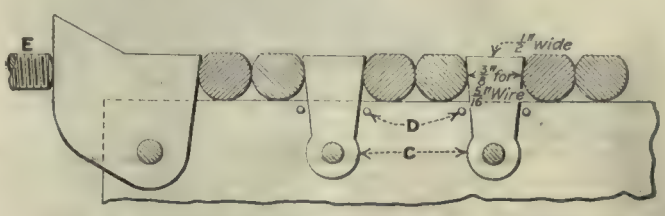


FIG. 2. METHOD OF CLAMPING RODS IN FIXTURE

SHOP EQUIPMENT NEWS

-Edited by-
S. A. HAND

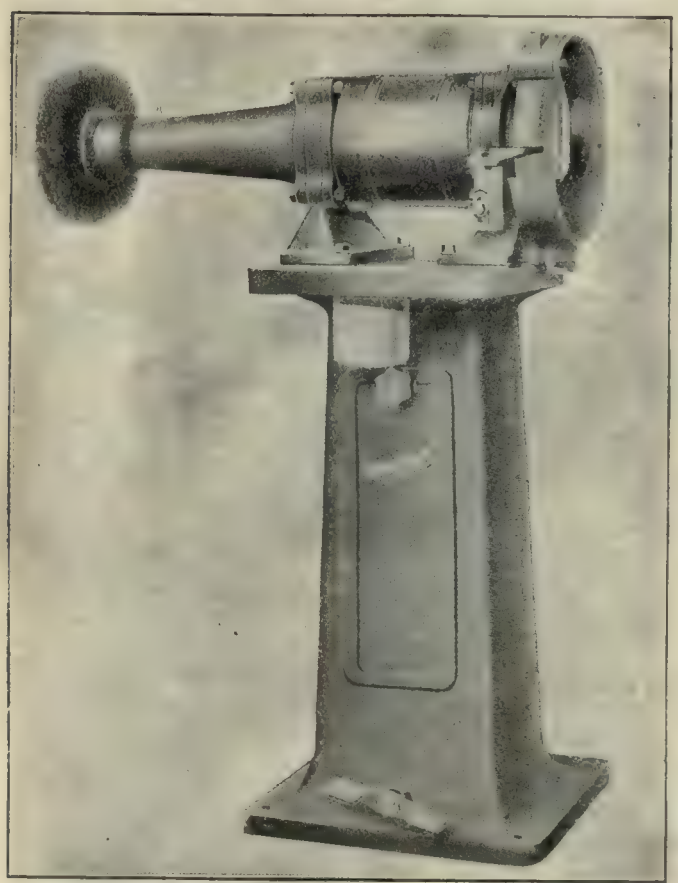
SHOP EQUIPMENT • NEWS •
A weekly review of modern designs and equipment

Descriptions of shop equipment in this section constitute editorial service for which there is no charge. To be eligible for presentation, the article must not have been on the market more than six months and must not have been advertised in this or any previous issue. Owing to the news character of these descriptions it will be impossible to submit them to the manufacturer for approval.

• CONDENSED • CLIPPING INDEX
A continuous record of modern designs and equipment

Van Dorn Heavy-Duty Electric Grinding and Buffing Machines

The Van Dorn Electric Tool Co., Cleveland, Ohio, is now manufacturing 1-hp. heavy-duty electric grinding and buffing machines in the floor, bench and aërial types. The motor is built and rated according to A.I.E.E. standards. It is claimed that it has a normal capacity of 1⅛ hp., a momentary overload capacity of 2¼ hp., and will drive 10 x 1½-in. abrasive wheels without stalling. With ventilation, the rise in temperature in continuous service is less than 50 deg. C. (90° F.); when fully inclosed, the rise will not exceed 55 deg. C. (99° F.) in 30 min. at 1⅛-hp. load. Ventilation is provided by means of a fan drawing air through screened openings at the rear of the frame.



VAN DORN 1-HP. ELECTRIC FLOOR GRINDING AND BUFFING MACHINE

Specifications: Height of spindle, 39 in. Base size, 17 x 18 in. Spindle diameter at wheel, ⅝ in. Weight of machine with one guarded wheel and one extension, as shown; net, 345 lb.; crated, 450 lb.; boxed for export, 500 lb. Contents, boxed for export, 21 cu.ft.

When direct current is used the speed is 2,000 r.p.m. while the alternating-current machine runs at 1,800 r.p.m. The a.c. stator and d.c. field assembly are interchangeable in the motor frame, so that the machine can be changed from one type of current to the other at minimum expense. The diameter of the frame is smaller than the diameter of the wheel, so that long work may be placed flat against the wheel face. The shaft is mounted in ball bearings inclosed in dustproof housings. Heavy non-removable guards are provided, arrangement being made for the attachment of an exhausting system. Extensions for carrying brushes or wheels can be furnished, as shown. The aluminum water pot is removable, and tool rests having both horizontal and vertical adjustments are provided

The floor type of machine, shown in the illustration, has a foot-operated switch, an automatic starter being placed inside the pedestal when a d.c. motor is used. D.c. machines can be furnished to operate on either 115 or 230 volts, and a.c. machines in either two or three phase on 110, 220 or 440 volts.

The machine can be furnished as an aërial grinding machine carrying a single wheel and having an over-all length of 33¾ in. and a net weight of 85 lb.

Van Keuren Combination Reference Gages

The Van Keuren Co., 362 Cambridge St., Allston, Boston, Mass., has added to its line sets of combination precision-gage blocks. The blocks are intended primarily as reference standards. It is claimed that the round or cylindrical shape gives the proper distribution of metal for a reference gage, as temperature changes affect the block uniformly.

The gages are made of an alloy tool steel which is said to have been selected for its properties of long wear, constancy of size and shape, uniformity and freedom from corrosion. They are given a seasoning or aging process.

The gaging surfaces are lapped to a mirror finish, and the blocks are guaranteed to be correct in size, flatness and parallelism within 0.00001 in. of the nominal marked dimensions. The gages are standardized by light-wave measurement with standards certified by the National Bureau of Standards. A serial number is stamped on each one to facilitate the keeping of records as to the accuracy of the gage both when new and during its life.



VAN KEUREN COMBINATION SET OF REFERENCE GAGE BLOCKS

The gages are arranged in various sets to meet the requirements of both large manufacturing concerns and individual mechanics. The set shown herewith contains five sizes in the binary fractions of an inch, namely, 1, ½, ¼, ⅛ and 1/16 in. With this set all sizes in sixteenths of an inch may be assembled in combination, making 31 sizes in all.

Electro-Magnetic Portable Grinding Machine

The Electro-Magnetic Tool Co., 2902 Carroll Ave., Chicago, Ill., is now building a portable grinding machine known as type 2UA. One of the chief features of the machine is the interchangeability of the pulleys, which permits its use either for internal grinding with a high-speed spindle, as shown in Fig. 1, or for external grinding, tool grinding or similar work with a slower speed and larger wheel, as in Fig. 2. The wheel may also be carried on an extension of the armature shaft.

The machine is furnished with a base or angle plate

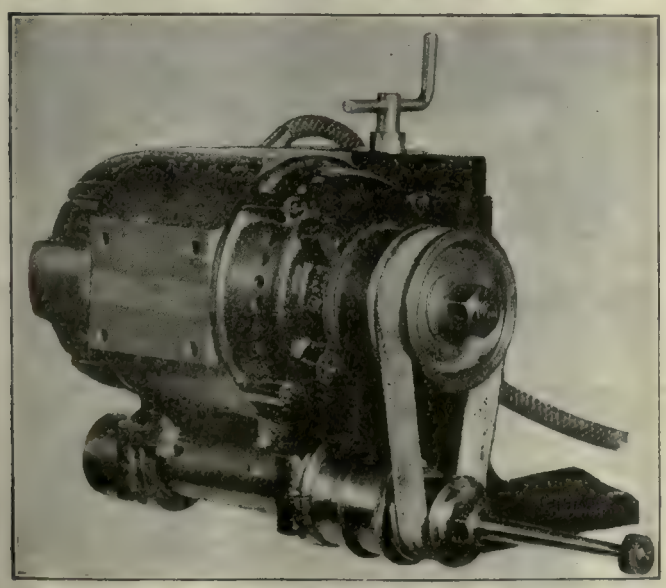


FIG. 1. ELECTRO-MAGNETIC PORTABLE TOOL ARRANGED FOR INTERNAL GRINDING

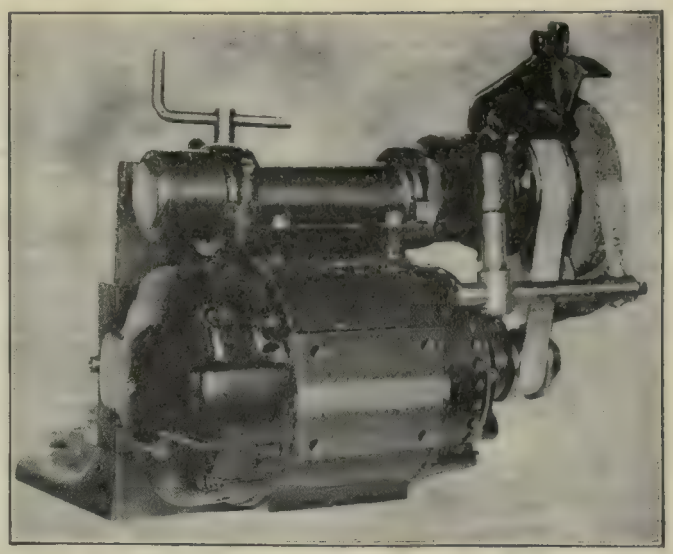


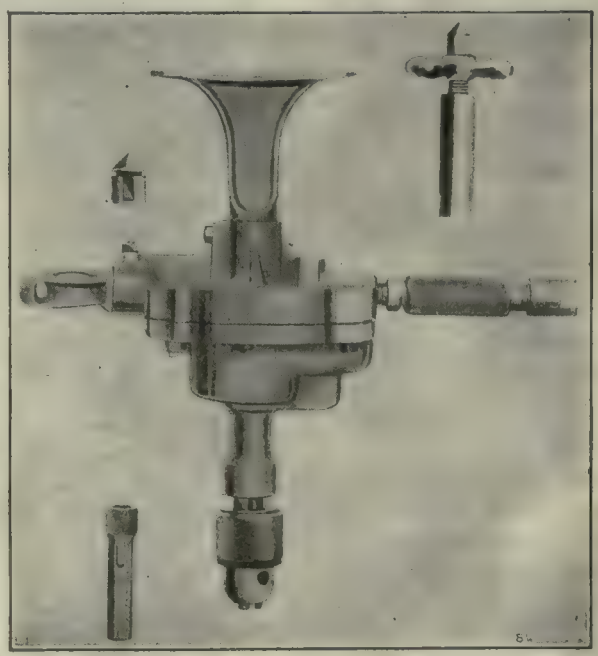
FIG. 2. PORTABLE GRINDING MACHINE WITH LARGE-DIAMETER WHEEL

suitable for mounting it in position on either the carriage of a machine tool or a bench, and slides are provided for vertical and horizontal adjustments. The motor body has flats finished on the top, bottom and outside faces, so that the spindle may be shifted to get it in the proper position.

Spindle extensions 5, 10 or 15 in. long may be attached for internal grinding. The armature speed is about 5,200 r.p.m., and the large pulley is approximately three times the diameter of the small one. A 5½- to 6-in. wheel can be used when operating at the slower speed. The motor is about ¼ hp., and the total weight of the tool, without equipment, is 25 lb.

Turbine Jr., Pneumatic Drill

The Turbine Air Tool Co., 710 Huron Road, Cleveland, Ohio, has brought out the portable pneumatic drill shown in the illustration. The machine operates on the turbine principle, being known as the Turbine



TURBINE, JR., PORTABLE PNEUMATIC DRILLING MACHINE

Jr. model. It is intended for drilling holes up to ½ in. in diameter in steel, and for boring holes up to 1 in. in diameter in wood.

The drill can be furnished with a screw feed, top point, breast plate and spade grip that are detachable and interchangeable, also screw chucks and No. 1 Morse taper socket.

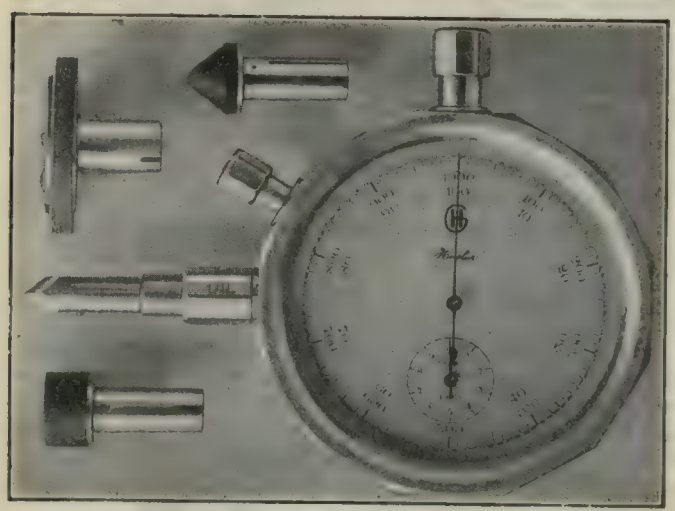
The housing and the turbine are made of aluminum, while nickel steel gears and vanadium steel pinions are employed. There are only fifteen primary parts and four wearing parts. The weight is 9 pounds.

The air consumption is given as 20 cu.ft. of free air per minute. The drill will operate on a pressure of 60 lb. per sq.in., although maximum efficiency is obtained at 100 pounds. The speed is controlled by a valve on the inlet. It is claimed that the machine is free from vibration and smooth in operation.

Hasler Speed Indicator

C. H. Boulin, 82 Duane St., New York, has placed on the market the Hasler speed indicator shown in the accompanying illustration.

This instrument will count speed during a period of three seconds and show on the dial the result in terms



HASLER SPEED INDICATOR

of revolutions per minute or yards per minute. No watch is needed as the timing is obtained automatically, thus eliminating the danger of error due to the necessity of observing both a watch and the counter.

In use, the instrument is placed in connection with the shaft, the revolutions of which are to be counted. Pressing the large button at the top sets the interior mechanism in motion. After running for three seconds this connection is automatically broken, while the hands remain in the reading position. The hands may be brought back to zero by pressing the smaller button at the side. When it is desired to take two or more readings for the purpose of verification or averaging, the hands should not be brought back to zero. When they are not brought back, each reading will be added to the one previously taken.

The figures in the outer circle represent revolutions per minute, while the figures in the inner circle represent yards per minute. When finding the speed in yards the small wheel shown is mounted on the spindle and held on the periphery of the work as it revolves.

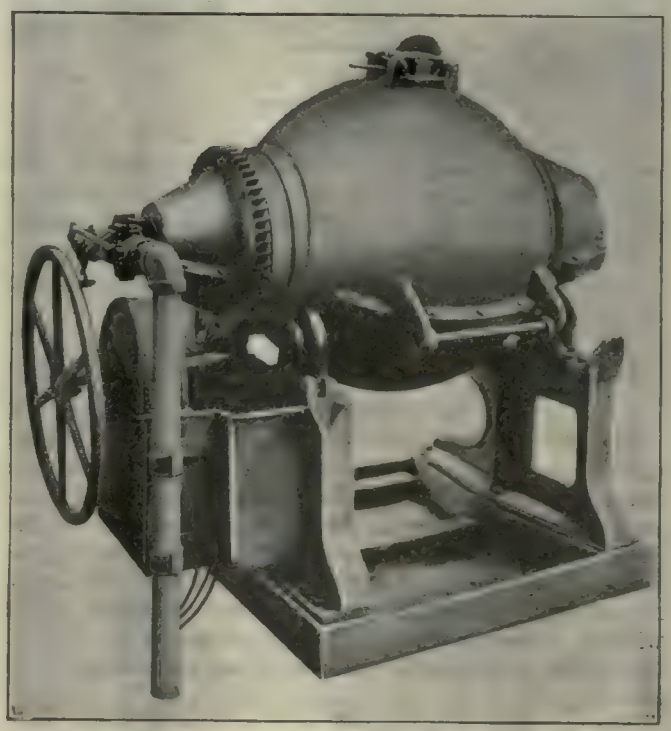
Speeds up to 10,000 r.p.m. or 1,000 yds. per minute can be counted each thousand revolutions or 100 yards being shown on the small dial.

The case is made of aluminum and the total weight of the instrument is less than 10 ounces.

Monarch Revolving Melting Furnace

The Monarch Engineering and Manufacturing Co., Baltimore, Md., has recently brought out the furnace illustrated, a development of its Simplex type. The furnace is non-crucible and revolves continuously during melting. It is motor-driven. A handwheel is provided for a limited amount of hand rotation. The burner is at one end; charging, skimming and venting of gases take place at the other end.

It is claimed that rotation increases the life of the linings and decreases the melting period. The furnace



MONARCH REVOLVING MELTING FURNACE

is designed for the melting of metals for general casting work, for disposing of foundry refuse such as slag, grindings and washings and for recovering soft metal drosses, skimmings and sweepings. This furnace is also made with double chamber.

Changes in Lambert Horizontal Boring Machines

The Lambert Horizontal Boring Machine, formerly built by the Lambert Machine & Engineering Co., Cleveland, Ohio, and described on page 270, Vol. 49, of the *American Machinist*, is now being built by the Carroll Foundry & Machine Tool Co., Bucyrus, Ohio.

The number of feeds of both the boring bar and the table has been increased from 16 to 32. Extra attachments, including an auxiliary table 8 in. x 4 ft., a circular table with or without worm feed, and a star-feed facing-head having a range from 0 to 3 ft., can be furnished.

In addition to the above, the machine can be arranged for motor drive through a silent chain.

What Other Editors Think

Economy May Mean Spending

From *Engineering News-Record*

NEARLY every proverb has its antithesis. Thus, on the one hand there is the advice to "do the best with what we have" and on the other it is urged that "the best is the cheapest." The conflict between these contrasting lines of policy in engineering work is suggested by discussions at the annual meeting of the mechanical section of the American Railroad Association. It appears that in many cases the policy of utilizing old plant and following old methods is being carried to a point where it results in direct waste and loss.

The common reason or excuse assigned is inability to obtain money. But under the conditions noted it should not be difficult to demonstrate conclusively that small immediate expenditure may mean a direct and continual saving. Have the men with the knowledge and responsibility failed to make this demonstration successfully?

In car repair work, for instance, it is still common practice to have gangs of men with jacks raise the car bodies from the trucks, a slow and troublesome job. If this was occasional work the practice might be justified, but it is work that goes on day after day, year in and year out. An overhead crane or gantry would do the work in less time and with fewer men, while the men would put in their time on productive repair work instead of non-productive hoisting. The same conditions may be found in some locomotive repair shops, where small and old machines are strengthened, modified or coaxed to do the necessary work of modern equipment.

In some cases this may be true economy. But in many more cases it means loss of time and energy, high cost of work and waste of material spoiled or given ineffective treatment.

These conditions are not peculiar to the railways but occur more or less in all lines of industry. In construction work, for example, there is frequently a tendency to use old or inadequate equipment in order to save expense. But if this results in delaying the work by breakdowns or insufficient capacity, the financial loss may far exceed the cost that would have provided more satisfactory equipment, to say nothing of the worry, friction and possible ill feeling between the contractor and the engineer or owner. In rarer cases there is the unnecessary expense of special employment, the cost of which is not justified by the work or the results. Such excess of plant may prove a losing investment.

What is needed is more careful exercise of judgment as to the relations between the plant and the work, as well as the relative economy of saving and spending, with a wider realization of the fact that direct saving may result from spending and that avoiding expense is not necessarily economy.

In other words, a more judicial balancing of the opposing policies of "make it do" and "get something better."

Labor More Efficient

From *New York Commercial*

AS A RESULT of a questionnaire sent out by the Merchants Association, large manufacturers report that labor is, on the whole, increasing its efficiency, especially where piece work is in vogue.

Some of these manufacturers declare that it is not the result of any conscience stricken attitude on the part of labor, but simply because they have come face to face with facts. In a number of lines of industry where demand has fallen off, there have been either temporary, partial, or complete shutdowns, serving notice upon labor that the limit of endurance has been reached.

In New England, where the woolen mills have closed down, much suffering is already in evidence, and there is talk of resorting to court proceedings to force the American Woolen Co. to open, and so forth. Apparently it makes a difference whose ox is gored. Talk of using court proceedings to force labor to work if it wants to strike would bring forth tremendous tirades on the "enslavement of the toilers" and "personal liberty." When the shoe is on the other foot, however, courts and injunctions might be classed along with the small boy's definition of a lie: "An abomination of the Lord, and a very present help in time of trouble."

However, it is not at all likely that any edict of a court could force a woolen company, or any other kind of a manufacturing concern, to spend money to keep labor employed at high wages, when it is impossible to sell the goods they manufacture, except at a loss.

What has happened in the woolen trade and a number of other lines is precisely what is going to happen generally, unless labor adopts a different attitude, for the public has the final say in such matters. When labor costs have forced prices up to a point beyond which the public is willing to go, manufacturing has to stop.

No sane person wants to see unemployment spread or wages forced down to a level that will not provide comfortable living for the workers. The country's whole attitude has undergone a change in that regard. The public is willing to pay a little more for goods if it means better living condition for the workers, and capital also realizes that times have changed and that the worker is entitled to a little larger share of the profit.

Forcing selling prices to prohibitive levels through greed on the part of either labor or capital simply reacts upon the greedy element. Capital has had its turn in being greedy, and has lost out, and now labor is going through the same experience. Labor has gained a great deal in the past few years, much of which it is legitimately entitled to, but recently there has been a tendency to overshoot the mark; in which case it will fall afoul of natural laws and force a readjustment which may undo far more of that which it has accomplished than the general welfare demands. Labor can prevent this by adopting a reasonable attitude, the controlling principle of which is a willingness to furnish a fair day's work for a fair day's pay.

The Manufacturer Should Provide the Necessary Guards

From *Utilities Mutual "Protection"*

"JOHN S., while working at a multiple boring-mill, had his hair caught in one of the universal joints above the drill-spindles. His head was badly cut and bruised and a portion of his hair was pulled out. This was a brand new tool, and, having just come from the factory, we thought it was complete as shipped and did not realize that it was necessary to add more guards to it."

This brings up a subject of increasing importance to the man who sees his compensation rate subjected to a decided penalty on account of the exposed parts of his new machines. A piece of machinery should, on leaving the works, be complete in every possible way. A guard over dangerous moving parts is just as much a proper piece of the machine as are the working parts themselves. And yet, how often do we see drill presses, planers, shapers—metal and wood working appliances of all kinds—with the gears and pulleys quite unprotected. While, of course, it is manifestly impossible for the manufacturer to provide guards for driving-belts under the greatly varying situations under which his machines will be set up, it seems unreasonable to expect the purchaser to add standard fittings which could so much more satisfactorily be made a part of the original design in the shop where these were built. And how much easier it would be for all concerned to know that the tool, when it was set up, was complete in all respects and would successfully comply with all the underwriters' requirements.

It would seem that, however faithfully "safety first" is practiced in the foundry and shop of many manufacturers, there is still room on several of their drafting boards for the application to their own designs of the principles which their shop superintendents so ardently advocate.

We are glad to note that there is a growing demand on the part of many of our assured for the purchase of fully guarded apparatus. We would like to see it universally laid down as a hard-and-fast rule that engineers, superintendents and purchasing agents should buy no new machinery which was not thoroughly equipped with the requisite and suitable guards over everything which could, in the language of the Rating Code, be construed as "a dangerous moving part, exposed to contact." This would not only decrease the accident hazard to the men, but also would relieve the master mechanics of the bother and inconvenience of making out of such material as they happen to have on hand, makeshift guards which are not only costly, but which also are apt to be a blemish on the beauty of a new and expensive machine.

Die Casting*

By CHARLES PACK
Doehler Die Casting Co., Brooklyn, N. Y.

Data on die casting have not been widely disseminated, as the more important developments in the die-casting process have taken place within the last few years. This fact will make very acceptable the accompanying analytical treatise, in which the author outlines the general properties of the alloys used, their fields of application and their limitations.

DIE CASTINGS may be defined as castings made by forcing molten metal, under pressure, into a metallic mold or die. It is erroneous to assume that all die castings have similar properties, since it is apparent that the properties of the die casting will depend upon the nature of the alloy used. The die-casting process is best adapted to alloys of comparative low fusing points which may, for convenience, be divided into the following groups:

Group A. Zinc Alloys, consisting essentially of zinc alloyed with tin, copper or aluminum.

Group B. Tin Alloys, consisting essentially of tin alloyed with copper, lead or antimony.

Group C. Lead Alloys, consisting essentially of lead alloyed with tin or antimony.

Group D. Aluminum Alloys, consisting essentially of aluminum alloyed with copper.

No general rules can be laid down governing the design and application of die castings since the art depends largely upon the skill of the designers, and quite frequently a part may be considered as impractical from a die-casting standpoint which, if measured by given standards, may be redesigned and die-cast very successfully. Nevertheless the writer will endeavor to outline briefly the general properties of the alloys used, their fields of application and their limitations.

*From *Mechanical Engineering*, August, 1920.

Group A—Zinc Alloys

Typical Alloy:			
Zinc	87.5 per cent	Aluminum	0.5 per cent
Tin	8.0 per cent	Copper	4.0 per cent
Properties:			
Color			Silver white
Weight per cubic inch			0.253 lb.
Melting point			780 deg. F.
Initial fusing point			275 deg. F.
Tensile strength			16,100 lb. per sq.in.
Elongation			2 per cent
Compressive strength			27,670 lb.
Pressure required to shorten bar 1 in. diameter			10 per cent
Hardness number (Brinell)			64.6
Casting Limits:			
Maximum weight for casting			8 lb.
Minimum limit of wall thickness			$\frac{1}{64}$ in.
Small castings			$\frac{1}{32}$ in.
Variations from drawing dimensions per inch of diameter or length			0.001 in.
Cast threads, minimum number, external			26 per inch
Internal			Depends on conditions, often cast
Cast holes, minimum diameter			0.031 in.

Depending largely upon the depth and thickness of casting
Draft: Cores, 0.001 in. per inch of length or diameter.
Side walls, 0.001 in. per inch of length.

General Design. Sections of castings should be as uniform as possible. Sharp corners should be avoided and fillets added wherever permissible. Undercuts in castings should be avoided wherever possible.

General Remarks. Alloys of this type are corroded by any alkaline or aqueous solutions of any salts. Castings may be polished to a high luster, but soon

tarnish when exposed to ordinary atmospheric conditions.

Castings made from this alloy may be readily plated with nickel, copper, brass, silver or gold. When properly plated such castings will retain their luster as well as those made from brass or bronze.

Applications. Castings made from this alloy should not be used for parts that are subjected to severe stress or sudden shock in service. They are used extensively for parts of phonographs, calculating machines, drinking-cup, cigar, candy, stamp and gum vending machines, magneto housing, automobile-body trimmings, pencil-sharpening machines, time-recording devices, stamp-affixing machines, and for many other devices of a kindred nature.

Group B—Tin Alloys

Typical Alloys	Tin, per cent	Copper per cent	Lead, per cent	Antimony, per cent
No. 1	90	4.5	0	5.5
No. 2	86	6	0	8
No. 3	84	7	0	9
No. 4	80	0	10	10
No. 5	61.5	3	25	10.5

Alloy No. 1 is a so-called "genuine babbitt" metal and was used very extensively during the war for main-shaft and connecting-rod bearings on all American-made airplanes and motor trucks. No. 2 is somewhat harder and is used extensively for bearings of internal-combustion engines. No. 3 is somewhat harder than alloy No. 2 and is the S. A. E. standard for high-grade internal-combustion-engine bearings. No. 4 is in general use for light bearings on stationary motors. No. 5 is a bearing metal for light duty and is used on a large number of moderate-priced automobiles for main-shaft and connecting-rod bearings.

In addition to the five compositions mentioned, hundreds of similar alloys may be made having various specific properties. A study of these alloys, however, would prolong this paper unduly, and in the opinion of the writer, is beyond its scope. The die-casting process, it may be said, is applicable to any of the alloys of this group and it may be left with the engineer to use his judgment in specifying the alloy best suited to his requirements.

General Properties:
Maximum fusing point.....450 deg. F.
Weight per cubic inch.....Depends on lead content
Casting Limits:
Maximum weight for casting.....10 lb.
Limit in wall thickness.....$\frac{3}{32}$ in.
Variations from drawing dimensions per inch of diameter or length.....0.0005 in.
Cast threads, minimum number:
External.....27 per inch
Internal.....Depends on conditions, often cast
Cast holes, minimum.....0.031 in. diameter, depending on depth and thickness of casting
Draft: Cores, 0.0005 in. per inch of length and diameter.
Side walls, 0.001 in. per inch of length.

Applications. Tin alloys find their largest field of application in their use as bearings for internal-combustion engines. They are also used for parts of soda fountains, cream separators, milking machines, surgical apparatus, galvanometer parts, player pianos, etc., where a tensile strength of over 8,000 lb. per sq.in. is not essential and where resistance to corrosion is of importance.

They are not affected by water, weak acid or alkaline solutions, and when free from lead, are extensively used for food-container parts.

Group C—Lead Alloys

Typical Alloys	Lead, per cent	Tin, per cent	Antimony, per cent
No. 1	83	0	17
No. 2	90	0	10
No. 3	80	10	10
No. 4	80	5	15

Alloy No. 1 is generally known as C. T. (Coffin Trimming) metal, due to its extensive use in the manufacture of coffin trimmings. This alloy is also a good bearing metal for light duty and is used for thrust washers and camshaft bearings on light internal-combustion engines. No. 2 is somewhat softer and more ductile than No. 1. No. 3 is used extensively for light bearing duty, being somewhat tougher and stronger than Nos. 1 and 2. No. 4 is somewhat harder than No. 3 but less ductile. Many similar alloys may be compounded, all of which may be die-cast readily.

General Properties:
Weight per cubic inch.....Depends on lead content
Maximum fusing point.....600 deg. F.
Casting Limits:
Maximum weight for casting.....15 lb.
Minimum wall thickness.....$\frac{1}{32}$ in.
Variation from drawing dimensions per inch of diameter or length.....0.001 in.
Cast threads, minimum number:
External.....24 per inch
Internal.....Depends on conditions, often cast
Cast holes, minimum diameter.....0.031 in., depending on depth and thickness of casting
Draft: Cores, 0.0005 in. per inch of length and diameter
Side walls, 0.001 in. per inch.

Applications. Lead alloys may be used where a metal of non-corrosive properties is desired and where a tensile strength of not over 8,000 lb. per sq.in. will suffice. They are used extensively for fire-extinguisher parts, low-pressure bearings, ornamental metalware, and many parts that come in contact with corrosive chemicals. They should not be used for parts that may come in contact with foods or that may be handled often in service, since the poisonous properties of lead and lead alloys are well known.

The main advantage of these alloys lies in their comparatively low cost, but their high specific gravity must be considered.

During the war lead alloys were used for all hand-grenade fuse parts and many millions of these parts were made. Lead-alloy die castings were also used for thermite grenades, offensive grenades, trench-mortar fuse plugs and many other parts where a non-corrosiveness was an essential requirement.

Group D—Aluminum Alloys

Typical Alloys:
Aluminum, 92 per cent; copper, 8 per cent.
Properties:
Color.....Silver white
Weight per cubic inch.....0.115 lb.
Melting point.....1,150 deg. F.
Tensile strength.....21,000 lb. per sq.in.
Elongation.....1.5 per cent
Hardness number (Brinell).....60.5
Casting Limits:
Maximum weight for castings.....5 lb.
Minimum wall thickness.....$\frac{1}{16}$ in.
Variation from drawing dimensions per inch of diameter or length.....0.0025 in.
Cast threads, external, minimum number.....20 per inch
Threads are cast oversize 0.01 in. to be chased to size. Internal threads rarely cast.
Cast holes: Minimum diameter 0.093 in. and not deeper than 1 in. Larger cores may be cast much deeper; smaller holes may be spotted to facilitate drilling.
Draft: Cores, 0.015 in. per inch of diameter or length. Side walls, 0.005 in.

Cores of less than ¼ in. diameter to have 0.005 in. draft per inch of length and diameter.

The composition described above is well known in the arts as No. 12 alloy and is used very extensively for automobile and airplane parts. By varying the copper content harder or softer alloys may be obtained, all of which may be die-cast successfully.

Applications. Aluminum die castings find wide employment in the manufacture of parts of automobiles, such as spark and throttle control sets, magneto parts, battery ignition and lighting systems, speedometers, etc. They are also used for parts of vacuum sweepers, phonographs, milking machines, vending machines, etc.

Brass and Bronze Die Castings

Die castings made from various types of brasses and bronzes were put on the market as early as 1910, but have never been successful commercially. At the present time there is only one die-casting manufacturer producing brass die castings in any appreciable quantity.

It is a comparatively simple matter to produce a small quantity of sample brass die castings, but no material has yet been found for die-making purposes, which will withstand the continuous action of molten brass and at the same time retain its shape, surface and size. The die casting of brass and bronze must be considered as in the experimental stage at the present time, with little or no immediate prospect of the solution of the problem.

Developments Due to the War

The most important development in the art of die casting during the war was the perfection of the process of die casting aluminum and its alloys. A suitable steel was developed for making the dies for this process that would withstand the action of molten aluminum without cracking, a problem the solution of which was essential to the development of the industry.

The part that this development played in the winning of the war will be readily appreciated when it is stated that at the cessation of hostilities there were being produced about one million aluminum die castings daily in this country for parts of gas masks, machine guns, airplanes, motor trucks, motor ambulances, surgical instruments, canteens, field binoculars, and many other appliances of war.

Comparative Cost of Die Castings

The cost of die castings cannot be computed on the pound basis since it depends on the design of the piece, the number and position of the cores, the quantity to be produced and certain other factors. For comparative purposes it may be stated that at the present time tin-alloy castings are the highest in cost, being followed by those of aluminum alloy, zinc alloy and lead alloy in the order named.

In considering the use of die castings it is well to bear in mind that on a pound basis die castings are far more expensive than iron sand castings where the machining cost is not considered. As the zinc alloys, whose properties are similar to cast iron, cost from $200 to $275 per ton in ingot form, it is apparent that the substitution of a die casting for an iron casting can only be considered when the machining cost is sufficient to compensate for the difference in cost of the raw materials.

How Can We Increase Production?

By Harry Senior

On page 385 of the current volume of *American Machinist* George Sidney Binckley asks the above important question, sets up several possible answers and then proceeds to batter them all down but one; thus arriving at the desired solution by process of elimination.

This is an excellent method. It has been expounded before—notably in certain works of detective fiction—and seldom fails to disclose the real solution in those cases where the problem has been carefully constructed beforehand by the person who is to solve it.

We have in the above question, however, a problem in the construction of which we had no conscious hand. It has been set for us by Mother Nature (not the less nature because it is *human* nature) and certainty of the correctness of our solution by the elimination method rests upon at least two things: First. we must know all possible solutions; second, we must know that there is but one practical solution; and that none of the elements of that one are bound up with, or in any way dependent upon, those that are to be eliminated. To make our success really satisfactory involves also a knowledge of how to apply the remedy indicated by our solution.

Three Possible Answers

Mr. Binckley sets up only three possible answers to the question; three human emotions to which appeal may be made for the purpose of securing the willing co-operation of other men: these are (in effect) fear, honor and cupidity. Of two of these he promptly disposes; the first not because it won't work but because it is a two-edged sword, as likely to cut coming as going; and the second because it is "uncertain, erratic and never permanent." Thus there is left only cupidity—perhaps the most sordid of human emotions—as a basis upon which to build increased production.

Mr. Binckley may be right; but that he has his doubts (as I have mine) is strongly indicated in his summing up, under the head of "Co-operative Individualism." Many interpretations might be placed upon this phrase, but to him it seems to mean a *"square deal all around."*

There are, I believe, many more than three possible solutions to the problem of securing co-operation; more than three emotions to which appeal may be made. In fact in a moderate-sized shop there is little likelihood that any two workmen will display exactly the same combination of characteristics; will yield to the same kind of treatment. I have myself during my short, sharp, but not yet decisive career, succeeded in persuading a goodly number of men to do just what I wanted them to do, but, although I am perfectly willing to admit that I don't know how I did it, I have never yet resorted to bribery, nor do I remember that any workman, even an apprentice boy, was ever seriously afraid of me.

I must also admit that I have on certain occasions failed conspicuously; but I am unwilling to believe that I might have succeeded in many of the latter cases by "making it worth the while" of the recalcitrant one.

To say, as Mr. Binckley does, that to "make it worth his while" is an infallible means of securing a

man's co-operation is to set aside all the finer instincts of mankind and cheerfully admit that all men are out for what they can get, regardless. Our civilization, such as it is, is in itself sufficient refutation of this theory; upon such an hypothesis everybody would become a footpad or a burglar and society would immediately revert to the cave-man period.

Even fear—the first of Mr. Binckley's answers—must be stronger than the last, for if cupidity, lust, desire for possession, or whatever it is to which the "worth while" proposition leads, is paramount, then fear of the consequences must be "paramounter" (forgive the paradox) for comparatively few of us habitually assault our neighbors, or even deliberately defraud them, for gain.

It is my belief, and I believe despite his assertions that it is also Mr. Binckley's, that honor, which covers a sense of justice, of duty, of personal responsibility, even of patriotism, is still the dominant characteristic of human society. I believe—and here Mr. Binckley is with me—that the square deal will attract and hold more desirable men than any other policy. And surely "making it worth his while" is a deal "on the bias" if ever one was, for it inevitably means injustice to the other fellow.

Causing Labor Turnover

Mr. Binckley's theory was given ample tryout during the war period and if I comprehend the system rightly was not the cure but the cause of the most appalling labor turnover our country ever experienced. Every shop was making frantic endeavor to make it "worth the while" of employees of other shops to quit their jobs and come over. They all succeeded; and held their newly acquired men—until the next day.

Were the shops that held the loyalty of their men, that maintained their production, that were immune from labor trouble, the shops that paid the most money? They were not! They were those whose managers best knew real human nature, who gave their employees the "square deal," who even preached "duty" and "patriotism"; who sought and obtained those men who had a sense of honor and personal responsibility.

Did those men who sacrificed their business or gave up positions of prominence and goodly emolument to devote their time and talent to the public welfare do so because it was "worth their while?" Maybe! but what was "worth while" to them can never be measured in dollars and cents.

Did the khaki-clad soldier who went "over the top" to almost certain death in the cold gray light of the morning before do so because he would get thirty-three dollars a month and found—if he was ever found? I don't think.

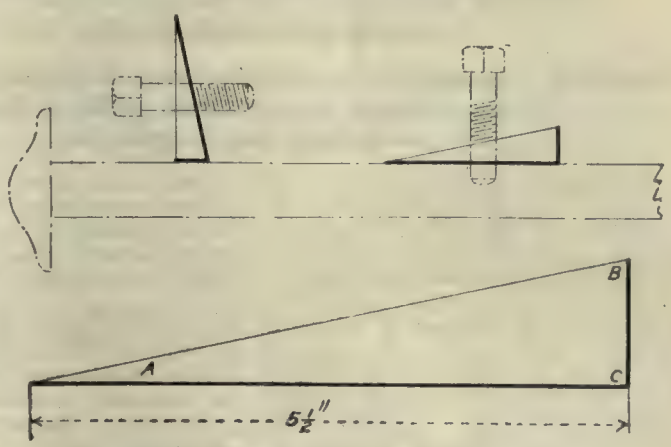
No! Mr. Binckley: you're wrong. Unless "making it worth while" includes an appeal to his sense of duty or his patriotism—which is an appeal to his honor—then your method will never get the "worth while" man. There are, as I intimated before, many human characteristics, and the manager who knows his men will know from their individual temperament upon what button to press to secure the desired results, but the competent manager who wants faithful and efficient service and is willing to render just return for it will never touch the button marked "cupidity."

Drafting Room Kink

By L. Weare

The triangle here shown has been used by the writer to great advantage for threaded work. It may be made of celluloid or other material such as is used for ordinary triangles.

Angle *B* is made 78 deg. and angle *A* 12 deg., causing *C* to maintain a 90-deg. angle.



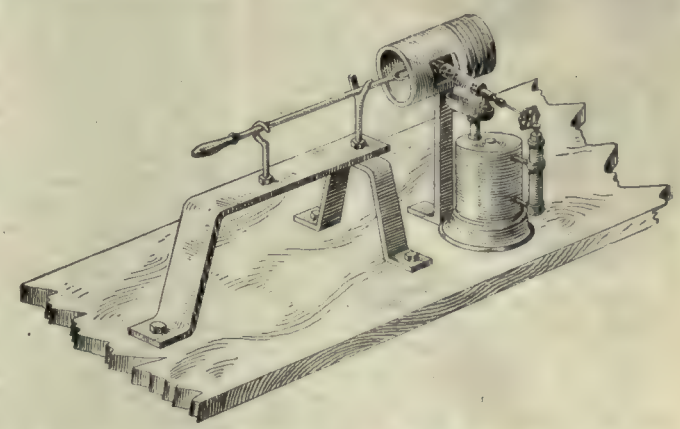
TRIANGLE FOR DRAWING SCREW THREAD

As will be seen the triangle may be used for either horizontal or vertical positioned screw threads. Left-hand screw threads may also be made by merely turning the upward face of triangle next to drawing board. It is apparent that all lines of screw threads may be kept parallel and much time can be saved on work that requires neatness.

Furnace for Heating Soldering Copper

By Charles H. Willey

The accompanying sketch plainly shows how one may construct from an old automobile piston and some flat stock a useful bench furnace in which a soldering copper can be very quickly heated by means of a torch. The



BENCH FURNACE MADE OF OLD PISTON, AND STAND FOR HOLDING COPPER

piston has an opening about 1½ in. square cut on one side where the piston-pin hole originally was, and the hole on the other side is used to bolt the piston to the leg made of ¼ x 1 in. flat stock. The stand for holding the copper needs no explanation.



National Industrial Conference Board Criticizes Public Health Bulletin No. 106

Essentially Unscientific, Not Justified and Misleading, Are the Conclusions Offered by the Board — Plants Studied in Bulletin Not Comparable

"Essentially unscientific and not justified by the data offered," is the conclusion of the National Industrial Conference Board as to United States Public Health Bulletin No. 106, recently issued as an official public document under the auspices of the U. S. Treasury Department. The conference board is publishing its criticism in a special report entitled "Unwarranted Conclusions Regarding the Eight-hour and Ten-hour Workday."

The Board's report makes it clear that it has no predilections for or against a workday of any specific length, but that it considers Public Health Bulletin No. 106 to be misleading, and looks upon its distribution with grave concern.

"Misleading, unwarranted and unscientific conclusions," says the critique, "are always to be deplored, but when such conclusions, carrying the weight of governmental sanction and bearing upon a highly controversial subject, are stated dogmatically and without qualification, they are dangerous."

The public document in question is principally devoted to a "Comparison of an Eight-hour Plant and a Ten-hour Plant," and the conclusions reached in the report are, that "A comparison of the eight-hour and ten-hour system leads to the conclusion that the eight-hour system is the more efficient"—specifically the Government report concludes: "(1) The outstanding feature of the eight-hour system is steady maintenance of output; (2) under the eight-hour system work with almost full power begins and ends approximately on schedule, and lost time is reduced to a minimum; (3) under the ten-hour system artificial limitation of output is widely prevalent, and under the eight-hour system output varies more nearly according to individual capacity, and (4) the importance of fatigue in the causation of accidents is emphasized by the fact that the higher accident risk accompanies the deeper decline of production—in the ten-hour plant as compared with the eight-hour plant."

The conference board's analysis of Public Health Bulletin No. 106 finds that the above conclusions are "essentially unscientific and not justified by the data offered for the following basic reasons: (1) The two plants from which data were obtained are not fairly comparable, and (2) the basis of experience is too small to justify comprehensive conclusions applicable to industry in general."

I. The Plants Studied Are Not Fairly Comparable

The Government report undertakes to compare a thoroughly established and highly efficient manufactory of automobiles running on an eight-hour schedule, with a rapidly expanding munitions plant "characteristic of the mushroom growth of war industries, and operating with a hastily recruited labor force.

On the basis of this astounding comparison, the Government investigators, the board finds, have undertaken to compare the effectiveness of the eight-hour day with the ten-hour day in industry.

In a description of the two plants presented in parallel columns, the board's report vividly reveals the glaring differences that make comparison as to efficiency of their respective work schedules, as such, utterly meaningless. The differences indeed were such as experience has shown to be causes of variation in production. Thus,

(1) The eight-hour plant was slightly reducing its labor force during the year under investigation, while the ten-hour plant was growing from a payroll of 3,600 in 1914 to more than twice that number in 1915 and at the end of 1917 had reached nearly 13,000; (2) the number of women at the eight-hour plant was only about one per cent of the whole, while in the ten-hour plant it was twenty-five per cent of the whole; (3) the minimum wage paid in the eight-hour plant was five dollars for men or women over eighteen, while in the ten-hour plant the piece-rate wage in 1918 was $3.20 per day for men and $2.80 for women; (4) the eight-hour plant was situated in an established industrial community and most of the workers are said to own their homes, while the ten-hour plant was located in a town not prepared to receive so large an influx of population, with resulting insufficiency of housing, lunch rooms, and other means of comfort; (5) the operations studied at the eight-hour plant were the characteristic processes of an automobile factory, to which the personnel were thoroughly accustomed, while the operations studied at the ten-hour plant were the novel ones of making brass fuses for three-inch shells.

In addition to these and many other material differences, the conference board's critique notes that there were also less tangible, but in practical effect no less important differences that render a comparison of the two plants with respect to the relative efficiency of their working schedules scientifically worthless.

II. Data Gathered Too Meager for Broad Conclusions Drawn

Even had the two plants been comparable with respect to the conclusion drawn, the basis of experience was too meager, the board's report finds, to warrant such conclusions as the Government's document presents.

"So complicated is the problem," says the board's report, "with so many collateral factors entering into it, that only by collecting experience from a large number of establishments are conclusions of a broad nature warranted."

Among the collateral factors entering into the problem are such as, disturbance of efficiency by changes in styles, patterns, etc.; changes in materials used; changes in methods of wage payments; quality of workers in a given department, or in a prior process; labor unrest; changes in management or processes; changes in machinery and equipment.

"Even if this investigation," says the report, "had compared an eight-hour schedule with a ten-hour schedule in the same plant the results must, from the nature of the problem, be accepted as tentative only, and under no circumstances could broad conclusions be safely reached as to the general effects of such schedules throughout the industry."

III. Qualifications Admitted in the Text Are Not Made in the Conclusions

Another feature of the Government's document which causes profound concern is, that while many of the insufficiencies of data and generally limited bases of comparison are recognized in the text of the study, the qualifications made in such connections do not appear in the conclusions. These, on the contrary, are stated broadly and without qualifications.

These conclusions, the board finds, have been given wide publicity and accepted at their face value as the results of scientific study bearing the

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official sanction of the Government. Instances are noted in the Board's critique in which the conclusions of the Government's document are quoted with no qualifications and as if they were the final and certain results of scientific investigation.

"There can, therefore," the board finds, "be no question that the difficult problem of industrial readjustment now pressing upon the country will be further complicated by the unqualified and dogmatic phrasing of the conclusions presented in the bulletin. . . . The official sanction behind the publication of these conclusions gives them special prestige in the minds of many people. It is always against public interest for unwarranted and unscientific statements relating to any important problem to be given publicity, whatever the source may be. In these days of industrial unrest it is especially unfortunate if that source is an agency of the Government. Such is the condemnation that can justly be leveled against Public Health Bulletin No. 106."

Industrial Accident Boards and Commissions Meeting

The seventh annual meeting of the International Association of Industrial Accident Boards and Commissions will be held in San Francisco, Cal., on Sept. 20 to 24, 1920, at the Hotel St. Francis.

The meetings each day will be divided into three sessions—morning, afternoon and evening—among which the usual business meetings and election of officers will take place. Round-table discussions on systems of compensation and other varied subjects will be a feature of the meetings and many useful papers will be read on safety methods by prominent men. Hon. William D. Stephens, Governor of California, will make the address of welcome and Senator Hiram Johnson will also speak.

On Sept. 22 there will be visits to nearby hospitals, and on Sept. 23 a trip to Muir woods and Mount Tamalpais.

Automobile Display at Canadian National Exhibition

The automobile show held at the Canadian National Exhibition at Toronto, Canada, on Aug. 28, was the largest ever held there. Two hundred and twenty motor vehicles were displayed; there were fifty-five different makes of passengeer cars and twenty-two different makes of commercial trucks. Prices of passenger cars ranged from $830 to $15,000, and the approximate value of exhibits was $1,500,000.

How To Make Better Use of Existing Railroad Equipment

Freight Traffic Has Outgrown Carrying Capacities of Railroads—Co-operation of Shippers, Receivers and Railroad Employees Urged—Loading More Heavily and Promptly a Big Help

An urgent appeal to manufacturers and business men of the country to join in making better use of existing railroad equipment as a means of providing an immediate improved transportation service was made in an open letter to industrial and commercial organizations today by the Railroad Committee of the Chamber of Commerce of the United States.

"Freight traffic has increased so rapidly in the United States during the past few years that it has completely outgrown the carrying capacity of the railroads," says the committee. "As a result, it is now necessary for the roads to devise a practical plan for increasing their transportation service. This can only be done by making extensive additions of new facilities and equipment, including freight cars, locomotives, yards and track terminals or by making greater use of existing facilities and equipment.

"The railroads cannot carry out the plan first suggested because under present conditions they are unable to obtain a sufficient amount of new capital; nor would it be possible for them to provide new facilities in time to relieve the present emergency even if the capital were available. They must, therefore, rely on making a maximum use of existing facilities and equipment with the co-operation of all of the other interests concerned—the shippers of freight, receivers of freight, and railroad employees.

"You, as shippers and receivers of freight can take a very important part in this movement. You can add 535,000 freight cars to the available car supply by loading your cars more heavily and loading and unloading them promptly. If the railroads were obliged to buy 535,000 new cars at the present price of about $3,000 per car, it would cost them $1,605,000,000 and would cost the public at least 6 per cent of that amount in the form of increased freight rates.

"The average freight car spends its time as follows: 37 per cent of the time in the hands of the shipper or the receiver; 43 per cent moving from the point of loading or unloading to the terminal where it is put into a train or onto a transfer track; 11 per cent in a train moving from one terminal to another; and 9 per cent laid up for repairs. You, as shippers and receivers of freight, can effect a substantial reduction in the 37 per cent; and the railroads can effect an equally substantial reduction in the 43 per cent.

"You can load and unload your cars promptly if you will. As a rule the railroads allow you 48 hours free time to load your cars and 48 hours to unload them before making any charge for demurrage. If you will use only one-half of this time, thus releasing your cars in one day instead of two, and in addition will order according to your loading capacity, restrict your car order to today's program, avoid the duplication of car orders, and avoid the use of cars for storage purposes, you should be able to reduce the time that the average freight car spends in your hands from 37 per cent to 22 per cent of its total time, and thus add 360,000 cars to the available car supply.

"The average freight car makes twenty round trips each year. By reducing the time needed for each trip 15 per cent, you will enable the car to make twenty-three round trips each year. This is equivalent to adding 15 per cent of 2,400,000 or 360,000 cars to the available car supply.

"The average capacity of the freight cars of the country is 41.6 tons. Some commodities, including coal, steel, ore, sand and gravel, can be loaded 10 per cent beyond the marked capacity of the car. Others, including the bulk commodities of various kinds occupy a great deal of space without adding proportionately to the tonnage carried by the railroads. In loading commodities belonging to either of these classes you should disregard the prescribed minimum carload provision for your commodity, and, if possible, load your cars to their maximum capacity.

"In 1919, the average load per loaded car of all commodities on all the railroads of the country as a whole was 27.8 tons—only 67 per cent of capacity. The railroads have now undertaken to attain an average of 30 tons per car. If you will co-operate with them and add an average of 2.2 tons to each carload, you will add nearly 8 per cent of 2,400,000 cars, or 175,000 cars to the available car supply.

"The Association of Railway Executives, representing 95 per cent of the

railroad mileage of the country has unanimously adopted a program for speeding up car movement and increasing car efficiency in which they undertake, with the co-operation of the public, to secure for the country as a whole: An average daily minimum movement of freight cars of not less than 30 miles per day; an average loading of 30 tons per car; reduction of bad-order cars to maximum of 4 per cent of total owned; an early and substantial reduction in the number of locomotives now unfit for service; more effective efforts to bring about the return of cars to the owner roads.

"You can help to reduce the present excessive number of bad order cars. The last monthly report submitted by the carriers shows 7.4 per cent bad-order cars in the United States as against 5.7 per cent at the beginning of Federal control, an increase of 50,000 cars unfit for use and actually out of service. It should ordinarily be possible to keep the number of bad-order cars below 4 per cent of the total number owned and, if that condition could be brought about today, it would result in immediately making effective on the railroads as a whole in the United States more than 75,000 cars that are now out of service because of unfitness to run.

"You can help the railroads to reduce the number of bad-order cars by loading your cars carefully so as to avoid the injuries to the car that frequently result from the shifting of freight in transit."

Spiral Machinery Co. Expanding

The Spiral Machinery Co., St. Louis, Mo., has purchased the East St. Louis (Ill.) plant of the Globe Motor Truck Syndicate for $60,000 and will convert the plant into a factory for manufacturing the "Adams Spiral Plow" and also for construcing several sizes of motor trucks.

Lytle S. Adams, general manager of the company, is the inventor of a special spiral plow to be used in power farming. The plow is adapted for use in all types of soils, especially hard soils, thereby facilitating plowing at any season of the year.

Robert S. Alter on Permanent Group Committee for San Salvador

Robert S. Alter, vice president of the American Tool Works Co. and a member of the Executive Committee Foreign Trade Association of the Chamber of Commerce, was notified yesterday of his appointment as a member of the Permanent Group Committee for San Salvador, appointed to consider means of carrying out the recommendations of the first and second Pan-American financial conferences with special reference to San Salvador. The appointment was made by Secretary of the Treasury D. F. Houston. Mr. Alter has also been appointed vice president of the Mississippi Valley Association for Zone 5.

Bethlehem's New Two-Cycle Fuel-Saving Marine Diesel Engine

Charles M. Schwab, chairman of the Bethlehem Steel Corporation, makes the following announcement:

"It is a great pleasure for me to announce that Bethlehelm Steel Corporation and the Bethlehem Shipbuilding Corporation, Ltd., has perfected a new two-cycle fuel-saving marine Diesel engine, especially designed for American operating conditions and adapted to land use as well as cargo vessels of any size. In the science and practice of marine engineering, this new engine represents a far greater advance over the oil-burning steamship than the latter is over the coal-fired steamship. It is also regarded as a signal triumph for American engineering skill in a field hitherto dominated entirely by Europeans.

"The development of the new Bethlehem fuel-saving Diesel engine represents two distinct phases of advance in marine engineering: (1) For the first time an internal-combustion heavy oil engine for either marine or land uses has been perfected which is not only designed and built by Americans, but is built especially for Americans and is adapted to American operating conditions. (2) For the first time a two-cycle internal-combustion heavy oil engine has been perfecteed which produces the same horsepower as a four-cycle engine practically twice its size, and is at the same time adapted to large cargo ships while saving two-thirds in fuel cost alone, as compared with steam-driven, oil-fired vessels.

"Neither of these developments is theoretically a new idea. For years Europeans have successfully operated large ships with Diesel engines. The achievement of Arthur West, the Bethlehem designer, who is at the head of our power department, is in the adaptation of the two-cycle engine to American operation and in its perfection for practical use in cargo vessels of any size.

"The success of this engine has already been demonstrated in two ways. It was installed and operated for ten months as part of the power plant of the Bethlehem Steel Corporation at Bethlehem, Pa. It was then installed in our new ore-carrying vessel, the "Cubore," which has just completed, on regular schedule time, its first voyage to Cuba and return.

"The operation of the engine at the Bethlehem plant was so successful that we are building another one to take its place as part of the auxiliary power plant for the steel mills. Its operation on the "Cubore" not only demonstrated its practicability but its remarkable economy. The "Cubore" made the voyage from Sparrows Point, Md., to Cuba and back on one-third of the amount of fuel ordinarily consumed by an oil-burning cargo vessel of the same size on the same voyage, and at a better rate of economy than has been achieved by any present type of Diesel engine.

"We also have in service between here and Cuba duplicate ships, except that some are fitted with turbine reduction gears and some with reciprocating engines, so that we have a direct comparison between the oil-engine installation and the most moderen steam installation."

Tenth Annual Convention of the American Railway Tool Foremen's Association

The American Railway Tool Foremen's Association held its tenth annual convention at the Hotel Sherman, Chicago, Ill., on Sept. 1, 2 and 3. The convention opened on Wednesday, Sept. 1, at 10 a.m. An address of welcome was read, followed by an address to railway tool foremen.

The following topics were discussed and reported on by committees at the convention: Standardization of Boiler and Staybolt Taps, Heat Treatment of Steels, Jigs and Devices for Locomotive and Car Shops, Power Punches and Dies, and Issuing and Checking Tools in Locomotive and Car Shops.

The entertainment committee did its work well. On Wednesday evening there was a theater party; on Thursday, 1 p.m., an automobile ride for ladies, and in the evening, the annual banquet followed by dancing; on Friday, the farewell reception.

The officers of the association for 1919-1920 are: J. C. Bevelle, president, El Paso & South Western R.R., El Paso, Tex.; J. B. Hasty, first vice-president, Atchison, Topeka & Santa Fe R.R., San Bernardino, Cal.; G. W. Smith, second vice-president, Chesapeake & Ohio R.R., Huntington, W. Va.; Charles Helm, third vice president, Chicago, Milwaukee & St. Paul R.R., Milwaukee, Wis.; B. Hendrikson, chairman executive committee, Chicago & Northwestern R.R., Chicago, Ill.; R. D. Fletcher, secretary-treasurer, Chicago, Ill.

The officers of the Supply Association are Charles N. Thulin, president, and G. W. Thomson, secretary-treasurer. The supply association's annual meeting was held on Thursday morning.

Navy Yard Machinists Not Pleased with Wage Award

Machinists and skilled mechanics in the various Navy Yards in the country are not at all pleased by the award growing out of the report of the Wage Adjustment Board. While a flat increase of 5 per cent was made in the present scale, the award puts into effect a Saturday half-holiday the year round, without pay, thereby reducing the working time four hours a week.

The machinists asked for 27½ per cent increase. They asked for $1.25 an hour, but under the award they will receive 93½ cents per hour. The weekly pay check of the machinists will be somewhat less, but they gain four hours of leisure time.

The reason given by the Secretary of the Navy for extending the Saturday half-holiday is to equalize the increase, so that it will not be necessary to lay off employees.

Twelve Principles of Industrial Rule Approved

The New York *Tribune* for Aug. 28 prints the following account of a referendum on principles of industrial relations:

A declaration of twelve principles of industrial relations, in which the open shop is advocated, restriction of output to create an artificial scarcity is condemned, arbitration of labor troubles is favored and state control of workers as well as of corporations is urged has been overwhelmingly indorsed by 108 commercial and industrial organizations in New York State.

A referendum on the declaration was taken recently by the Chamber of Commerce of the United States at Washington in every state in the Union, and virtually the entire nation is in accord on the insistence that the twelve principles should be adopted in the intercourse between employer and employee.

The twelve recommendations submitted were as follows:

Every person has the right to engage in any lawful occupation and to enter individually or collectively into any lawful contract of employment, either as employer or employee.

The right of open-shop operation—that is, the right of employer and employee to determine the conditions of employment relations with each other—is an essential part of the individual right of contract possessed by each of the parties.

All men possess the equal right to associate voluntarily for the accomplishment of lawful purposes by lawful means, but such association confers no authority over, and must not deny any right of, those who do not desire to act or deal with them.

Associations or combinations of employers or employees, or both, must be legally responsible for their conduct and that of their agents.

The restriction of productive effort or of output by either employer or employee for the purpose of creating an artificial scarcity of the product or of labor is an injury to society.

The wage of labor must come out of the product of industry and must be earned and measured by its contribution thereto. It is the duty of management to co-operate with the worker to secure continuous employment.

The number of hours in the work day or week in which the maximum output, consistent with the health and well-being of the individual, can be maintained in a given industry should be ascertained by careful study and never should be exceeded except in case of emergency, and one day of rest should be provided. Reduction in working hours below such economic limit, in order to secure greater leisure for the individual, should be made only with understanding and acceptance of the fact that it involves a commensurate loss in the earning power of the workers, a limitation of output and increase in the cost of the product.

Adequate means, satisfactory both to the employer and his employees, and voluntarily agreed to by them, should be provided for discussion and adjustment of employment relations.

When the employer and his employees do not deal individually, but by mutual consent through representatives, representatives should not be chosen or controlled by or represent any outside group or interest.

The greatest measure of reward and well-being for employer and employee and the full social value of their service must be sought in the successful conduct and full development of the particular industrial establishment in which they are associated.

While the right of government employees, to secure just treatment must be amply safeguarded, the community welfare demands that no combination to prevent or impair the operation of government or of any government function shall be permitted.

The power of regulation and protection exercised by the state over the corporation should properly extend to the employees in so far as may be necessary to assure unimpaired operation of public utility service.

American Foundrymen's Association Exhibit Activities

"Bringing Together the Buyers, the Sellers and the Goods," is the title of a circular being sent out by the American Foundrymen's Association. It follows:

"Perhaps you are overlooking an exceptional opportunity to effectively reach an important part of your market. Consider for a moment the great possibilities of actually bringing together your product and your prospects.

"Nothing equals an actual demonstration for convincing sales value.

"No sales opportunity equals that of reaching thoroughly the cream of the buying power of the vast metals manufacturing industries.

"This superior sales method applied to this superior audience of potential buyers is what is available to you in the exhibit space of the 1920 Foundry and Machine Exhibit at Columbus, Ohio, the week of Oct. 4.

"The Annual A. F. A. Foundry and Machine Exhibits have steadily increased in size and importance until the exhibits this year will fill seven large buildings, comprising three acres under roof and surpassing in both size and quality any that have preceded it. All exhibits are grouped systematically according to plans that fifteen years of experience shows to be best.

"The exhibit is not a private enterprise conducted for profit, but is part of the educational and promotional benefits that work hand in hand with the technical research and the other activities of the American Foundrymen's Association. Thousands of "metal" men from every part of the country, and many from foreign lands, annually attend this joint convention and exhibit. It is the one big event of the year in the foundry and allied industries.

Big Chance for Engineers in South America

The Editor of *Ingenieria Internacional*, Verne L. Havens, has just returned to New York after a seven months' visit to Panama, Peru, Chile, Argentina, Brazil and the Windward Islands.

When he sailed from North America last January he believed that the unusual conditions existing in the United States were peculiar, in a general sense, to that country. He knew that every country of the world had serious problems, but thought they would be notably different in different places.

From personal visits with a large number of the readers of *Ingenieria Internacional*, public officers, engineers, bankers and contractors throughout the countries mentioned, and correspondence with many others in other parts of the continent, several fundamental facts have been encountered. In nearly every instance the persons with whom he has talked have believed that the conditions in their country or city were also peculiar to that place, but the reports were always the same.

The people are in a highly nervous state throughout all the Americas. They are groping for new ideals and standards on which to base their lives. This is no doubt due to the excitement and emotions caused by the war and can only be overcome by the leaders teaching peace, co-operation and calmness.

The second great fact in all the Americas, perhaps in all the world, is the actual shortage of labor, and especially of skilled men. The millions of selected men who died in Europe and on every sea, the tens of millions of people who will not work, or cannot work, have created an enormous shortage all over the world.

Why is it that men are scarce in Sao Paulo—because others have died in Europe? Because at one time Europe made cloth and pottery and leather for the Paulistas? To-day the Paulistas make it for themselves, but the persons who make cloth cannot build railways nor plant coffee nor load ships. The establishment of the new industries, small though many of them are, has drawn men from other kinds of labor and they have not been replaced.

The city labor of Buenos Aires has gone to the farms and ranches to replace the Spanish and Italian "golondrinas" or immigrants, who, in turn, have remained in their own country or gone to France. Every country has had to pay the price of the loss of men, generally skillful workers, during the last five years.

The shortage of men and the lack of production during this period has caused prices and wages to increase. In general, it may be said that wages have gone up 50 per cent throughout South America, in some isolated localities the increase has been more or it has been less, but 50 per cent is a fair average. In general the number of working hours has decreased about 20 per cent and no doubt due to the general ner-

vous condition, the production is only about 75 per cent of what it was a few years ago. All this means that in the worst cases, where all these changes have occurred, the cost of production today is about 250 per cent of that of 1913, and there are only two ways to improve this condition. The first will take years; namely, to train the boys to take the place of the men who are gone, or who for any reason have ceased to labor. The second method is one that will help much sooner; machinery must be used wherever possible to reduce the work of the man. Waterpower must be developed and the unnecessary mining, transporting and burning of fuel must be stopped.

The world has always looked to engineers to build the physical elements of that civilization which existed in various epochs, but at no time in the history of the world has the engineer been called upon to face the social, industrial and economic problems as he has today. The work of the engineers of this generation will decide whether we are to progress or retrograde; and perhaps at no time in all the centuries to come will the engineers and industrial executives of Latin-America have the opportunity to build for the future that lies before them today.

Canada and England Opposed to Metric System

Despite the renewal of propaganda work for the adoption of the metric system in English speaking lands, there is little prospect that the system will be substituted for the present system in use in those countries. The Canadian Manufacturers' Association at its last convention resolved to oppose any attempt to substitute the metric system. With such influential bodies as the National Association of Manufacturers, in the United States; the Federation of British Industries, in the United Kingdom, and the Canadian association in the Dominion opposed, there is said to be little chance for the metric system's advocates making headway with their hobby.

Trade Catalogs

Thor Universal Electric Drills. Independent Pneumatic Tool Co., Chicago, Ill. Circular No. 33 giving illustrated descriptions of several new types of Thor portable electric drills. Tables of specifications for drilling with these tools are also included.

Differential Electric Dumping Car. Differential Steel Car Co., Inc., Findlay, Ohio. Bulletins D-4 and D-5, giving descriptions of the various types of steel dumping cars. Photographs of these cars are included to make the bulletins very clear and understandable.

Wire Coil Springs. Reliance Spring and Manufacturing Co., Inc. (formerly Charles A. Cook & Co., Inc.), 3911 Second Ave., Brooklyn, N. Y. Catalog, pp. 20, 3½ x 6 in. A handy-sized booklet containing complete information on Reliance spring products. The data presented covers wire springs, extensions and expansion springs, torsion springs, flat steel springs and "Samson" exercisers and muscle developers. Tables of decimal and metric equivalents for spring measurements are also included.

Business Items

The Mason Machine Works Co., of Taunton, Mass., has recently been incorporated with a capital stock of $1,000,000, to carry on the manufacture of machinery, etc.

The Foerster and Kaysing Iron Works, St. Louis, Mo., has purchased the 50 x 145-ft. building which it formerly occupied under lease, and will make extensive improvement on its new property. The plant consists of a two-story brick office building and a one-story shop for foundry work.

The Roberts Manufacturing Co., Atlantic City, N. J., will manufacture well points, iron pumps, soil pipe, soil fittings and cast-iron specialties for the plumbing trade. It will be in the market to buy, when ready, special punches and foundry machinery. The company has an option on a large factory building.

The Port Chester Pneumatic Tool Co., Inc., of Greenwich, Conn., has recently been organized to manufacture pneumatic tools, etc.

The Waltham Lathe and Manufacturing Co., of Waltham, Mass., was recently organized and incorporated with a capital of $50,000, to make and deal in lathes and machinery.

Personals

BRENT A. TOZZER, for twelve years Cleveland sales manager for Niles-Bement-Pond, will sail about Oct. 1 for India and the Far East. He expects to be gone about a year in the interests of N. B. P.

P. Z. VERNON, of Alfred Herbert, Ltd., New York, arrived in New York on the "Kaiser Augusta Victoria" on Sept. 9 for a few weeks to familiarize himself at first hand with conditions in the United States.

THOMAS W. PANGBORN, president of the Pangborn Corporation, Hagerstown, Md.; John C. Pangborn, vice president, and W. L. Lytle, general sales engineer, will all attend the American Foundrymen's Association Convention at Columbus, Ohio, on Oct. 4 to 8.

Obituary

CHARLES P. TOMLISON, president of the Belleclair Foundry Co. of Belleville, Ill., died at his home in Belleville on Aug. 28; he was 62 years old. Mr. Tomlison was a native of Philadelphia, Pa., and had been active in Mississippi Valley industrial circles for the past twelve years.

C. HAROLD PUTNAM, assistant treasurer and general manager of the Malleable Iron Works, Baltimore, Md., died recently in the John Hopkins Hospital.

New Publications

Accounts in Theory and Practice—Principles. By Earl A. Saliers. Three hundred and one 6 x 9-in. pages. Bound in light brown cloth boards. Published by the McGraw-Hill Book Co., 239 West 39th St., New York.

This is the first of a two-book series, the second volume being intended to deal with advanced accounts. This book comprises a course in the principles of accounts for the first half year of college work, but as the book presents an effective combination of theoretical discussion and practical application, it will also interest accountants and business men generally. The author is assistant professor of accounting in the Sheffield Scientific School, Yale University. There are six part divisions and a total of 51 chapters. The part headings are: Fundamental Principles, Partnership Accounting, Expansion of Accounting, Records, Corporation Accounting, Financial Statements, Special Applications of Principles.

Vocational Arithmetic. By Clarence E. Paddock, Wentworth Institute, Boston, Mass., and Edward E. Holton, head of the department of machine shop practice, Technical High School, Springfield, Mass. Two hundred and thirty-two 4¾ x 7-in. pages. Published by D. Appleton & Co., New York.

A splendid little book which should fill a long-felt demand for a practical arithmetic for the student without an instructor as well as the student in the vocational school and the man in the shop. The subjects are skilfully handled, being presented plainly and logically. All concrete problems involve objects chosen to excite the interest of the vocational student. Chapters worthy of special mention are those on decimals, the use of formulas, mensuration measurements of lumber and toothed wheels. Price $2.00.

Forthcoming Meetings

The American Steel Treaters' Society and the Steel Treating Research Society will hold their second annual convention and exhibition at the Commercial Museum, Philadelphia, Pa., on Sept. 14 to 18, inclusive. J. A. Pollak, of the Pollak Steel Co., Cincinnati, Ohio, is secretary of the former society.

The Sixth National Exposition of Chemical Industries will be held in New York on Sept. 20 at the Grand Central Palace.

The Association of Iron and Steel Electrical Engineers will hold its fourteenth annual convention at the Hotel Pennsylvania, New York, Sept. 20 to 24.

The seventh annual meeting of the International Association of Industrial Accident Boards and Commissions will be held in San Francisco, Cal., on Sept. 20 to 24, 1920, at the Hotel St. Francis.

The National Safety Council, 168 North Michigan Ave., Chicago, Ill., will hold its ninth annual safety congress in Milwaukee on Sept. 27 to Oct. 1.

The American Foundrymen's Association will hold its annual convention and exhibit at Columbus, Ohio, on Oct. 4 to 9. C. E. Hoyt, 1401 Harris Trust Building, Chicago, Ill., is secretary.

An exposition of U. S. manufacturers at Buenos Aires, Argentine Republic, S. A., has been arranged for the month beginning Nov. 15. Information can be obtained from the American National Exhibition, Inc., Bush Terminal Sales Building, 132 West 42nd St., New York.

The National Machine Tool Builders' Association will hold its 19th annual Fall convention at the Hotel Astor, New York City, on Thursday and Friday, Dec. 2 and 3, 1920. C. Wood Walter, care of the association at Worcester, Mass., is secretary.

The 1920 annual meeting of the American Society of Mechanical Engineers will be held in the Engineering Societies Building, 29 West 39th Street, New York City, from Dec. 7 to Dec. 10.

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Programs of Apprenticeship and Special Training In Representative Corporations

By J.V.L. Morris



I. The General Electric Co., Schenectady, N. Y.

The subject of the systematic training of workers is becoming increasingly important. This is the first of a series of articles in which apprenticeship, as it exists today, will be comprehensively treated. The methods used in different representative machine concerns of various sizes will be presented and discussed, this article dealing with the system in use in the Schenectady plant of the General Electric Co. The different forms of training carried on and the various factors entering into the conducting of an apprenticeship program in the electrical manufacturing industry are fully considered.

THE Schenectady works of the General Electric Co. is the largest plant of this important electrical manufacturing concern. Here are located the principal offices, research laboratories, and a manufacturing plant, each organized as a distinct unit, for the design and manufacture of electrical machinery and apparatus of nearly every description; of steam turbines of small, medium, and large capacity, and of many other mechanical devices of intricate design. Over 20,000 people are employed. The general management is committed to an established policy of apprenticeship and special training for all types of employment in the plant. There seems, however, to be considerable variation in the method of development of this policy in the various branches of the industry and to some extent in the different departments. The system may well be considered under six headings: (1) Apprenticeship, (2) graduate engineers' training, (3) foreman training, (4) instructor training, (5) intensive training, and (6) Americanization.

Apprenticeship

Since 1901 a shop apprenticeship system has been in operation. To quote from the attractive announcement of the department: "It began with a systematized training in the various uses of machine tools. Later, night classroom work was added, which was subsequently changed to day classes." By the records of those who have completed the courses to Nov. 1, 1919, it will be noticed that the instruction has been confined mainly to three trades. (See table in left-hand column.)

Trade	No. Graduated	Per Cent of Total
Machinist	626	61.5
Draftsman	251	24.7
Molder and coremaker	129	12.7
Blacksmith	9	0.9
Tinsmith	2	0.2
Total	1,017	100.0

In connection with these statistics, it should be noted that tinsmithing or sheet-metal working is no longer offered as a field for apprenticeship and that, while blacksmithing is still offered, there are at present no apprentices. On the other hand, within the past three years apprenticeship in patternmaking has been introduced and there is a growing number of apprentices in this branch.

Statistics are not available telling the present positions held by the graduates, but the records of the company show that the most capable men are constantly being advanced to responsible positions. In the announcement of the apprentice system compiled in 1919, of the men still at the Schenectady works from the drafting course, twenty had received promotions to the following positions:

Designing engineer	1	Temporary foreman	1
Commercial engineer	1	Assistant foremen	2
Assistant engineer	1	Division leaders	12
Section chief	1	Assistant division leader	1

Of those who had completed the courses for machinists and blacksmiths, some fifty are enumerated as follows:

Foremen	8	Tool designers	13
Assistant foremen	9	Tool inspector	1
Gang foreman	1	Shop instructors	5
Sub-foremen	10	Group leader	1
Designing draftsmen	2	Following special turbine work	1

The organization of the instruction department is typical of an efficient apprenticeship and training plan. In charge of the department is a superintendent, who has himself been apprentice trained, with a long practical experience, coupled with a good general education



FIG. 1. LATHE SECTION OF APPRENTICE TRAINING ROOM



FIG. 3. MILLING-MACHINE AND GEAR-CUTTING SECTION OF APPRENTICE TRAINING ROOM

and a strong human interest in the boys under his charge. He has direct control of the shop training department, which is elaborately equipped with all varieties of standard machines and provided with a staff of five machinist instructors, all apprentice trained. Figs. 1, 2 and 3, give a good idea of the equipment of this department, and they show apprentices at work. Here ordinarily the apprentice machinists and draftsmen spend at least one year of their training, both in learning to operate all types of machine-shop equipment on actual production and in doing bench and floor work. There is suitable supervision of transfer from machine to machine, so that each man gets an opportunity to do all kinds of work.

In conjunction with this is the apprentice school, which has four instructors and which machinist, patternmaker and draftsman apprentices are required to attend three sessions a week during working hours—the sessions being from an hour to an hour and a half in length.

Applicants for entrance as machinists and patternmakers must be between sixteen and eighteen years of age. They must have good habits, be of respectable parents and able to speak, read and write English. It is also considered desirable that apprentices come directly from school, as it is found, to quote the superintendent, "that such boys have not lost habits of discipline, obedience, and study." For the four-year drafting course the requirements are identical to those stated above, while to enter the three-year course graduation from high school is invariably required, and satisfactory samples of the high-school work in mechanical drawing must be submitted. Not much, however, in the way of academic education is apparently expected of molders, although they are given an examination in common fractions, and they report for class instruction only one session a week. Only young men eighteen to twenty-one years of age and strong physically are accepted for this trade.

The course of study for machinists and patternmakers, as outlined in the announcement, seems to be a rather formal review of school arithmetic with some algebra and geometry and a course in mechanical drawing, one plate of which is to be completed each month at home. Fig. 4 shows a class in mechanical drawing in session. Two class sessions a week are devoted to mathematics and mechanics and one to drafting. For home preparation a schedule of problems and drawing is assigned, which is expected to require about four hours a week of study.

The four-year drafting apprentices spend their first year in the blueprint and tracing departments and their second year doing mechanical work in the machine-shop training department, the foundry and the pattern-shop. Fig. 5 is another picture of apprentices at work, while Fig. 6 shows some apprentices and the class of work that they turn out. The three-year apprentices in this field enter upon the mechanical work in their first year. The two final years in each case are spent in the drafting departments with two weeks in the



FIG. 2. GRINDING-MACHINE SECTION OF APPRENTICE TRAINING ROOM



FIG. 4. A CLASS OF APPRENTICES IN MECHANICAL DRAWING



FIG. 5. SHAPER SECTION OF APPRENTICE TRAINING DEPARTMENT



FIG. 6. MARINE SETS BUILT COMPLETE, EXCEPT FOR GENERATORS, IN APPRENTICE TRAINING DEPARTMENT

physical testing laboratory during the last year. For classroom work algebra, plane geometry, solid geometry, trigonometry, descriptive geometry, mechanics and strength of materials with laboratory work are substituted for the more elementary mathematics of the machinists' course.

RATES OF PAY—During the past two years remuneration has more than doubled. In 1917 the rate of pay for machinists ranged from eleven cents an hour for the first year to eighteen cents during the fourth year. It now ranges from twenty cents to thirty-six cents per hour. A premium of two cents an hour is also paid for good records in class and shop. Finally, a bonus of $100 is paid at the conclusion of apprenticeship. For draftsmen the same improvement in pay is to be noted, the rate now ranging from twenty cents an hour for the first year to forty cents for the fourth year, and similar regulations hold as to premiums and the final bonus. High-school graduates start with the second-year rate of twenty-six and one-half cents. For molders the pay is twenty-one cents an hour the first year, twenty-six and one-half cents the second year, thirty cents the third year, with minimum journeyman's rate (now ninety cents an hour) for the fourth year, and a bonus of $50 is paid when the certificate is conferred. It should be noted in connection with all the trades already referred to that indentures are in each case entered into between the company and the young man, together with his parents.



GENERAL ELECTRIC COMPANY

SCHENECTADY WORKS

Certificate of Apprenticeship

Granted to

*In recognition of the satisfactory termination of a*_____*year course of* PRACTICAL TRAINING *as a*

_____

Said apprentice has also received classroom instruction as provided by the Company

_____

*Schenectady, N. Y.*_____*19*____

FIG. 7. CERTIFICATE GIVEN AT COMPLETION OF APPRENTICE TRAINING

At the satisfactory completion of the term of apprenticeship a certificate is conferred, a copy of which is shown in Fig. 7.

TRAINING IN THE TESTING DEPARTMENT FOR ENGINEERING STUDENTS.—There are two distinct groups receiving training in the testing department by doing the regular work of that department. The first group is made up of high-school graduates, the second in the main of college graduates in electrical engineering but also of men who have successfully completed the work laid out for the first group.

In the first group there are at present seventy-five enrolled in what is called a "preliminary course," which to some extent approximates apprenticeship as electricians. Their course is normally two and one-half years in length, though a man may materially reduce the time required to cover it if he displays unusual ability. The practical work consists of measuring work during the first year, with work as assistants in testing during the remainder of the course. Instruction, in which a standard electrical textbook is used, is given once a week with monthly quizzes. The management of the department emphasizes the fact that each boy being trained is considered individually upon his own merits. It is evident that young men undergoing this training have large opportunities to learn by observation, as well as by the book instruction and the practical work performed. The pay starts at thirty cents an hour, or $17.60 a week, with normal increases of four cents an hour every six months. At the end of this informal apprenticeship the young men pursuing the course are given an examination and, if they pass successfully, are admitted to the regular test course for engineering graduates.

In the test course open to the second group there were 377 student engineers during 1919, coming from the leading technical schools both in this country and abroad. Ordinarily the student spends a year at this work, this corresponding to the year of interneship of

the medical school graduate. The student acquires training through observation and the practice in the work which he performs, but also by the technical lectures and discussions constantly available through the club to which he is admitted while pursuing the course. The pay of these student engineers is at the rate of fifty cents an hour for a forty-nine-hour week for the first six months and fifty-five cents for the second six months, which figures out at $24.50 and $27.50 per week for the respective periods.

From the standpoint of the company, this course serves two purposes. It provides a large corps from which the departmental heads may select recruits for their respective departments, and it familiarizes the student engineers with the products of the company, so that they will be in a position to utilize them even though they enter the employ of other companies at the end of their year of training. To what extent and in what field the company absorbed these men may be gaged from the following summary of transfers occurring in 1919:

Total number of men engaged for the year 1919	304
Total number of men leaving the testing dept	209
Of these there were transferred to commercial dept	44
To engineering dept	48
To construction dept	6
To factory dept	7
To district offices	8
Total remaining with the company	113
Leaving to accept position with other companies	77
Miscellaneous (dropped, discharged, leaving on account of health, resigned, etc.)	23

This shows that about 55 per cent of those finishing the course accepted permanent employment with the company, which conforms to the condition shown by the records of recent years. Mention should also be made of the seventy-three engineering students, who in the summer of their junior year were employed in this department.

Foreman Training

As a step in the comprehensive scheme of systematic training for all employees entering the plant, and for "upgrading" those being advanced to improved positions, there have this year been organized classes for foremen, meeting once a week for an hour and a half and extending through fifteen to twenty weeks. Since the completion of the first groups the plan of having them meet daily is now being tried, so that the series concludes in five weeks' time. This plan seems to be more favorably received than the protracted course, as it permits closer connection of the units of the series. Upon this basis the director is handling three groups simultaneously.

These classes are composed of general foremen, foremen, assistant foremen and sub-foremen, and are limited to twelve in each group so as to provide for free discussion. An average of 85 per cent in attendance was maintained, which is satisfactory when the difficulties of assembling the administrative force of a large plant are considered. The practice is to limit the attendance in each section to not more than two men from any one department, so that the discussion will be general rather than of special departmental problems.

The course seems to be a combination of what might be called labor psychology with an analysis of the duties of foremanship. The following topics are typical; handling men through leadership, interest and job pride; carelessness, temporary and persistent; safety; health and hygiene; production and managerial phases; machines; records and reports; job analysis; man analysis; tying up man and job.

The next step planned is to organize training classes for instructors in special and intensive training for the important types of semi-skilled and specialist employment. For these intensive full-time courses a length of four or five weeks is planned. They will consist of a careful analysis of all the operations involved in the plant and of the difficulties to be overcome in teaching them to the beginner, to the end that his time of inefficient production may be shortened as much as possible.

Intensive training is now provided in several departments. It is not at present the policy to provide a "vestibule school," that is, a training department distinct from that used for regular production. Instead, training is provided on the regular production floor and at the regular machines, either the foreman or an experienced workman giving the instruction. Thus, for example, armature winders are trained to the skillful manipulation of their machine until the qualities of uniform winding and a reasonable speed are attained.

Americanization

The final phase of training and education in the works is found in the field of Americanization, in teaching English and in giving civic training to alien employees. A department was organized for this purpose, which early in the past winter completed a survey as its initial step. Of the total employees 6,200 were found to be foreign born. Of these 2,000 were illiterate in English and 700 in both English and their native language. Forty volunteer teachers were enlisted and classes arranged to meet twice a week for one hour at 4:30 p.m., just after the day shift stopped work, or at 7:30 p.m., just before the night shift started.

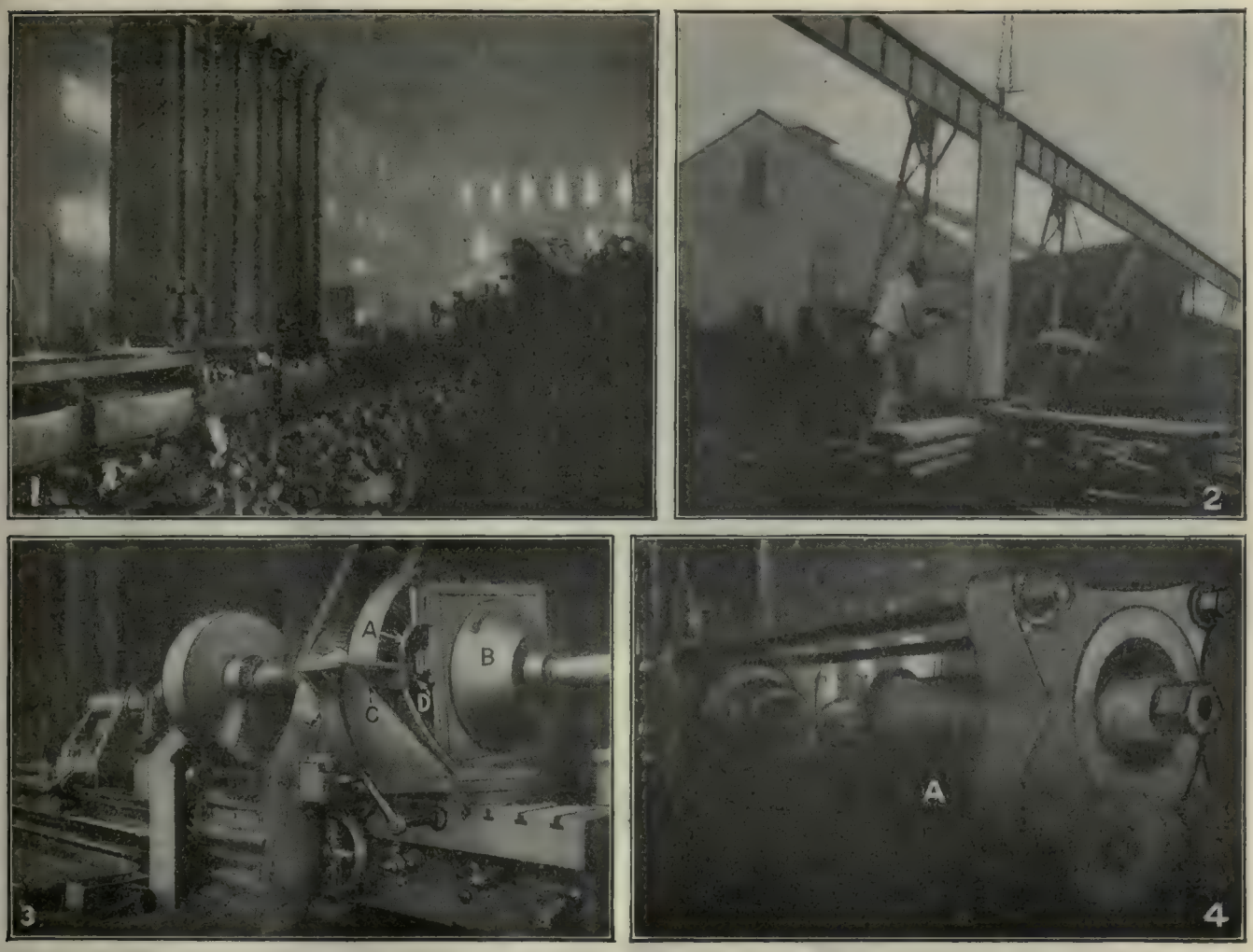
The places of meeting were throughout all sections of the works. A partitioned-off recitation room was not considered essential, a blackboard and seating benches which would collapse against the wall being the only equipment installed. This saves loss of time in going to recitation rooms not readily accessible, reduces the inconvenience to both instructors and students to the minimum and insures that the attendance be as regular as the attendance at work. At the conclusion of the series of classes held, about 800 men have obtained or are applying for their first and second papers. The department is offering them all assistance possible, providing them with conveyance to the court for going through the formalities, and in conferences clearing up by explanation the difficulties which naturally arise. This part of the program is being carried through at the rate of about sixty men a week.

Odd Jobs in a New Orleans Shop

Special Correspondence

The shop of Dibert, Bancroft & Ross, New Orleans, La., always has interesting methods by which it solves the many problems which are presented to it from time to time. Much of its work is sugar-mill machinery and large engine-room fittings, while occasional jobs of structural castings also come its way. This means that it must be prepared to handle almost anything in the way of foundry and machine work.

A somewhat unusual foundry job is shown in Figs.



FIGS. 1 TO 4. SOME OF THE ODD JOBS
Fig. 1—Drying molds over fire. Fig. 2—Cleaning castings under the crane. Fig. 3—A double facing tool. Fig. 4—Heating work for press fits.

1 and 2. Fig. 1 shows a method of drying the molds for the castings shown in Fig. 2. The castings are practically flattened cast-iron tubes of which a large quantity are made. The molds shown in Fig. 1 are being dried out over a coke fire built in the pans beneath the platform on which they are placed. The molds are located by dowel pins so as to bring their openings over corresponding openings in the platform which allow the heat to pass freely up to the molds.

Fig. 2 shows the way in which the castings made from these molds are cleaned in the foundry yard. The runway is one side of the craneway which runs from the foundry out over the yard. The castings are held suspended as shown, and the sand knocked out of them, as well as the rough spots chipped off.

One of the jobs which occurs quite frequently is that of making platform plates either for sugar-mill machinery or similar purposes. In order to true up the raised edges of these plates and at the same time keep their sides true the plates are held between large cupped surfaces, as shown in Fig. 3. One of the cups *A* is bolted to the faceplate of the lathe and the other cup *B* mounted on an easily revolving bearing on the tail spindle. With the plate clamped in position it is only necessary to feed the cutting tools down the sides until the entire raised edge has been faced. The tools are simply arranged in the holder *C*, which has a U-shaped opening at the top carrying a tool on each side. This in reality forms a double toolpost in which the tools are easily held as at *D*.

As an emergency proposition, the pressing on of a heavy hub which was heated in place on the press is interesting because of its being unusual. An idea of this is shown in Fig. 4, which shows a heavy press of special construction and a wood fire was built at *A* under the hub when it was in place in the press. The fire was built on a heavy plate so as to disturb the bed of the press as little as possible.

Making a Cylindrical Shell with Two Internal Flanges

By E. A. Dixie

The illustration, Fig. 1, shows a sheet-brass part made in three operations on the punching machine. Formerly, these pieces were made partly on the punching machine and the final operation in the spinning lathe.

As shown in Fig. 2 the first two operations are simple everyday ones; no time will be wasted in describing the tools with which they were performed.

The part *A* shows the work as it comes from the first operation dies, just an ordinary cupping and blanking operation in which the piece is blanked, cupped and pierced on the bottom in a combination die.

The second operation is shown at *B*. The upper half

of the vertical flange has been closed inwardly to an angle of about 20 deg. from the perpendicular. For this the blank from the first operation is held in a plain cup-shaped die while a punch in the form of a female cone descends and closes the vertical flange to put the work in shape for the third operation. At *C*, Fig. 2, the work is shown completed.

Six pieces of flat steel, $\frac{3}{8}$ in. thick, are made the shape of *D*, *E*, *F*, *G*, *H* and *I* Fig. 3, respectively, but slightly oversize. The toolmaker is careful to see that the edges are square with the sides. A plug is then turned between centers and milled or shaped square on the shank as shown at *L*. The pieces *D* to *I* are then assembled around the shank of *L* and, when properly fitted, are tinned and carefully soldered to each other and to the flange and stem of *L* which has also been tinned. The whole assembly is then put in the lathe and the pieces turned to size on their circumference, and the edges slightly rounded over so that they will not mar the inner surface of the work. After unsoldering from the plug *L* both the pieces and the plug are hardened and tempered so that a smooth Swiss file will just "take hold."

The opening in the die *J* is made about 0.002 in. larger than the work from the second operation. The die *J* is turned on the outside about $\frac{1}{32}$ in. smaller than



FIG. 1. THE SHELL WITH TWO INTERNAL FLANGES

the cylindrical hole in the bolster *O*. On work of this character it is well to make the dies and punches heavy wherever possible as the closing of the work is done just as the crank goes over the bottom center, and the pressure is apt to be greater than most of us estimate. This being the case, dimensions *M* and *N* should be ample for the work demanded of them. As the inner loose pieces and the plug are subjected on all sides to stresses, the stresses are more or less balanced but, as the dimensions of the loose pieces cannot be anything but those determined by the size of the work, all we have to worry about is to see that the material is right and hard and tough enough.

The opening in the die *J*, for the square stem on the spreader plug *L*, is round and considerably larger than the size of *L* across the corners. The cylindrical head of *L* can be made any size so long as it is larger than the square stem and smaller than the hole in the work after the edges *B* have been closed over.

The punch for this operation is shown at *P*. It is a plain cylindrical punch with a recess in the face to permit the cylindrical head of *L* to enter when the punch *P* is in its lowest position. The face of *P* is flat and should be finished smooth so that the edges *B* of the work will readily slide inward when the punch is forming the internal flange.

The operation is as follows:

The die *J* is lifted out of the recess in the bolster *O*. A cup *B* from the second operation is placed in it with the angular flange upward. The sectional pieces,

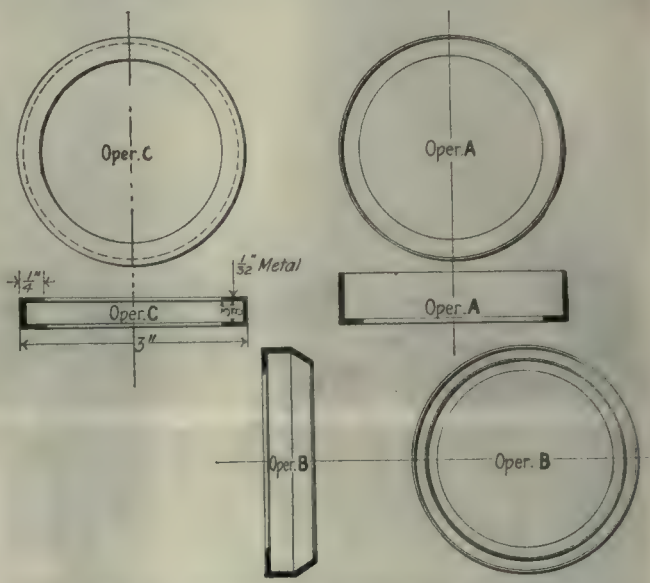


FIG. 2. SECTIONS OF THE BLANKS FROM THE THREE OPERATIONS

D and *E*, and *H* and *I*, are slipped into place, after which the locking pieces *F* and *G* are placed. The spreader plug *L* is now placed and the whole assembly is put back in the bolster *O*. The press is now tripped and the punch *P* descends and flattens the flange of *B* on to the sectional pieces *D*, *E*, *F*, *G*, *H* and *I*. When the punch *P* ascends to top position the assembly is turned 180 deg. in the bolster *O*, the press is tripped again and work subjected to another blow. The assembly is now removed from *O* and turned over to cause the spreader plug to drop into the operator's hand. Either sectional piece *F* or *G* is slid toward the central square opening *K*, previously occupied by the plug *L*, and taken out, after which the other one is taken out. This releases the other pieces *D*, *E*, *H* and *I* so that they can be taken out. The operation is then repeated.

While the operation of forming the flange is much slower than either of the preceding operations it is much faster and produces more uniform work than was possible when the spinning method was employed.

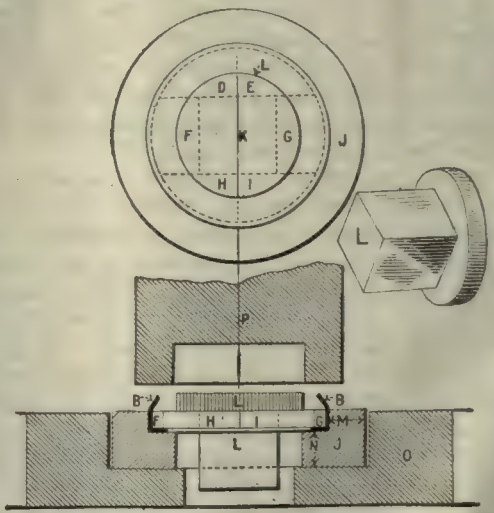


FIG. 3. PUNCH AND DIE FOR THE LAST OPERATION

CYLINDERS IN THE OAKLAND SHOP

By Fred H. Colvin
Editor American Machinist



A GENERAL view of the layout of the cylinder department in the shops of the Oakland Motor Car Co., Pontiac, Mich., can be had from the headpiece of this article. This view shows the liberal use of the roller type of conveyor and the general appearance of the Ingersoll milling machine used especially for this work. The operations are shown in Fig. 1, the blank triangles showing how the piece is held. The machine at the left in the headpiece is performing the first operation, which is that of surfacing the lower side, before the drilling of the cylinder block. This shows the type of fixture used, while Fig. 2 gives a detailed view of the three cutters used in the work. The top of the cylinder block is next milled, as shown in Fig. 3. This also shows the four supporting pins in each fixture as at *A*. It also shows adjusting fingers or stops at *B* for setting milling cutters on different kinds of work. The blocks then go to the machines shown in the headpiece and in detail in Fig. 4.

This article describes the operations on the cylinders of a small six-cylinder motor in which the cylinder block can be readily handled and for which some interesting tools and fixtures have been designed. The removable head carrying the valves makes a somewhat different machining problem than is usually found.

The fixtures are very substantial, having an angular base *A*, so as to make it possible to mill the surfaces surrounding the timing gear pocket with as small a diameter milling cutter as possible. At the same time the surface which supports the cooling fan is also milled. Substantial clamps *B* are provided, together with the

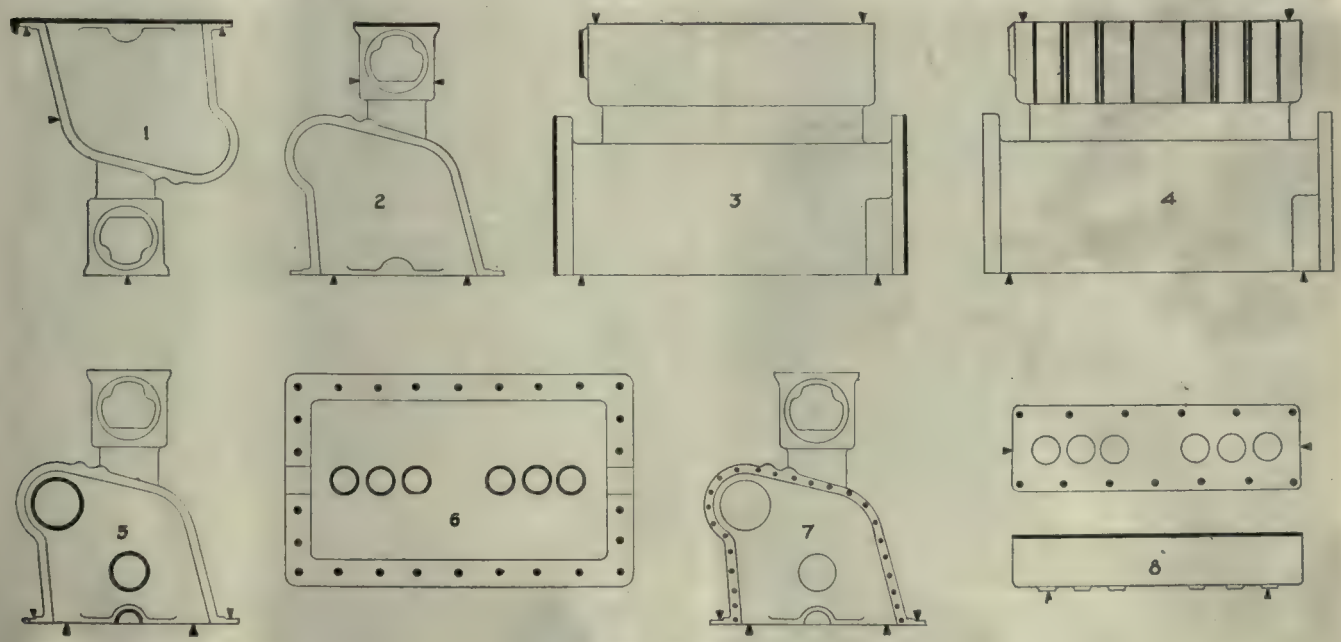


FIG. 1. OPERATION DIAGRAM

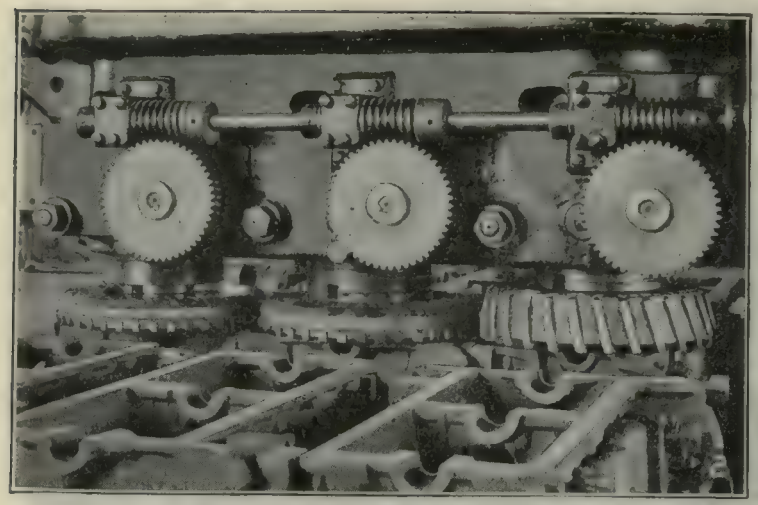


FIG. 2. MILLING THREE ROWS OF CYLINDERS AT ONCE

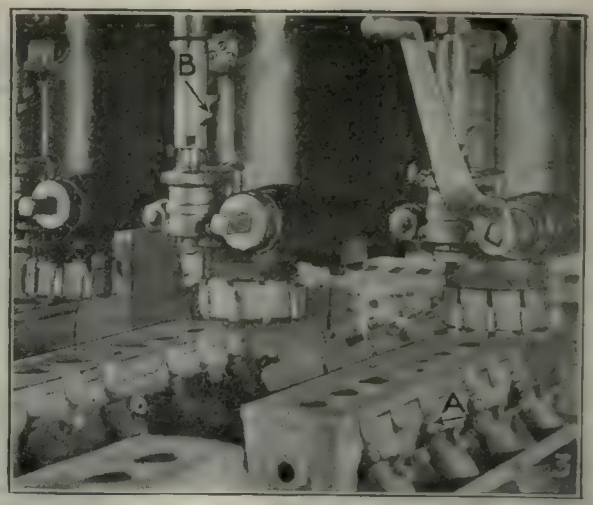


FIG. 3. MILLING TOPS OF CYLINDER BLOCKS

supporting pins *C*, which are adjusted so as to contact with the cylinder casting and prevent springing under the thrust of the milling cutter.

The cylinder boring and reaming is done on Foote-Burt machines, as shown in Figs. 5 and 10. The lower or base flange of the cylinder rests upon the hardened steel pins *A*, Fig. 5, the top being held by the clamps *B*, which are pivoted at *C* and forced down by the screws *D*. The carriage is counterweighted, as can be seen. The rod in front controls the supporting plates which, when the cylinder is in place, are dropped to permit the casting to rest on the plunger beneath and to be located by the dowels.

Boring and Reaming of Holes

The boring and reaming of the holes for the crankshaft, camshaft, starter and generator, are done in the special fixture shown in Fig. 6. The cylinder block is mounted in a substantial fixture located by dowels, and firmly clamped as shown. Special boring bars suitably guided and provided with convenient feeding mechanism, make it an interesting operation. The boring machine merely furnishes power for driving the various boring bars.

The fixture for drilling the base flange of the cylinder block is shown in Fig. 7, as well as part of the drilling head of the Natco multiple-spindle drilling machine. As will be seen, the plate carrying the bushings is deeply ribbed so as to combine strength and lightness.

The ends are drilled in a double-ended Baush multiple-spindle drilling machine, as shown in Fig. 8, the casting being located and held in the usual manner.

The tapping of the cylinder flange holes for studs is also done on a similar drilling machine, as shown in Fig. 9, no fixture being necessary, as it is easy to position the cylinder block against stops on the drilling machine table.

Cylinder Reaming

The cylinder reaming is done on a machine of the same kind as that used for boring, the only difference being the absence of elaborate fixtures, as it is only necessary to position the cylinder block so as to bring the reamers in line with the holes already bored. As shown in Fig. 10 the cylinder rests on four parallel strips, and it is interesting to note the blocks in front of these strips which are made from an I-beam.

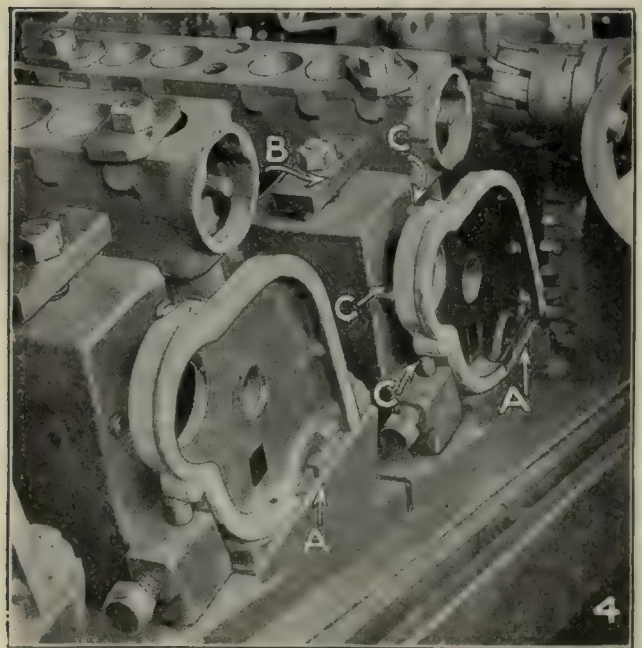


FIG. 4. HOW THE ENDS ARE MILLED

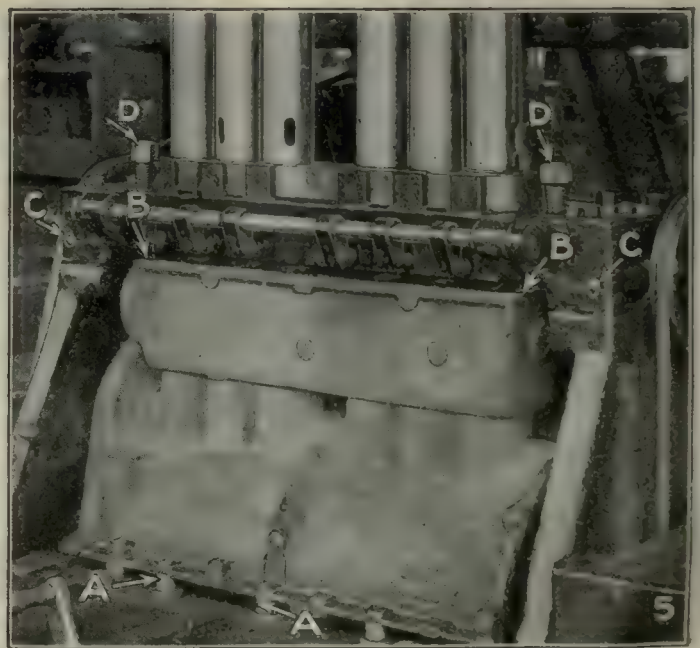


FIG. 5. ROUGH BORING THE CYLINDERS

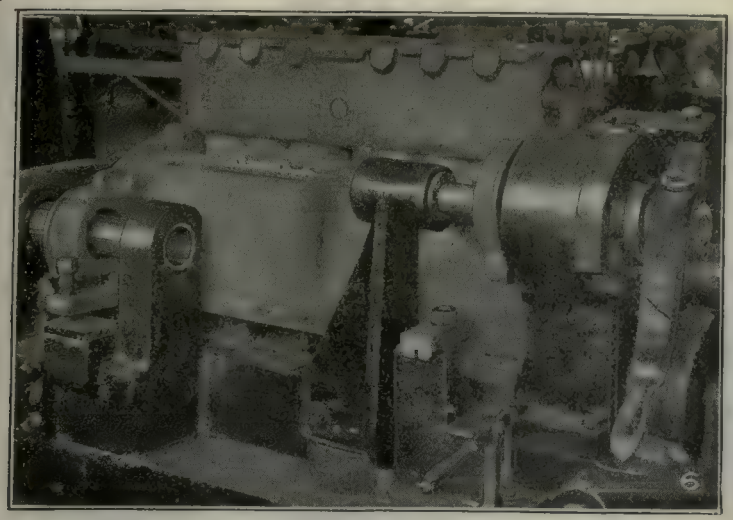


FIG. 6. REAMING THE CRANKSHAFT, CAMSHAFT, STARTER AND GENERATOR HOLES

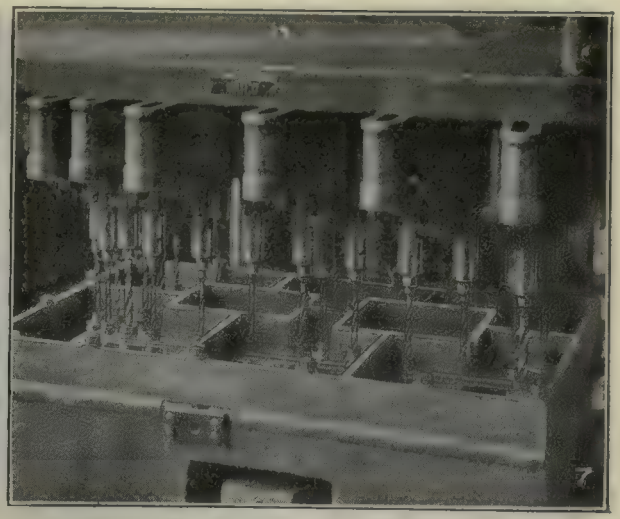


FIG. 7. DRILLING THE CYLINDER FLANGE

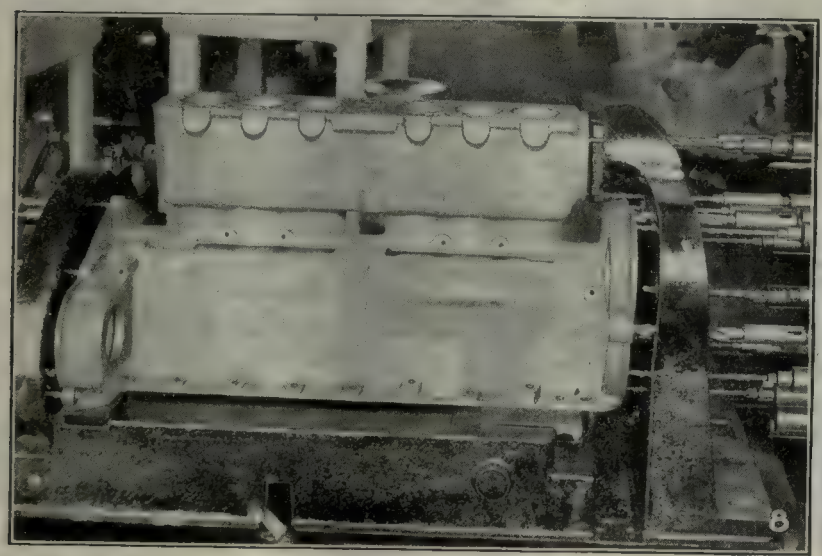


FIG. 8. DRILLING BOTH ENDS

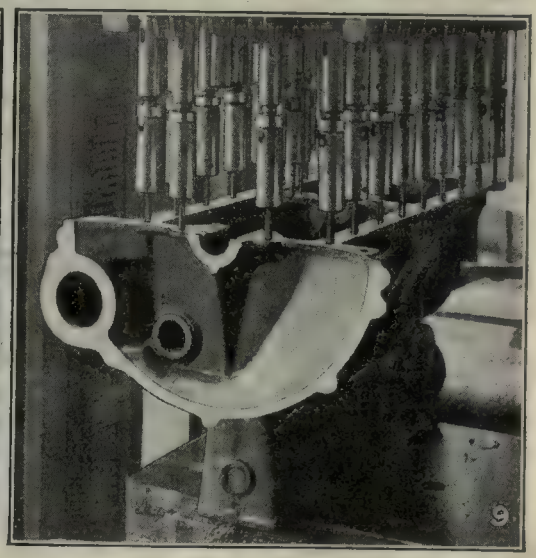


FIG. 9. TAPPING CYLINDER BLOCK

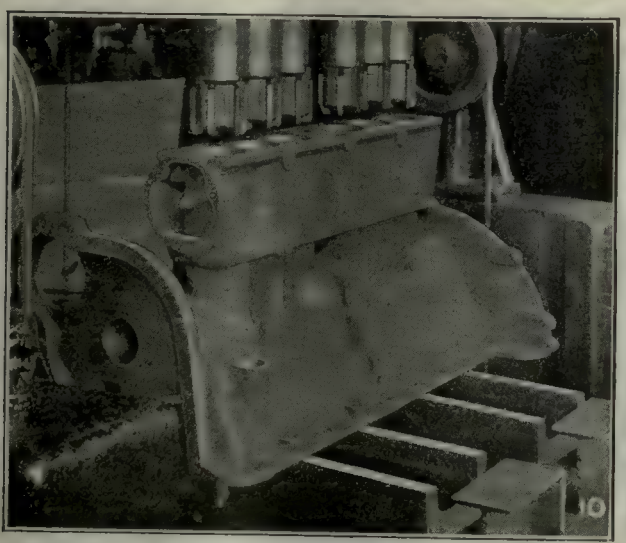


FIG. 10. FINISH-REAMING THE CYLINDERS

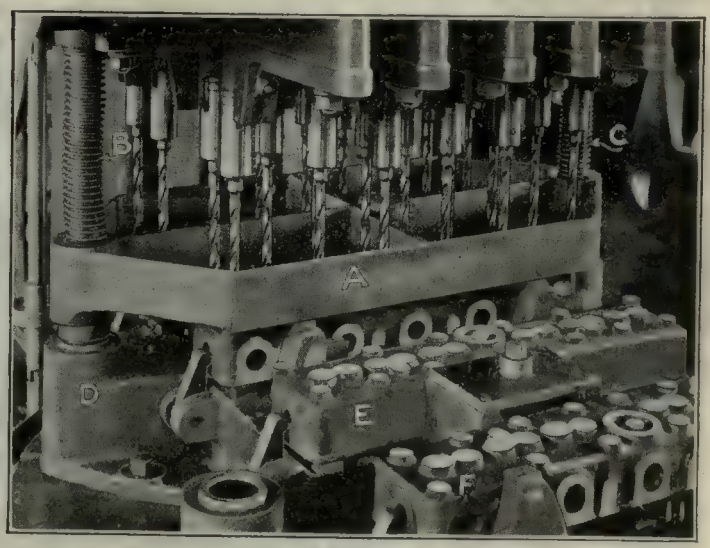


FIG. 11. DRILLING BOLT HOLES IN CYLINDER HEAD

This is a valve-in-the-head motor, which makes a somewhat different construction than the usual removable head. First come the usual milling operations, in which string jigs are employed. Then follows the drilling of the bolt holes which involves the use of a Natco multiple-spindle drilling machine and a double revolving fixture, so that two heads are drilled at the same time, as shown in Fig. 11.

This illustration shows the method of locating and clamping the cylinder heads, and also that the guide

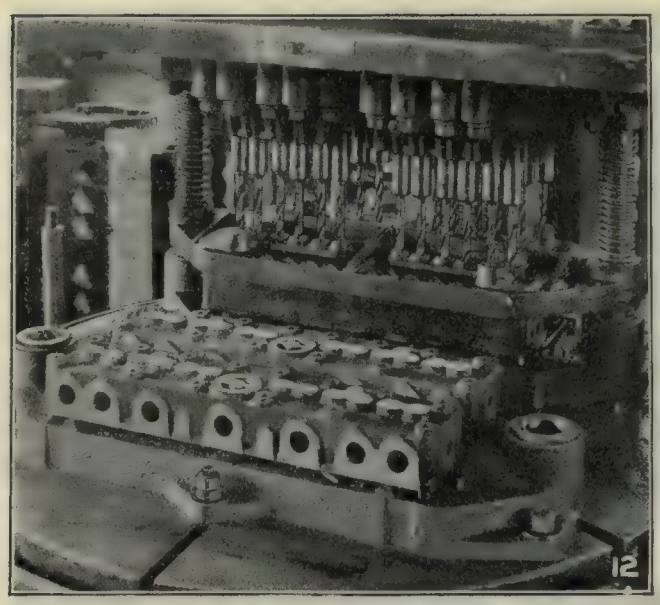


FIG. 12. DRILLING VALVE GUIDE HOLES IN HEAD

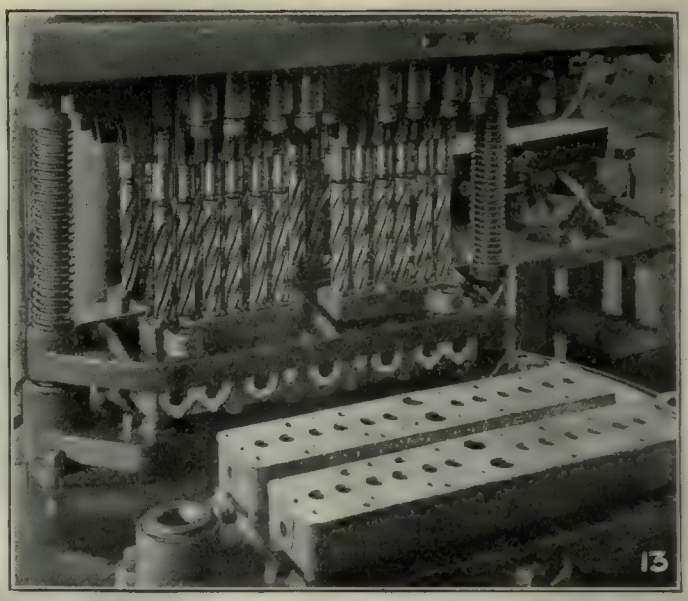


FIG. 13. DRILLING THE VALVE HOLES

plate *A* is carried on the drilling head and guided on the rods *B* and *C*. These rods project from the bushing plate sufficiently to enter the locating holes in the fixture itself, as at *D*. The springs allow the plate carrying the drill bushings to slide up on the guiding rods as the drills feed through the work, and also insure the plate being held in contact with the cylinder head during the drilling operation.

While one pair of cylinder heads is being drilled, another pair is being loaded, as at *E* and *F*, and can be readily swung into place by means of the turntable, or indexing fixture, so that the finished pieces may be removed and new ones put into place.

Another very similar fixture for drilling the holes for the valve guides is shown in Fig. 12. The same idea is also shown in Fig. 13, in which the cylinder heads are placed face up so that the valve holes can be readily drilled in their proper position.

The method of reaming the valve holes and the valve-stem guide holes at the same time is shown in Fig. 14. No guides are necessary, and this also shows how the smaller reamers used for the valve-stem guides are fitted to the large reamers for the valve holes, in the same way as the taper shank drill is fitted to a drilling spindle or collet. After this comes the final drilling for the various manifold studs and other connections, then valve guide bushings are pressed in as in Fig. 16 and the head is then ready to take its place in the procession, which will eventually bring it to the cylinder in the assembling department.

Rotary Grinding

The joint surface, where the head fits the cylinder, is finished by grinding on a Blanchard rotary table grinding machine, Fig. 15. This method is an indication of the way in which former prejudices in regard to rotary grinding have been overcome. Being accustomed to seeing the grinding marks run parallel to the surface of the piece, they were not considered as scratches, and the natural inclination upon the introduction of rotary grinders was to criticize the work on account of the apparent scratches, which were circular instead of being straight. This prejudice has fortunately been overcome, and the use of a cup wheel has become one of the standard methods of finishing flat surfaces. The growing use of the magnetic chuck has also aided along this line, and has made it possible to secure extreme accuracy at a minimum cost.

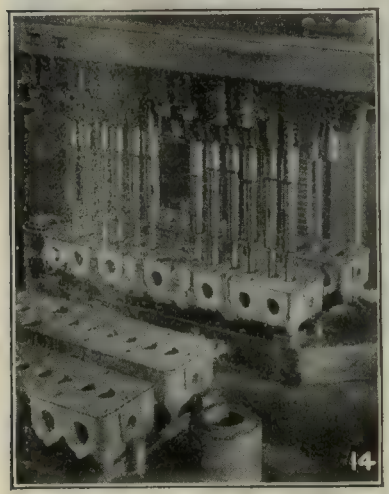


FIG. 14. REAMING VALVE AND VALVE-STEM GUIDE HOLES

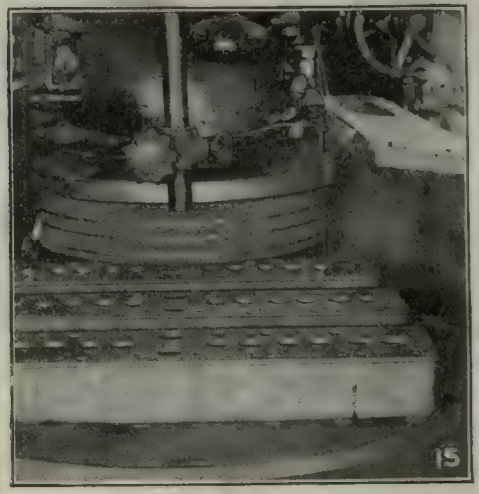


FIG. 15. GRINDING FACE OF CYLINDER HEAD

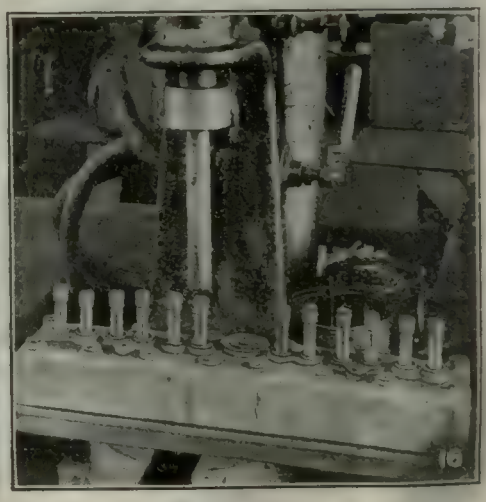


FIG. 16. PRESSING IN VALVE-GUIDE BUSHINGS

The Studebaker Methods of Cylinder Production

This article describes the methods of a large producer of medium-size six-cylinder motors. Some of the tools and fixtures illustrated are of particular interest. Coupled with the fact that the motors shown are built in crowded quarters, the handling methods as well as the production are both interesting and the results are extremely creditable.

THE transformation sheet, Fig. 1, shows the sequence of operation. The first machining operation on the cylinder block is to mill the three sides, as shown in Fig. 2. The upper end of the cylinder is located on the steel block *A*, while the flange is held

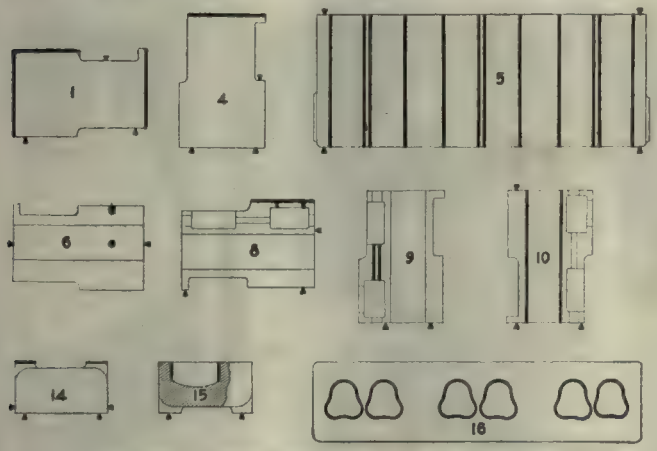


FIG. 1. TRANSFORMATION SHEET

against the face *B*. The clamping bar *C* is of H-section and when swung down into the position shown is held by the pin *D*. The screw *E* holds the cylinder block.

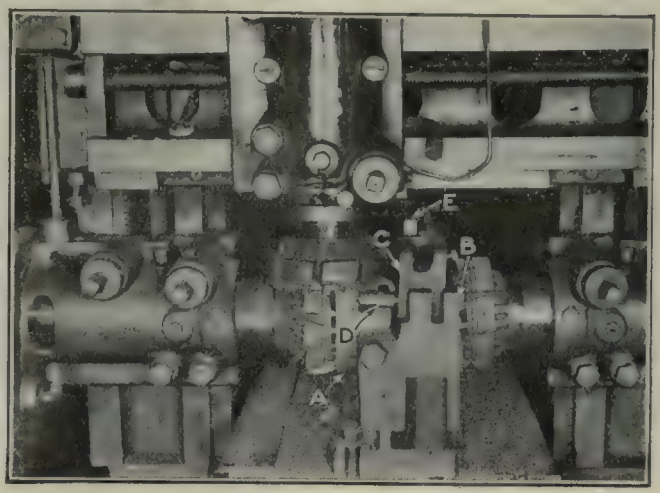


FIG. 2. THE FIRST MILLING OPERATION

A general view of this operation, together with the conveying methods, is shown in Fig. 3. Every effort is made to reduce manual labor by providing conveyors and hoists where they can be satisfactorily used. The conveyor at the extreme right allows the cylinder to be easily handled between departments.

The flange bolt holes are then drilled and two of them used for locating future operations, after which the cylinders are bored vertically. From this operation they come down the slide *A* at the extreme right of Fig. 4 and are loaded, nine to the truck, for annealing to remove internal strains. The trucks are pushed into the annealing ovens which are on a level with the floor in front of them and remain for about 45 min. at a temperature of approximately 500 deg. F.

Next comes the grinding of the cylinder bottom on a Pratt & Whitney machine, as in Fig. 5, this being followed by the second boring on the Foote-Burt machine



FIG. 3. CYLINDER MILLING DEPARTMENT

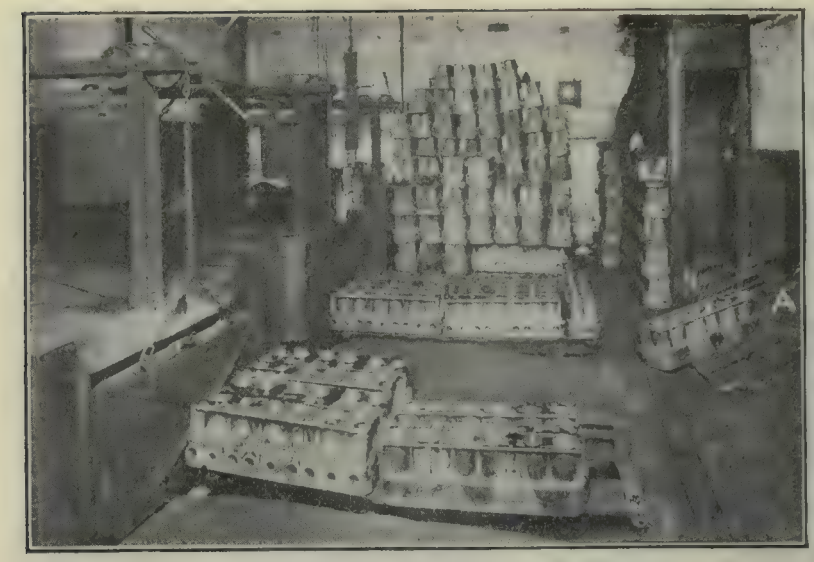


FIG. 4. ANNEALING THE CYLINDERS

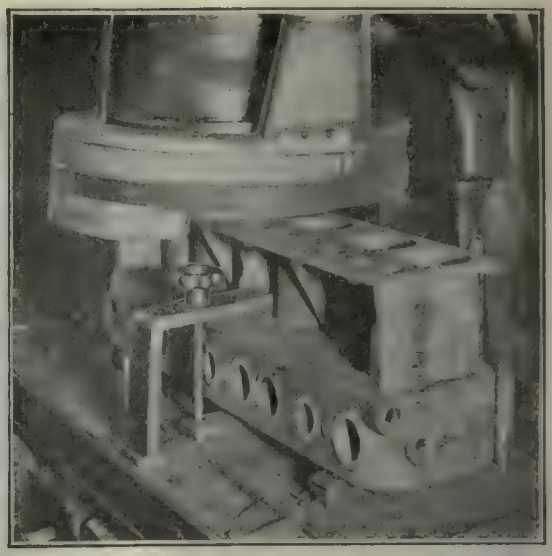


FIG. 5. GRINDING THE BOTTOM

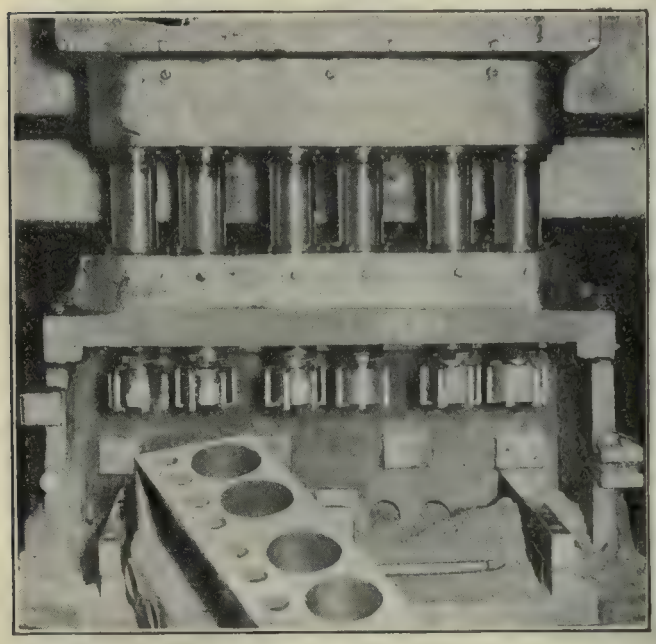


FIG. 6. THE SECOND BORING OPERATION

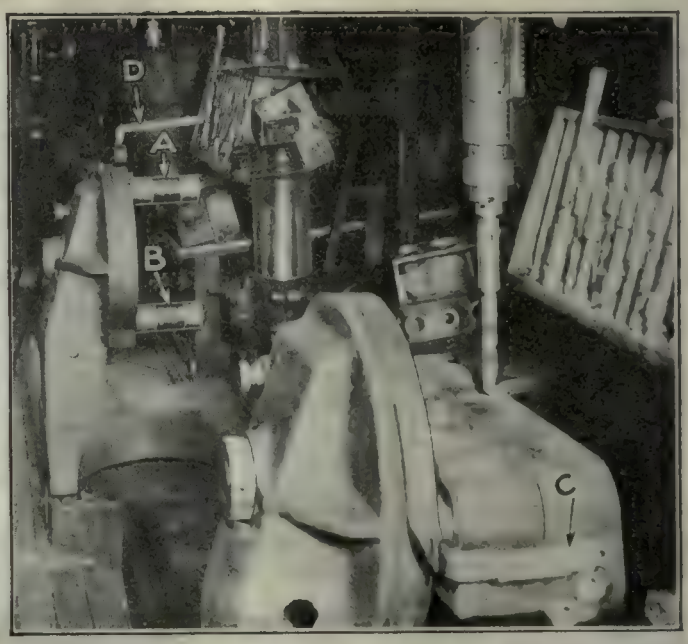


FIG. 7. DRILLING WATER-JACKET PLUGS

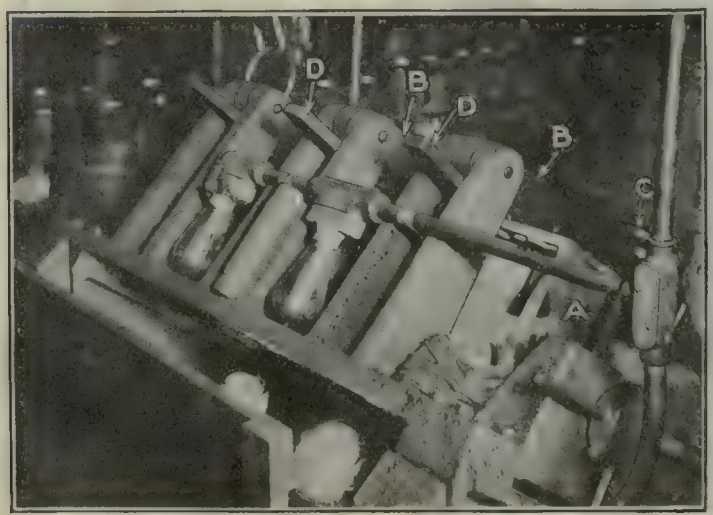


FIG. 8. THE WATER TEST

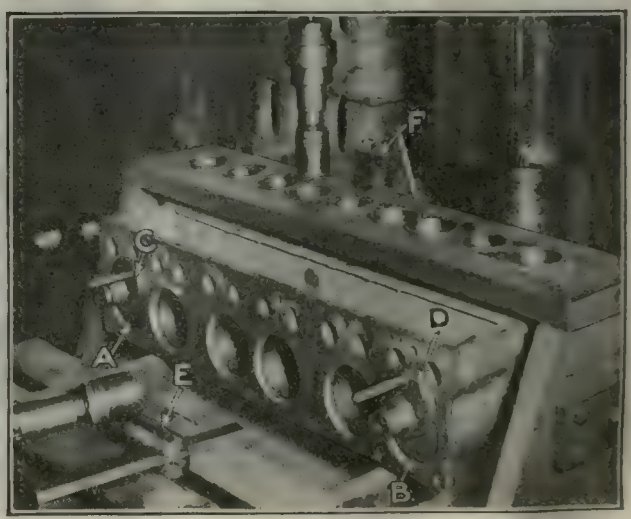


FIG. 9. COUNTER BORING INLET

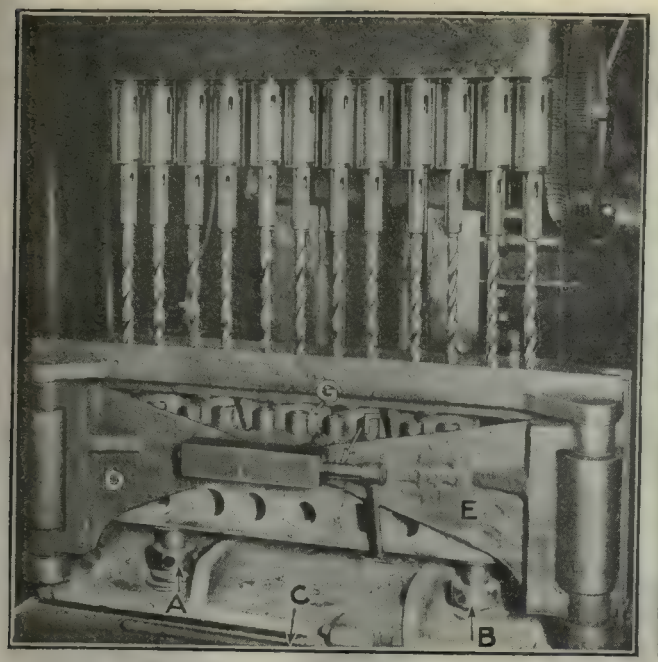


FIG. 10. DRILLING VALVE-GUIDE HOLES

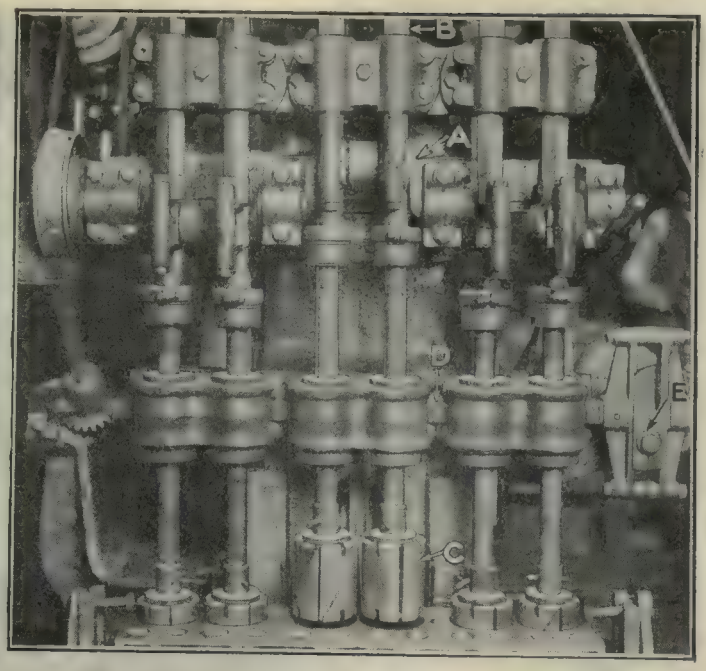


FIG. 11. LAPPING THE CYLINDER BORE

in Fig. 6. This illustration shows the usual type of fixture with the cylinder block resting on parallel bottom strips and held in position in the usual manner.

The water-jacket plug holes are next drilled and reamed on the fixture shown in Fig. 7. These fixtures have two studs or horns, *A* and *B*, which enter the second and fifth cylinder bores and so locate the cylinder blocks. This is an indexing fixture so that the block can be swung through a complete circle, bringing the arm *C* into the position *D* for drilling the end hole. The convenient rack for holding the drilling tools should also be noticed.

The Water Test

Next comes the water test in the fixture shown in Fig. 8, the operator standing on the opposite side. A small hoist is provided for those who desire it and the cylinder block placed in position as at *A*. The arms *B* are screwed down into place by means of handwheels, of which the rim of one can be seen at *C*, that act as nuts. The projections *D* are for holding the levers in an upright position when released, so as to be easily reached by the operator. Electric lights are provided so as to make inspection easy at all points. Should any leaks develop all necessary repairs can be satisfactorily made and the water test again applied.

The lower ends of the cylinder bores are then chamfered, the cylinder head bolt holes drilled and the inlet and exhaust ports counterbored. The latter operation is done in the fixture shown in Fig. 9, which is somewhat out of the ordinary. This fixture has two horizontal posts or studs, *A* and *B*, each carrying an eccentric cap as shown at *C* and *D*. When the caps are swung down they become concentric with the post so that the cylinder bore can be easily slid over them. After the cylinder block has been located they are turned up into the position shown and hold the cylinder block in place during the counterboring operation. The block is located endwise from the central hole by means of the plug *E*, with its swinging bar which fits into the slot in the block *F*. One of the counterboring tools is shown beside the locating plug.

The valve-guide holes are drilled in the fixture shown in Fig. 10. The cylinder is held with its face flange against the underside of the drill bushing, being forced in place by means of jackscrews *A* and *B*. These screws are readily set up by means of the bar *C*.

The swinging arms *D* and *E* are then closed in front of the cylinder block as shown and locked in position by means of the bar *F* which goes through both arms. The arms carry the bushings *G*, which guide the drills close to their work in the L-head of the cylinder block.

Then the valve-guide holes are reamed, the clearance holes bored and the valve seats beveled. Guide bosses are then faced and manifold stud holes drilled.

Lapping the Cylinders

The finishing of the cylinder bore comes next, this being done by lapping instead of grinding, reaming or rolling. Fig. 11 is a close view of the lapping machine showing the details. The three-throw crankshaft *A* imparts vertical motion to the laps, the upper ends being

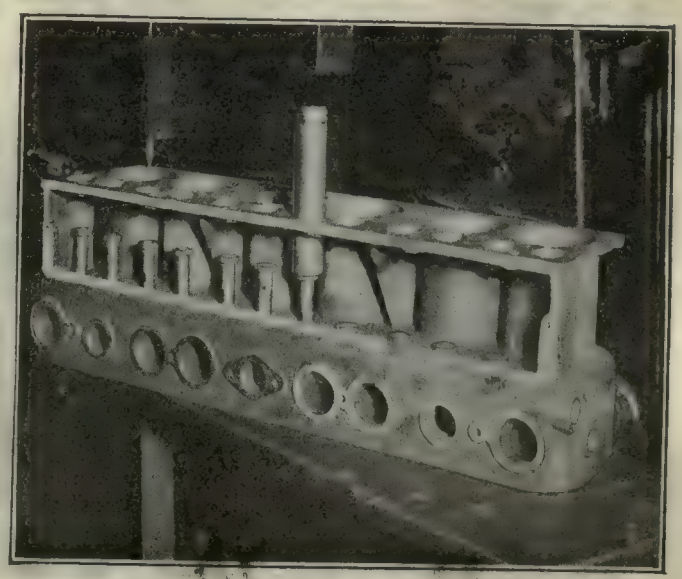


FIG. 12. PRESSING VALVE GUIDES IN PLACE

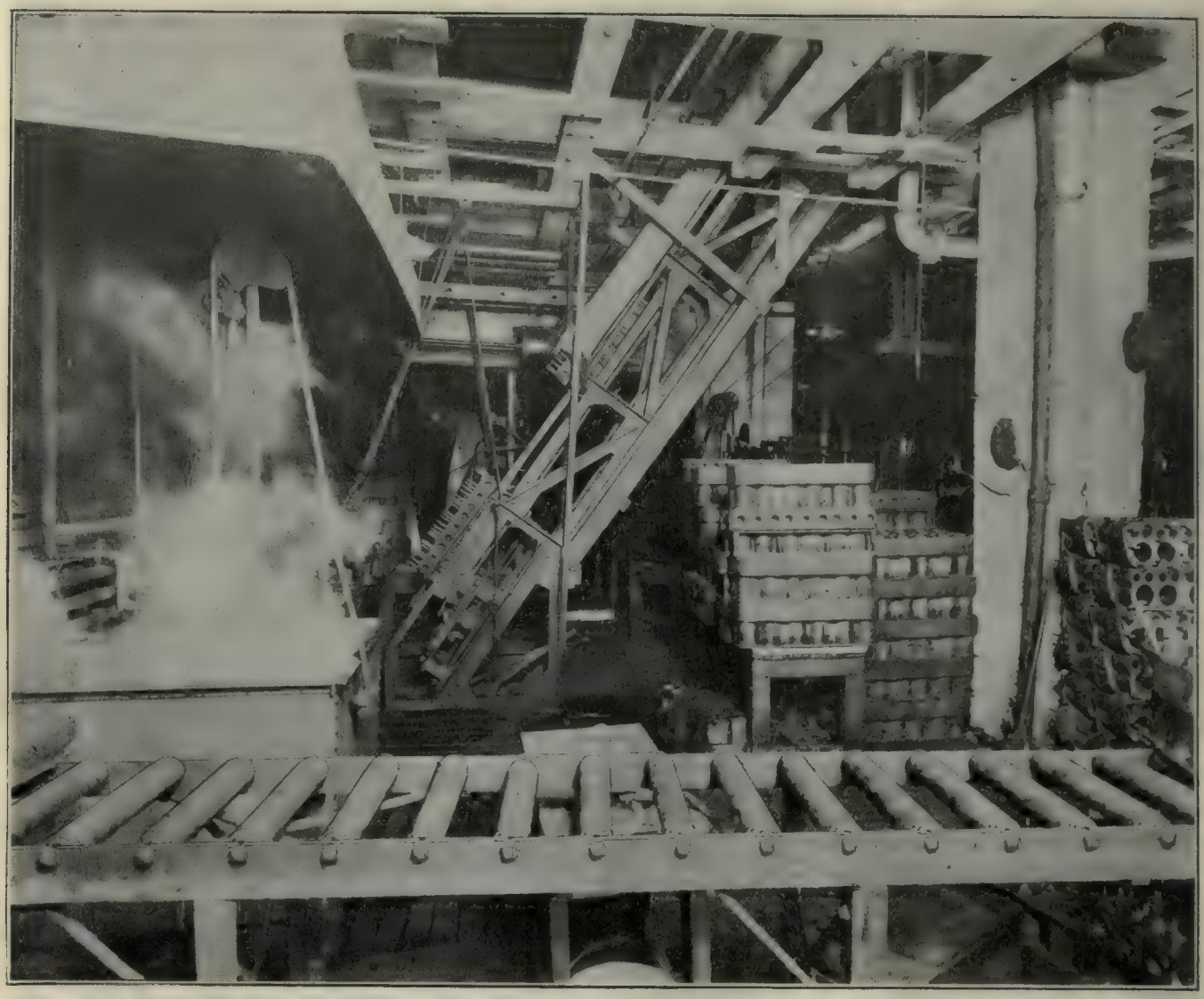


FIG. 13. CONVEYING CYLINDERS TO SECOND FLOOR

guided by the square bars *B*. The crankshaft works in Scotch yokes so as to avoid the angularity incident to the use of connecting rods. The rods driving the laps *C* are free to rotate, each carrying a pinion which meshes into the rack *D* that engages pinions on all six spindles. Motion is imparted to this rack by the crank *E*, also working in a Scotch yoke, the two movements giving a turning and reciprocating motion at the same time.

The laps themselves are of cast iron and made in four parts. They are prevented from turning by pins which engage the slots at each end of the section and are expanded by light springs so as to insure proper contact with the cylinder walls. A very fine abrasive is used, and this of course is carefully washed out after the lapping operation has been completed.

After this all the top holes are drilled and the top

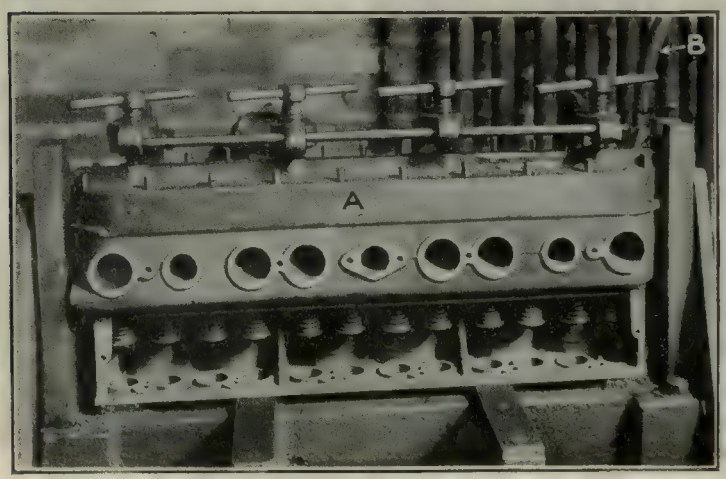


FIG. 14. TESTING THE VALVES

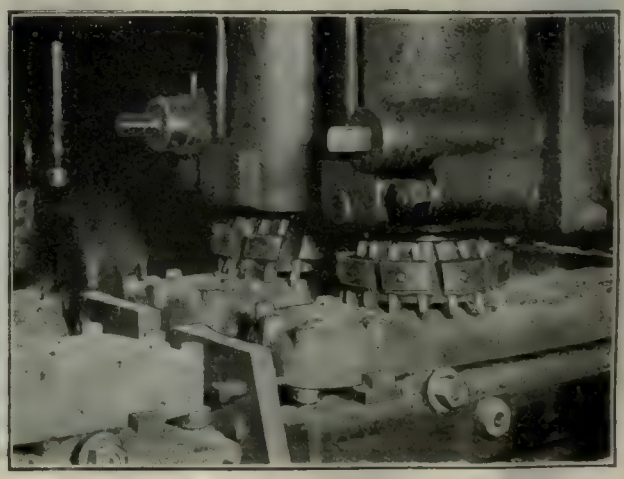


FIG. 15. MILLING CYLINDER HEADS

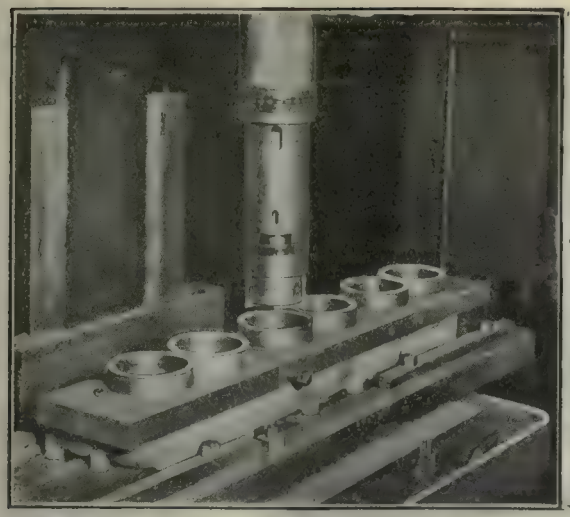


FIG. 16. MACHINING THE CYLINDER DOME

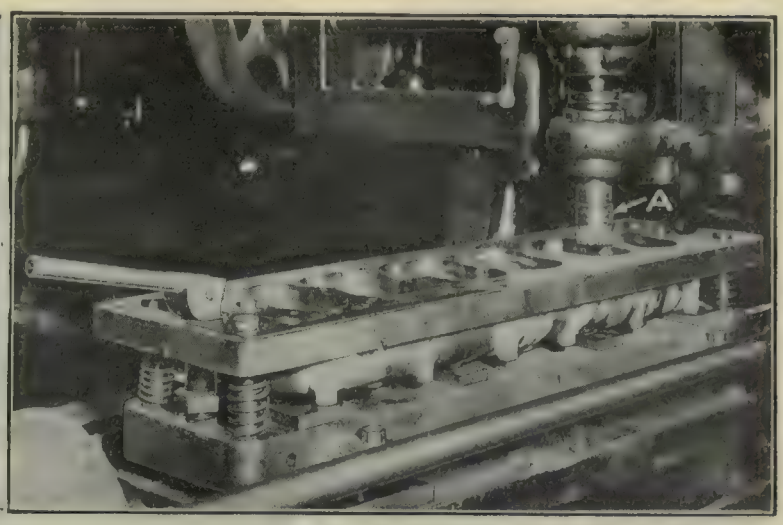


FIG. 17. PROFILING THE CYLINDER HEAD

surface ground in the same way as the bottom flange. The top of the bore is then chamfered, and all holes tapped, both in the top and for the manifold. Then the block is thoroughly washed and is ready for pressing in the valve guides. This is done in a power driven arbor press, as shown in Fig. 12. The valve-plunger guide hole makes it easy to position the plunger used in forcing the guides into position.

The Assembly Department

The valve-stem guides are then reamed and the studs for holding the cylinder heads are screwed into place. The congested condition of the plant makes it necessary to economize space in every way and the assembling department is on the floor above. After thoroughly cleaning the cylinder blocks in a hot solution they are placed on the conveyor and carried up to the assembling department, as in Fig. 13. Here the valve seats are hand reamed, the valves put in place and ground and after being carefully inspected, cleaned, and assembled, the valves are air-tested, as shown in Fig. 14. A special head shown at *A* is firmly clamped on the cylinder block by means of the four screws shown. Air pressure is then admitted from the air line at *B* and leaks are readily detected. The cylinder head is tested in the same way, after which the head is put in place on the cylinder and the edges ground flush, cleaned and sprayed with two coats of enamel.

The Cylinder Head

Going back to the manufacture of the cylinder head itself, the first operation is to drill the spark plug holes, after which the top and bottom are milled. The first milling operation is shown in Fig. 15, which gives an idea of the sort of fixture used and the amount of metal removed by the cutters.

All the remaining holes are then drilled and tapped, after which the cylinder head is finished on the inside on a Baker drill, as shown in Fig. 16. The demands for more uniformity in cylinder compression and greater fuel economy have led to the finishing of the compression space and this operation is typical of the newer methods which are being introduced into the manufacture of motors for medium-size cars. The cutting tool is guided by the substantial bushing shown and after this operation the head is profiled for the valve clearance and a finishing cut taken in the profiling machine.

Next comes the profiling of the cylinder head, as shown in Fig. 17. This view also shows the construction of the holding fixture, which uses the guide for the profiling cutter as part of the holding-down plate. This fixture is quick acting, as when the clamping levers are thrown in a vertical position the upper plate can be lifted entirely free if desired. The springs on the corner posts raise the plates out of contact and allow the work to be readily changed. The guiding surfaces for the roller *A* are sectional and fastened in the plate so as to be easily renewable. It will also be noticed that the whole plate is surrounded by a steel band to add to its strength.

Finishing

After profiling, the bottom or joint surface is ground the same as the cylinders, the spark plug holes are reamed and tapped and the head water-tested. It is then ready to join the cylinder on its way to the motor assembling department.

The Essex Cylinder

In adding the methods of machining the Essex cylinder it has been necessary to omit the majority of the operations which are more common and to illustrate only a few which are a little out of the ordinary.

The bottom flange of the cylinder block is first milled to provide a surface for future location as shown in Fig. 1. The cylinder blocks are strung on the long bed

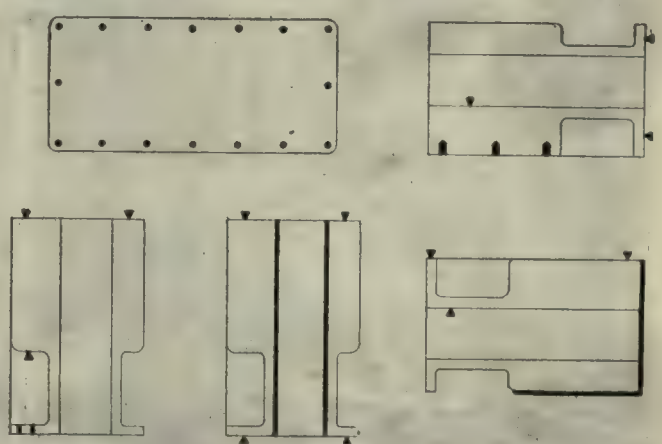


FIG. 1. TRANSFORMATION OF ESSEX CYLINDERS

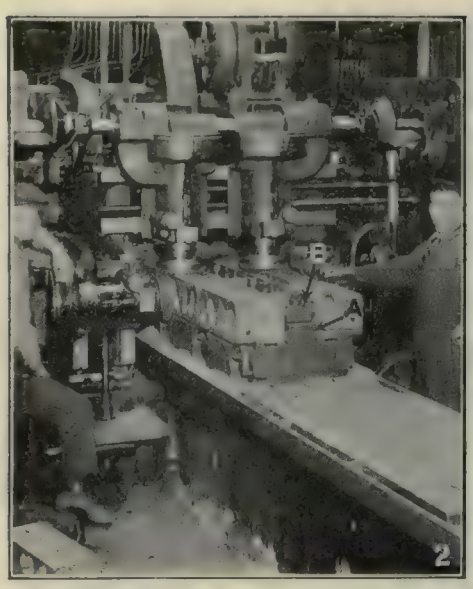


FIG. 2. DOUBLE CYLINDER FIXTURE

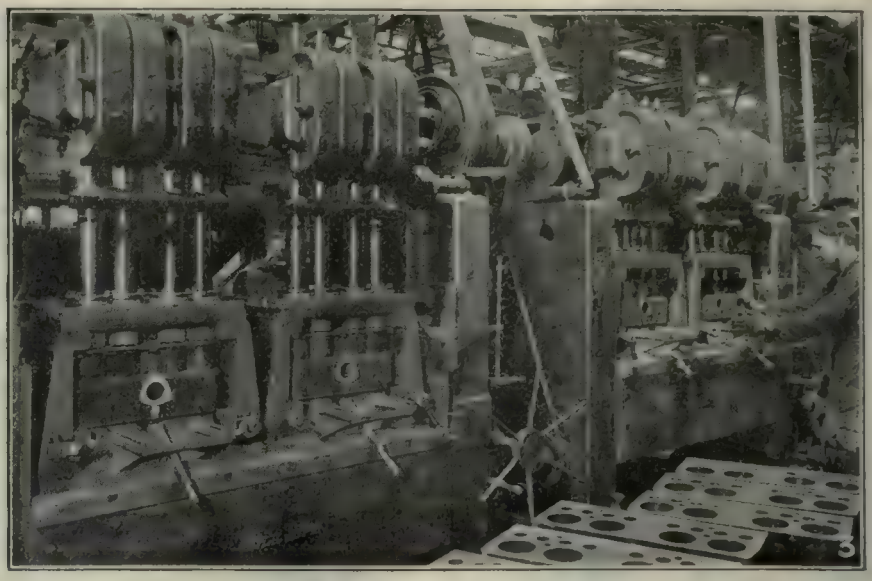


FIG. 3. BORING THE CYLINDERS

of the planer-type milling machine shown in Fig. 2. As will be seen, the fixture carries a double row of cylinder blocks, each with its bottom flange butted against a raised central portion *A*, of the fixture and squaring the other operations with the base flange.

The fixture is easily loaded and after the cylinders are in position, the clamps *B* hold them firmly in place by the insides of the cored holes. The combination of a comparatively light-weight cylinder block, together with the design of the fixture which enables the castings to be easily and quickly strapped in place, insures good production with little idle time of the machine.

The cylinder holes are bored on "hole hog" boring machines, as shown in Fig. 3 The fixtures are of the usual type, but the double machines shown are somewhat out of the ordinary.

Drilling and Reaming

The drilling and reaming operations shown in Fig. 4 involve the use of interesting and easily handled fixtures. The drilling and reaming of the valve plunger holes on the machine at the left employ individual fixtures, on which the cylinder blocks are fastened by means of the single clamps *A*, the fixtures being slid onto the raised ways *B*, in which position the work under the drills and reamers is done. Suitable stops are also provided as at *C*, all tending to save time and secure maximum production from the machine itself.

This view also shows another operation, the drilling of the holes for the manifold studs and similar openings on the side of the cylinder. The fixture for this is shown at *D*, mounted on the table of a Baush multiple spindle drilling machine. Thi. fixtur. has two studs or mandrels, which not only center, but support the cylinder block by entering the end cylinder bore. These studs have been flattened on four sides, leaving a suitable guiding surface, but eliminating friction and the possibility of scratching the cylinder bore, by means of chips caught in the hole.

Multiple-Spindle Drilling Machines

In Fig. 5 is shown a group of multiple spindle drilling machines, working on the cylinder heads. These machines are arranged with special tables which are connected so that the drilling fixtures are easily moved from one machine to the next, and after the last operation has been performed, and the work removed, the empty fixture is placed on the roller conveyor conveniently placed directly behind the men, so that it can be returned to the starting point without difficulty.

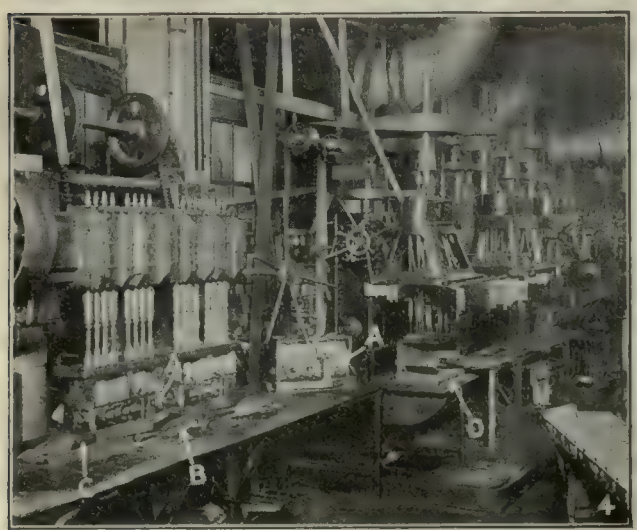


FIG. 4. TWO DRILLING OPERATIONS

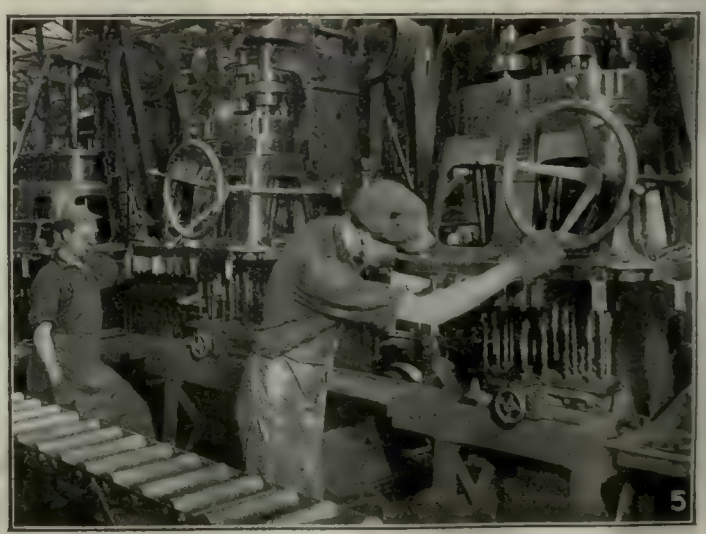


FIG. 5. DRILLING THE HEADS

Steel Compression Springs of Circular Cross Section

By T. F. STACY

THE accompanying set of charts was developed by the writer in connection with his work for the Hydraulic Press Manufacturing Co. They have been used for the design of compression springs varying in size from those used on the checks of small valves to those for pull-back springs on large hydraulic presses and for shock absorbers on large weighted accumulators.

The computations are based on the usual formulas for cylindrical compression springs of circular cross section, the derivation of which may be found in any reference book on springs. The usual form in which these appear is as follows:

$$W = \frac{\pi d^3 S}{8D} \qquad f = \frac{8WD^3}{d^4 G}$$

in which

W = force acting along axis,
D = pitch diameter of coil—center to center of wire,
d = diameter of wire,
S = maximum fiber stress (in torsion) in pounds per square inch.
G = modulus of torsion,
f = deflection of spring per acting coil.

Since it is desirable to know the outside rather than the mean or pitch diameter or the spring, $O.D. - d$ was substituted for D in the above formula. These were combined and reduced by substituting suitable values of G and S to get them into suitable form for making computations.

The values of S vary in the different charts according to the size of wire used. These allowable stresses are based on the recommendations of the Raymond Spring Co., of Corry, Pa., and are somewhat higher than those given in the older reference books on the subject. The charts are for round steel wire.

For brass or phosphor-bronze wire the allowable force W acting along the axis of the spring is 0.60 times and the deflection per coil is 0.84 times that given in the chart for a steel wire spring of the same outside diameter and same size of wire. These figures are based on a maximum fiber stress of 60,000 lb. per square inch and a modulus of torsion of 8,000,000 for brass or phosphor bronze.

Springs made of square wire have an allowable force W equal to 1.2 times that of a spring made of round wire, but for the same fiber stress have an allowable deflection per coil equal to 0.707 that for round wire. It can be shown that a spring made of square wire will be 50 per cent heavier than the same spring (i.e. of the same maximum load and same deflection) of round wire.

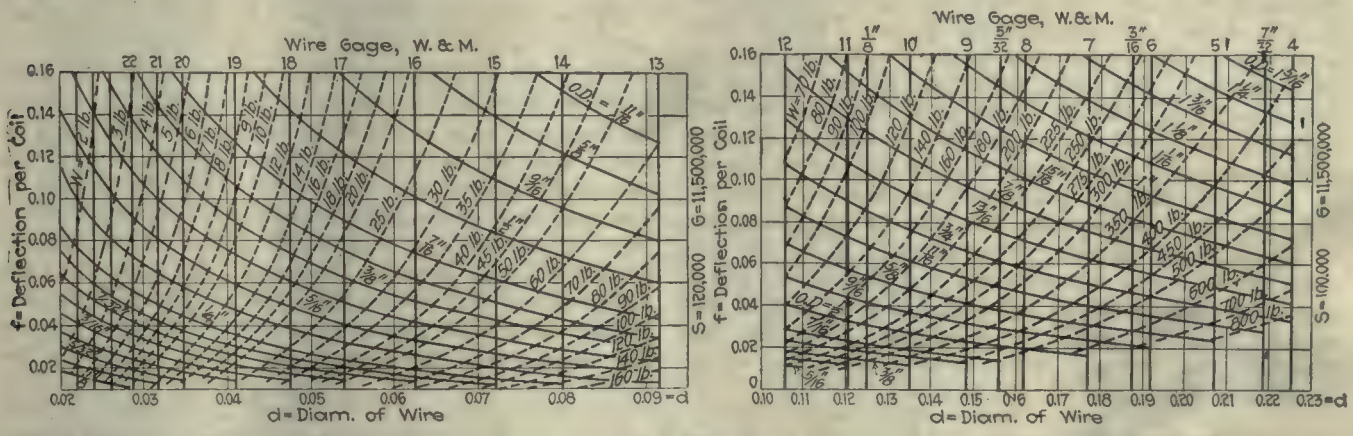


FIG. 1. COIL SPRING CALCULATION CHART FOR WIRE FROM 0.02 TO 0.23 IN. DIAMETER AND DEFLECTION PER COIL FROM 0.02 to 0.16 INCHES

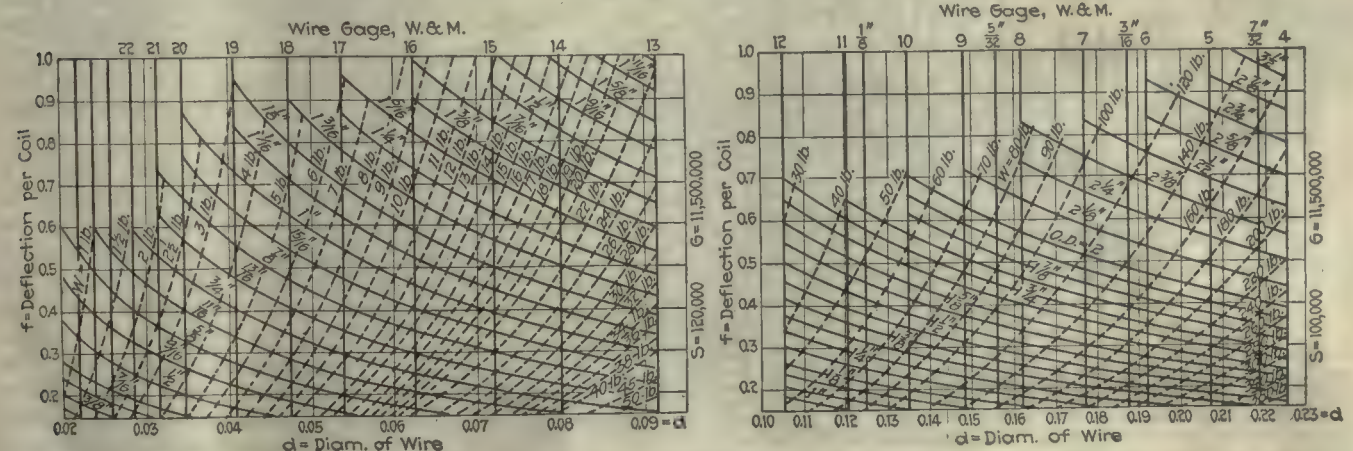


FIG. 2. COIL SPRING CALCULATION CHART FOR WIRE FROM 0.02 TO 0.23 IN. DIAMETER AND DEFLECTION PER COIL FROM 0.2 TO 1.0 INCHES

The charts take the form of so-called contour charts, made use of where four variables are to be considered. The variables here are maximum load, outside diameter, diameter of wire and allowable deflection per coil. The diameter of wire is plotted along the axis of ordinates, and to aid in choosing wires of standard size vertical lines are ruled heavy and numbered along the top of each chart according to the Washburn and Moen gage which is the standard for spring wires. This gage is the same as the American steel wire gage and the Bureau of Standards has recommended the name "U. S. Steel Wire Gage" or merely "Steel Wire Gage." The charts possess the advantage over tables of being more compact and of showing to the eye how a change of one variable will affect the design. This is most valuable since first computations are seldom final One problem will be worked out as an illustration.

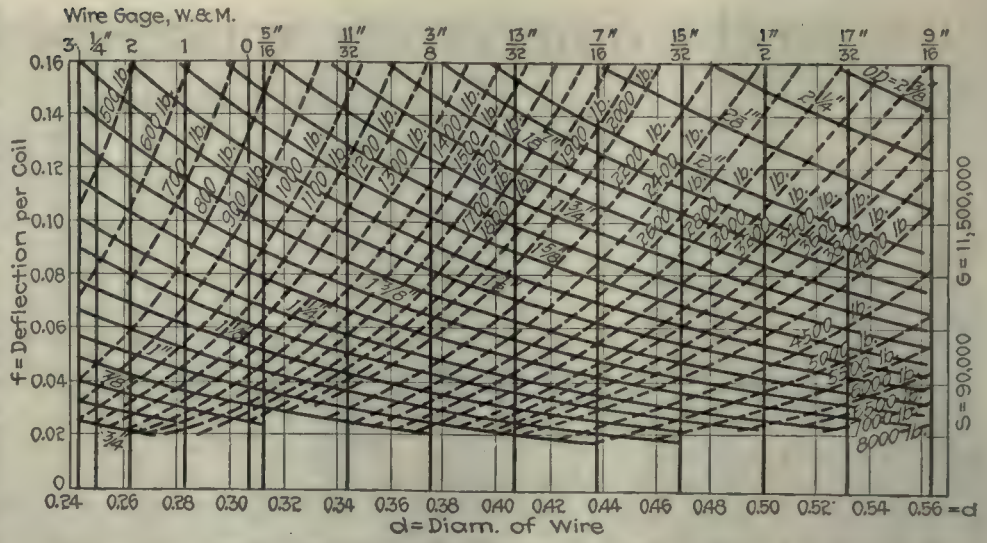


FIG. 3. COIL SPRING CALCULATION CHART FOR WIRE FROM 0.24 TO 0.56 IN. DIAMETER AND REFLECTION PER COIL FROM 0.02 TO 0.16 INCHES

We will assume it necessary to design a spring to fit inside a 3½ in. standard pipe. It is to carry at all times a minimum compression of 300 lb. and it shall be deflected 4 in. from this point under a maximum load of 450 lb. Since 150 lb. increase over the initial loading deflects the spring 4 in. the initial load of 300 lb. will deflect the free spring 8 in. This is true according to Hook's law and up to the elastic limit of the material. The total deflection of the spring is therefore 12 in. To fit inside a 3½ in. pipe we will choose a spring of 3¼ in outside diameter. On the charts we find at the intersection of the curves for 3¼ in. *O.D.* and 450 lb., a diameter of wire of 0.334 in. We will take the next largest wire of standard size which is $\frac{11}{32}$ in. diameter. For an *O.D.* of 3¼ in. this gives an allowable deflection per coil of 0.61 in. and a maximum load of 495 lb. The spring is safe since the working load is under the maximum given for the allowable fiber stress. With a total deflection of 12 in. and an allowable deflection per coil of 0.61 in. we need 12/0.61 = 20 acting coils. If the ends are to be squared and ground we will allow two extra coils. The solid height of the spring will be $22 \times \frac{11}{32} = 7\frac{7}{8}$ in. The free length of the spring will be $7\frac{7}{8} + 12 = 19\frac{7}{8}$ in. Its length at the point of initial or minimum compression will be $11\frac{7}{8}$ in.

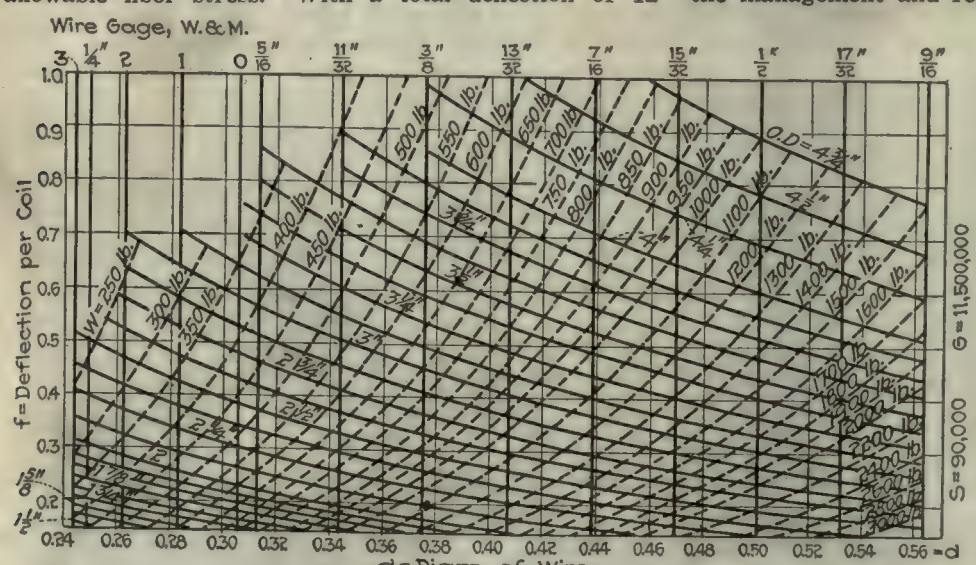


FIG. 4. COIL SPRING CALCULATION CHART FOR WIRE FROM 0.24 TO 0.56 IN DIAMETER AND REFLECTION PER COIL FROM 0.2 TO 1.0 INCHES

Senator Davenport in the Machine Shop

BY G. F. OLIVER

We read with interest [page 340, *American Machinist*] that Senator Frederick M. Davenport, from the Thirty-Sixth (Oneida) district of the State of New York, is spending his vacation in the plant of the Franklin Automobile Co. at Syracuse, N. Y., his object being to study and get at first hand the industrial relations between employer and employee. While his action in donning the overalls indicates an honest desire to obtain this information, we venture to predict, that because he is known as Senator Davenport, his point of view of conditions will not be the same as that of the wage earner. Naturally great courtesy will be shown him by the management and respect and consideration by the men, and to both he will always be Senator Davenport. He may be able to find the inner workings of the lathe, but he will never get to the inner workings of the minds of men, because not being one of them, he can but study them from the outside.

The Senator's effort is praise-worthy, and a step in the right direction, but he should have gone further, until he had arrived at the real standpoint of the worker (not that conditions are anything but good). The Senator could have gotten information had he applied for and obtained employment with identity unknown.



XXVII. Different Makes of Arc Welding Sets*

This is a continuation of the subject discussed in last week's issue. In this installment a number of well-known makes of arc welding sets are described.

(Part XXVI was published in last week's issue.)

IN SHOWING examples of different makes and types of arc welding sets, only enough will be selected to cover the field in a general way, and no attempt whatever will be made to make the list complete.

The General Electric Co., Schenectady, N. Y., puts out the constant energy metallic electrode set shown in Fig. 322. This, however, is but one type of its machines as this company makes a varied line covering all needs for welding work.

This particular machine combines high arc efficiency and light weight. The balancer set is of the well-known G-E standard "MCC" construction. It is built for operation on 125-v., d.-c. supply circuits, which may be grounded on the positive side only, and is rated "MCC" 3 kw., 1,700 revolution, 125/60/20 v., compound-wound, 150 amperes, RC-27-A frames, the two armatures being mounted on one shaft and connected in series across the 125-v. supply circuit, one welding circuit terminal being taken from the connection between the two armatures and the other from the positive line. By this means each machine supplies part of the welding current and, consequently, its size and weight is minimized. The design of the fields and their connections is such that the set delivers the voltage required directly to the arc without the use of resistors or other energy-consuming devices. The bearings are waste packed: this type of bearing being desirable in a set which is to be made portable either for handling by a crane or for mounting on a truck.

The welding control panel for the balancer set is shown in Fig. 323. This panel consists of a slate base, 24-in. square, which is mounted on 24-in. pipe supports for portable work and on 64-in. pipe supports for stationary work.

The entire set consists of one ammeter, one voltmeter, one dial switch, two field rheostats (motor and generator) one starting equipment with fuse, one reactor mounted on the pipe frame work of panel. The ammeter and voltmeter are enclosed in a common case. The ammeter indicates current in the welding cir-

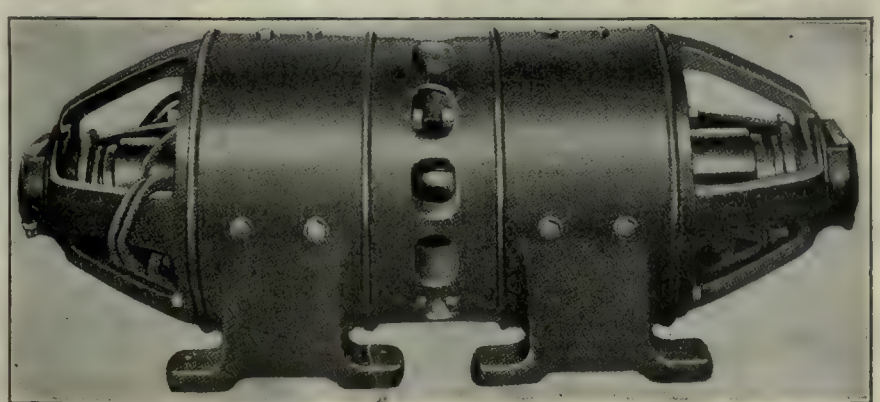


FIG. 322. GENERAL ELECTRIC 3-KW., 1,700-R.P.M., 125-60-20-V. COMPOUND-WOUND BALANCER-TYPE ARC WELDING SET

*For the author's forthcoming book, Welding and Cutting.
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cuit and the voltmeter is so connected that by means of a double-throw switch, either the supply line voltage or the welding line voltage can be read.

The dial switch is connected to taps in the series field

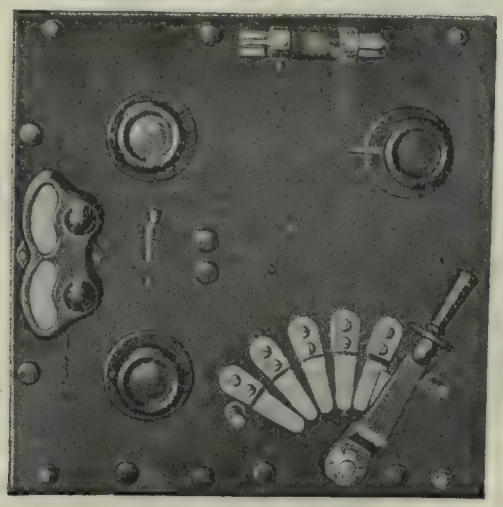


FIG. 323. WELDING CONTROL PANEL FOR BALANCER SET

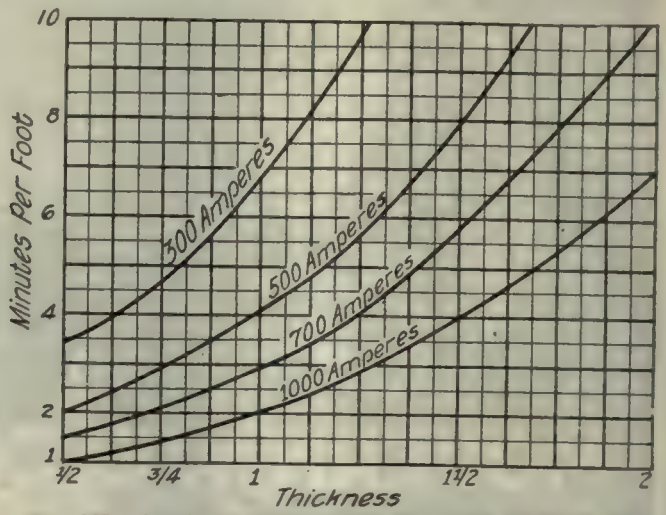


FIG. 325. CARBON ELECTRODE CUTTING SPEEDS FOR DIFFERENT THICKNESSES OF PLATE

of the generator, the field being connected to oppose the main field. This feature provides the current control by which six steps are obtained of the approximate values 50, 70, 90, 110, 130 and 150 amp., which enables the operator to cover a very wide range. In addition, if intermediate current values are required, they can be obtained by means of the generator field rheostat.

A small reactor is used to steady the arc and current both on starting and during the period of welding.

Arc welding is usually done on metal which is grounded and this is especially unavoidable in ship work, where the ship structure is always well grounded. Since successful operation requires that the positive terminal be connected to the work the supply circuit should be safely grounded on the positive side.

Where a 125-v., d.c. supply system is not available, standard "MIC" or "MCC" sets are furnished to supply power at 125 v., the motor being either 3-phase, 60-cycle, 220, 440 or 550 v., or d.c., 230 or 550 v., and in three capacities, 5½ kw., 7 kw., and 15 kw. With each motor generator set there is supplied a panel containing generator field rheostat and motor starter, which may be mounted beside the balancer panel. A diagram showing the balancer and control panel is shown in Fig. 324.

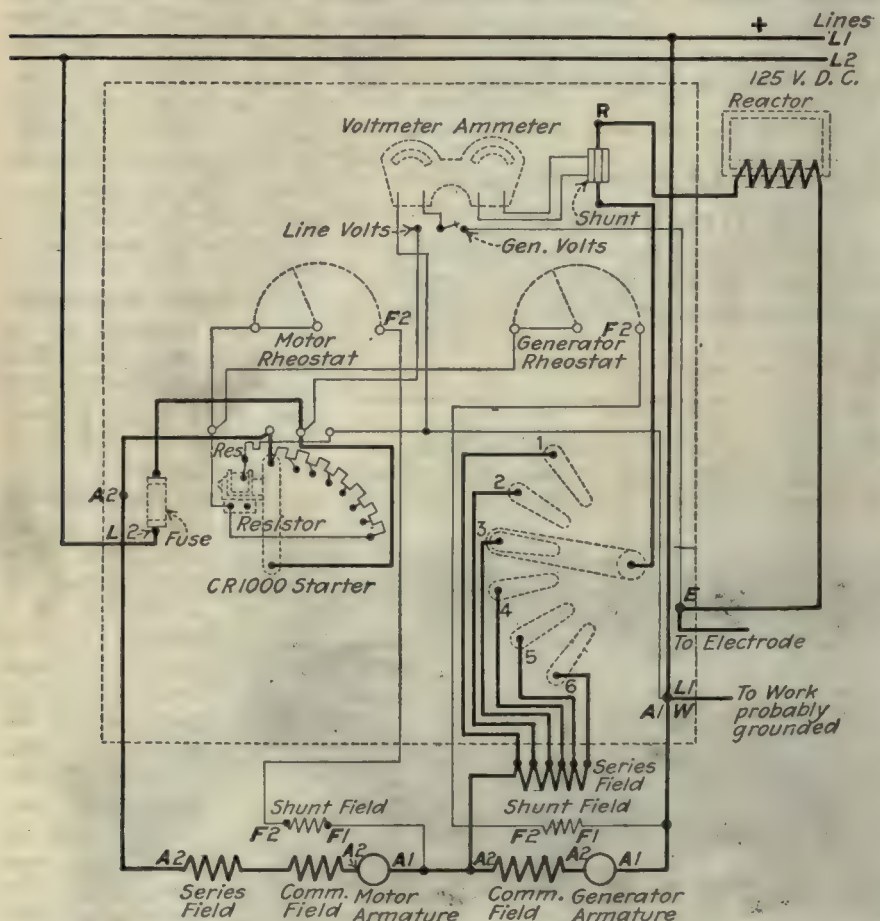


FIG. 324. BALANCER AND CONTROL PANEL CONNECTIONS FOR GENERAL ELECTRIC CONSTANT-ENERGY CONSTANT-ARC SET

The constant energy arc-welding equipment supplies, to the arc, practically constant energy throughout the welding range for metallic electrode welding only. If the arc is lengthened slightly the voltage increases and the current decreases, the total energy being practically constant. As the voltage required by the arc varies, the generator readjusts itself to this condition and automatically supplies the required voltage; the remainder being utilized by the motor end of the set. The interchange of voltage between the motor and generator is practically instantaneous, no perceptible lag occurs. This feature is valuable when metal drops from the electrode and causes an instantaneous increase in current. The commutation is sparkless and the welding circuit may be short-circuited without injury to the machine.

In connection with welding with an outfit of this kind, the practical man and student will find Table XXV of considerable interest. For sheet steel cutting using the carbon arc, the chart Fig. 325 is given.

BUTT WELDS BY METALLIC ELECTRODE—LAP WELDS WILL BE APPROXIMATELY THE SAME AS TWO BUTT WELDS—POWER 3c PER KW-HR:—LABOR 30c PER HR. ELECTRODE 5c PER LB.

Thickness of Metal	Diameter Electrode	Speed Ft. per Hr.	Amperes	Mean Kw. at 60 Volts	Mean Kw. at 70 Per Cent Eff	Approx Electrode per Hr Lb.	Power per Hour ¢	Labor ¢	Electrode ¢	Total per Hr ¢	Total per Ft. ¢
1/16	1/16	20	High 50 Mean 40 Low 30	1.8	2.0	0.9	6.0	30	4.5	40.5	2.0
1/8	1/8	16	90 70 50	1.4	3.6	1.4	10.8	30	7.0	47.8	3.0
1/4	1/8 or 3/16	10	125 100 70	2.0	5.1	3.1	15.3	30	15.5	60.8	6.1
3/8	3/16 or 1/4	6.5	150 125 100	2.5	6.4	3.6	19.2	30	18	67.2	10.3
1/2	1/4	4.3	150 140 120	2.8	7.2	3.8	21.6	30	19	70.5	16.4
5/8	1/4	2.8	150 125	3.0	7.7	3.4	23.1	30	17	70.1	25.4

NOTE.—The figures given for power labor and material are arbitrary and may be changed to suit local conditions.
* Based on power supplied.

TABLE XXV. DATA FOR METALLIC ELECTRODE ARC BUTT AND LAP WELDS

The Wilson "plastic arc" process and apparatus was first developed in railroad work by the Wilson Welder and Metals Co., New York, in order to enable the welder to control the heat used. By this system it is claimed that any number of operators can work from one large machine without one welder interfering in any way with the work of another. Each operator can have properly controlled heat and a steady arc at the point of application. This system was largely used in the repair of the damaged engines on the German ships which were seized by us. By regulating the heat it is claimed that any metal can be welded without preheating.

A two-arc set is shown in Fig. 326 and a close-up of a control panel in Fig. 327. A portable outfit is shown in Fig. 328.

This outfit consists essentially of a constant voltage generator driven by any constant-speed motor, all mounted on a common bedplate. The regulation of the welding current is maintained by means of a series carbon pile acting as a series resistance of varying quantity under the action of increasing or decreasing mechanical pressure. This pressure is produced by means of a series solenoid operating mechanically on a lever and spring system which varies the pressure on the carbon pile inversely as the current in the main circuit. This establishes a constant current balance at any predetermined adjustment between a maximum and minimum range designed for. This change in adjustment is controlled by the operator at the point of work by means of a small pilot motor which shifts the lever center of the pressure mechanism, thereby raising or lowering the operating current. This system maintains a constant predetermined current at the arc regardless of the arc length. The operation of the mechanism is positive and quick acting. A special series choke-coil is mounted on the control panel for use as a cutting resistance.

The portable arc-welding outfit illustrated in Fig. 329 is the product of the Lincoln Electric Co., Cleveland, Ohio. The outfit is intended for operation where electric current is not available and consists of a 150-amp. arc-welding generator direct connected to a Winton gasoline engine. An interesting feature of the machine is the method used to insure a steady arc and a constant and controllable heat. A compound-wound generator is used, the series windings of which are connected to oppose the shunt field, the two windings being so proportioned that the voltage increases in the same ratio that the current increases, thus limiting the short-circuit current. Another important effect of this is that the horsepower, and therefore the heat developed for a given setting of the regulator switch shown on the control board above the generator remains practically constant. It is claimed that this method of control gives considerably more work on a given amount of electricity than where the machines use the ballast resistance. Additional arc stability is insured by the stabilizer at the right of the illustration, this being a highly inductive low-resistance coil connected in the welding circuit and serving to correct momentary fluctuations of current.

WESTINGHOUSE SINGLE-OPERATOR ELECTRIC WELDING OUTFIT

The single-operator electric arc-welding equipment shown in Fig. 330 is manufactured by the Westinghouse Electric and Manufacturing Co., East Pittsburgh, Pa. The generator operates at arc voltage and no resistance is used in circuit with the arc. The generator is designed to inherently stabilize the arc, thereby avoiding the use of relays, solenoid control-resistors, etc.

The generator has a rated capacity of 175 amp. and is provided with commutating poles and a long commutator, which enable it to carry the momentary over-

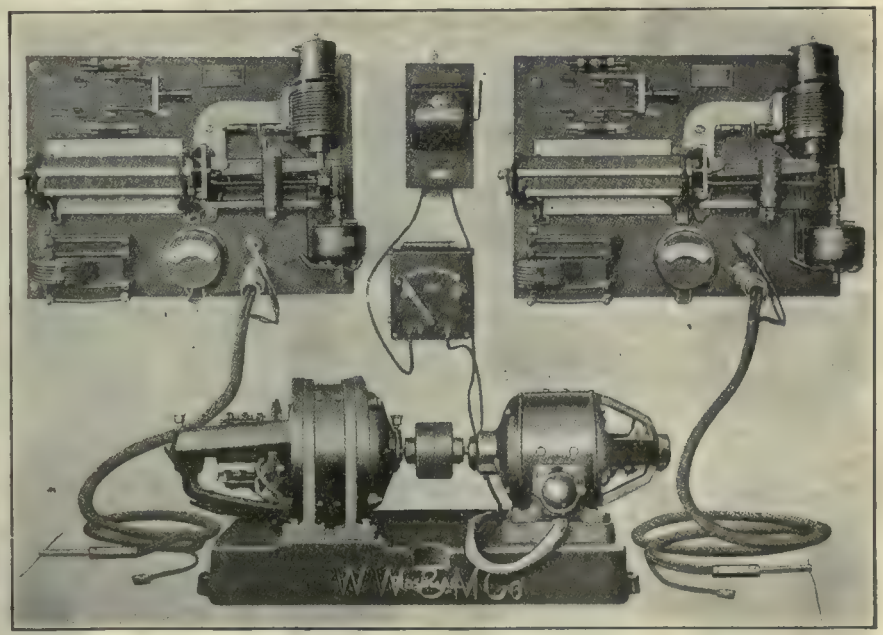


FIG. 326. WILSON TWO-ARC, 300 AMP., "PLASTIC ARC" WELDING SET

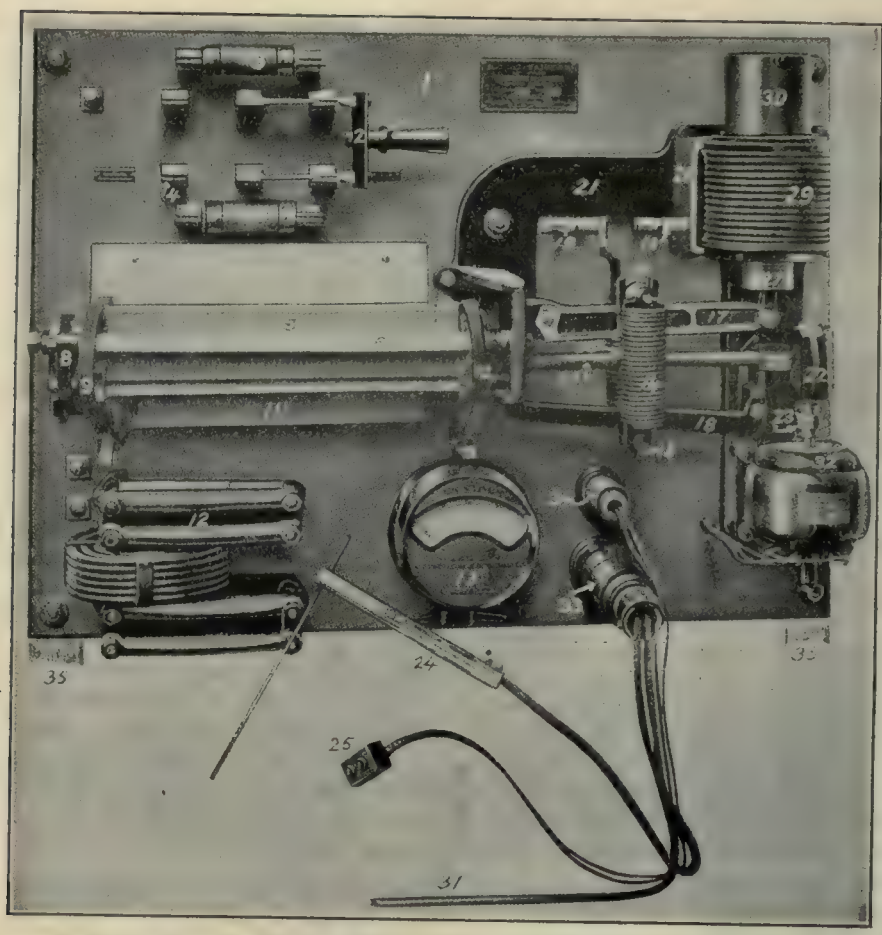


FIG. 327. WELDING AND CUTTING PANEL FOR WILSON SET

load at the instant of striking the arc without special overload protection.

Adjustment of Current Easily Made

Very close adjustment of current may be easily and quickly made, and, once made, the amount of current at the weld will remain fixed within close limits until changed by the operator. There are twenty-one steps provided which give a current regulation of less than 9 amp. per step and make it much easier for a welder to do vertical or overhead work.

The generator is mounted on a common shaft and bedplate with the motor. A pedestal bearing is supplied on the commutator end and carries a bracket for supporting the exciter which is coupled to the common shaft. Either d.c. or a.c. motors can be supplied. Where an a.c. motor is used leads are brought outside the motor frame for connecting either 220- or 440-v. circuits. An electrician can change these connections in a few minutes' time. This feature is desirable on portable outfits which may be moved from one shop to another having a supply circuit of different voltages. For portable service, the motor-generator set with the control panel is mounted on a fabricated steel truck, equipped with roller-bearing wheels. The generator is compound-wound, flat compounded, that is, it delivers 60 v. at no-load and also at full-load. The portable outfit, Fig. 331, is made by the U. S. Light and Heat Corp., Niagara Falls, N. Y. It is 28 in. wide, 55 in. high, 54 in. long, and will pass through the narrow aisle of a crowded machine shop. It weighs 1,530 lb. complete. In case a d.c. converter is used, the weight is about 125 lb. less. Curtains are provided to keep out dirt. A substantial cable reel is provided carrying two 50-ft. lengths of flexible cable for carrying the current to the arc. The reel is controlled by a spring which prevents the paying out of more cable than the welder needs. The outfit is made in several models to use 4 kw., 110-220-440-550 v., 2 and 3 phase, 25 and 60 cycle.

"Zeus" Arc-Welding Outfit

The "Zeus" arc-welding outfit shown in Fig. 332 is a product of the Gibb Instrument Co., 1644 Woodward Ave., Detroit, Mich. In this device the motor-generator customarily used has been supplanted by a transformer with no moving parts. The outfit is built on a unit system, which allows the installation of a small machine, and if the work becomes heavier a duplicate set may be connected in parallel. One of the features of the machine is the arrangement for regulation. It is not necessary to change any connection for this purpose, as a wheel connected with a secondary and placed on the top of the case raises and lowers this secondary, and provides the regulation of current necessary for different sizes of electrodes. The inherent reactance of the outfit automatically stabilizes the arc for different arc lengths.

The Arcwell Corporation, New York, has on the market an electric welding apparatus built for operation on alternating current of any specified voltage or frequency. It is shown in Fig. 333. It differs from the company's

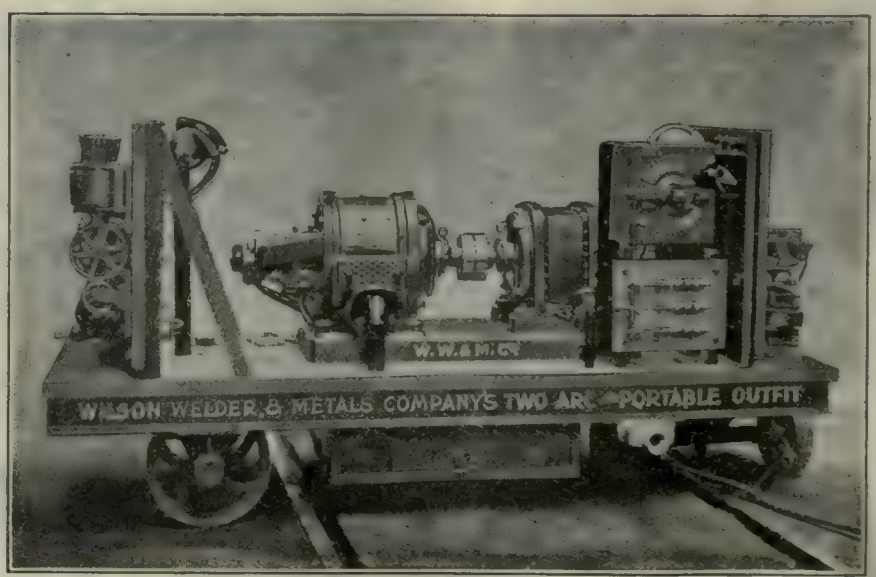


FIG. 328. PORTABLE SHOP-TYPE WILSON SET

standard outfit in that it is being put out expressly for the use of smaller machine shops and garages, its capacity not being sufficient to take care of heavy work on a basis of speed. It will do any work that can be done by the larger machines, but the work cannot be performed as rapidly, the machine being intended expressly for use by concerns who have only occasional welding jobs to perform. The machine weighs approximately 200 lb. and, being mounted on casters, it can be moved from one job to another.

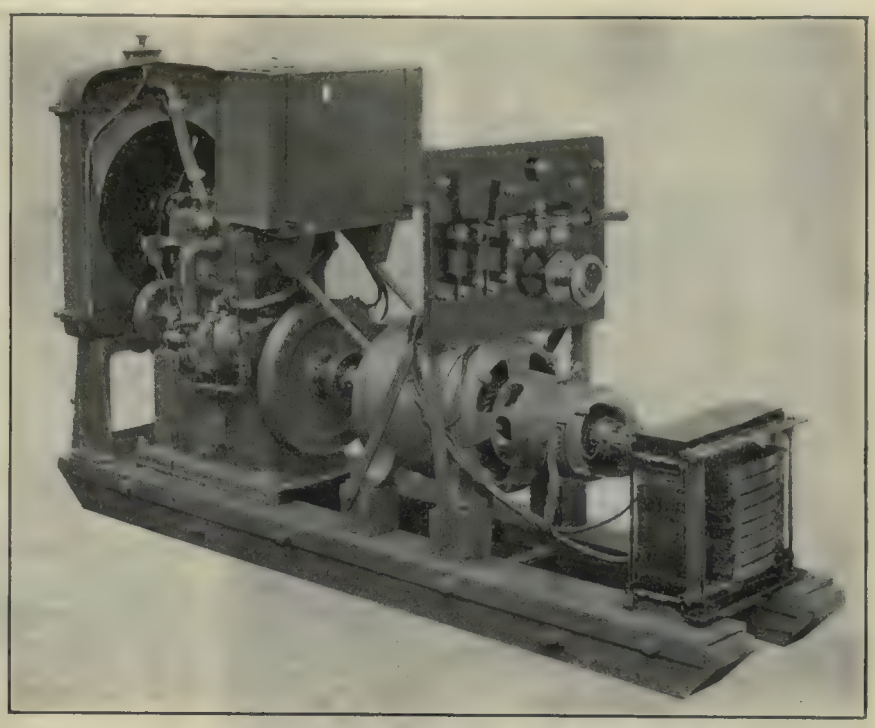


FIG. 329. LINCOLN SELF-CONTAINED PORTABLE SET

Alternating-Current Arc-Welding Apparatus

The Electric Arc Cutting and Welding Co., Newark, N. J., is now marketing the alternating-current arc-welding outfit shown in Fig. 334.

This illustration shows the entire apparatus for use on a single-phase circuit, the current being brought in through the wires seen protruding at the lower left corner.

The device consists principally of a transformer with no moving parts and is claimed to last indefinitely. In this apparatus, instead of holding either current or voltage constant as with direct-current sets, the wattage, or the product of voltage and current, is held constant. The alternating-current set holds the arc wattage without moving parts; hence the heat is substantially constant for any given setting, and it is claimed that as soon as any person becomes accustomed to the sound and sight of the arc and can deposit the molten metal where he desires it is impossible to burn the metal from too much heat or make cold-shut welds from too little heat. The amount of heat generated is controlled by means of an adjusting handle on the transformer together with taps arranged on a plugging board. It is stated that the kilowatt-hours required to deposit a pound of mild steel with this machine varies from 1½ to 2¼.

Their Largest Alternating-Current Set

Their largest a.c. set made is of the 60-cycle type and weighs about 200 lb., which places it in the portable class. The set can be furnished for any a.c. power supply, but it is not advisable to use a greater voltage than 650 on the primary. The set can also be made single phase, two phase three wire, two phase four wire, to operate across the outside wires of the two-phase system or from a three-phase power supply. Polyphase sets are about 30 per cent heavier than the single-phase sets. In the two-phase machine balanced current can be drawn from each of the two phases by placing the sets across the outside wires. This is advocated, as it provides for leading current on one phase which brings up the total power factor of the system and a

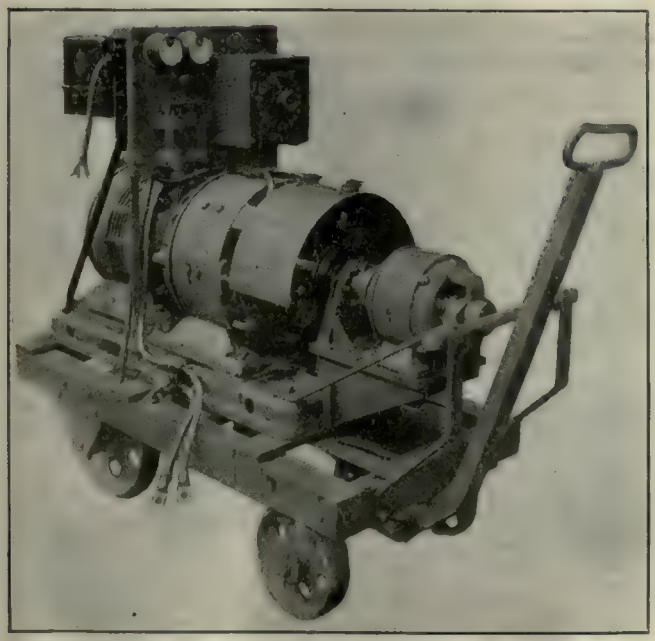


FIG. 330. WESTINGHOUSE SINGLE-OPERATOR PORTABLE OUTFIT

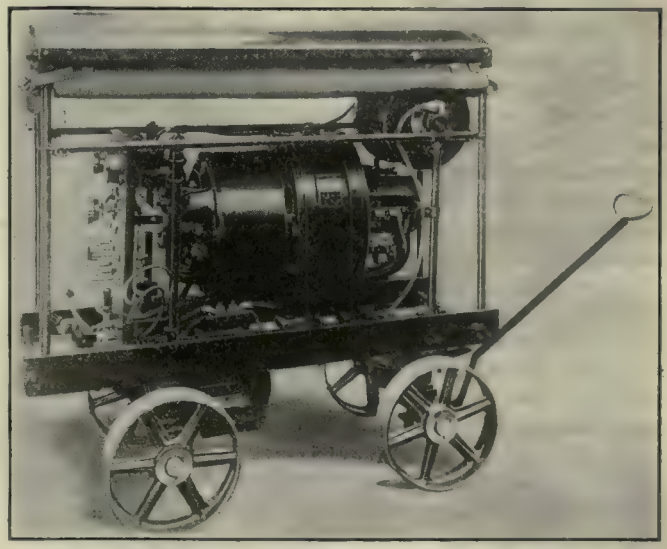


FIG. 331. U. S. L. PORTABLE, A.-C. MOTOR-GENERATOR SET

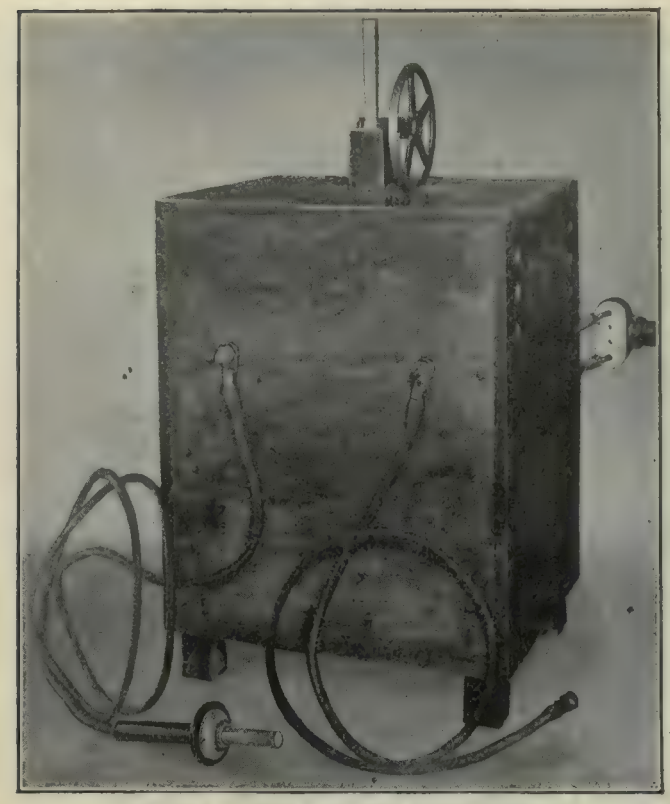


FIG. 332. ZEUS ARC-WELDING OUTFIT



FIG. 333. ARCWELL OUTFIT FOR ALTERNATING CURRENT

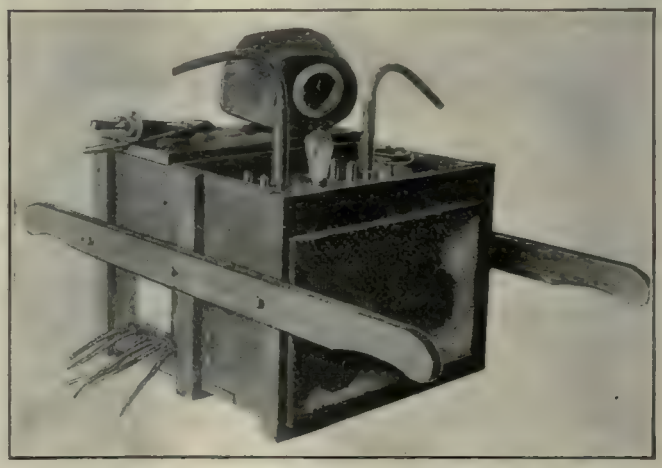


FIG. 334. APPARATUS MADE BY THE ELECTRIC ARC CUTTING AND WELDING CO.

better power rate can be obtained. In polyphase circuits where more than one set is used single-phase sets can be distributed among the several phases.

The outfit can be made especially for welding and for cutting or for combination welding and cutting and can make use of bare wire, slag-covered, gaseous fluxed or carbon electrodes. An operator's mask and the electrode holder used may be seen on top of the apparatus.

General Electric Lead-Burning Transformer

This lead-burning transformer, Fig. 335, a product of the General Electric Co., Schenectady, N. Y., can be used for lead burning, soldering electric terminals, splicing wires and tinsmith jobs, and even brazing can be done by placing the work between a blunt carbon point and a piece of cast iron. The transformer is designed to be connected to the ordinary 110-v., a.c. lighting circuit. Heavy rubber-covered terminal leads are used to convey the low-voltage, heat-producing current to the work, one terminal ending in a clip for fastening to some convenient portion of the work while the other terminal has a carbon holder arranged with an insulated handle. When the welding carbon is brought into contact with the work the pointed end becomes intensely hot and melts the metal over a restricted area. It should be noted that no arc is drawn, the end of the carbon point being heated to such a temperature that the metal in the vicinity is melted. The device uses about 800 watts while in actual use, the consumption dropping to 4½ watts when the point is removed from the work. It is stated that the device is very convenient in plumbing, roofing and tank-building jobs, as well as other such work.

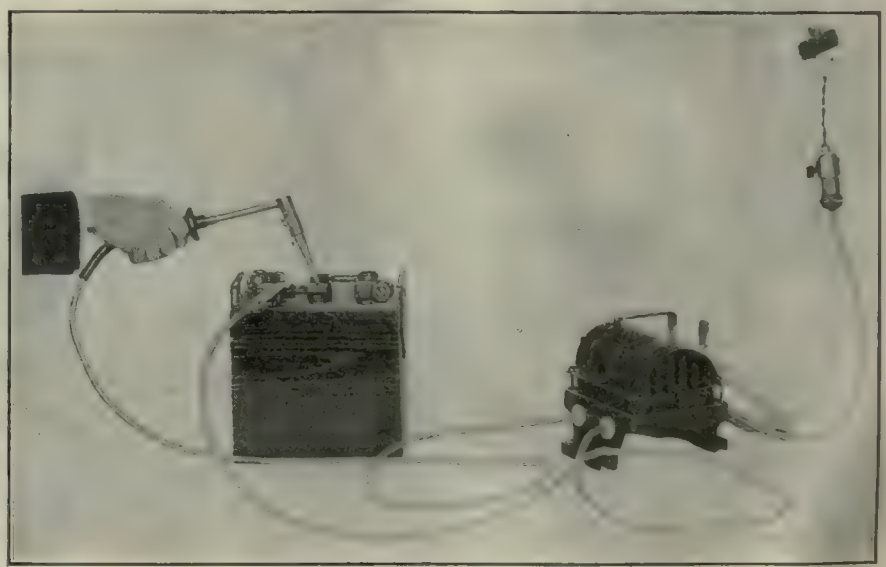


FIG. 335. GENERAL ELECTRIC LEAD-BURNING OUTFIT

Gaging Employees' Magazine Results

By JOHN T. BARTLETT

The plant paper furnishes a means of contact between the company and the employees. It is run much on the order of any advertising scheme, usually for the promotion of the morale of the workers. The author tells of means of estimating the results obtained by such papers, and also of means of getting results through them.

NO CONCERN publishes an employees' magazine for the fun of it. The paper is either going to pay or it isn't. If it doesn't pay it is going to be dropped. How are you going to tell whether a plant paper is a success or not?

Several hundred employees' magazines are now being published. Many more will be; some inevitably will die. Some are going to be "killed" when they ought to be maintained, and others in urgent need of first-aid treatment of a vigorous kind will be continued unchanged—all because the employees' magazine is a new institution, and uncertainty is common concerning the proper way to gage results, and even the sort of results to look for.

A manufacturer can study his product, determine what it is costing him to produce and distribute it and reckon what the margin of profit is. But with an employees' magazine, at the end of a year's operation you can't use any such simple process of figures. The results are mainly indirect. They consist principally of intangibles on the value of which it is difficult to put a convincing appraisal.

Advertising is a commonly used business device which naturally suggests itself in relation to this phase of the employees' magazine. Advertising during one period was frequently adopted by over-enthusiastic persons with much too rosy anticipations. It was considered a magic process which, when invoked, automatically and quickly brought wonderful returns. If the returns didn't come at once, the advertiser's enthusiasm flickered out. He concluded that advertising as a device to build business was a "false alarm."

Some publishers of plant papers, it is a foregone conclusion, will make the same mistake. The employees' magazine is rather a new idea, but numbers have already lived and died. Just as it has happened many times with advertising campaigns, so now it happens with employees' magazines, that after a paper has been published for a few months, the company may begin to look for some marvelous transformation in the working spirit of its employees, and when this is not apparent, to conclude that the device is not worth while. Persistence is indispensable to sane, successful advertising and it is also indispensable in the plant publication. Clever handling plus persistence is the recipe for results.

Results You Can Put Your Finger On

In gaging plant publication returns, one way is to look for accomplishments you can put your finger on. There are actually tangibles of this sort.

The relation of the paper to company welfare measures is one field to survey. If the publication has worked heartily for the company's savings plan, and the percentage of the employees participating in it grows and grows until it is the largest ever. the magazine has done something there that you can put your finger on. Company sports in which many participate are a healthful, constructive thing, for both the men and the company. A plant paper which stimulates company sports and is instrumental in bringing out the largest possible number of candidates, is doing something tangibly worth while.

Or, the paper may have rendered signal help in a ticklish situation. An incident in this field came to the writer's notice some time ago when an employees' magazine editor, in sending me a copy of his latest issue, apologized for it, explaining that it had been "rushed through." Then he told me why it had been. The men performing a certain very important operation had gone out on an unauthorized strike. The labor body having jurisdiction over most of the trades employed in the plant, but not over the one striking, had taken the company's side and assured the company, known as a supporter of the closed-shop principle, that it might employ non-union labor in the emergency. So far so good, but the firm didn't wish to employ non-union help. Here was the dilemma. A portion of the plant was already thrown out of work because of the unauthorized strike, and unless the strikers or substitutes soon resumed work, the whole plant would be made idle. On the other hand, if the firm employed non-union men, there was danger of the other union workers refusing to work, despite the mandate of the council, and a general strike.

"Not much of an issue," the editor said in effect. "Been having hourly conferences with L. M. (the company head), and finally decided to publish a little ahead, and talk plain."

I examined the issue, I confess, with some eagerness. The "talk plain" of the editor's letter was simply a frank review of the situation, including the assurance received that the company might go ahead and employ non-union men. The company said it didn't want to do this, and told why. It endorsed the closed-shop and was a friend of union labor. On the other hand, the trouble threatened to throw many hundred innocent employees out of employment and cause loss which could little be afforded. The company did not state definitely what it intended to do, but it paved the way for the employment of non-union men, if that should become necessary. It "put it up to" the striking employees. There was no general strike. The company steered safely through, and production was shortly on a normal basis.

In some industries more than in others the tangible value of having a mouthpiece for such possible emergencies as the foregoing is great. It furnishes one means of contact between the company and the men when the need arises.

Respecting results which "stick out," the management of the plant paper, and also the local circumstances, have much to do. Many editors tread lightly on material of a propaganda nature, believing it better judgment

to have the publication first of all a pleasant, entertaining sheet. The degree with which others campaign along various specific lines differs a great deal. One magazine editor has attacked certain wasteful practices, trying to drive home the idea that the workers owe it to the company to be careful. He says he expects to save the cost of the publication in the waste averted on two items. Allow for a little over-optimism, and it is apparent that he has accomplished a great deal in one field.

If the experiences of all employees' magazines could be tabulated they would be found to contain a fairly numerous list of constructive results upon which a finger could be placed. There would be a great diversity in the character of such accomplishments. Much of this is inside story stuff and hard to get at, but its existence is no less real.

Influence on General Morale

Employees' magazines are usually published for their influence on the general morale. A clear survey in this field is hampered by conditions surrounding circulation. The employees' magazine differs from the orthodox publication in that its distribution is free. Every employee is conceived of as an eligible reader, and in practically all cases an endeavor is made to attain 100-per cent circulation. The magazine is given an employee whether he asks for it or not.

Here, at the outset, the employees' magazine runs into a snag, or seems to. There are going to be instances in which some employees manifest little interest in the paper. After the distribution, a survey of the plant is going to reveal, many times, thrown-away copies. The degree to which lack of interest will be thus revealed will vary much, depending on the type of employees and the internal situation. A rational attitude toward such disquieting evidence is best maintained by viewing the problem as an advertising one. The company has certain ideas it wishes to sell employees. It wishes to educate them to a better feeling about things. If their viewpoint can be swayed to become sane and wholly constructive both employees and employer are going to be benefited.

But to assume that because a person works for the company he or she is bound to be interested in a plant paper is ignoring people as they are. Some people will read anything handed to them, and even aren't at ease on the street cars unless their eyes are fixed on car cards. For others, print, in itself, has no attraction whatever. There are millions in this country who don't read a piece of fiction in a year, and can't get interested in it. The newspaper is the most widely read publication there is. It reaches the highest proportion of possible readers. Yet the newspaper, dealing in news, the variety of printed material most primitive and elemental in its appeal, is "going some" when it is read by seven out of ten families in its territory. And it should be remembered that the newspaper is read by people who read nothing else. Practically speaking, everybody who reads peruses the newspaper, yet no newspaper is ever able to interest all to the point of regular reading.

These facts should be borne in mind when it is realized that an employees' magazine has a problem on its hands in getting read. The fact that a percentage of employees manifest lack of interest doesn't indicate the failure of the publication, but rather the existence of a problem. A manufacturer takes it for granted that, under normal conditions, persistent, energetic effort is associated with the sale of his product. He doesn't rave at the nature of things or throw up his hands because a prospect is only to be landed with persistent effort. Facing such a condition, what does he do? He hammers. The same tactics in successful employees' magazine management are necessary. Hammering and the persuasive message account for advertising and selling success, given a meritorious product. Accomplishment of results with plant publications must respect the same principles.

So, in gaging progress, not the existence of some uninterest, but the movement of that uninterest, whether growing or decreasing, should be the test applied. Every endeavor to cut it down should be made. If definite progress is being made in this direction, if employees are growing to like the paper and respect it, so that they receive each issue with growing anticipation, then the enterprise is making good. As a healthy, normal paper, constructively American and a sincere exponent of mutual co-operation, its ultimate influence for great good among employees is inevitable. Employees who receive the paper in this spirit simply can't escape its influence. All the laws of suggestion which have made advertising the great business force it is are behind it.

Method of Distribution Important

If the employees' magazine doesn't appear to be coming along as fast as it should, constructive measures—still viewing the problem as educational and one in which persistence is naturally required—are practical.

One well-known plant publication is distributed only to employees who apply for it. Psychologically, the average human is so constructed that he gains interest in an article from asking for it, just as he values a thing more which has cost him something. This plan is said to be successful in the case mentioned.

The consensus of opinion at present, however, does not favor this method. The management has certain ideas which it is anxious to sell the workers; it plans to sell them through the printed page, a medium with which, working month after month, it can build toward large ends. The fact that an employee is not interested in a plant paper is no reason why the company should not wish him to have it and read even a little of it. Some consumers will pass a billboard a dozen times without noticing the advertisement of "Crispnut" butter thereon. Then they will pass it fifty times more before, through reiteration, that particular brand is made especially attractive to them. The advertiser naturally likes voluntary attention, but if he can't have voluntary attention he turns to forced attention. Most advertising starts out with some form of forced attention. Some varieties of advertising, like billboard and moving picture, are built entirely on it. Its importance in the periodical field is attested by the premium paid for preferred position.

There is a Pacific Coast shipyard which distributes the employees' papers when the men are in line for their pay. The paying-off process is tedious, and the employees' paper is greeted as a relief, in addition to the normal interest in it. You could call this a trick to get the paper opened and read. Call it what you will—it's a good idea. Another idea is to pass the papers out as the employees leave the plant at night,

boys standing at the main exit. It is figured that by this method more papers are carried home. Another strategic time is the dinner hour.

If the employees' magazine doesn't seem to be progressing, judged by reader interest, any of several practical "first-aid" measures are easily applied. The magazine may not be lively enough. Heavy emphasis on personal items is good medicine. Snapshots also brighten up a publication wonderfully; their appeal is universal. Some employees' magazines use none; one I know of sometimes uses as many as ninety in an issue. In between are all degrees, but I have yet to see a paper that used too many. Use a lot of photos in that paper which hasn't been "coming along," and watch results. When the girl employees are the ones backward in interest, go after them with a woman's page. A goodly number of papers have successful departments of a social and home nature for the women.

That one or two, or even seven or eight, issues of an employees' magazine should completely alter the working spirit in a plant is asking too much of human nature. If workers earning much, in a period when work is plentiful, get off their base somewhat, to use the expressive colloquialism, it is only human. These conditions, as well as the "false prophets," are opponents of the plant paper.

The Evolution of the Engine Lathe

By Harry Senior

In an article on page 184 of *American Machinist*, reprinted from *The Link*, J. E. Franzen tells us that the engine lathe is so-called because it came into general use as a power-driven machine contemporaneously with the development of the steam engine.

While this is an ingenious explanation it is hardly conclusive for the reason that, though we have engine lathes, we have no engine planers, engine slotters, etc.; machines whose periods of development correspond very closely to that of the lathe and which as certainly derive their power from the same source.

I am not a student of history nor of philology, and I frankly confess that I do not know why the mechanics of a century ago prefixed the word "engine" to the name of their most versatile tool, but the term seems to me to have such a very obvious origin and meaning that there should be little doubt about it.

The word engine in old English signified a device that once set in motion was capable of accomplishing of itself the object for which it was designed. Webster says that it was formerly applied to almost any kind of mechanical appliance and it is still retained in some instances as "fire engine," "beer engine" (now obsolete), "ruling engine," etc. A machine designed to destroy life or property is commonly called an "engine of destruction." Likewise we have "dividing engine," "gear cutting engines," etc.; machines that, when once the preliminary calculations and adjustments are made, are capable of continuing the cycle of operations to its completion.

Even as applied to the steam engine, the right of which to the title is unquestioned, the word has the same significance: A steam engine, strictly speaking, does not generate power; it merely converts the power generated by the burning fuel into motion that can be utilized to accomplish useful work. The water, the steam, the valves, the moving pistons are but links in the chain of conversion. The steam engine is therefore an engine because it converts power from a definite source (the boiler) into motion; the lathe is an engine because it converts motion into useful work.

This is my belief; unsupported by anything but logic. If Mr. Franzen's theory is correct, and the engine lathe is so-called because of its connection to its prime mover we narrowly escaped having a "waterwheel lathe" to explain.

Increasing the Output of Labor

By J. E. Bullard

After the Civil War the output of labor was very materially increased by the adoption of machinery. Work that had previously been done by hand, began to be done by machinery. This was especially the case in the woodworking industry, and in other industries where it was necessary to increase production.

Since the end of the last war we have been faced with a very serious shortage of material, both the raw and the finished product. It is going to be necessary to greatly increase the output of labor if we are not to meet disaster.

There is, however, not much opportunity of doing this along the line of introducing more machine methods. About all that can be done along that line has already been done. The course that offers the greatest promise appears to be to pay more attention to the human machine, the worker himself, with a view of getting more out the machines through him.

From an energy standpoint, the human being is a sort of combination boiler and engine room. The food that he eats is his fuel. The air that he breathes burns this fuel and it is only when the right combination of food and air is made that the maximum amount of energy can be produced. If the average workingman could be fed the right kind and the right amount of food at the right times; if as much attention was given to his feeding as is given to the stoking of boilers, and if the air that he breathes was given as much attention and controlled as carefully as is the air that is supplied to the boiler fires, there is no question but that, in spite of himself, he would turn out at least 50 per cent more work than he actually does under present conditions.

It is obvious that it will not be possible to have such complete supervision over the human-being fuel (the food that he consumes) but it is possible to control the air in which he works. In other words to control the drafts of the fuel furnace.

In order to have this air supply result in the most efficient operation of the human engine it is necessary to have it meet three requirements: It must contain the right percentage of moisture. It must be at the right temperature. It must be sufficiently free from adulterations of bacteria, germs, and poisonous gases. It is somewhat hard to say just which of these three things is most important. If the air is perfectly pure but the temperature and humidity are not right, then production falls off. Any one or two of the three requirements may be just right and the third be bad enough to come very near completely offsetting any advantages that have been gained.

Cotton mill men have given it as their experience that the humidifiers that they use to keep the humidity of the air in the mills uniform in order that the threads will not be broken, have had the result of making the

employees more keen and active, that these machines actually reduce the time lost due to colds and the like and that in this way they have tended to cut down the cost of operating by increasing production. No argument is needed to show that pure air is necessary. Everyone knows that foul air is extremely dangerous to health and that it is not possible for any person to do his best work unless the air is pure.

Any one who has made tests along these lines also realizes that there is a certain temperature which results in the greatest production. This temperature will vary with the kind of work that is being done. A temperature that will prove comfortable and energizing where light work is being done may be altogether too high for another kind of work requiring more muscular energy which in turn will generate body heat. It is, to a certain extent, a case of fitting the temperature to the kind of work being done.

This question of air is one which can be given a great deal more attention than it has ever been given before. It is the thing more than anything else, that can be controlled by the plant, which determines the degree of energy of the workers. That which finally determines the best conditions is the condition of purity, humidity and temperature which results in the greatest possible production. Pathological, physical and chemical calculations and tests only aid in reaching the ideal conditions. There is only one thing that will show when they have actually been reached, and this is the record which shows the greatest possible production per worker, and the least possible time lost due to sickness. This means that the best conditions can only be arrived at by experimentation and carefully kept records.

All sorts of welfare work will not get results if the workers have to work in an atmosphere that is enervating. The correct working atmosphere will get the right results in production, no matter whether any welfare work is done or not. If you feed a gas engine a certain mixture of gas and air at a certain rate, that engine will run at a certain speed. Make the mixture absolutely correct and increase the rate at which it is fed to the engine and that engine will run faster. It will have to do so.

Put a man into a certain atmosphere and set him to work and he will work at a certain speed. He will be unable to exceed a certain maximum effort in that atmosphere and maintain the effort. Make the atmospheric conditions ideal for the greatest production and that man will speed up. He will have to do so for the very simple reason that he is generating more energy. He is in exactly the same condition as the gas engine with the right mixture being fed to it at a rapid rate.

When we speed up the energy, however, it is highly important that we keep it upon the right track and do not allow it to result in destructive effort. On a railroad, the heavier the trains and the faster they run, the more necessary a good road bed becomes and the heavier the rails that must be used. If the road bed is not improved and heavier rails used as the weight of locomotives and trains increases and the speeds at which they are run become greater, accidents are going to increase and in the end little if anything has been gained.

Lighting in the industrial plant corresponds to the rails and roadbed of a railroad. Where the air is very bad and the temperatures and humidities are such that they reduce the energy of the working man, good lighting may not be entirely essential. The man won't do enough in the course of the day anyhow so that he either can make or spoil much. Where the atmospheric conditions, however, are such as to fill him full of energy, he is bound to spoil a lot of material and possibly meet with an accident himself if the lighting is so poor that he cannot see clearly what he is doing.

Air and light go together. The better the air conditions, the greater the energy of the people who work in the plant. The better the lighting conditions, the more productive this increased energy can be made. Improve one without improving the other and the best results can never be obtained.

Just how much artificial lighting is required for the very best results has not yet been determined. Up to date when it has been thought that the very best conditions have been reached, it has been found that production can be still further increased by increasing the amount of light used. Probably the maximum is somewhere near the amount of light that we have at noonday on a bright sunny day.

In all lighting, however, that which is by far the most important is freedom from glare. A light shining directly in the eyes of any one not only cuts down his productivity but increases the accident hazard. Place the lights where the worker can't look directly at them, increase the amount of light that falls upon his work and he immediately increases the amount of work that he does. He usually does this without realizing it. It has become so much easier to produce that he does better and more work than he has been doing heretofore and with less effort than he has been putting forth.

If in all of our manufacturing plants in this country we could bring about the best conditions of light and air, there is no question about the production increasing at a great enough rate to catch up very shortly with demand. At the present time it is doubtful if there is a single plant in the world that comes up to the ideal. Improvements are constantly being made in lighting installations that had already been made as nearly ideal as was thought possible. These improvements in illumination almost invariably result in worth-while increases in production. This indicates that there are no plants with lighting installations so perfect that they cannot be improved.

The amount of moisture in the air is rarely given the attention that it deserves, except in cotton mills and similar plants where such attention is necessary in order to turn out a satisfactory product. The percentage of moisture in the air, however, has just as great an effect upon the productivity and the health of the operator as it does upon the cotton threads. Ventilating systems do not always work as they are expected to work. Merely removing a certain volume of air from the room per hour does not necessarily mean that the air in all parts of the room has been changed. The final test in all cases is the productivity and loss of time through sickness of the people working in the different parts of the room. It matters not what the theory may be, what really counts is getting greater production from the man on the job and having him lose the minimum amount of time due to sickness. Records made of each condition under which he works will show which condition gives the best results.

Obtaining the Radius of Three Equal Inscribed Circles

On page 1055, Vol. 52, of the *American Machinist*, there appeared a letter by Henry R. Bowman under the above title. Three different solutions to the problem—which is to determine the radius of the three equal inscribed circles in terms of the side of the circumscribing equilateral triangle—have come in since that time, all of them being simple and worthy of examination.

Mr. Bowman states that the solution of his problem could not be found in any handbook. The writer refers Mr. Bowman to "Practical Mathematics," by Palmer (McGraw-Hill Book Co.), where he will find, page 72, part 2, a similar problem giving the relation between the very two elements in question. In fact, it is Mr. Bowman's problem reversed.

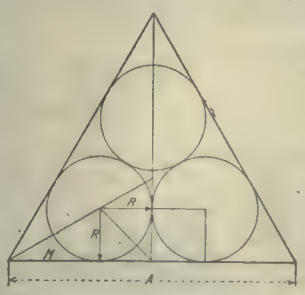


FIG. 1. DIAGRAM SHOWING THREE EQUAL INSCRIBED CIRCLES

Mr. Bowman's problem solved by this method begins as follows: It can plainly be seen by the figure (1) that side A of the triangle is composed of two equal segments M plus two radii of the circles.

The equation then can be formed thus:

$$\frac{\frac{R}{A-2R}}{2} = \tan 30°$$

The writer believes the solution of this equation for either of the unknowns to be simpler than Mr. Bowman's method of solving the problem, since it does not deal with oblique triangles. It also eliminates the necessity of looking up more than one trigonometric function or an oblique triangle formula, as few people carry these formulas in their memories.

B. E. Tool.

An easier way to obtain the radius R of three equal circles which will be tangent to the circumscribing equilateral triangle and to each other, is shown in the following work, referring to Fig. 2:

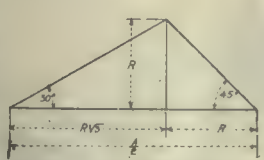


FIG. 2. SHOWING RELATION BETWEEN RADIUS AND SIDE OF TRIANGLE

$$R(\sqrt{3}+1) = \frac{A}{2}$$

$$R = \frac{A}{2(\sqrt{3}+1)} = \frac{A(\sqrt{3}-1)}{2(3-1)}$$

$$R = \frac{0.7321\,A}{4} = 0.183\,A$$

Gustaf E. Nordstrom.

The following solution may be of interest, inasmuch as only one function is used instead of three, as in Henry R. Bowman's article.

Referring to Fig. 3, by geometry the radius R is at right angles with the altitude; and a line passing through an apex of the triangle and the center of the adjacent circle will make an angle of 30 deg. with the base, as shown. Therefore:

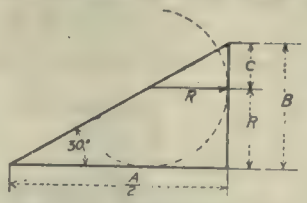


FIG. 3. DIAGRAM FOR CALCULATING RADIUS OF CIRCLES

$$R \tan 30° = 0.57735\,R = C.$$

$$R + C = R + 0.57735.$$

$$R = 1.57735\,R = B.$$

$$B = (\tan 30°)\frac{A}{2} = \frac{0.57735}{2}A$$

$$\therefore 1.57735\,R = \frac{0.57735}{2}A$$

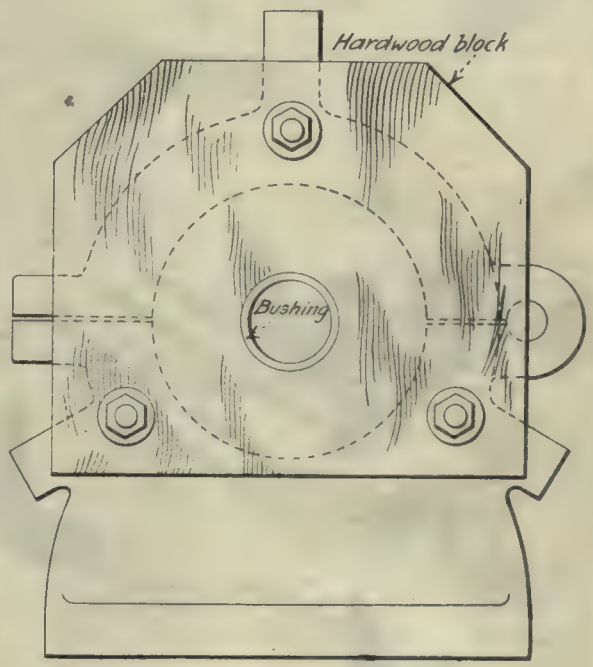
$$R = \left(\frac{0.57735}{1.57735 \times 2}\right)A = 0.183\,A.$$

Leo A. Brennan

Hardwood Steadyrest Guide

By H. H. Parker

Sometimes it is desired to turn a piece of finished work which must be supported in a steadyrest and where there would be danger of cutting the work if held in the regular jaws. This can be avoided by bolting a hardwood block across the steadyrest frame after removing the jaws, using, if possible, the bolt holes of the jaw-clamping bolts. A hole of the required

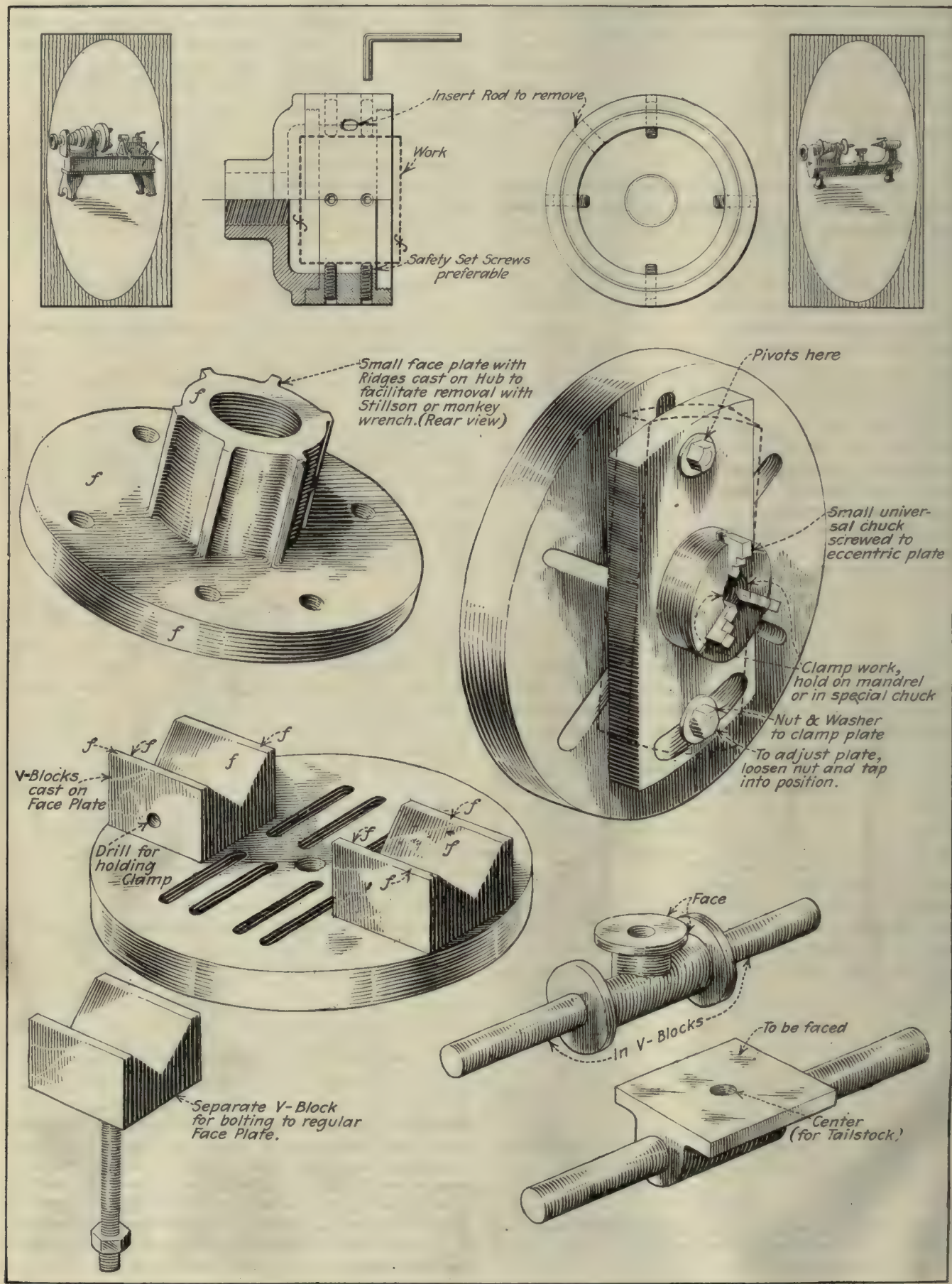


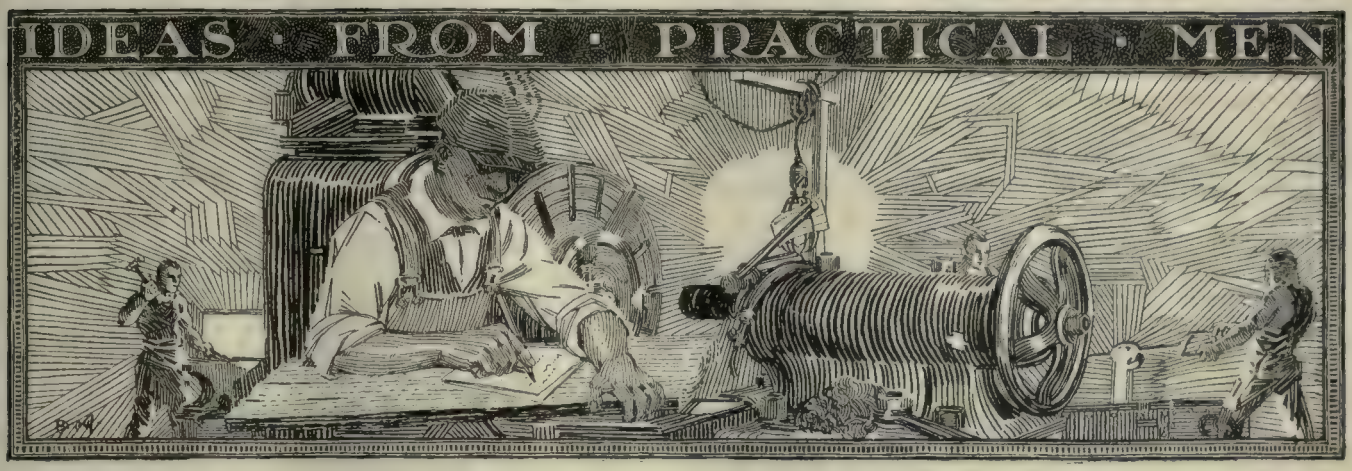
HARDWOOD GUIDE FOR STEADYREST

diameter is made in the block and if the bolt holes are larger than the bolts, the block may be aligned by tapping into place before finally tightening the bolts. In some cases it would be preferable to insert a brass or bronze bushing in the hole, or babbitt could be poured in and the opening reamed out to the required diameter. This is one way of turning keywayed or flatted work in the steadyrest.

Lathe Kinks

By H. H. Parker

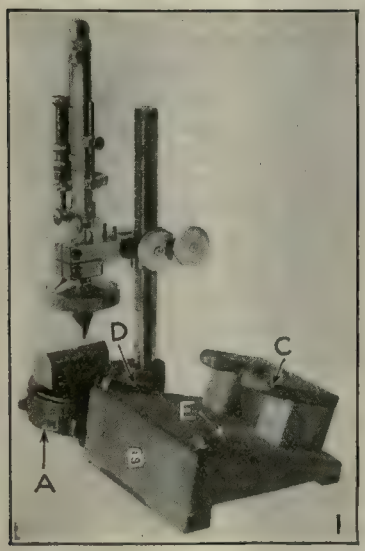


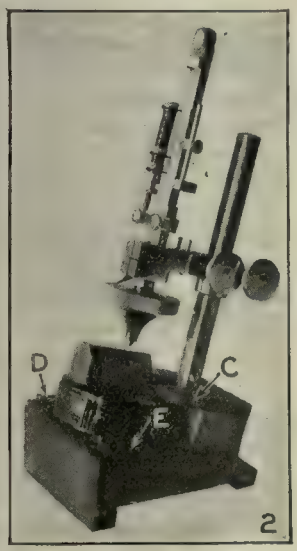


Tilted Stand for the Prestometer

By William Older

We have a great deal of comparing to do with the prestometer. The one we have was bought with the anvil parallel to the bottom of the base as shown at *A* in Fig. 1. This form of base is satisfactory for a great deal of our work but there are some pieces which are handled to better advantage with the instrument on a tilted stand. Our first idea was to make a stand with a quadrant so that it could be tilted over to the desired angle no matter what that might be. Before starting to make anything so complex, however, we decided to get out a simple tilted stand, as shown at *B*, Fig. 1. This was made of some scraps of mahogany from the pattern shop. The stand is about 6 in. square and gives a solid support for the instrument. A recess at the back accommodates the post. The ½-in. flange *C* just clears the top of the back of the base. Two ½-in. high lugs *D* and *E* on each side of the front just clear the projecting feet of the prestometer and prevent it from moving sidewise. Flanges could be put on top of the lugs *D* and *E* so that they would project over the feet. This would be necessary only if the angle at which the instrument is tilted is such that there would be a tendency for it to tip over backwards. Fig. 2 shows the instrument in place on the tilted stand.





FIGS. 1 AND 2. ARRANGEMENT OF PRESTOMETER AND STAND

Fig. 1—Prestometer and tilted stand made of wood. Fig. 2—Prestometer in place on the tilted stand.

Quick-Operating Clamp

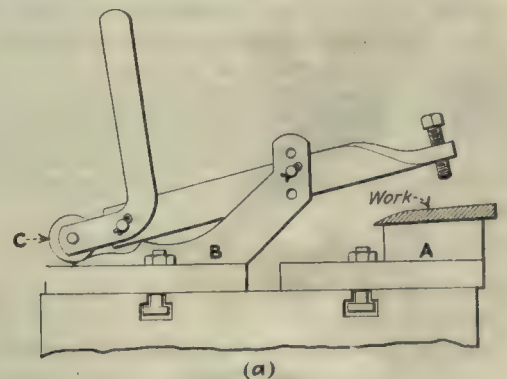
By H. M. Johnson

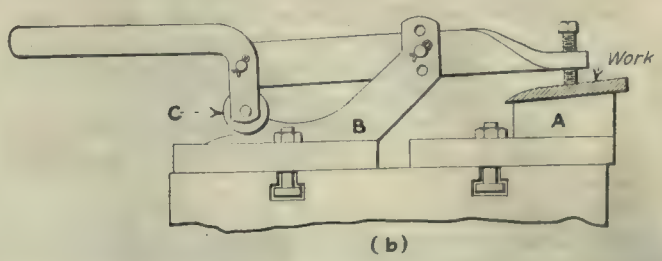
The clamp shown in the accompanying illustration was designed for use on a grinding machine to hold a plow share while grinding the rear edge on a cupped wheel.

The work is laid on the fixture *A* and located by pins not shown. The clamp is arranged to give a generous opening over the fixture, as shown in (a), to facilitate placing the work. Pressing down the handle causes the clamp to approach the work, rapidly at first, but finally with a slow, powerful movement as the roller *C* climbs the cam surface. The roller goes very slightly past center and stops against the end of the cam track, as shown in (b).

The bracket *B* has three pivot holes drilled to permit a wide range of adjustment in height. The setscrew takes care of small adjustments. By making the clamping device separate from the workholder, one clamp will serve a large number of fixtures. I have used this same clamping principle on a drill jig with good results.

The proportions of the levers were much different, but the principle involved was the same.





FIXTURE AND QUICK-OPERATING CLAMP

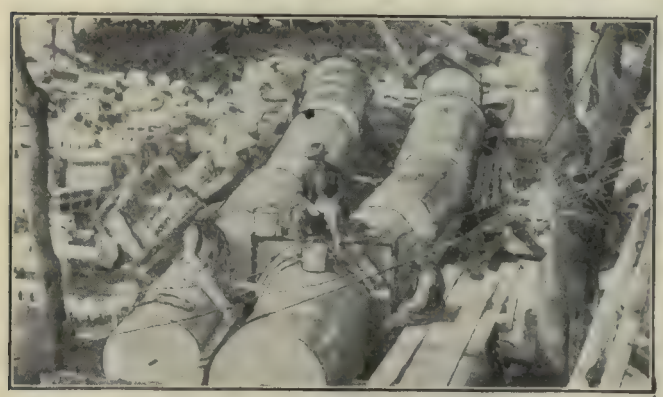
Hand-Sawing 3-ft. Cold Rolled Rounds

By E. A. Dixie

The illustration shows a job which was recently done on some columns for the new Times building, Hartford, Conn. The columns are granite. They had been *rolled* into the yard in place for cutting and the temperature was but a few degrees above freezing, so there is no deception in the caption.

When the Parkhurst church, New York, was razed a great part of the material was bought by the proprietors of the Hartford *Times* with a view to using it in the construction of their new building.

The columns are a little over 3 ft. in diameter, made up of several sections each about 9 ft. long. Certain of the sections had ornamental flanges cemented to them which had to be removed. Some of them came away from the cylindrical portion without much trouble, wedges being used to start a crack in the cement which held them together. There were others which positively refused to yield to this treatment so it was decided to saw them apart. The equipment consisted of an old



HIGH-SPEED HAND SAWING

two-man cross-cut wood saw, a bucket of water and one of sharp sand. The personnel, or organization, comprised three men. About four times daily during the week or so while they were cutting the flange off I passed the scene of their operations and can vouch for the fact that on at least one occasion I saw as many as two of them working at the same time. In order to plot an authentic motion study chart of the job, which would indicate the functions of each of the three men, I interrogated all the men in our shop which is just across the street from where the work is being done.

Sons of Rest

Of our force of 250 men there were 133 who said the three men were:

"Statues from Parkhurst's church, Judas Iscariot, Annanias and Pontius Pilate or some other of them 'Ginney' saints, to judge by their mugs."

One hundred and fifteen said that the three were giving a demonstration of "New Thought," or the power of mind over matter, as they seemed to be trying to wish the saw through the column.

The remaining two of our men had seen each one of the three in motion on various widely separated occasions.

From data culled from them and added to my own observations the flanges were separated in about the following manner:

The cement on top of the joint, between the column section and the flange, was scratched with a cold chisel till the scratch was deep enough for the saw to follow it. The saw was then reciprocated by the two men on each side of the column while the one on top occasionally dribbled a little water and sand in the kerf. When the saw was once in the kerf between the two sections of granite it automatically followed the joint, as the cement was softer than the granite.

It took the three men over a week to make the cut. There was a small gasoline engine on the contract which could have been rigged up by any intelligent mechanic in three hours to do the job, and with it the cut could have been made in not more than a day and a half, saving at least 18 days' wages.

A Short Proof for Long Division

By Alan G. Wikoff

I have read with interest J. Madden's article, entitled "A Short Proof for Long Division," on page 480 of *American Machinist*. It may interest your readers to know that the process of "casting out the nines" referred to can be shortened considerably in the following manner:

Take Mr. Madden's first example, 8761. His procedure is $8 + 7 = 15 - 9 = 6 + 6 = 12 - 9 = 3 + 1 = 4$.

The resultant is obtained more simply by adding the digits together and continuing this process until a single digit is obtained.

Thus $8 + 7 + 6 + 1 = 22$; $2 + 2 = 4$.

The step of subtracting 9 each time is unnecessary. In adding the digits, 9's or numbers whose sum is 9, may be neglected.

As another example, taking his figures for proving subtraction:

$$\begin{array}{rrr} 879654 = 39 = 12 = 3 \\ 123007 = 13 \quad\quad = 4 \\ \hline 756647 = 35 \quad\quad = 8 \\ 84 = 12 = 3 \end{array}$$

The process of "casting out nines" is thus reduced to straight addition which can be performed mentally with rapidity. I do not make any claim for the originality of this short-cut, since it is constantly used by bookkeepers and accountants.

It is also obvious that this method fails when an error involving 9 or some multiple of 9 has been made. While the probability of such an error is small, it may occur in addition and subtraction.

If, for example, the sum given on page 481 had been found on first trial to be 3760508 instead of 3850508, the proof would have indicated that the summations had been made correctly, for

$$\begin{array}{l} 3760508 = 29 = 11 = 2 \\ 3850508 = 29 = 11 = 2 \end{array}$$

A few trials will show that any change involving 9 or a multiple of 9 will give the same "remainder."

Thus:

$$\begin{array}{l} 3850517 = 29 = 11 = 2 \\ 3851408 = 29 = 11 = 2 \\ 3761408 = 29 = 11 = 2 \end{array}$$

It is well to keep this point in mind, although it is seldom that it will interfere with the application of this proof.

World Trade Club Methods!

THERE was a notable gathering of business men in Paris in June of this year when American delegates met their European associates in the first meeting of the **International Chamber of Commerce.**

The advocates of the "Compulsory introduction of the metric system in the United States" presented to this body for adoption a strongly worded resolution, urging this country and Great Britain to discard their present system of weights and measures and in its place to compel the exclusive use of the metric system.

At the head of this movement was Albert Herbert, "Angel" of the "World Trade Club," of San Francisco. The resolution presented by Mr. Herbert bore his name as: "Chairman, Delegate of World Metric Standardization Council, World Trade Club, Foreign Trade Club, San Francisco." Five other names were signed to this resolution, among which was that of, Prof. George B. Roorbach, "Delegate of the Business Education Section of Harvard University, Boston, U. S. A."

The method employed in framing this resolution and what happened to it can best be gathered from a letter sent to the American Institute of Weights and Measures, and given below.

HARVARD UNIVERSITY,
GRADUATE SCHOOL OF BUSINESS ADMINISTRATION
CAMBRIDGE, MASS., Aug. 21, 1920.

Dear Sirs:

In reply to your letter of Aug. 6, I wish to state that the resolution introduced by Albert Herbert at the International Chamber of Commerce in Paris, and purporting to be signed by me, was done **without any authorization on my part.** I was astounded when I saw the resolution with my name attached. I not only did not sign this resolution but had no idea that such a resolution was to be presented and had previously indicated to Mr. Herbert that I had no wish to be connected with the introduction of any resolution on this topic. I had told Mr. Herbert that in a general way I was in favor of a greater amount of uniformity in the use of weights and other units for International Trade. I did not, however, know enough in regard to the particular matter under discussion to commit myself in favor of the metric system.

I would like to add that the resolution that Mr. Herbert sent out was not passed by the International Chamber of Commerce. **It was introduced, discussed, and definitely turned down.** When I vigorously objected to Mr. Herbert for the use of my name on the resolution, he stated that the resolution was mimeographed only for distribution among the delegates at Paris and that it was not to be given any wide publicity. I now find that he is sending it to various parties in the states, and I presume elsewhere, and giving the impression that it was adopted by the International Chamber.

Thanking you for bringing this to my attention, I am

Very Truly Yours,
(signed) G. B. Roorbach, Professor of Foreign Trade.

No comment is necessary.

Ethan Viall
Editor

WHAT to READ —for the man in a hurry



Suggested by the Managing Editor

THIS week we begin a series of articles on apprenticeship and special training programs in more than a score of the leading shops and plants of this country. Their appeal will be more particularly to employers, employment managers, superintendents, and other executives directly interested in the education and training of personnel.

The author is John Van Liew Morris whose expressive countenance appears on this page. Mr. Morris is a Harvard man and also wears a Ph.D. from Teachers College, Columbia University. Incidentally, the research work on which these articles are based was done while he was working for his doctor's degree. In addition to his university training he has put in eight years as a teacher, during six of which he was principal of a technical institute. His broad experience in his particular line is reflected in this series. The first article of the series discusses the various forms of training at the Schenectady plant of the General Electric Co.

What to read was not a difficult matter to decide two hundred years ago when books were few and magazines unheard of. It is far different now when so much reading matter is offered to pass the time pleasantly or profitably as the reader chooses. We are doing our utmost to make the "American Machinist" not only profitable but indispensable as a clearing house of ideas and news of the machinery world. This page is the editors' advertisement of their section of the paper. It gives the high spots.

Page 571 is the first of ten devoted to one of the deferred automotive cylinder articles by Fred Colvin that was mentioned last week. Starting with the methods at the Oakland shop which are given in considerable detail we are following up with the Studebaker and Essex practice. The three cylinders are widely different in design and consequently the contrasts between the practices of the three shops are interesting.

Following the automotive article is one by T. F. Stacy on spring design. This paper discusses springs of circular cross-section and includes valuable design charts.

On page 583 is the twenty-seventh of Ethan Viall's welding articles. This one is a continuation of last week's and describes the constructional details and operating principles of various makes of arc-welding sets, both stationary and portable. Suggestions for improving relations and working conditions in the shop are made by John T. Bartlett on page 589 and by J. E. Bullard on page 591. Mr. Bartlett tells of the possibilities of the plant paper in clearing up misunderstandings and Mr. Bullard takes up the important items of fresh air and abundant light and discusses their effect on output. Nothing so very new, perhaps, but it does no harm to remind people of these things periodically. The second and concluding part of Lineham's article on the hardening of screw gages with minimum distortion appears on page 604a (omitted from European edition). The author's conclusions are worth noting. Editorially, we feel it necessary to take one more crack at the viciously misrepresenting methods of the "World Trade Club" and allied interests. Page 597.



J. V. L. MORRIS

On page 599 is the tentative program for the first meeting of the American Engineering Council of the Federated American Engineering Societies. This most important meeting will take place in Washington on Nov. 18 and 19. In our opinion too much stress cannot be laid upon the fact that the formation of this organization is a matter of considerable consequence for all engineers. We have been guilty of repeating the facts about the Federation more than once but it has been done with intent for we are anxious that no engineer reached by the *American Machinist* shall be ignorant of the aims of the Federation and its significance for himself and other members of the profession.

First Meeting of the American Engineering Council of the Federated American Engineering Societies

THE Organizing Conference of The Federated American Engineering Societies, held in Washington June 3-4, 1920, was attended by 140 delegates representing over 71 organizations, having an aggregate membership of over 110,000, or over 80 per cent of the aggregate membership of all of the organizations that were invited. The questions have been asked:

"WHO ARE THESE MEN?"—
"WHO WERE INVITED?"
and—
"WHO SHOULD BE INTERESTED IN THIS MOVEMENT?"

The Federated American Engineering Societies is constituted of engineering and allied technical organizations, whose chief purpose is the advancement of the knowledge and practice of engineering and allied technical arts, which are not organized for commercial purposes. It includes the individual engineer and the allied technologist who is represented through the society or sosieties of which he is a member, which have membership in the organization. It includes civil, mining, metallurgical, mechanical, electrical, testing, railway, highway, municipal, hydraulic, sanitary, water-works, bridge, agricultural, illuminating, heating, ventilating, refrigerating, safety, radio, fire protection, automotive, industrial, military, marine, naval and chemical engineers, architects and naval architects, chemists and geologists. These branches of engineering and allied sciences cover the whole range of activity in this country upon which is dependent its economic success. It has been said that "EVERYWHERE YOU LOOK YOU SEE WORK THAT ENGINEERS HAVE DONE."

Engineers and allied technologists have been content to perform their work without notoriety. Dating from a period considerably before the war, the engineer was gradually developing class consciousness, and a desire to be of public service. This desire was intensified as a result of the World War and led to the formation of Engineering Council by the American Society of Civil Engineers, the American Institute of Mining and Metallurgical Engineers, the American Society of Mechanical Engineers, and the American Institute of Electrical Engineers. In the effort of these societies to determine in what way their activities could be improved and rendered of greater value, committees were appointed by each, and these committees in turn appointed conferees, who met and organized the Joint Conference Committee. As a result of this intensive desire for service, it was the unanimous opinion of the Joint Conference Committee that a comprehensive organization was desirable that could speak for the engineering and allied technical professions wherever engineering experience and technical training are involved, as well as in matters of common concern to these professions. This recommendation was accepted by the constituent societies who authorized the committee to call, without delay, a conference of representatives of national, local, state and regional engineering organizations and affiliations for the purpose of bringing into existence the comprehensive organization recommended. The committee issued a call to 110 engineering and allied technical organizations for the thoroughly representative Organizing Conference of June 3-4, 1920, which has been characterized as the greatest event in the engineering history of this country.

This organizing conference, without a dissenting vote, created The Federated American Engineering Societies and authorized the Joint Conference Committee to act as the Ad Interim Committee between its adjournment and the first meeting of its governing body, American Engineering Council.

The Federated American Engineering Societies already has an aggregate membership greater that that of any other engineering organization in the world. As has been pointed out repeatedly, the question is not whether this organization will come into existence but the number of members it will have; it already is in existence, and the Joint Conference Committee as the Ad Interim Committee representing it, is engaged in furnishing the organizations invited to become charter-members with information and other assistance to enable them to act intelligently on the invitation. From the advices already received, the committee can state that American Engineering Council will have a greater number of member-societies than Engineering Council and will also represent a much larger aggregate membership—estimated considerable in excess of 60,000. This meeting of the American Engineering Council will deal with the future work of the organization.

Program

Thursday, November 18, 1920

Morning Session

8.30 a.m. Registration.
10.00 a.m. Opening session of American Engineering Council.
1. Call to Order; Richard L. Humphrey, Consulting Engineer, Philadelphia, Pa., chairman of the Joint Conference Committee.
2. Election of Temporary Chairman.
3. Election of Temporary Secretary.
4. Appointment of the following Temporary Committees:
(a) Program; (b) Credentials; (c) Constitution and By-Laws; (d) Nominations; (e) Plan and Scope; (f) Budget; (g) Resolutions.

Afternoon Session

2.00 p.m. Address—"Engineering Council," J. Parke Channing, Consulting Engineer, New York, N. Y., Chairman.
2.30 p.m. Discussion of the field of activity for The Federated American Engineering Societies.

Friday, November 19, 1920

Morning Session

9.00 a.m.
1. Report of Committee on Nominations
2. Election of Permanent Officers
3. Report of Committee on Constitution and By-Laws.
4. Formal Ratification of Constitution and By-Laws.
5. Report of Committee on Plan and Scope.

Afternoon Session

2.00 p.m.
1. Report of Committee on Budget.
2. Report of Committee on Resolutions.

Evening Session

8.30 p.m.
1. Introductory remarks by presiding officer, the President of American Engineering Council.
2. Address (subject to be announced later) Herbert C. Hoover, President, American Institute of Mining and Metallurgical Engineers, New York, N. Y.

9.30 p.m. Informal reception and smoker

Saturday, November 20, 1920

9.00 a.m. Organization Meeting, Executive Board, American Engineering Council, of The Federated American Engineering Societies.

Alfred Herbert No. 5 Automatic Turret Lathe

SPECIAL CORRESPONDENCE

The development of automatic machinery follows slightly different lines in England than in the United States. One of the latest general-purpose automatic machines, representative of the best English practice, is here described. It has a number of patented features, and will be found to be somewhat different from the American automatic turret lathes.

THE illustration shows a turret lathe recently put out by Alfred Herbert, Ltd., Coventry, England, with offices at 54 Dey St., New York, N. Y. The machine has a maximum swing over the bed of 18½ in. and is known as the No. 5 model. All operations are automatic, except chucking, and the machine stops automatically at the finishing of a piece. There are a number of interesting features to the lathe, such as the longitudinal adjustment of the headstock, the independent operation of the front and rear cross-slides, and the low position of the spindle, which makes setting up an easier task.

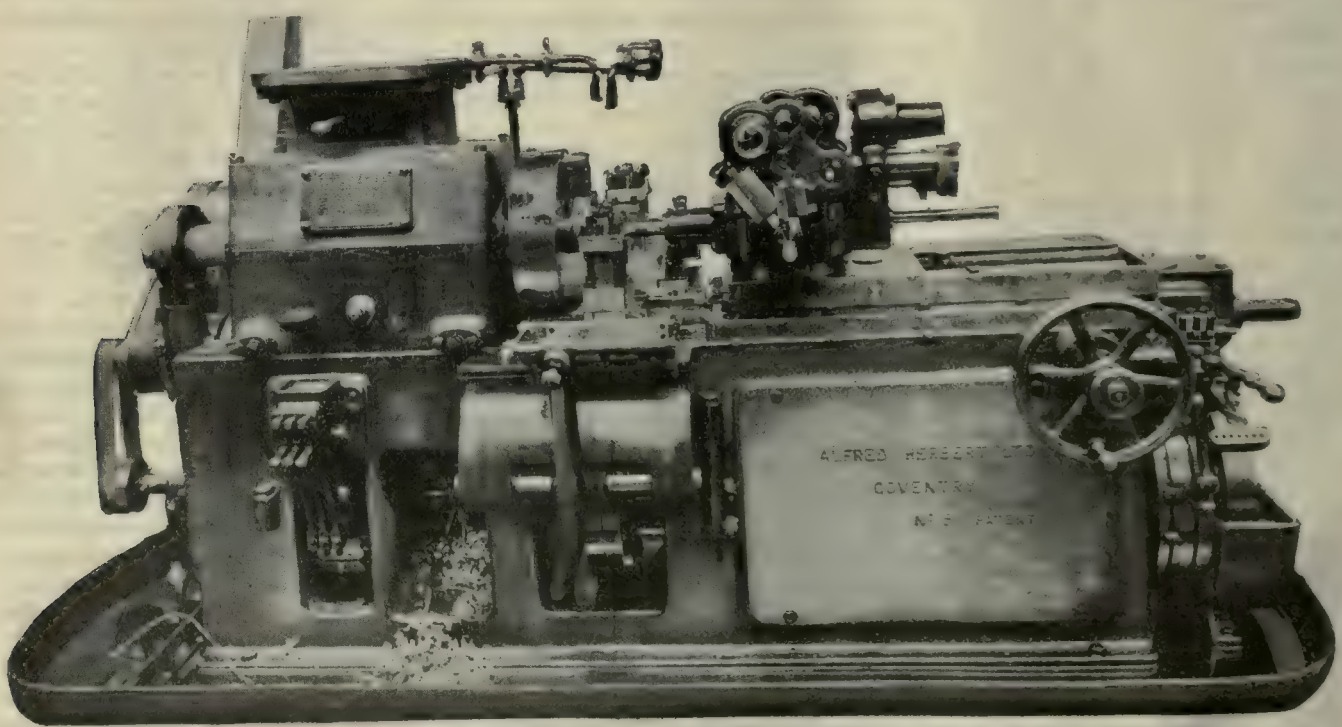
Constant-speed drive by a 4-in. belt is employed, the 10-in. driving pulley running on ball bearings. The drive can be engaged for starting the machine by means of a friction clutch operated by a hand lever. The headstock is adjustable along the bed for a length of 6 in. and its mechanism is completely inclosed, the gears running in oil.

There are five spindle speeds that are changed automatically. It is claimed that the changing is performed instantaneously and silently, and that it can take place while the tools are cutting, if necessary. Change gears are provided to give six principal or substantive speeds, by which the range of the automatically operated speeds is changed. Since these five automatically changed speeds can be used with each substantive speed, a total number of 30 steps is provided in a range from 14 to 411 r.p.m., the maximum gear ratio being 28.5 to 1. If desired, change gears can be furnished to give additional speeds.

The hollow spindle is 5⅛ in. in diameter at the front neck and has a flange on the nose 10 in. in diameter. It has a bore of 3⅜ in., runs in white-metal bearings and is provided with a ball thrust bearing. It can be stopped automatically at any instant and then restarted automatically in time for the next cut. This action is valuable, particularly, to enable the withdrawing of a tool at the end of a cut without leaving a helical mark on the work.

The turret has four faces, machined square with the spindle. The tool holes are 2¼ in. in diameter. The turret is mounted on a slide having a working stroke of 13 in. It is indexed at the extreme back position and then clamped automatically.

The cam controlling the action of the turret con-



ALFRED HERBERT NO. 5 AUTOMATIC TURRET LATHE

Specifications: Maximum swing over bed, 18½ in. Maximum swing between cross-slides, 16 in. From spindle to face of turret: maximum, 34 in.; minimum, 15 in. Spindle to floor, 40¼ in. Turret: number of holes, 4; length of working stroke, 13 in. Cross-slides: adjustment along bed, 7½ in., transverse feed, 4½ in.; maximum distance from spindle, 11½ in. Horsepower, 7. Speed of driving pulley, 400 r.p.m. Spindle speeds: automatically changed, 5; substantive, 6; 14 to 411 r.p.m. Feeds, rev. per in.: turret slide, 16, 27, 48, 64, 83, 110, 144; cross-slides, 40, 68, 122, 163, 212, 280, 366. Floor space, 6 x 12 ft. Approximate weight: net, 8,500 lb.; gross, 10,100 lb. Boxed for export, 340 cu.ft.

sists of a drum running in oil and driven directly by a worm. It is provided with two grooves, one for moving the turret slide and the other for indexing the turret. Since the latter action occurs only when the turret is in its extreme back position, all of the working stroke is available for actual machining operations. The turret-actuating groove is cut like a screw-thread and returns upon itself, so that the turret moves with a smooth and steady motion. It is claimed that no irregularity or jumping occurs, even when taking heavy cuts. For each complete forward and return movement of the turret the cam makes three complete revolutions. Rotation of the turret to present a different tool to the work requires but 1.1 sec., and the time for a complete cycle of the machine at high speed is only 48 seconds. The turret is 11¼ in. in diameter and the centers of the tool holes are 4⅛ in. above the slide. The distance between the face of the turret and the face of the spindle varies from 15 in. as a minimum to 34 in. as a maximum.

Cross-Slides

The front and back cross-slides are independent of each other in their action, and can be set to work either at the same time or separately, as required. For example, roughing and finishing facing cuts can be taken simultaneously. The cross-slide cams can be adjusted to operate at any part of the cycle of operations. Each cross-slide is provided with a double toolholder and a stop with screw adjustment for regulating the diameter turned.

The center of the spindle is 4½ in. above the top of the front slide and 3½ in. above the back slide. The slides have adjustments along the bed of 7½ in., independently of each other. The horizontal distance from the spindle to the cross-slides can be varied from nothing to 11½ in., power feed being available for a stroke of 4½ in. The maximum diameter admitted between the cross-slides is 16 in. Ample room is provided under the tools for the chips to get away, the chute for this purpose being plainly visible in the illustration.

Ranges of Feed

The "self-selecting" feed motion provides, for both the turret and the cross-slides, ranges of 7 feeds, any one of which can be brought into action instantly at any part of the cycle, even during a cut, if required. The feeds are driven from the headstock; but the quick or idle motions are driven from the constant-speed driving pulley, so that the idle motion always takes place at the same rate of speed. It is claimed that the range of feeds is sufficiently broad so that it is never necessary to change the feed cams. The feed of the turret slide varies from 16 to 144 rev. of the spindle per inch of feed and that of the cross-slides from 40 to 366 rev. per in.

The bed is a box casting. It is built low, the spindle being only 40¼ in. above the floor, so that the machine can be tooled up and attended more conveniently. The tray extends the full length of the bed and provides ample room for chips.

A pump with fittings, including splash guards, is supplied at extra cost. Oil supply through the turret can be furnished for use with hollow tools for carrying lubricant to the cutting edges.

A back-facing attachment can be furnished if desired. It is claimed that its use often enables a piece to be completely machined at one setting instead of two.

The 15-in. Coventry chuck is suitable for use with this machine, although special chucking fixtures can be furnished for work that cannot be handled by it. A standard tool outfit can be supplied and the maker recommends its use for general work. The outfit includes a centering tool, facing tools for the cross-slides, boring bars and combination boring, turning, and facing tools that are provided with an overhead support.

The machine is intended to be driven by a 7-hp. motor. The floor space required is 6 x 12 ft., the approximate net weight is 8,500 lb., and the size when boxed for shipment is 340 cu.ft.

A Question in Factory Management

By H. L. Smith

In the *American Machinist* for August 19, W. Burr Bennett raises a question in factory management having to do with the establishment of a department for a new class of work.

Assuming that a comparatively small space of time will elapse before the out-put of the department will be great enough to employ a man full time on this new work, and assuming that the man selected is inexperienced in this work, but is ambitious and anxious to learn, he should be assigned to this work for his entire time.

Just as a Vestibule School is run for the training of new employees and the cost charged to the current burden of the operating department, so the wages of this man while he is learning should be charged as a burden on the department.

This will then reflect the actual condition which is that the cost of performing this work in the new department is relatively higher than it will be when the production is sufficient to occupy the full capacity of the man and of the department.

A Deferred Expense Account

If the expense of setting up and operating the department until it is on a production basis is large enough to warrant, it is advisable to establish a Deferred Expense Account to which all expenses incident to the establishment of the department, which are not of an asset nature, may be charged. This Deferred Expense is then divided into twelve, twenty-four or more parts and one part is charged into the burden of that department each month until the Deferred Expense is thus disposed of.

In this manner, it is possible to make the production of the following year or two or more bear a proportion of the expense of starting this department. This tends to keep the burden rate for that department more nearly uniform.

The man working a part of his time on production and spending the balance in learning his job is creating an asset to the company, the expense of which is thus distributed over the work of the future which is to profit by his experience.

The ratio of the expense of starting the department to the expense of the department after it is operated, helps to determine the period over which the Deferred Expense should be spread.

SHOP EQUIPMENT NEWS

-Edited by-
S. A. HAND

SHOP EQUIPMENT • NEWS •
A weekly review of modern designs and • equipment •

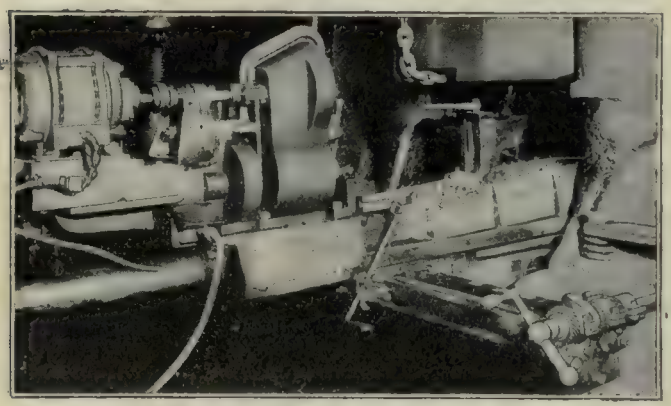
Descriptions of shop equipment in this section constitute editorial service for which there is no charge. To be eligible for presentation, the article must not have been on the market more than six months and must not have been advertised in this or any previous issue. Owing to the news character of these descriptions it will be impossible to submit them to the manufacturer for approval.

• CONDENSED • CLIPPING INDEX
A continuous record of modern designs • and equipment •

Whitcomb Blaisdell (Damerell) Portable Shaper

A portable shaper designed for truing up drop-hammer parts has been brought out by the Whitcomb-Blaisdell Machine Tool Co., Worcester, Mass., and is illustrated herewith.

The machine is distinctly a draw-cut shaper, is made in two sizes and is motor driven. It is claimed that the ram will stop in reverse within ⅛ in. without overtravel, allowing the tool to cut close to corners and shoulders. The horizontal feed can be operated either by hand or automatically, while the vertical feed is by hand.



WHITCOMB-BLAISDELL PORTABLE SHAPER

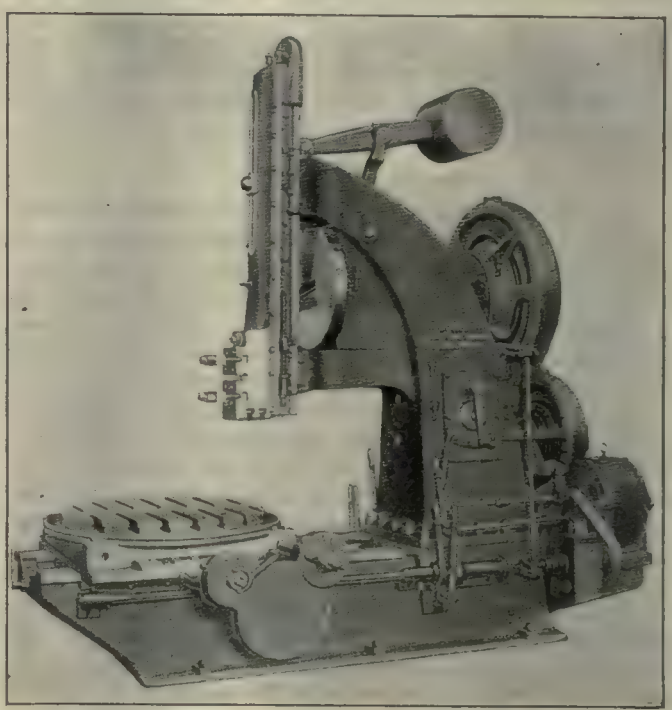
Specifications: Small size. Capacity; will plane 48 x 48 in. horizontally and 8 in. vertically. Large size: capacity, will plane 66 x 66 in. horizontally and 8 in. vertically. Motor, 3 hp. for both sizes. Speed; cutting stroke, 20 ft. per min.; return 40 ft. per minute.

Jones 20-in. Slotting Machine

The Jones Machine Tool Works, Media and Edgewood Sts., Philadelphia, Pa., has placed on the market the slotting machine illustrated herewith.

This machine has a single pulley drive and may be driven by belt from a two-speed countershaft or by direct connection to a motor. The drive is through a friction clutch and the ram can be quickly stopped by a brake. The feeds for the saddle, cross-slide and circular table are of the usual intermitted ratchet-type. All operating levers are conveniently placed and are in duplicate, complete sets being placed on both sides of the machine. Quick power-traverse is provided for all feeds and may be engaged without throwing in the main clutch which starts the ram.

The circular table is graduated on its periphery and in addition is provided with an indexing device. The feeds for the cross-slide and the circular table are interlocking so that both can not be engaged at the same time.



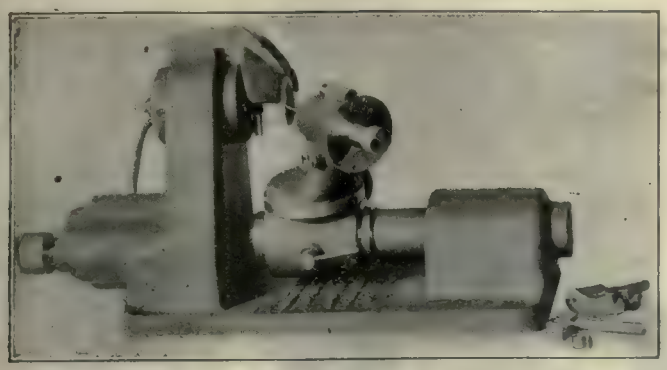
JONES 20-IN. SLOTTING MACHINE

Specifications: Speeds; four, 8 to 16 strokes per minute with constant speed motor; or, 8 to 42 strokes per minute with variable speed motor or two speed countershaft. Motor, 10 hp. Floor space, 7 ft. x 12 ft. 7 in. Height, 13 feet.

Gorton Engraving Cutter Grinding Machine

For grinding the cutters used on its engraving machines, the George Gorton Machine Co., Racine, Wis., has brought out the machine illustrated herewith.

The abrasive wheel is direct driven by a small high-speed motor incorporated in the machine. The motor is of the universal type and can be used with either d.c. or a.c. current. Motors can be furnished for any desired voltage. The tool to be ground is supported in a sleeve which holds it identically as it is held in the engraving machine, the sleeve being provided with indexing means for determining the cutting angle. The tool carrier has a graduated swivel-base so that the tool point can be presented to the wheel at any angle desired. The regular equipment includes an attachment for grinding the point of the stylus used in connection



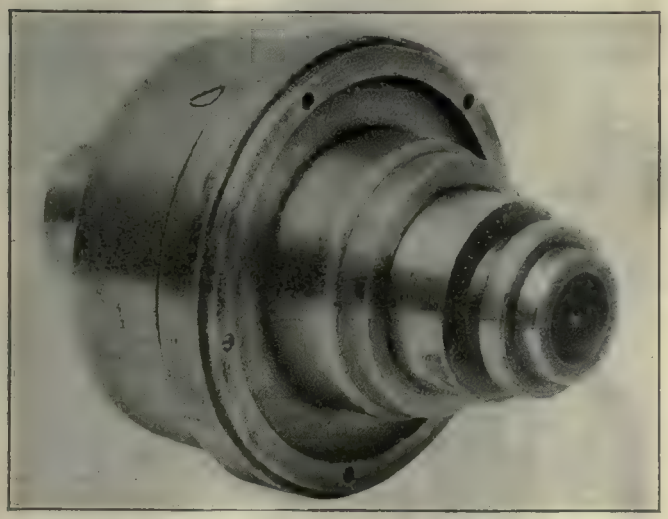
GORTON ENGRAVING-CUTTER GRINDING MACHINE

with the master plate on the engraving machine, also a holder for the truing diamond.

The machine as shown is intended for bench use, but can be furnished mounted on a pedestal if desired. Weight as shown, 75 pounds.

Mill Duplex Friction Clutch

The friction clutch shown in the illustration has recently been placed on the market by the A. Mill Clutch Co., 2116-20 Colerain Ave., Cincinnati, Ohio. Contact is made by means of both an expansion friction ring and two side plates, so that all of the surface available for friction inside of the case is utilized. When the clutch is operated, the ring engages first



MILL DUPLEX FRICTION CLUTCH

and then the side plates, thus securing a jerkless grip on the rotating shaft.

The case is said to be perfectly dustproof and capable of holding oil for a long time. The clutch is especially adapted to high speeds, can readily be engaged and disengaged and is easily adjusted for wear.

Wedge Optical Pyrometer

The Rohde Laboratory Supply Co., 17 Madison Ave., New York, N. Y., has placed on the market the instrument shown in the illustration, intended for the measurement of high temperatures and is known as the Wedge optical pyrometer. The instrument can be used whenever the object to be examined shows a distinct coloration due to heating. It is claimed that the size of the object or its distance from the pyrometer does not affect the reading.

The instrument contains an achromatic telescope, the objective of which focuses the image of the heated body on a movable prism. The observer views the image on the prism through the eye piece, exterior light being shut out by means of a shield. The prism is made of dark glass and can be moved across the field of vision by means of a rack and pinion. It is moved until the proper thickness of glass is interposed to just shut off the light emitted by the heated



WEDGE OPTICAL PYROMETER

body. At this point, when the image disappears, the temperature of the heated body can be read under the pointer on the scale of the instrument.

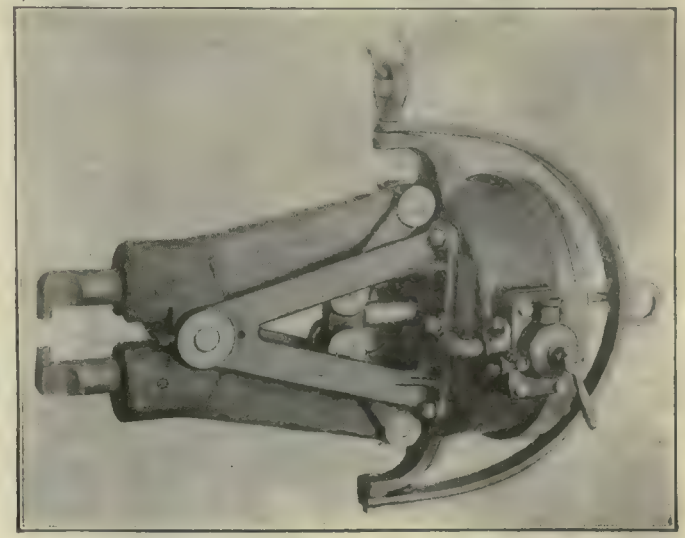
The pyrometer can be furnished in three standard types to cover ranges of 400, 650 or 800 deg. C., the scale of the first mentioned instrument being graduated in 20-deg. intervals and the scales of the others in 25-deg. intervals. A stand with a clamp can be furnished.

Baird Close-Corner Riveter

The Baird Pneumatic Tool Co., Kansas City, Mo., has added to its line the riveter illustrated herewith.

This riveter is a special machine and, as its name implies, is intended for work in extremely close corners where riveting by a hand hammer is impossible.

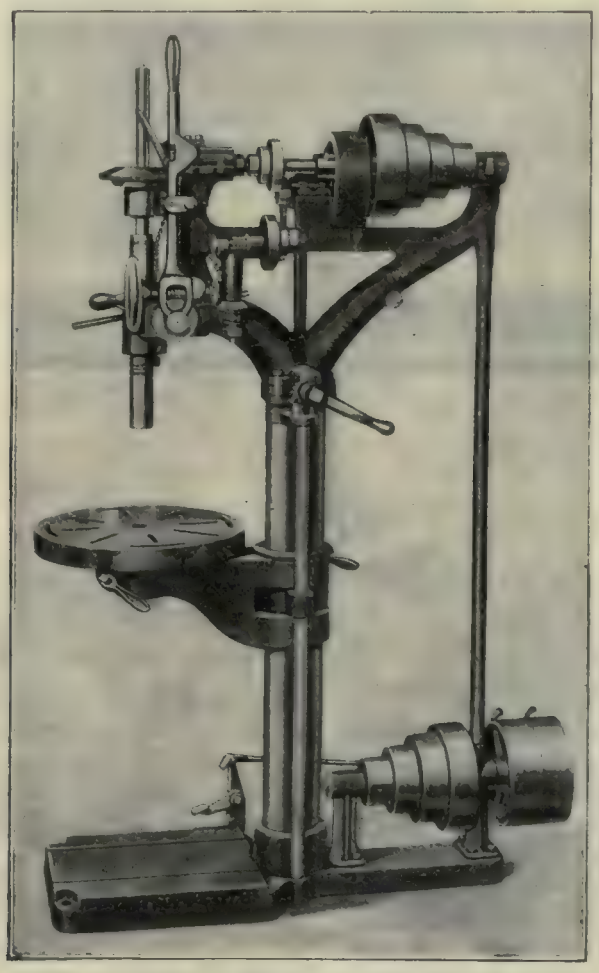
It is claimed that in this riveter, a pressure of 50 tons is exerted on the dies and that ⅞-in. rivets can be driven cold.



BAIRD CLOSE-CORNER RIVETER

Frontier 20-In. Drilling Machine

The 20-in. drilling machine illustrated is manufactured by the Frontier Machine Tool Co., Inc., 128 Lakeview Ave., Buffalo, N. Y., and is designated as



FRONTIER 20-IN. DRILLING MACHINE

Specifications: Table diameter, 17 in. Capacity, up to 1¼ in. drill. Distance between table and spindle, 26 in. Distance between spindle and base, 38½ in. Vertical travel of table on column, 24 in. Hole in spindle, No. 3 Morse taper. Number of speeds, 8, with use of back gear. Feeds; 0.005, 0.015, and 0.030 in per revolution. Floor space 15 x 48 in. Weight; net, 635 lb.; crated, 700 lb.; boxed for export, 950 pounds.

No. 5. An important feature is the double column. The rear column is intended to counteract the effect on the column of the upward thrust on the spindle.

Bremer Babbitting Fixture

The babbitting fixture shown in Fig. 1 is used for rebabbitting bearings of connecting rods up to 12 in. in length, center to center, and any bore from ¼ to 2½ in. It is being manufactured by the O. A. Bremer Co., 222 Division St., Burlington, Ia., and is intended for the use of the garage repair shop. The wrist-pin of the connecting rod is clamped in the V-slot at one end of the base and the rod supported in the center so that it is parallel with the base of the fixture, to which the arbor is clamped. The bearings may be babbitted while in the rod or made removable. The claim is made that very little scraping is required to make a perfect fit on the crankshaft. This fixture is supplied with four wooden arbors, 1¼, 1½, 1¾ and 2 in. Its shipping weight is 15 pounds.

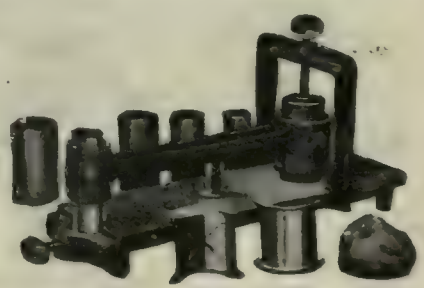


FIG. 1. BREMER BABBITTING FIXTURE

The same concern has brought out the fixture shown in Fig. 2 for rebabbitting Ford connecting rods. This device is equipped with a special metal arbor which is machined to the one-thousandth part of an inch. It is said that with the use of this device it is possible to cast the bearings to the exact size and shape without any scraping, with the exception of a few strokes of a coarse file to remove sharp corners. Weight, 8 pounds.

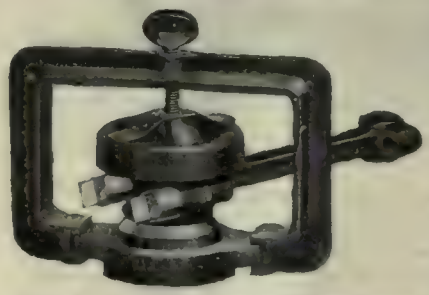
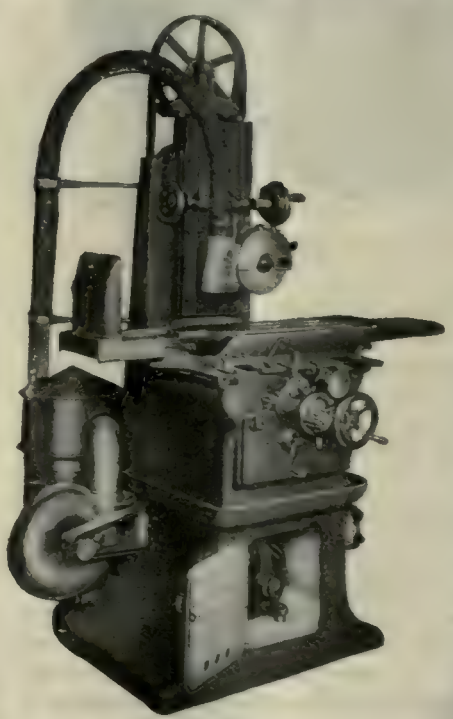


FIG. 2. BABBITTING FIXTURE FOR FORD CONNECTING RODS

Exhauster Attachment for Surface Grinding Machines

The Abrasive Machine Tool Co., of East Providence, R. I., has designed a complete exhaust system for its machines, as shown in the illustration. The exhauster is equipped with S-K-F ball bearings and aluminum fan, running at 4,000 r.p.m. It is connected with the aluminum dust collector on the wheel hood by means of a large flexible wire-insert rubber suction tubing. The wheel dust is drawn in through the flexible tubing, and forced into the centrifugal drum attached to the rear of the machine, where the dust is separated and deposited at the bottom of the cone. The accumulation of dust can be easily removed by unscrewing a cap at the bottom of the separator drum, which should be attended to each morning. Although designed primarily for single machines not placed in a battery where a central exhaust system can be employed, the claim is made that this exhauster is more economical in many cases than the central system because it is not running when the machine is idle.



THE EXHAUSTER ATTACHMENT

The Hardening of Screw Gages With the Least Distortion in Pitch*

By WILFRID J. LINEHAM†
Goldsmiths College, London

The first paper was complete in itself. A quenching temperature of 700 deg. C. (1,292 deg. F.) was indicated as the position of smallest stable distortion in length under the conditions carefully stated. There were six sets of experiments (Experiments 1 to 6) and the time of casing in cyanide was about half-an-hour, calculated to produce a case of about 0.003 inch. It should be noted that the experiments did not actually prove more than was claimed in the paper, and nothing was made evident regarding any other possible conditions. Continuing his experiments, the author subsequently found other important results, which are now described in this second paper.

(Part I was published last week)

II. Oil Hardening

AN ACTUAL screw-gage was prepared to the dimensions in Fig. 15A. This was screwed in the lathe to 0.0002 in. minus in total pitches and to the diameters shown in the chart, Fig. 16. It was cased in barium carbonate and bone black for two hours at a temperature estimated at 800 to 850 deg. C. (1,472 to 1,562 deg. F.). It was immediately afterward transferred to the cyanide bath, which stood at 770 deg. C. (1,418 deg. F.), allowed a quarter hour to even up, and another quarter to lower to 695 deg. C. (1,283 deg. F.), at which temperature it was quenched in water at about 15 deg. C. (59 deg. F.).

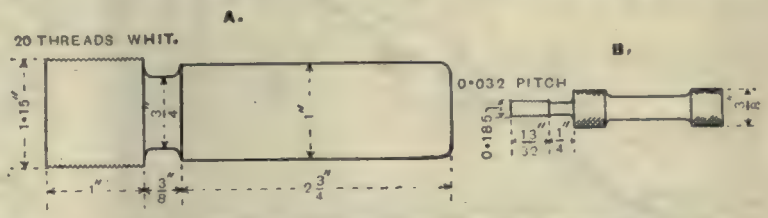


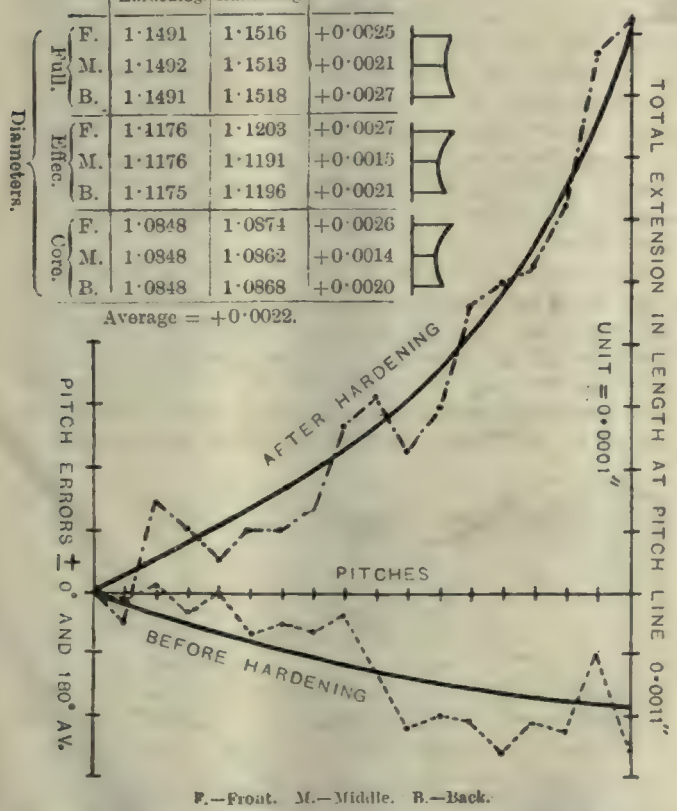
FIG. 15. GAGES USED IN EXPERIMENTS
A for Figs. 16 to 19, 24, 24A, 25 and 25A. *B* for Figs. 26 to 29.

The results of this test are shown in Fig. 16, from which it will be seen that the length increased to 0.0011 in., while the diameters were enlarged by about 0.0022 in., the festoon shape being definitely formed on the rim. It is evident that the extension of 0.0002 in. found in the previous paper is only correct for gages cased for half-an-hour in cyanide and does not apply to the treatment under present consideration. [This experiment took place May 22, 1918, and was labeled No. 7.]

*Read at a meeting of the Institution of Mechanical Engineers.
†Deceased.

Diameters.		Before Hardening.	After Hardening.	Change.
Full.	F.	1·1491	1·1516	+0·0025
	M.	1·1492	1·1513	+0·0021
	B.	1·1491	1·1518	+0·0027
Effec.	F.	1·1176	1·1203	+0·0027
	M.	1·1176	1·1191	+0·0015
	B.	1·1175	1·1196	+0·0021
Core.	F.	1·0848	1·0874	+0·0026
	M.	1·0848	1·0862	+0·0014
	B.	1·0848	1·0868	+0·0020

Average = +0·0022.



F.—Front. M.—Middle. B.—Back.

FIG. 16. EXPERIMENT 7. CASED FOR 2 HOURS IN BOX, HARDENED IN WATER FROM 695 DEG. C.

Diameters.		Before Hardening.	After Hardening.	Change.
Full.	F.	1·1490	1·1515	+0·0025
	M.	1·1490	1·1501	+0·0011
	B.	1·1490	1·1507	+0·0017
Effec.	F.	1·1181	1·1207	+0·0026
	M.	1·1182	1·1195	+0·0013
	B.	1·1182	1·1200	+0·0018
Core.	F.	1·0848	1·0869	+0·0021
	M.	1·0849	1·0855	+0.0006
	B.	1·0949	1·0959	+0·0010

Average = +0·0016.

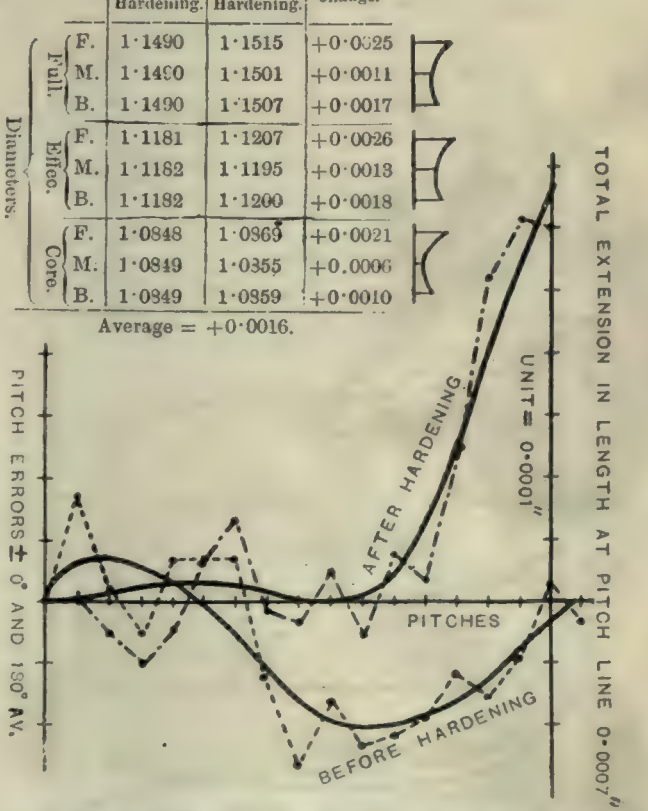


FIG. 17. EXPERIMENT 8. CASED FOR 1 HOUR IN CYANIDE, HARDENED IN WATER FROM 695 DEG. C.

		Before Hardening.	After Hardening.	Change.
Diameters. Full.	F.	1·1489	1·1511	+0·0022
	M.	1·1489	1·1511	+0·0022
	B.	1·1490	1·1510	+0·0020
Effec.	F.	1·1170	1·1190	+0·0020
	M.	1·1170	1·1184	+0·0014
	B.	1·1172	1·1192	+0·0020
Core.	F.	1·0861	1·0877	+0·0016
	M.	1·0855	1·0872	+0·0017
	B	1·0858	1·0872	+0·0014

Average = +0·0017.

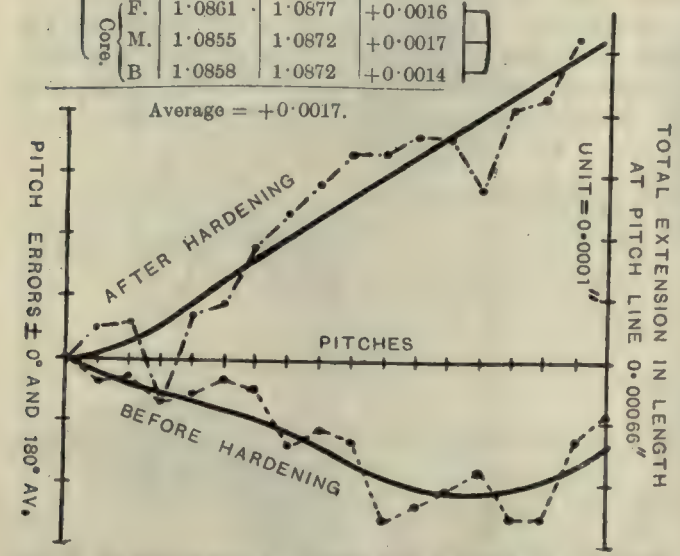


FIG. 18. EXPERIMENT 9. CASED FOR 1 HOUR IN CYANIDE, HARDENED IN WATER FROM 695 DEG. C.

Experiment 8 (May 24, 1918).—A similar screw-gage was heated for one hour in cyanide and afterward quenched at 695 deg. C. in *water* (Fig. 17). The extension is now 0.0007 in., and the increase in diameter about 0.0016 in. It should be noted that the gage has

		Before Hardening.	After Hardening.	Change.
Diameters. Full.	F.	1·1491	1·1492	+0·0001
	M.	1·1491	1·1492	+0·0001
	B.	1·1491	1·1492	+0·0001
Effec.	F.	1·1172	1·1173	+0·0001
	M.	1·1175	1·1173	−0·0002
	B.	1·1172	1·1173	+0·0001
Core.	F.	1·0847	1·0845	−0·0002
	M.	1·0844	1·0845	+0·0001
	B.	1·0845	1·0844	−0·0001

Average = 0.

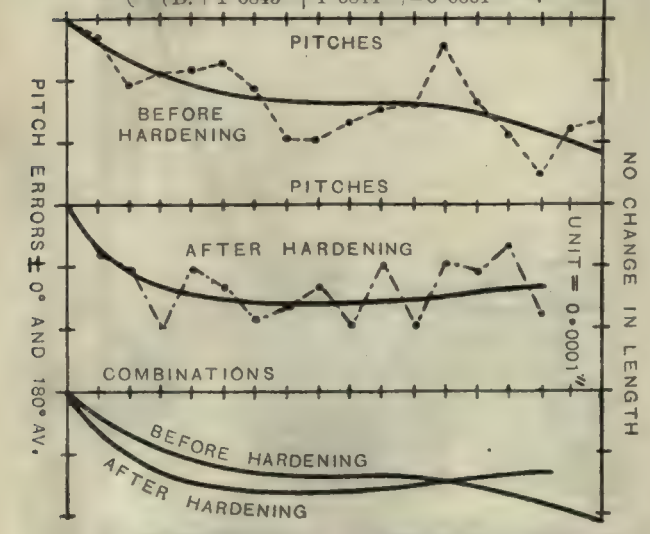


FIG. 19. EXPERIMENT 10. CASED FOR 1 HOUR IN CYANIDE. HARDENED IN OIL FROM 695 DEG. C.

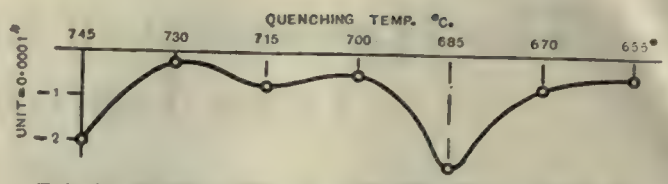


FIG. 20. EXPERIMENT 11. HEATED FOR 1 HOUR IN CYANIDE AT 770 DEG. C. AND QUENCHED FROM TEMPERATURES GIVEN IN OIL AT 22 TO 29 DEG. C.

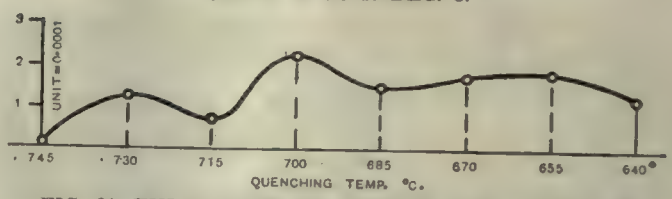


FIG. 21. EXPERIMENT 12. HEATED FOR 1 HOUR IN CYANIDE AT 770 DEG. C. AND QUENCHED IN OIL FROM TEMPERATURES GIVEN

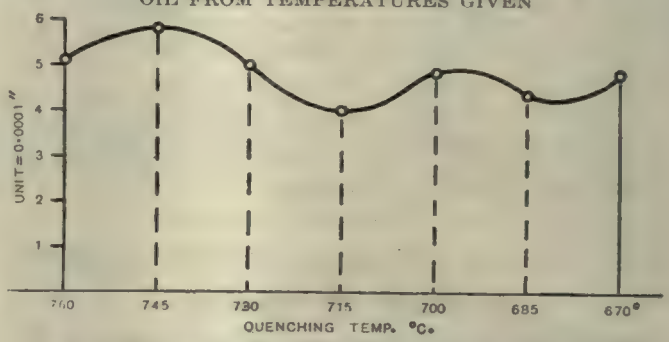


FIG. 22. EXPERIMENT 13. HEATED FOR 1 HOUR IN CYANIDE AT 770 DEG. C. AND QUENCHED IN OIL FROM TEMPERATURES GIVEN, OIL AT 20 DEG. C.

a long screw and the experiment rather suggests that length is a factor in total extension.

Experiment 9 (May 24, 1918).—This gage is another repetition of that in Fig. 15A and the results of cyanide casing for one hour with a quenching from 695 deg. C. in *water* are given in Fig. 18. The extension in length, 0.00066 in. is only a trifle better than the last gage: while the diameter change, averaging 0.0017, is about the same, but it is much more variable. The general result of Experiments 8 and 9 is to suggest a stable extension of 0.0007 in. under the exact conditions given.

Experiment 10 (May 25, 1918).—The same form of gage, after heating, was cooled in *cold machine oil*, and the chart in Fig. 19 shows an essentially unaltered condition on all dimensions. The quenching temperature was 700 deg. C. (1,292 deg. F.). The use of oil as a quenching medium was entirely due to the initiative of E. W. Eager, and the result is indeed remark-

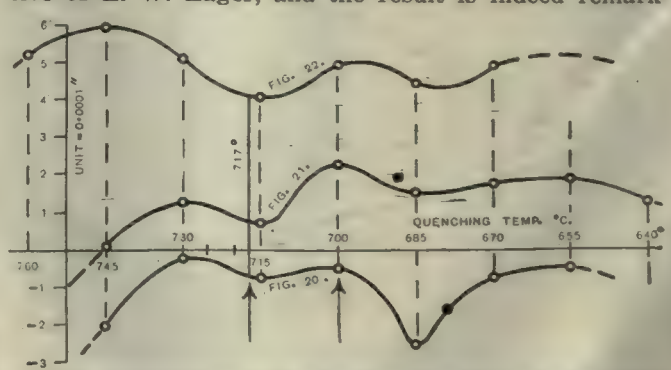


FIG. 23. COMPARISON OF THE DISTORTION CURVES. THE CURVES SHOW CHANGES IN LENGTH ONLY

able. The hardness was tested with a new file, and no kind of scratch was obtainable. The author's attempts to eliminate lapping seemed reasonably in sight, and it was decided to attack the subject afresh by the use of specimens as in the first paper.

Experiment 11 (May 27, 1918).—Seven cylindrical specimens were provided, each about ⅝ in. in diameter

			Before Hardening	After Hardening	After Lapping
Dia.	Full.	F.	1.1495	1.1500	1.1494
		M.	1.1498	1.1504	1.1494
		B.	1.1498	1.1504	1.1494
	Effec.	F.	1.1171	1.1180	1.1174
		M.	1.1170	1.1177	1.1174
		B.	1.1170	1.1179	1.1174
	Core.	F.	1.0862	1.0864	1.0858
		M.	1.0861	1.0864	1.0858
		B.	1.0862	1.0864	1.0857

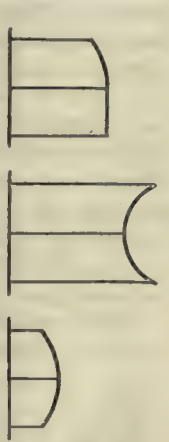


FIG. 24. DIAMETRAL DISTORTION; APPLICATIONS OF THE HARDENING LAW FOR OIL. 1 HOUR CASED. QUENCHED AT 717 DEG. C. (1,323 DEG. F.)

and 0.7 in. long, of J and L steel, 0.14 per cent carbon. They were heated in cyanide for one hour, and quenched from the temperatures given in Fig. 20 in oil at from 22 to 29 deg. C. (72 to 84 deg. F.). The mode of measurement was as described in the first paper, and the distortions were taken on length only. The hardness in this and the following experiments was excellent. In every case there is a decrease in length, but

			Before Hardening	After Hardening	After Lapping
Dia.	Full.	F.	1.1492	1.1499	1.1495
		M.	1.1494	1.1499	1.1495
		B.	1.1495	1.1500	1.1494
	Effec.	F.	1.1178	1.1173	1.1175
		M.	1.1177	1.1173	1.1174
		B.	1.1178	1.1172	1.1172
	Core.	F.	1.0853	1.0856	1.0853
		M.	1.0853	1.0856	1.0853
		B.	1.0855	1.0856	1.0851

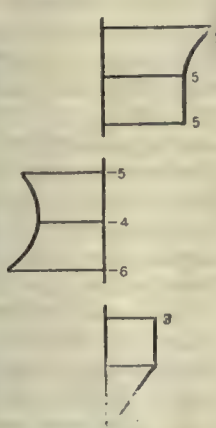


FIG. 25. DIAMETRAL DISTORTION. FURTHER APPLICATIONS OF THE HARDENING LAW FOR OIL

the amount is generally very small. The best temperatures are between 700 and 730 deg. C. (1,292 and 1,346 deg. F.).

Experiment 12 (May 28, 1918).—The distortions are all extensions, Fig. 21, and their amounts somewhat larger on the whole, though not really great. No good law is yet apparent.

Experiment 13 (June 5, 1918).—The distortions are again plus, Fig. 22, but they are much larger than in the two previous cases. This the author believed to be entirely due to the fact that the material was unannealed beforehand, while in Experiments 11 and 12 the material was annealed. It is found that with annealed gages the first two experiments can be repeated nearly

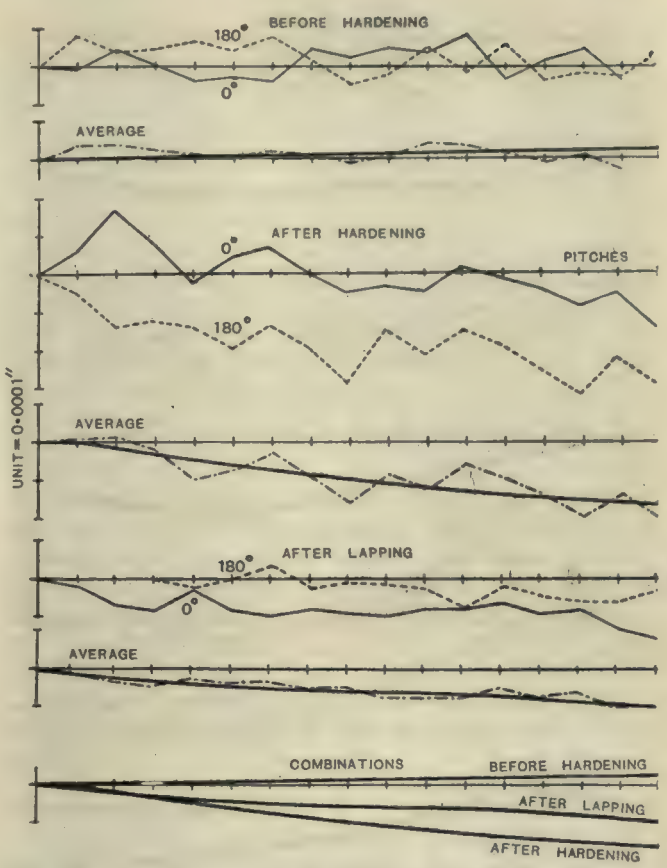


FIG. 24a. APPLICATIONS OF THE HARDENING LAW FOR OIL. 1 HOUR CASED. QUENCHED AT 717 DEG. C. CURVES OF PITCH ERROR

every time, and Experiment 13 may be viewed as abnormal although it has a certain value in the way of comparison, as follows:

In Fig. 23 the three curves are compared on a common base. No crossing law can be found as in the first paper, but a curious "stream-line" effect is noticeable, and a minimum or dip in the curves at the temperature of 717 deg. C. (1,323 deg. F.). This temperature is therefore indicated as that of least distortion on quenching and is that which the author definitely adopted in screw-gage manufacture.

Applications of the hardening law for oil are next given in Figs. 24 to 29. The charts, Figs. 24 and 25, and diagrams, 24A and 25A, show at a glance the results of the application of the quenching temperature of 717 deg. C. Both the diametral and pitch distortions can be seen from this chart.

In Fig. 24, the respective gage in Fig. 15A was screwed without serious error and was reduced in total length by hardening to the extent of 0.0001 in. As the diameters had been turned a little large, lapping had to be used, but the effect was good, and the final gage was only about 0.00005 in. short.

In Fig. 25A the three curves at bottom of diagram show only small changes due to hardening and lapping. The most serious change is that due to lapping, which has caused a difference between the readings at 0 and 180 deg. of the gage circumference. This clearly indicates that a small thickness of surface removed may warp a gage, just as a shaving taken off timber will do, by releasing internal stress.

The remaining diagrams, Figs. 26 to 29, which show the final combinations only for the smaller gage, Fig. 15B, each exhibit distinctive features worthy of study.

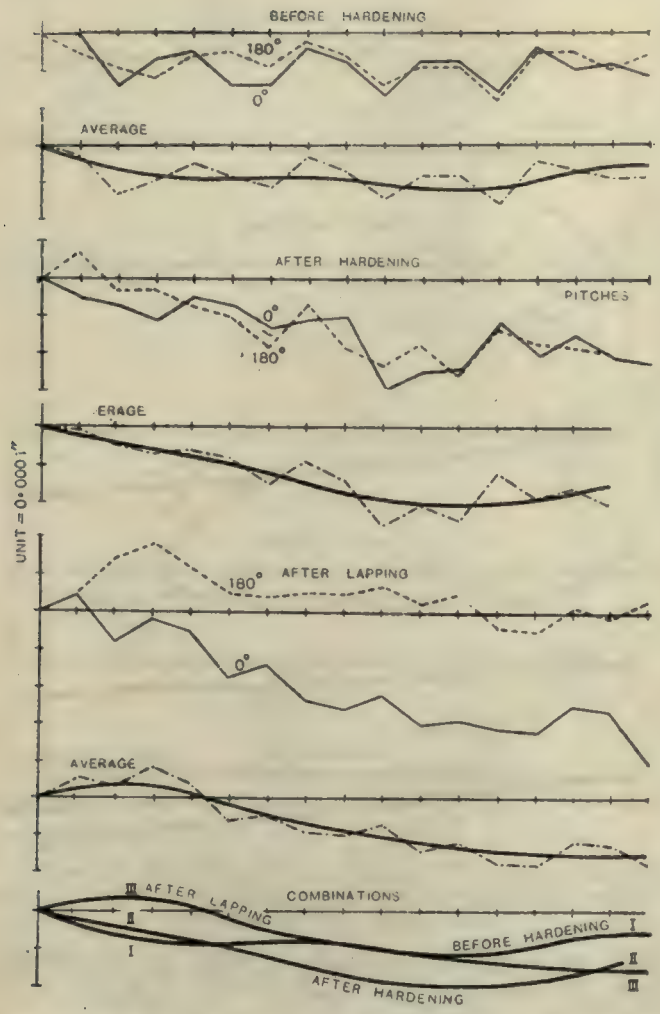
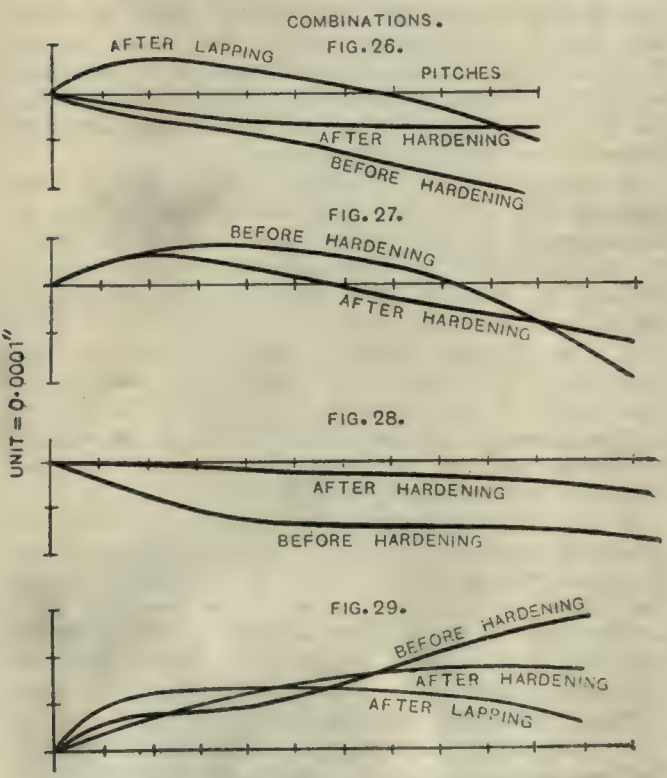


FIG. 25a. FURTHER APPLICATIONS OF THE HARDENING LAW FOR OIL. CURVES OF PITCH ERROR



FIGS. 26 TO 29. FURTHER APPLICATIONS OF THE HARDENING LAW FOR OIL

What is claimed generally is that screw-gages can now be produced, which if screwed to correct pitch, in a lathe having a correcting bar, and to diameters which are two-thirds of the limit below high and one-third above low, and hardened by quenching from 717 deg. C. in oil, will not need to be lapped at all, but merely polished with a little rouge or other fine powder. The advantage is a great saving in time and cost, both important in wartime, for two-thirds of the cost of a gage often lies in the lapping. Even if lapping has to take place it need not be more than the very smallest amount, but the great majority of the gages should not be lapped at all. The best ideal is to try and retain the perfect work that a good lathe produces, for lapping nearly always distorts. The only advantage that lapping possesses lies in its partial elimination of bad periodic errors, but these again can be overcome in the lathe itself.

The conclusions drawn from this paper are:

(1). Hardening screw gages in oil, after casing in cyanide, can be performed with less distortion than if water is the quenching medium.

(2). The temperature of 717 deg. C. (1,323 deg. F.) is the best heat for quenching.

(3). By screwing gages to accurate pitch and to diameters at two-thirds below high limit and one-third above low limit, lapping can be dispensed with.

Co-operation Between Manufacturer and Dealer

By C. A. Herberts
President, Herberts Machinery and Supply Co.

There seems to exist a lack of co-operation between the machine-tool manufacturer and the dealer. Machine tools as a whole are a line which is by no means easy to understand, but instead one in which the best of engineers are engaged, everlastingly re-designing and making improvements which will increase production. These are some of the problems of the manufacturer, who, however, has little to worry about in placing his line upon the market, since he sells his product to the dealer who pays promptly and carries from his commission the real selling and financial burden.

The machine-tool dealer should give considerable study and thought to his line because it is a business about which many things must be understood, e.g., which machine is best adapted to do certain classes of work; the most accurate method of producing the parts; and the most simple methods to secure the greatest production, which is essential on account of the scarcity of skilled labor as well as the high wages in existence. Therefore, it is essential that the machine-tool dealer must understand his business to meet with real success with the trade as well as for himself.

One of the most important points which some dealers at times overlook is the fact that the salesmen in their employ are not thoroughly practical men and that these men are in constant contact with men who are practical, who understand the correct use of machine tools and who know what they will and will not do. The average machine-shop foreman and superintendent, upon whom the "catalog" salesman calls, laugh up their sleeves after he leaves, on account of the breaks he made in good faith while trying to impress his prospective customer with the tool he was trying to sell.

The machine-tool manufacturer should be very careful in whose hands he places an agency. It is not necessarily the largest machinery dealer who gives the best representation; it is the dealer who makes a study of his own lines, knows them thoroughly, can operate the various machine tools and make recommendations as to set-up and jigging methods, spindle speeds, and feeds. A concern buying equipment loves to talk shop to a fellow next to his job and one who makes a suggestion once in a while that means dollars and cents instead of giving the reply: "I do not know; I'll look it up or write the factory."

The manufacturer of machine tools should know with whom he is doing business, and should give the following points serious consideration when securing a new agent:

1. What success has the dealer had?
2. What progress has he made?
3. Does the trade in his territory approve of his business methods?
4. Does he play the game fair with his trade?
5. Does he make the proper adjustment whenever necessary?
6. Does he extend too much credit, thereby jeopardizing himself and doing an injustice to his creditors, who are machine-tool builders?
7. Will he carry in stock a sufficient number of machine tools to make a just showing as well as to keep him in a position to make fairly prompt deliveries?
8. Will he pay his bills promptly?
9. What type of salesman does he employ?
10. Is he a live-wire, who does things, or perhaps a half-way-between, or else a has-been?
11. Can he be depended upon?

If some of you machine-tool manufacturers will give the above points more consideration in the future than you have in the past, you, no doubt, will be better off. Should present conditions become reversed and your production be greater than the demand, kindly remember that some day—it may be a matter of from three to five years, yes, perhaps ten—a reverse is bound to come, and then when money tightens up, sales drop off, credits are extended, money from dealers comes in more slowly, prices due to these conditions adjust themselves and profits are lower, and above all you endeavor to keep your plant running full force, it is then you will need a real live-wire, enterprising, full-of-pep concern to represent you, to assist in keeping up production in quantity, thereby lowering the cost of manufacturing—in other words keeping down your overhead.

Now then, I have said enough to you machine-tool manufacturers in the way of suggestion and advice, and I am sure you are going to do as you please about it, no matter what my ideas may be; therefore, allow me to look at the manufacturer from a dealer's standpoint, and endeavor to enumerate the qualifications we should require as machine-tool dealers:

1. That the concern we represent manufacture a high-grade article, one that can be depended upon.
2. That you keep up with the times, making improvements, not by copying after your competitor has already made them, but by setting the pace and keeping it up.
3. That you do not quote misleading delivery dates, falling down continually, and having dealers make enemies out of friends and customers, due to your misrepresentations.
4. That you answer telegrams and letters promptly, and be careful about what you say—don't let the office boy do it.
5. That when shipping machine tools you be careful in crating them securely and slushing them well, because it is a nasty job putting through claims with the railroad, and a nastier job collecting them. Moreover the tool which arrives all broken up may have been previously sold, and its condition cause cancellation of the order and secure the ill will of the customer.
6. That you give each dealer a square deal; not giving one concern the greater part of your products, half of which may be for stock purposes, and failing to furnish machines to another who has them actually sold, with customers continually pounding him for delivery.
7. That, whenever possible, you ship machinery intact, because few dealers are operating factory branch assembly departments where they can spare help to do this work, and where they do have such departments they are not so competent as you in making adjustments, etc.
8. That you have pity on your poor dealer; remember that he is in the middle, catching it from both sides, the customer and the manufacturer, and must fight all battles to a conclusion satisfactory to both concerned. This, I assure you, is a mighty hard job, because each machine-tool manufacturer believes that he is almost infallible and that so poor a job as outlined by his dealer is impossible and could not have slipped by his inspector, saying "we do not turn out that class of goods."
9. That you, therefore, give your dealer credit for common horsesense.
10. That you remember when you sell a machine or quantity of machines to a dealer, that you take practically no financial risk whatsoever, because you, in most cases, have had years of business dealings with him and know his pocketbook almost as well as your own, whereas the dealer is taking chances every day by extending credits on open accounts to concerns who may be good, but slow pay, and by selling others upon lease contracts, which cause him to wait months for his money, and in some cases much work and worry to secure these payments.
11. That you CO-OPERATE!

It might interest you to learn that the writer established this concern just five years ago. Our first store was nothing but a small hole in the wall, size about 10 x 20 ft. We were obliged to move into larger quarters five times during the five years we were in business in Los Angeles, and now occupy a large two-story building, which has a floor space of 12,300 sq.ft., corner 3rd and San Pedro Sts., in the heart of the machinery district, with modern display floor, crane, and railroad siding.

Our San Francisco branch was opened about a year ago, at 168 Second St., and we must admit that our growth in that city has been so rapid that we were compelled to build, and are now erecting a two-story-and-basement building at a cost of approximately $75,000 at the corner of First and Minna Sts., having about 13,500 sq.ft. of floor space, which we hope to occupy within a month.

Perhaps our growth is in part the result of the policies outlined above together with the fact that one must keep everlastingly after whatever he may undertake, accept knocks with a smile, and do things, not becoming discouraged when an order is lost, because no one can secure them all. Remember, the other fellow has to live, too. However, making up your own mind to secure a certain order is half of the battle.

Norton 10-inch "B" Type Grinding Machine

Improvements in machine design are generally comparatively slow developments, a little here and a little there. But we expect an occasional big step to add to the excitement of the dull season When a grinding machine manufacturer announces a grinding speed 200 per cent faster than anything he has attained before we are inclined to think that a big step has been taken. There are other improvements here worth studying.

THE Norton Co., Worcester, Mass., has recently completed and put on the market a grinding machine which embodies some novel features.

Heretofore the speed of table traverse in this class of machinery has been limited to 10 or 12 ft. per minute; principally because of the necessity for instant and accurate reversal of direction at the predetermined point. This reversal has hitherto been accomplished through the medium of positive clutches with hardened contact jaws, and at the expense of severe strains imposed upon the table driving mechanism.

To obviate this strain, even though the table speed

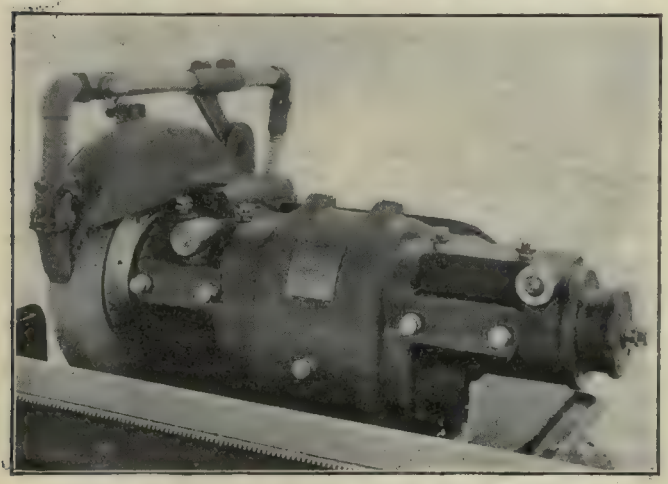


FIG. 1. THE WHEEL SPINDLE AND BEARING

be increased from 200 to 300 per cent over the older type, as well as to eliminate the disagreeable jar and noise incident to the reversal, an entirely new principle has been introduced.

The table is driven by rack and gear in the usual manner, and the drive is through a worm and wheel; but the worm, instead of being keyed to the clutch shaft merely floats upon it so that the shaft is free to revolve within it and the worm is free to move endwise on the shaft, within certain limits.

Rigdly attached to each end of the worm is a face-cam the rise of which has been plotted to a gravity curve. Keyed to the clutch shaft at a distance apart that allows the worm and its attached cams a free end movement of about 3 in. on the shaft, are two spiders, each carrying a ball-bearing roller. Rises of the two cams are opposed to each other.

The action at the instant of reversal is as follows: When the clutch shaft stops its rotative movement and begins to turn in the opposite direction (this reversal is by positive clutch, operated by the table dogs) the worm does not immediately begin to revolve. Instead, the roller on the spider rides up the curve of its cam, pushing the cam and worm endwise along the clutch shaft until this movement is stopped by the spider at the opposite end.

This endwise movement of the worm of course starts the table on its return, but the latter, instead of being started instantly at full speed, is started from zero speed, accelerating by the gravity curve of the cam, until the limit of endwise movement of the worm is reached; at which time the table is travelling at full speed and at this same moment the worm begins to revolve, carrying the table to the end of its stroke, where the cycle is repeated in the reverse direction.

With a table speed of 36 ft. per minute, three times that of the fastest speed hitherto attempted, the reversal is accomplished without perceptible jar and with so little noise that the car can hardly detect the moment at which it takes place. The endwise movement of the worm and cams is stopped by oil dash-pots between the hubs of cam and spider.

The main spindle of the machine runs in bronze half-boxes, set at an angle to take the thrust of the work and the pull of the belt. Quarter boxes of babbitt metal, adjustable only by thumbscrews, are provided at the top and front of each bearing; these quarter boxes serving only to prevent vibration of the spindle.

The wheel slide is shown in Fig. 1, where the top and front adjusting screws may be seen; also the adjusting screw for limiting end movement of the spindle. This screw bears upon the outer member of a ball-bearing thrust collar. Adjustment may be made with the machine running, and as there is no way to use a wrench it is impossible to stall the spindle.

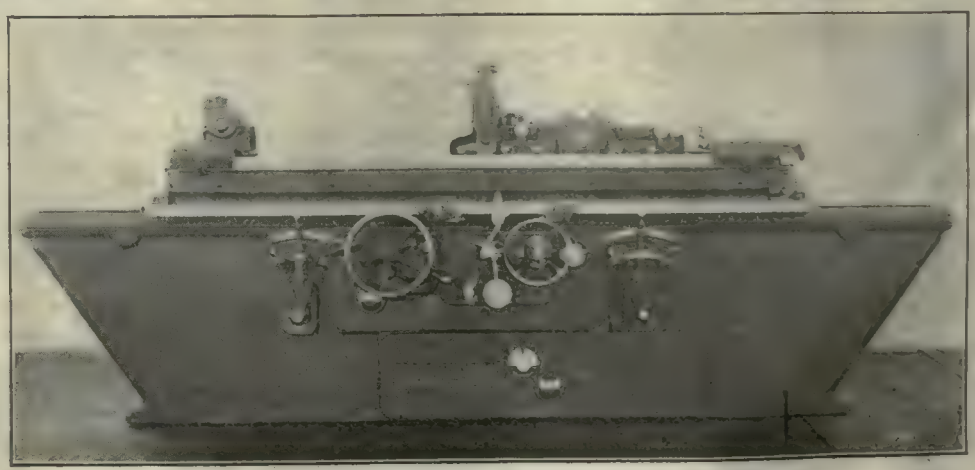


FIG. 2. FRONT VIEW OF MACHINE READY FOR BUSINESS

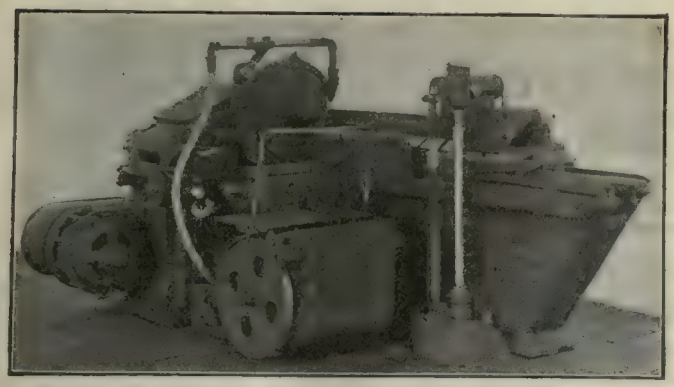


FIG. 3. PERSPECTIVE REAR VIEW OF MACHINE

The base of the wheel slide forms an oil chamber from which a pump, located within the chamber and driven by sprocket and chain from the spindle, forces oil to the main and thrust bearings. The bulls eyes upon each bearing furnish ocular evidence that oil is flowing properly, for if at any time the flow should stop these little chambers would instantly be flooded.

Wheels of 2½ in. face and with a large hole in the center are used. The large wheel-spider is recessed to allow the main bearing to project nearly to the center line of the wheel, thus insuring a maximum of rigidity and freedom from vibration. But one spindle speed is provided, and that is calculated for maximum wheel efficiency at a wheel diameter that is half-way between the diameter of a new wheel and that of one that is worn down as far as is safe to go.

Fig. 2 shows the general appearance of the machine. The levers shown at the left control the rotative movement of the headstock and the levers at the right, the table movements. These controls are so designed that when the position of both sets of levers coincide, the relative movements of work and table are such that a 2½-in. wheelface exactly covers the angular advance of the work. The control is through the medium of heat-treated steel change-gears very much like the "transmission" of an automobile. The horizontal lever back of the larger handwheel operates a disk clutch by which the table traverse may be stopped and started at any point; it also operates a clutch that disengages the handwheel, so that the latter is idle while the table is being traversed by power. Raising the lever stops the power movement and automatically brings the handwheel into action.

The "in-and-out" movement of the grinding wheel is by means of the smaller handwheel upon which is the power feed and automatic sizing mechanism. The power feed is adjustable by quarter thousandths, to operate at each reversal of the table, or to feed continuously with the table idle, as for facing a shoulder.

A rear perspective is shown in Fig. 3 displaying the unique method of getting power to the headstock. The latter is driven by helical gears enclosed in an oil-filled chamber. The upright shaft seen near the right end of this view connects directly with helical gear members mounted in swiveling cases so that the shaft is free to swing back and forth at the upper end, following the movement of the table to its extreme in either direction. Though the picture does not make it evident, this shaft is in two parts, one telescoping within the other to compensate for the varying length.

The bar outside the shaft is called the "torsion rod." It connects together the two swiveling gear-cases and has no other office than to relieve the drive shaft of any side strain due to its oscillating motion. It will be noted that there are universal joints in the drive-shaft; these do not, however, come into action as such unless the upper table is swivelled to grind a taper. On parallel work the drive-shaft, whatever its angular position, is always a straight line.

Another unique feature of the machine is the settling basin and tank for the grinding lubricant, seen in place in Fig. 3 and detached in Fig. 4. This is a sheet metal tank mounted on ball-bearing wheels and having a bail or handle for convenience in handling it.

By having one extra tank for a battery of five or six machines, no machine need be put out of business for cleaning out. To roll a clogged tank out of the way and roll into its place another tank filled with fresh clean grinding solution is but the work of seconds. The helper can clean out the clogged tank at his convenience.

The machine is self-contained. The drive is from a 15-hp. motor mounted on the machine. There are no countershafts or overhead works of any kind. The machine as shown in the illustrations is ready for business.

There are but two belts on the machine and these are both completely enclosed. One drives from the motor to the power shaft within the base; the other from the power shaft to the wheel spindle. Six-inch belts are used. All other mechanisms are driven through spur or helical gears running in oil.

All important bearings except those of the wheel spindle are ball bearings, of which there are forty-seven in the machine. For every place on the machine where a wrench is needed the crank wrench shown in place on the headstock in Figs. 2 and 3, is available. The wheel collar is removed with a screwdriver.

The machine swings an 18-in. wheel with a face width of 2½ in., though wheels 6 in. wide may be used. The spindle runs 1,300 r.p.m. The table traverse has six work speeds ranging from 10 to 36 ft. per minute and a separate very slow speed for wheel truing. The headstock has six rotative speeds ranging from 53 to 167 r.p.m.

The floor space required is 16 ft. 3 in. x 7 ft. 2 in. and the extreme height is less than 5 ft. The approximate net weight complete, with motor is 11,000 lb. The machine, as built at present, will swing work up to 10 in. in diameter and will take 72 in. between centers.

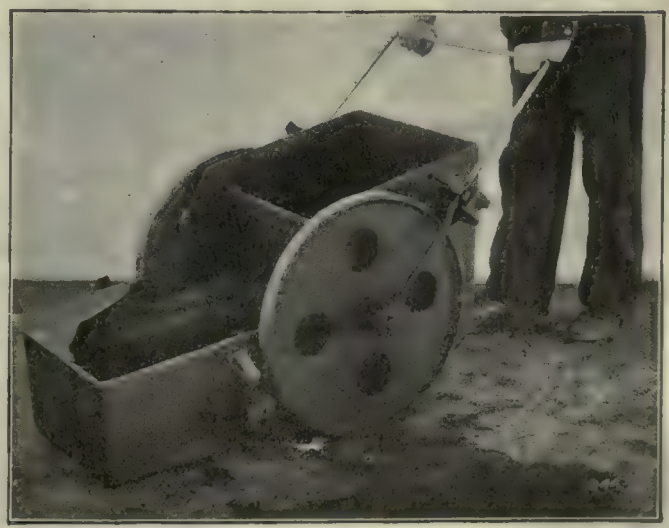


FIG. 4. THE DETACHABLE COOLANT TANK AND SETTLING BASIN

SPARKS FROM THE WORK

Valentine Francis

Program of Safety Council Congress Attractive

The program of the Ninth Annual Safety Congress of the National Safety Council, which has already been announced in our "Forthcoming Meetings" column, includes many subjects of interest to the machine-building industry. This congress will be held at the Auditorium, Milwaukee, Wis., from Sept. 27 to Oct. 1. Milwaukee, in co-operation with the congress, has selected this week as its "no accident week."

The congress has been divided into sections and each of these sections will hold its own sessions. There will be automotive, cement, chemical, construction, metals, mining, public utilities, steam railroad, textile, woodworking, engineering sections, and many others. There will also be joint meetings. Round-table discussions, with the object of invoking "pep" into the various meetings, will be held daily. Many nationally prominent men will speak.

Among papers of interest to the machine shop are: The Essentials of a Plant Safety Organization, How to Promote Safety Education in a Plant, Building a Safety Organization in a Foundry, Training Machine Operators in Safe Methods, Safety Features of Overhead Electric Traveling Cranes from the Standpoint of Construction and Design, Safe Practices in Blast-Furnace Operation, the Trade Journal as a Valuable Aid to Safety and Shop Accidents.

There will be plenty of entertainments; smokers, banquets, dances and moving pictures being arranged for. Visitors will be given an opportunity to see all the latest films which have been produced on safety subjects.

Bilton Salesmen's Convention

The Bilton Machine Tool Co. held the second annual convention of its salesmen on Sept. 7, 8 and 9 at its plant in Bridgeport, Conn. The gathering offered the opportunity not only for instructing the salesmen and familiarizing them with the plant which they represent, but also for the staff to become acquainted. The men heard talks from officers and heads of different departments, so that they were put in touch with all phases of the business. One of the principal men outside of the Bilton organization to address the salesmen was Mason Britton, manager of the *American Machinist*, who spoke on the machine-tool industry in Europe and the sales possibilities for American goods over there.

Denver's Open-Shop Declaration

The following open-shop resolution (unanimously reported from the executive committee of the *Denver Civic and Commercial Association* on April 12, 1920) was unanimously adopted by the board of directors of said association at its meeting on Wednesday, April 14, 1920:

RESOLVED: That we believe in freedom of thought, speech, action and contract as guaranteed under the Constitution of our country.

We oppose no man or set of men in the assertion of such rights in LAWFUL WAYS.

We recognize the right of every man to exercise his right of suffrage, his right of religious belief, his right of contract.

We recognize the right of every man to earn a living for himself and his dependents REGARDLESS of his political, religious or labor affiliations.

We recognize the rights of both union and non-union labor and the right of every man to join or refuse to join a union as he pleases.

We recognize the necessity of full discussion between employers and employees of issues that arise between them.

We declare the use of force, violence, blacklist, boycott or lockout as a means of contesting such issues, to be unlawful and contrary to the public welfare.

THEREFORE; We are unalterably IN FAVOR OF THE "OPEN SHOP"—open to both union and non-union men.

Associated Employers of Indianapolis, Inc.

The recent election of officers of the American Railway Tool Foremen's Association resulted in the following selections: President, J. B. Hasty, A. T. & S. Fe R.R., San Bernardino, Cal.; first vice president, G. W. Smith, C. & O. R.R., Huntington, W. Va.; second vice president, Charles Helm, C. M. & St. P. R.R., Milwaukee, Wis.; secretary-treasurer, Richard D. Fletcher, Chicago, Ill.; chairman executive committee, P. Renfrew, Indianapolis.

Method for the Accurate Measurement of the Interior Diameter of Ring Gages

A method for measuring the inside diameter of plain ring gages has been developed by the Bureau of Standards during the past month. The method is a very simple one and employs two steel balls, the sum of whose diameters is slightly larger than the nominal inside diameter of the ring to be measured. The ring is laid on a surface plate and the larger ball placed in the ring; the smaller one then rests against the inside of the ring and on the larger ball. The difference in vertical position between the upper surfaces of the two balls is determined by means of a micrometer attachment. This dimension is easily converted into the vertical distance between the centers of the two balls. The value thus obtained forms one side of a right-angle triangle whose hypotenuse is the line joining the centers of the two balls and whose base it is desired to determine. Knowing the vertical side and the hypotenuse, it is possible to calculate the length of the base, which added to the radii of the two balls gives the inside diameter of the ring. The method permits an accurate determination of the contact pressure and can be, and has already been, used on extremely small holes. A greater accuracy can be obtained by this method than by any other.

Standardization Conference to Act Upon Invoice Form

The Standardization Conference, called by the Standardization Committee of the National Association of Purchasing Agents, at the Congress Hotel, Chicago, on Oct. 10, is to be held the day preceding the opening of the convention of the National Association of Purchasing Agents and will consider the work of the Standardization Committee for the year, with a view to passing finally upon the recommendation to be made to the National Association regarding the Standardized Invoice Form.

It is important that everyone interested in this subject be present at this conference, because after the matter has been acted upon by the National Association it will be difficult to effect changes in the form.

The committee desires to have all suggestions in before the final form is selected. Some trade associations have agreed to have representatives present to discuss certain phases of the form, and apparently the conference will result in something worth while.

LD'S INDUSTRIAL FORGE
News Editor

Labor's Gains of a Decade in Compensation Laws Against Industrial Accidents

With workmen's compensation laws enacted to date in forty-three states and in Alaska, Porto Rico and Hawaii, in addition to the model measure adopted by the federal government for its half-million civilian employees, rapid progress is being made toward providing industrial accident insurance at cost through state funds, according to a statement issued today by the American Association for Labor Legislation.

"Now that Georgia has at last enacted a workmen's compensation law," the statement says, "there remain only five states, and these non-industrial states in the South, without social insurance protection against industrial accidents. This means that more than five-sixths of the map of the United States has been covered by compensation laws within ten years. There has been a marked tendency in nearly all states to strengthen the laws in the direction of more liberal benefits, shorter waiting periods before payment begins and wider scope.

"Sixteen states and Porto Rico have established state funds for insuring at cost the liability of employers, and in seven of these states the funds are exclusive, eliminating expensive commercial insurance competition. Recent official investigations in Pennsylvania, Ohio and New York disclosed that, compared with the stock casualty companies, the state funds result in savings of millions of dollars every year to industry while at the same time permitting more certain and liberal benefits to injured workmen and their families. It is significant that Ohio's exclusive state fund, which has the united support of employers and employees, is shown to give the best results to both labor and industry."

"Recent reports from all parts of the country," the statement continues, "indicate that along with the development of social insurance against accidents there is a widespread movement for the extension of social insurance laws to protect workers also against the hazard of sickness and the menace of unemployment."

The *Wall Street Journal* states that world-wide revival of manufacturing activity is reflected in increase in exports of lubricating oil from the United States in the last two years. In the year ending June 30, 1920, exports totaled 338,801,130 gal., and in the previous year 273,148,540 gal., compared with 196,884,700 gal. in 1914.

James Hartness Republican Candidate for Governor of Vermont

The many friends of James Hartness will join us in congratulating the State of Vermont in securing such a man as a candidate for Governor on the Republican ticket. Mr. Hartness was opposed by three other candidates, two of them party machine men, and it is a striking tribute, both to his personality and to



JAMES HARTNESS

the good sense of the electorate of Vermont, that Mr. Hartness won hands down.

Running on what was called an Industrial platform, Mr. Hartness pointed out both the needs and the possibility of developing the industries of Vermont. His own achievements in that line were shining examples which evidently appealed to the people more than the platitudes and empty promises of the average candidate.

The country needs sane and forward looking executives as never before. And it is particularly gratifying and hopeful to find the voters selecting a man with broad engineering and business experience for such an office. The best wishes of the whole machine-building industry go with him.

Dates for the national automobile shows in 1921 have been selected as follows by the National Automobile Chamber of Commerce: Jan. 8 to 15, at Grand Central Palace, New York; Jan. 29 to Feb. 4, at the Coliseum, Chicago.

Improvement in General Business Conditions

The *Commercial Monthly* for September, published by the National Bank of Commerce of New York has this to say about business conditions in the United States:

Although superficially not much change is evident in the general business situation from that of July 15, nevertheless underlying intrinsic conditions are slowly and steadily making for a sounder situation. An important element is the determination of business interests to carry into effect a new policy of conducting their affairs on sane and conservative lines, looking toward stability and continuance in business rather than to the policy which until recently prevailed of doing as much business as possible at high prices on a basis of excited public buying with resultant abnormal profits.

Wholesale Commodity Market

With few exceptions, the wholesale markets are now in a conditon of inactivity not paralleled since the period of uncertainty which followed the armistice.. Normally this is the dullest season of the year and the condition of stagnation is partially ascribed to that fact. To a far greater extent, however, it is the result of a widespread realization which has at last become general throughout the business commuity, that the present downward price movement is not a temporary tendency but a decline toward a new level applicable to postwar conditions, a level which can be found only by cautious experimentation in the market. It is possible that in some commodities this new level has already been reached.

International Competition

Totals for the foreign trade of the United States for the year ending June 30, 1920 are now available. Exports from the country amounted to $8,111,000,000, and imports were $5,239,000,000. Due allowance must be made for the price increases which took place during the year, and for changes in the method of valuing imports, which tended to reduce reported figures. Nevertheless, these values serve to point out in a general way certain important changes which have taken place in the foreign trade of the country as compared with the abnormal tendencies during the war period.

Exports increased over the total for the fiscal year ending June 30, 1919, by $879,000,000, while the increase in exports in 1919 as compared with 1918 was $1,313,000,000. The increase in

imports is the outstanding feature of the trade of the year, the gain being from $3,096,000,000 for the year ending June 30, 1919, to $5,239,000,000 in the year ending June 30, 1920, a gain of $2,143,000,000 as compared with the preceding year. The gain in imports for 1919 over imports for 1918 was only $150,000,000. The favorable trade balance of the country for the year was $2,872,000,000, a marked decrease from the favorable balance of $4,137,000,000 for the fiscal year ending June 30, 1919.

The changes in the direction and character of the foreign trade of the United States during 1919 were anticipated, and the decline in the favorable trade balance should not be regarded as undesirable. The situation throughout the war period was entirely abnormal and could not continue. Trade relations, to be satisfactory, must be mutual. However, the American producer, whether he be a farmer or a manufacturer, must face the international situation squarely. Despite industrial disorder and difficulties in adjustment to a peace basis, reports from every direction indicate that with the exception of those countries actually in a state of war, agricultural and industrial production is steadily increasing. This means that American business must prepare to meet steadily increasing European competition; first, in European markets, second, in the export markets of other countries, and third, in the domestic market of the United States.

Personals

C. B. COLE has severed his connections with the Union Twist Drill Co., as manager of its Chicago store and will become associated with the W. L. Romaine Machinery Co., Milwaukee, Wis., in the capacity of vice president and sales manager.

MAJOR HILL resigned recently from head of the engineering department of the Pratt & Whitney Co., of Hartford, Conn., which position he held for the last eighteen months. Mr. Hill has not divulged his future plans.

S. JAY TELLER will have charge of the engineering department of the Pratt & Whitney Co., of Hartford, Conn., succeeding Major Hill, who resigned.

Obituary

P. G. PUFFER, purchasing agent of American Tube and Stamping Co., Bridgeport, Conn., died recently, after a brief illness. Mr. Puffer was formerly with the Union Metallic Cartridge Co., of Bridgeport, Conn., and the Baush Co., at Springfield, Mass.

Lamont and Whitham Declare China and Far East To Be Best Market for U. S. Products

Machinery and Railroad Material Greatest Immediate Need—Export Manufacturers Are Urged To Develop Far East Trade—"Go-Get-It Policy" Urged in Relation to Business There

Thomas W. Lamont, of J. P. Morgan & Co., and Paul Page Whitham, American trade commissioner, were the principal speakers at the luncheon conference of the American Manufacturers' Export Association at the Hotel Pennsylvania recently, according to an account appearing in the *New York Commercial*. Few luncheons held by the association have attracted as large a number of manufacturers engaged in export trade. The ballroom was crowded with almost 500 exporters who listened attentively while Mr. Lamont and Mr. Whitham emphasized that China is the best market for American exporters today.

Mr. Lamont dwelt at some length upon the friendly feeling existing in China for America, due largely, he explained, to the large expenditures in China by Americans with the sole object of contributing to the advancement of the Chinese. He amusingly told of his conceptions of the Chinese before and after his recent trip to the Orient. Before, he said, he little understood the vast resources of the Chinese nation and their huge capacity for buying American goods. Now, he went on to say, this is readily understandable and he urged those present to investigate without delay the great trade possibilities in the Far East.

"I never imagined—until I went out there—a region calling for the products of American industry so strongly as China will call in the next twenty years," said Mr. Lamont. "A great system of railways must be built over there, and its inception should not be long delayed. These railways will require a fair share of American steel, of American bridges, American equipment. The country calls for electrical equipment—for all the multitudinous forms of farming implements required in that intensely agricultural land, now cultivated with the crude implements of the long ago. China will demand cotton mill machinery on a great scale, and machine making tools. Then it will require quantities of mining machinery, both for the base and the precious metals. Finally, those 400,000,000 of kindly, honest and highly intelligent people will require, on a prodigious scale, the many domestic appurtenances that American ingenuity has evolved. Don't forget, too, that to keep 400,000,000 people supplied with moving picture shows will be quite a task even for Americans!"

Turning from China, Mr. Lamont presented a brief discussion of Siberia, stressing the great natural resources of that country, and America's ability to supply the equipment for developing these resources. "If ever peace comes to Russia—as come it must some day—then," he said, "Siberia will find itself. And for that day American manufacturers should be prepared. Don't forget, too, that England regards close trade intercourse between America and Siberia as natural and inevitable. England realizes that the United States is particularly well adapted to furnish to Siberia the kind of manufactures that Siberia requires."

Discussing Japan Mr. Lamont said: "Japan would welcome American capital on a large scale to develop her own industries. She has a limited supply of coal and is anxious to develop her water powers on a large scale. She feels sorely the need of building good roads and of constructing new trolley lines. The United States will, as time goes on, be in a position to supply a good part of this demand. You manufacturers can supply much of the machinery and equipment that are needed. Our investment community can furnish much of the capital."

Mr. Whitham described some of his observations and experiences in China and then told of the trade possibilities of that country. He said in part:

"The Chinese are alive to the advantage of modern machinery and means of transportation. They want railways and factories. They desire to open their coal and iron mines and develop their agricultural and material resources. And they are doing these things, too. Technical and in some instances foreign financial assistance is sought. In this respect Americans are preferred above other nations.

"China has a great Northwest, nearly as large as the American West, west of the Mississippi, exclusive of the Pacific Coast, thinly inhabited but of large potential productivity and resources. It awaits the building of the railways as did America's West, so that the young Chinese may go west and grow up with the country.

"Twenty-one thousand miles of railways must be added to the existing 6,500 miles in order to complete the trunk lines only, the backbone of a system. The Chinese must look to America and Europe for capital as the United States depended upon Europe during the great era of railway expansion. It will pay to make investments in this direction. In fact Chinese American trade expansion is dependent on the transportation development of China.

"The Chinese now purchase foreign goods to the extent of about $1.50 per capita. China properly served with railways and other transportation facilities, the ensuing industrial and production development should raise the purchasing power to five dollars per capita within a short time and much more eventually. Approximately an

BOTH COULD USE HOME DISCIPLINE TO ADVANTAGE

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Why not spend a little less time complaining about the behavior of the neighbors' children—



And devote a little more attention to administering some discipline at home?

equal amount would be exported so that the foreign trade of China would then amount to four or five billion dollars a year instead of about one and a half billion as now. It is predicted that many of the Amerian business men will see that day and participate in a Chinese-American trade of at least one billion dollars per year instead of $287,000,000 as in 1919. A go-get-it policy must be pursued, however. The world's greatest future developments will be in Asia and the lands bordering on the Pacific.

"The combined foreign trade of the countries of the Far East alone amounts to about $6,500,000,000 per year. America's share in 1919 was $1,656,000,000. If the needed developments can be financed the total foreign trade of the Far East should rise to at least $12,000,000,000 per year within a reasonably short time and America's share properly should be at least $3,000,000,000 per year, provided American business interests go get it and participate in the transportation and material resource developments.

William L. Saunders, president of the association, presided. This was the first association luncheon held since Arthur W. Willmann assumed the duties of secretary, succeeding Robert F. Valentine. It was pronounced a great success and many members present took occasion following the luncheon to congratulate the new secretary and pledge to him their co-operation.

Export Opportunities

The Bureau of Foreign and Domestic Commerce, Department of Commerce, Washington, D. C., has inquiries for the agencies of machinery and machine tools. Any information desired regarding these opportunities can be secured from the above address by referring to the number following each item.

Merchant in Spain desires to purchase and secure an agency for the sale of twist drills, and machine tools in general. Quotations should be given c.i.f. Spanish port. Correspondence may be in English. References. No. 33,687.

A commercial agency firm in France desires to secure the representation of firms for the sale of iron and steel bars, sheets and tools, and mechanical machinery. References. No. 33,679.

New Publications

Oxy-Acetylene Welding and Cutting. The "Eveready" Instruction Book. Fifty-five 5 x 8-in. pages, 48 illustrations and several tables. Issued by the Oxweld Acetylene Co., Newark, Chicago and Los Angeles.

This is a very good little instruction booklet, and contains information of value to all users of gas torch welding and cutting apparatus. It contains directions for setting up both welding and cutting outfits, how to prepare for a weld, examples of typical welding jobs, instructions for preheating, reheating and annealing, tells about various welding rods, fluxes, how to use the torch, treatment of different steels and metals and deals quite extensively on lead burning. The last is of interest to almost every garage man in the country.

House Wiring. By Thomas W. Poppe. 4th edition, revised and enlarged. 200 pages, 4 x 6, 160 illustrations, flexible cloth binding. Norman W. Henley Pub. Co., 2 West 45th St., New York.

A handy, practical pocket book for the electrician, helper and apprentice. The more advanced electrical worker will at times find it instructive and useful. The book is written in simple language and unexplained technical terms are avoided. In addition to the chapters on ordinary house wiring for lights, etc., there are chapters on burglar alarm wiring, telephone wiring, wiring in concrete construction, direct current motor connections and motor wiring. There are included methods of installing flexible and rigid conduit, diagrams of wiring, switches, etc.

Forthcoming Meetings

The National Safety Council, 168 North Michigan Ave., Chicago, Ill., will hold its ninth annual safety congress in Milwaukee on Sept. 27 to Oct. 1.

The American Foundrymen's Association will hold its annual convention and exhibit at Columbus, Ohio, on Oct. 4 to 9. C. E. Hoyt, 1401 Harris Trust Building, Chicago, Ill., is secretary.

An exposition of U. S. manufacturers at Buenos Aires, Argentine Republic, S. A., has been arranged for the month beginning Nov. 15. Information can be obtained from the American National Exhibition, Inc., Bush Terminal Sales Building, 132 West 42nd St., New York.

The National Machine Tool Builders' Association will hold its 19th annual Fall convention at the Hotel Astor, New York City, on Thursday and Friday, Dec. 2 and 3, 1920. C. Wood Walter, care of the association at Worcester, Mass., is secretary.

The 1920 annual meeting of the American Society of Mechanical Engineers will be held in the Engineering Societies Building, 29 West 39th Street, New York City, from Dec. 7 to Dec. 10.



THE WEEKLY PRICE GUIDE

IRON AND STEEL

PIG IRON—Quotations compiled by The Matthew Addy Co.:

	Current	One Year Ago
CINCINNATI		
No. 2 Southern	$45.60	$29.80
Northern Basic	51.30	27.55
Southern Ohio No. 2	47.80	28.55
NEW YORK—TIDEWATER DELIVERY		
2X Virginia (Silicon 2.25 to 2.75)	54.30	31.90
Southern No. 2 (Silicon 2.25 to 2.75)	49.70	33.95
BIRMINGHAM		
No. 2 Foundry	42.00@44.00	25.75
PHILADELPHIA		
Eastern Pa., No. 2x, 2.25-2.75 sil.	50.00	30.65
Virginia No. 2	50.00*	30.85
Basic	48.00†	29.90
Grey Forge	45.00*	29.90
CHICAGO		
No. 2 Foundry local	46.40	27.25
No. 2 Foundry, Southern	48.00	31.75
PITTSBURGH, INCLUDING FREIGHT CHARGE FROM VALLEY		
No. 2 Foundry	49.00	28.15
Basic	48.50	27.15
Bessemer	50.00	29.35
MONTREAL		
Silicon 2.25 to 2.75%	43.25	.....

* F.o.b. furnace. † Delivered.

STEEL SHAPES—The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and la rger, and plates ¼ in. and heavier, from jobbers' warehouses at the cities named:

	New York			Cleveland		Chicago	
	Current	One Month Ago	One Year Ago	Current	One Year Ago	Current	One Year Ago
Structural shapes	$4.58	$3.97	$3.47	$5.00	$3.37	$3.97	$3.47
Soft steel bars	4.73	4.12	3.37	4.50	3.27	3.87	3.37
Soft steel bar shapes	4.73	4.12	3.37	....	3.27	3.87	3.37
Soft steel bands	6.43	5.32	4.07	6.25	.....	.....	.....
Plates, ¼ to 1 in. thick	4.78	4.17	3.67	4.50	3.57	4.17	3.67

BAR IRON—Prices per 100 lb. at the places named are as follows:

	Current	One Year Ago
Mill, Pittsburgh	$4.25	$2.62
Warehouse, New York	4.57	3.37
Warehouse, Cleveland	3.52	3.22
Warehouse, Chicago	3.75	3.37

SHEETS—Quotations are in cents per pound in various cities from warehouse; also the base quotations from mill:

Blue Annealed	Large Mill Lots Pittsburgh	New York Current	New York One Year Ago	Cleveland	Chicago
No. 10	3.55-7.00	7.23@8.00	4.57	8.10	7.02
No. 12	3.60-7.05	7.28@8.05	4.57	8.15	7.07
No. 14	3.65-7.10	7.33@8.10	4.67	8.20	7.12
No. 16	3.75-7.20	7.43@8.20	4.77	8.30	7.22
Black					
Nos. 18 and 20	4.20-6.20	8.41@9.80	5.30	8.70	7.80
Nos. 22 and 24	4.25-6.25	8.46@9.85	5.35	8.75	7.85
No. 26	4.30-6.30	8.51@9.90	5.40	8.80	7.90
No. 28	4.35-6.35	8.61@10.00	5.50	8.90	8.00
Galvanized					
No. 10	4.70-8.00	8.91@11.50	6.20	9.00	8.15
No. 12	4.80-8.10	9.01@11.50	6.25	9.10	8.20
No. 14	4.80-8.10	9.01@11.60	6.30	9.10	8.35
Nos. 18 and 20	5.10-8.40	9.26@11.90	6.60	9.40	8.65
Nos. 22 and 24	5.25-8.55	9.41@12.05	6.75	9.55	9.05
No. 26	5.40-8.70	9.56@12.20	6.90	9.70	9.20
No. 28	5.70-9.00	9.86@12.50	7.20	10.00	9.50

Acute scarcity in sheets, particularly black, galvanized and No. 16 blue enameled.

Automobile sheets are unavailable except in fugitive instances, when prices are 9.45c per lb. for No. 16; 9.50 for Nos. 18 and 20, and 9.55c for Nos. 22 and 24.

COLD FINISHED STEEL—Warehouse prices are as follows:

	New York	Chicago	Cleveland
Round shafting or screw stock, per 100 lb. base	$6.36	$5.80	$6.00
Flats, square and hexagons, per 100 lb. base	6.86	6.30	6.50

DRILL ROD—Discounts from list price are as follows at the places named:

	Per Cent.
New York	50
Cleveland	50
Chicago	50

NICKEL AND MONEL METAL — Base prices in cents per pound F. O. B. Bayonne, N. J.

Nickel	
Ingot and shot	43
Electrolytic	45

Monel Metal			
Shot and blocks	35	Hot rolled rods (base)	40
Ingots	38	Cold rolled rods (base)	56
Sheet bars	40	Hot rolled sheets (base)	55
Special Nickel and Alloys			
Malleable nickel ingots			42
Malleable nickel sheet bars			47
Hot rolled rods, Grades "A" and "C" (base)			60
Cold drawn rods, grades "A" and "C" (base)			72
Copper nickel ingots			45
Hot rolled copper nickel rods (base)			54
Manganese nickel hot rolled (base) rods "D" — low manganese			62
Manganese nickel hot rolled (base) rods "D"— high manganese			67

Domestic Welding Material (Swedish Analysis)—Welding wire in 100-lb lots sells as follows, f. o. b. New York: $\frac{5}{32}$, 8½c. per lb.; ⅛, 8c.; $\frac{5}{32}$ to ¼, 7½c Domestic iron sells at 12c. per lb.

MISCELLANEOUS STEEL—The following quotations in cents per poundare from warehouse at the places named:

	New York Current	Cleveland Current	Chicago Current
Openhearth spring steel (heavy)	7.00	8.00	9.00
Spring steel (light)	10.00	11.00	12.25
Coppered bessemer rods	9.00	8.00	7.50
Hoop steel	6.68	6.50	5.32
Cold-rolled strip steel	12.50	8.25	10.75
Floor plates	6.91	6.00	6.91

WROUGHT PIPE—The following discounts are to jobbers for carload lots on the Pittsburgh basing card:

Inches	Steel Black	Steel Galvanized	Inches	Iron Black	Iron Galvanized
	BUTT WELD				
¼ to 3	54–57½%	41½–44%	⅛	15½–25½%	+1½–11½%
			¼	19½–29½%	1½–11½%
			⅜ to 1¼	24½–34½%	8 –18½%
	LAP WELD				
2	47 –50½%	34½–38%	1¼	.....	.....
2½ to 6	50 –53½%	37½–41%	1½	.....	.....
7 to 12	47 –50½%	33½–37%	2	20½–28½%	6½–14½%
13 to 14	37½–41 %	.....	2½ to 6	22½–30½%	9½–17½%
15	35 –38½%	.....	7 to 12	19½–27½%	6½–14½%
	BUTT WELD, EXTRA STRONG PLAIN ENDS				
¼ to 1½	52 –55½%	39½–43%	⅛ to ½	24½–34½%	9½–19½%
2 to 3	53 –56½%	40½–44%			
	LAP WELD, EXTRA STRONG PLAIN ENDS				
2	45 –48½%	33½–37%	1¼	.....	.....
2½ to 4	48 –51½%	36½–40%	1½	.....	.....
4½ to 6	47 –50½%	35½–39%	2	21½–29½%	8½–16½%
7 to 8	43 –46½%	29½–33%	2½ to 4	23½–31½%	11½–19½%
9 to 12	38 –41½%	24½–28%	4½ to 6	22½–30½%	10½–18½%
			7 to 8	14½–22½%	2½–10½%
			9 to 12	9½–17½%	5½–+2½%

	New York Black	New York Galv.	Cleveland Black	Cleveland Galv.	Chicago Black	Chicago Galv.
⅜ to 3 in. steel butt welded	38%	22%	39%	30%	54%&40%	40½@30 %
2½ to 6 in. steel lap welded	33%	18%	41%	26%	50@40%	37½@27½%

Malleable fittings. Classes B and C, banded, from New York stock sell at plus 45%. Cast iron, standard sizes, plus 5%.

METALS

MISCELLANEOUS METALS—Present and past New York quotations in cents per pound, in carload lots:

	Current	Month Ago	Year Ago
Copper, electrolytic	18.50	19.25	21.75
Tin in 5-ton lots	45.50	61.50	70.00
Lead	8.50	9.00	5.50
Zinc	8.50	8.70	8.00
ST. LOUIS			
Lead	8.00	8.87½	5.25
Zinc	7.70@8.05	8.37½	7.65

At the places named, the following prices in cents per pound prevail, for 1 ton or more:

	New York Current	New York Month Ago	New York Year Ago	Cleveland Current	Cleveland Year Ago	Chicago Current	Chicago Year Ago
Copper sheets, base	29.50	33.50	29.50	34.00	33.50	36.00	36.50
Copper wire (carload lots)	31.25	31.25	26.50	29.00	29.50	29.00	25.00
Brass sheets	28.50	28.50	23.00	36.00	29.00	27.00	28.00
Brass pipe	33.00	33.00	34.00	34.00	36.00	34.00	37.00
Solder (half and half) (case lots)	35.00	33.00	45.00	40.50	41.00	38.00	41.00

Copper sheets quoted above hot rolled 16 oz., cold rolled 14 oz. and heavier, add 2c.; polished takes 5c. per sq.ft. extra for 20-in. widths and under; over 20 in., 7½c.

BRASS RODS—The following quotations are for large lots, mill. 100 lb. and over, warehouse; net extra:

	Current	One Year Ago
Mill	25.00	19.00
New York	27.00	21.50
Cleveland	27.00	30.00
Chicago	30.00	30.00

September 30, 1920 **American Machinist** Vol. 53, No. 14

Making The Almond Micrometer



By
Ethan Viall
Editor American Machinist

While we can illustrate some of the mechanical processes through which the parts of a micrometer go, we cannot illustrate the infinite care and workmanship that accompany each step. It requires work to almost the nth degree, in order that cumulative errors may not spoil the final result.

THERE is no more universally used instrument of precision than the micrometer. What was but a few years ago considered to be of use only to the toolmaker is now part of the kit of, or is used by, machine shop workers from the most inexperienced cub to the all-around old timer and expert. The workman of today has been so educated that he thinks and talks in thousandths and ten thousandths of an inch. This has been brought about by his constant use of micrometers.

Naturally in making an instrument of such precision, careful workmanship and a considerable percentage of high-grade workmen must be employed. This means that the skill of the worker is at least as important a factor as the jigs and tools he uses. In other words, the tools and methods described in this article, while good in themselves, would be almost useless unless handled by properly trained mechanics.

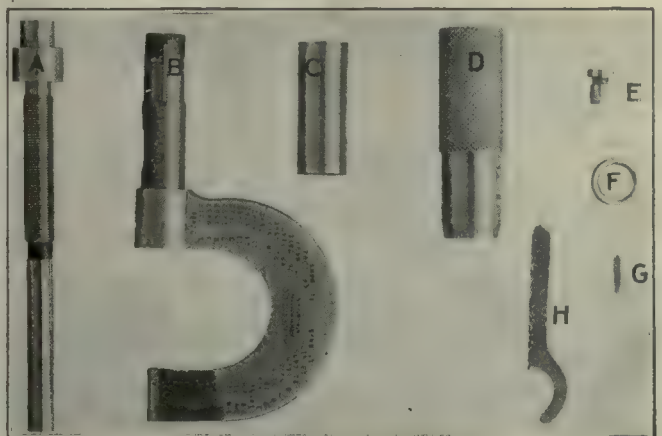


FIG. 1. COMPONENT PARTS OF AN ALMOND MICROMETER

The T. R. Almond Manufacturing Co., Ashburnham, Mass., makes both inside and outside micrometers, but only the production of the principal parts for outside micrometers will be touched upon. These micrometers are made regularly in ½- to 24-in. sizes, and have drop-forged frames in the smaller sizes, and screws with buttress threads. A one-inch micrometer is shown in the headpiece, and its component parts in Fig. 1. In this illustration *A* is the screw and spindle, which are made of one solid piece of tool steel. *B* is the frame; *C* the sleeve; *D* the barrel, or thimble; *E* the anvil; *F* the adjusting nut;

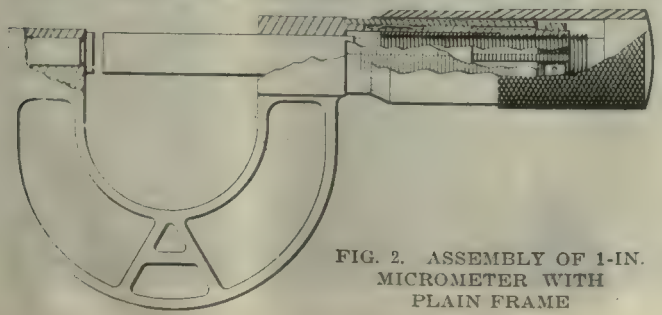


FIG. 2. ASSEMBLY OF 1-IN. MICROMETER WITH PLAIN FRAME

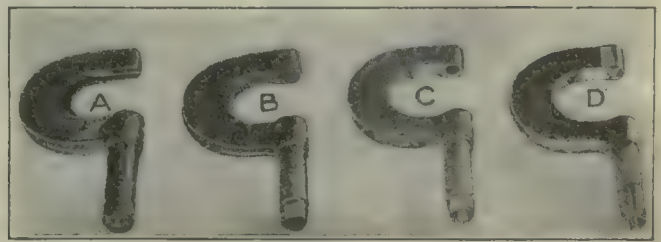


FIG. 3. A FEW STEPS IN FRAME WORK

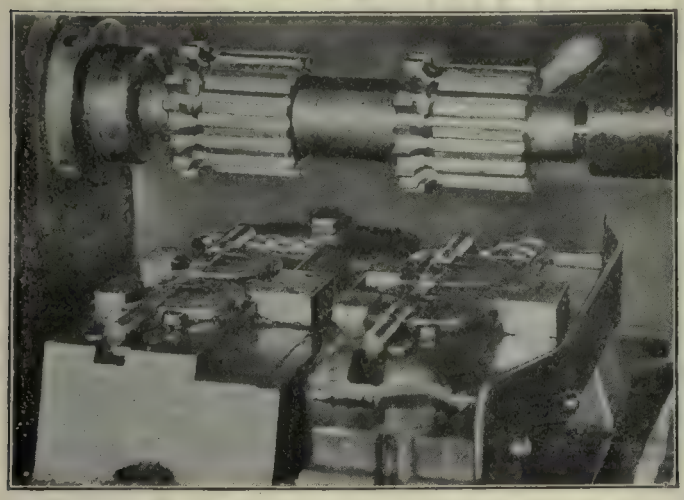


FIG. 4. MILLING SIDES OF FRAMES

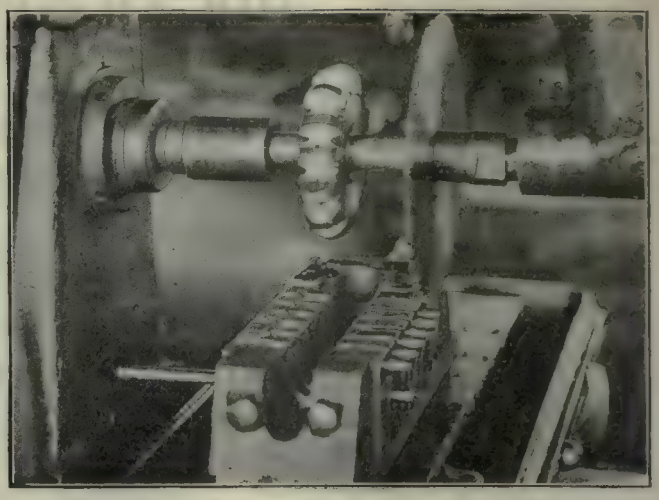


FIG. 5. MILLING INSIDE OF FRAMES AND CUTTING ENDS OF STEMS

G the sleeve tension spring and *H* the adjusting wrench. An assembly drawing of a 1-in. micrometer with plain frame is shown in Fig. 2.

Machining Micrometer Frames

It must be kept in mind that every part of a micrometer must be finished with the greatest care, so that in the final assembly the accumulative result will be satisfactory. On a drop-forged frame, the operations are:

1. Snagging.
2. Milling sides.
3. Milling inside and cutting off end of stem.
4. Drilling, rough-turning, cutting thread.
5. Recessing hole.
6. Reaming hole.
7. Tapping.
8. Splitting.
9. Taking off burrs.
10. Finish turning.
11. Milling recess for tension spring.
12. Drilling anvil hole.
13. Reaming anvil hole.
14. Polishing.
15. Etching.
16. Assembling.

Taking these operations up in turn, we will first refer to Fig. 3. Here *A*, *B*, *C* and *D* represent the principal, though not all, of the steps from the forging to the finished frame ready for assembling.

Snagging consists simply in grinding off the forging flash and roughly smoothing up the frame. Next the frames are placed, four at a time, in the jig shown in Fig. 4, and the sides milled. As both sides have to be milled, two frames are finished at each pass of the formed cutters.

The inside of the frame is milled and the end of the stem is cut off as shown in Fig. 5. The holder is a simple form of clamping jig made up of stationary end pieces and sliding formed jaw-blocks. The frames, six at a time, are placed between these formed blocks and clamped in place by tightening the screws in the end piece shown in the foreground.

The next thing is to drill the spindle hole, rough-turn the outside of the stem and thread the end for the adjusting ring. For this purpose the frame is put into a turret lathe, as shown in Fig. 6. The frame is located in the spindle fixture by means of the milled inside surface which fits over a formed and hardened block on the stationary "jaw" of the holder. A simple formed and screw-operated clamping block keeps the frame in

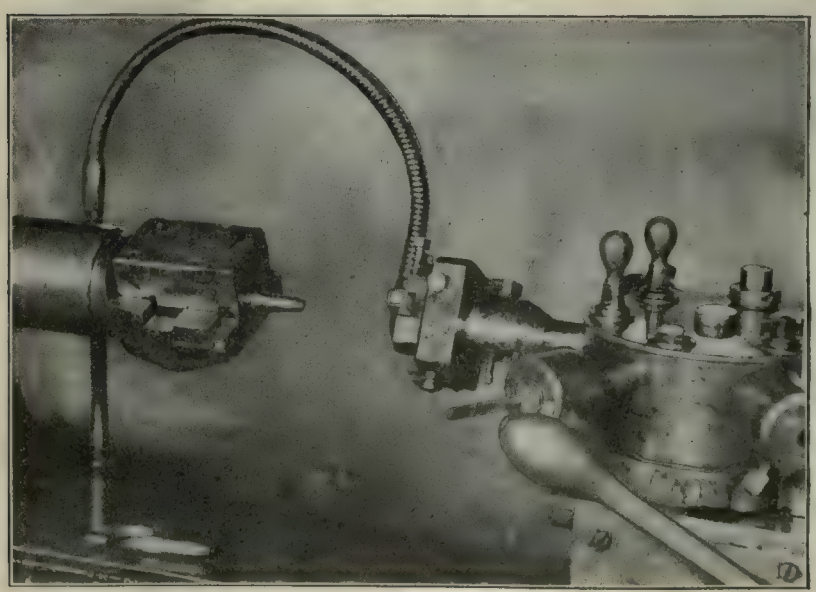


FIG. 6. ROUGHING OUT THE STEMS

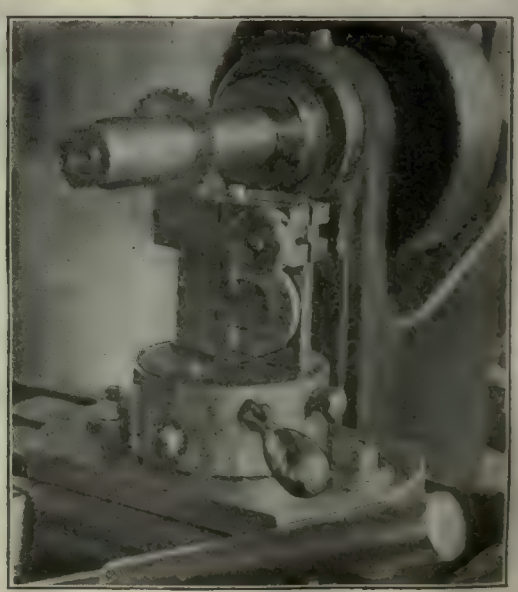


FIG. 7. SLITTING THE END OF A STEM

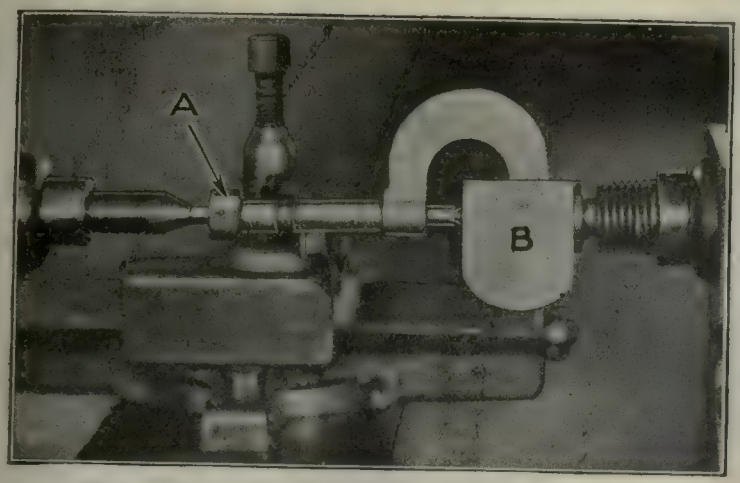


FIG. 8. FINISH TURNING OUTSIDE OF STEM

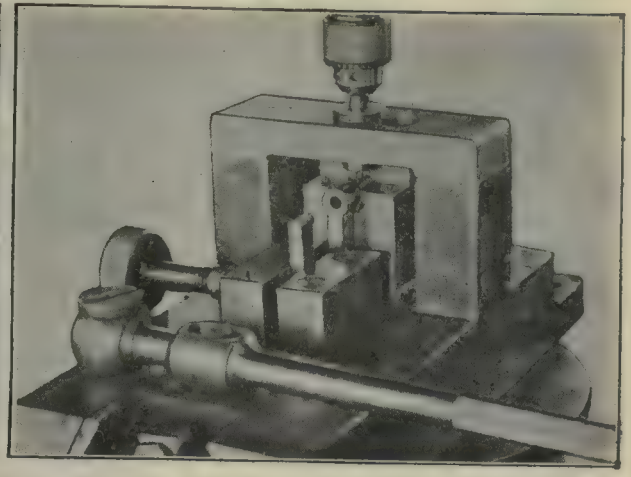


FIG. 9. MILLING RECESS FOR SLEEVE TENSION SPRING

place. The rough-turning is done with a box tool and the threading with a self-opening die head. The hole is next hand-reamed to size and recessed for clearance. Following this the buttress threads for the screw are tapped by hand with a piloted tap.

The tapped end of the stem is split to allow for adjustment, as shown in Fig. 7. The frame is held by the stem in a hinged clamp which is locked by means of a knurled hand nut. Proper height of the work in the jig is secured by means of a hardened screw head on which the frame rests. One cut is made and then the jig is indexed a quarter turn for the other cut. This divides the end into four parts.

Finish Turning Frame

The burrs are removed by hand and then the frame is ready for finish-turning the outside of the stem in a small lathe. For this work the frame is placed on a mandrel. A knurled "draw-in" nut *A*, Fig. 8, pulls the stem to a seat at both ends. The work is driven by the "dog" *B* which has a recess into which the end of the frame fits.

The recess in the stem for the tension spring is milled as indicated in Fig. 9. The frame is located and clamped as shown, and the recess is milled out with an end mill guided by a bushing in the top cross-piece of the jig. After the mill is fed down to the proper depth the length of the slot is secured by movement of the hand lever.

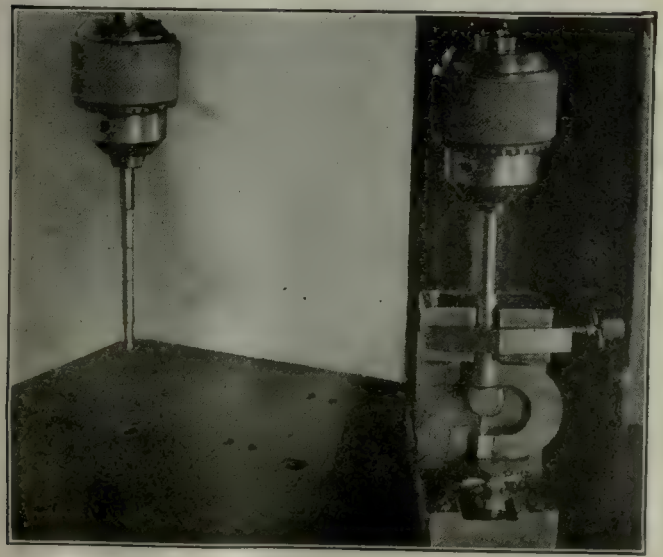


FIG. 10. DRILLING AND REAMING ANVIL HOLE

While listed as separate operations, the drilling and reaming of the anvil hole are done in a two-spindle drilling machine. The frame is held in a jig, as shown at the right in Fig. 10, and the hole is drilled. The jig is next moved over and the hole line reamed with the reamer shown at the left.

The frame is now polished and the figures etched on it. This etching is accomplished by coating the surface of the sides and cutting in the characters on a multiple pantagraph machine, after which acid is used to etch the characters into the metal.

Machining the Spindles

As has been previously mentioned the spindles and screws are made of one solid piece of tool steel.

A spindle is first roughed out from the bar in a screw machine, and the small end centered. The piece is then

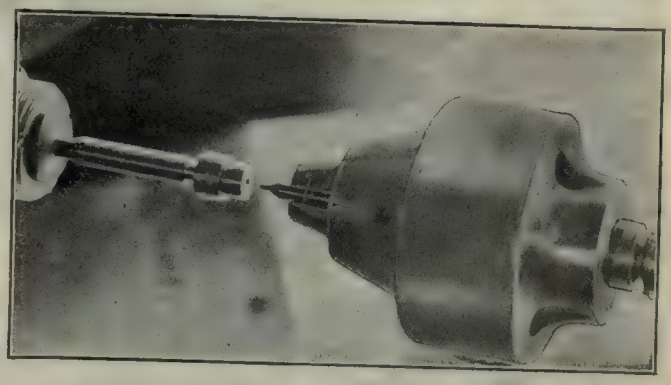


FIG. 11. CENTERING LARGE END OF SPINDLE

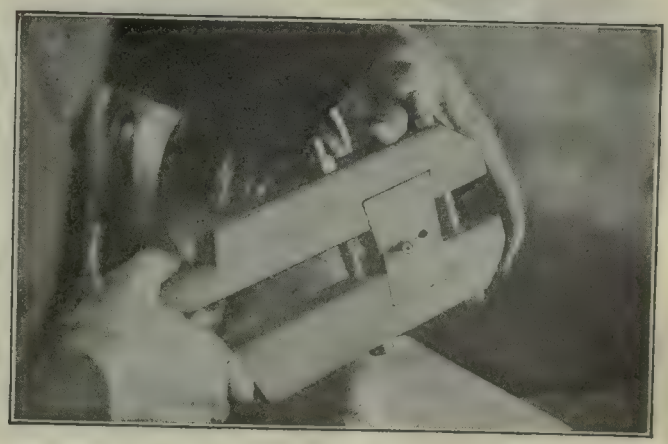


FIG. 12. LAPPING OUTSIDE OF SPINDLE



FIG. 13. FINISH-TURNING SPINDLE FOR THREADING

placed in the collet chuck of a small lathe and the large end centered, as shown in Fig. 11.

The small end is next hardened and then the spindle is ground on centers in a grinding machine. Following this it is lapped to size in a small lathe as shown in Fig. 12. The laps are lead blocks, charged with fine abrasive, held in a wooden clamp as shown.

The part of the spindle on which the thread is to be cut is next turned to size in a bench lathe, Fig. 13. The spindle is now ready for turning the thread, which is one of the most particular jobs imaginable.

The Thread Cutting Machine

The thread cutting machine is shown in Fig. 14. The work to be threaded is shown at *A* and the threading tool at *B*. The threading tool has only a cross-feed movement, as the work is fed past it. The lead screw is cut directly on the lathe spindle at *C*, and feeds through the split nut *D* which is set into the bearing or pillow block *E*. The tail spindle *F* is counterweighted and slides in the split bearing *G* as the work is fed forward or back. In putting in or removing the work the tail spindle may be locked out of contact by pushing it back until the latch *H* drops into the notch *I*. The work to be turned is carried on centers and driven by a small dog so adjusted as to eliminate play. The lead screw is of the same lead as the thread cut on the micrometer spindle, which is 40 threads per inch. This lead screw is cut as accurately as it is possible to cut a screw and it took several months to get one uniform enough for the purpose. However, differences of temperature make it necessary to provide some means of compensating for changes in the lead. The same mechanism can, of



FIG. 14. THE SCREW CUTTING MACHINE

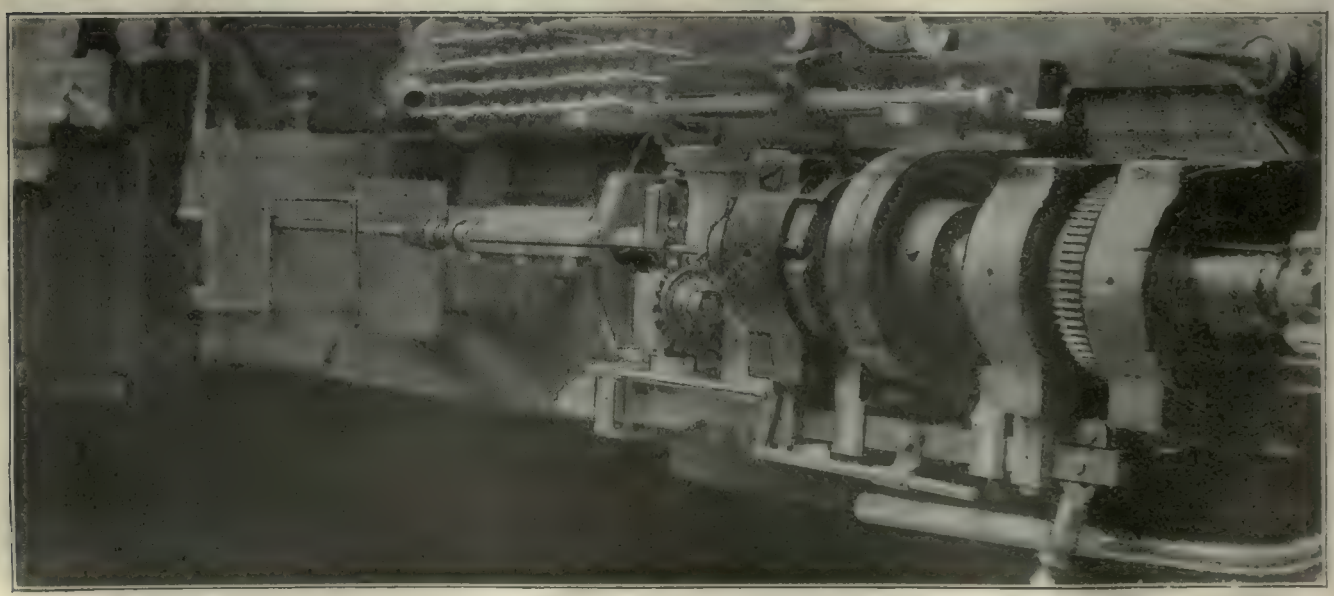


FIG. 15. TOP VIEW OF SCREW CUTTING MACHINE

course, be used to offset the errors caused by a screw that leads too fast or too slow. The method employed is to mount the lead screw nut in a pillow block, as previously mentioned, in such a way as to eliminate all end play but leave it free to rotate within certain limits. A bar screwed solidly into one flange of the nut connects it to the slide *J* on the bar *K*. It will be seen that the greater the angle at which bar *K* is set, the greater the amount which the nut *D* will be turned as the lathe spindle feeds the work past the threading tool. If the direction of rotation of the nuts is the same as that of the rotation of the lead screw, the lead of the thread cut will be lessened. If the nut is turned in the opposite direction to that in which the lead screw is turning, the lead of the thread being cut will be lengthened. However, as the length of thread cut, and consequently the lengthwise movement of the lathe spindle, is about 1¾ in., the distance traversed is not sufficient to give good results. To get around this condition a scheme is resorted to by which the bar *K* is given a movement parallel to the lathe spindle, at approximately three times the speed at which the spindle feeds forward or back. This is done by mounting the bar *K* on a slide having a rack *L* into which the threaded disk *M* meshes.



FIG. 20. ANVIL AND SPINDLE END WRUNG TOGETHER

will be seen that approximately three times the feed is given the rack *L* and compensating bar *K* as is given to the lathe spindle and work. In consequence, the lead screw nut is given approximately triple the movement it would have if the spindle movement alone was used, with the compensating bar *K* at the same angle. This avoids an excessively steep bar angle.



FIG. 16. MAGNIFIED VIEW OF SCREW THREAD

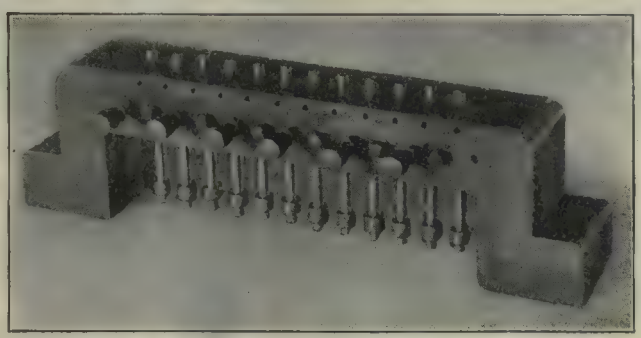


FIG. 17. SPINDLE END GRINDING JIG

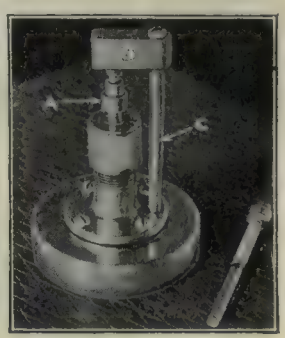


FIG. 18. THE SPINDLE END LAPPING JIG

This disk is keyed solidly to the lathe spindle but the thread on it is cut 12 to the inch, in contrast to the 40 to the inch thread on the spindle itself. Hence it

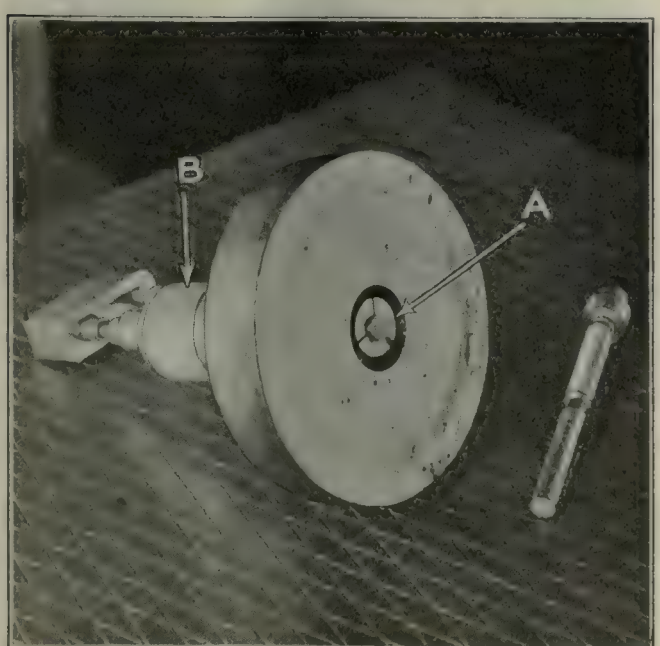


FIG. 19. BOTTOM OF SPINDLE END LAPPING JIG

In cutting threads it has been found that the angle at which compensating bar *K* has to be set varies considerably in hot summer and cold winter. Where temperature changes are sudden, the angle has to be adjusted from day to day, in order to obtain accurate results in the lead of the screw cut.

The thread on the lathe spindle is right hand and so is the thread cut on the micrometer spindle. This makes it necessary to set the threading tool up-side-down, but this has several advantages, one of which is that the chips more readily fall away from the cut.

After the lathe spindle has fed forward with the work on a cut, the bar *N* is automatically forced to the right by means of a stop and allows the tool carriage to slide back and the tool clear the work. The spindle then runs back to the starting point and another stop slides the bar *N* to the left which pushes the tool forward into the cutting position again. The cutting tool is fed forward the right amount for each individual cut by the ratchet action of the small sliding bar *O* which acts on a ratchet wheel *P* on the end of the feed screw.

Some of the mechanism described is more clearly shown in the top view of the same machine given in Fig. 15.



FIG. 21. REAMING OUT THE BARRELS OR THIMBLES



FIG. 22. FINISH-TURNING OUTSIDE OF BARRELS



FIG. 23. TURNING BEVEL ON END OF BARREL

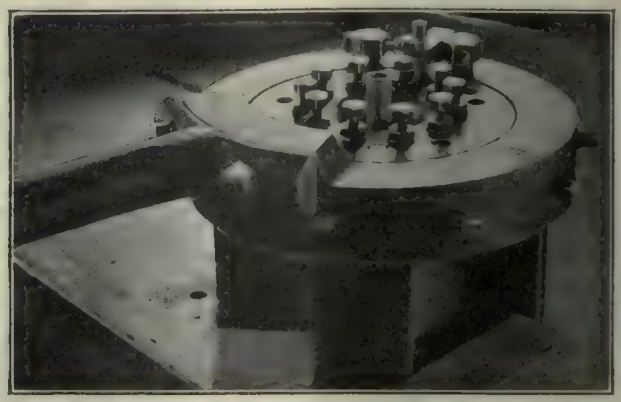


FIG. 24. STAMPING FIGURES ON THE BARREL

The way the thread cut on this machine looks when magnified is indicated in Fig. 16.

The hardened ends of the micrometer spindles are ground on an ordinary surface grinding machine, using the holding jig shown in Fig. 17.

The lapping of the spindle end is a real precision job. The spindle to be lapped is placed in the holder as shown at *A*, Fig. 18. The block *B* on part *C* may be swung around out of the way when putting in or taking out a spindle. The post has a limited amount of vertical spring movement and tends to press the spindle downward when in position.

A view of the bottom of the holder, showing the split collet *A* that grips the end of the spindle, is given in Fig. 19. This collet is tightened by means of the knurled sleeve *B*. In using this holder, the operator rubs it over the diamond-grooved cast-iron lap, rotating it slightly at each stroke in order to wear it evenly. A special gage is used to test the truth of the bottom of the holder from time to time in order to be sure that it is in good shape. Two laps are used, one to take off most of the metal needed and the other to give the final finish. So accurate is the lapping that the ends of the spindle and the anvil may be wrung together as shown in Fig. 20.

Barrels, or thimbles, are drilled, rough-turned and knurled from the bar in a turret lathe, then they are carefully reamed out with an adjustable reamer, as shown in Fig 21. The next step is to place the barrel

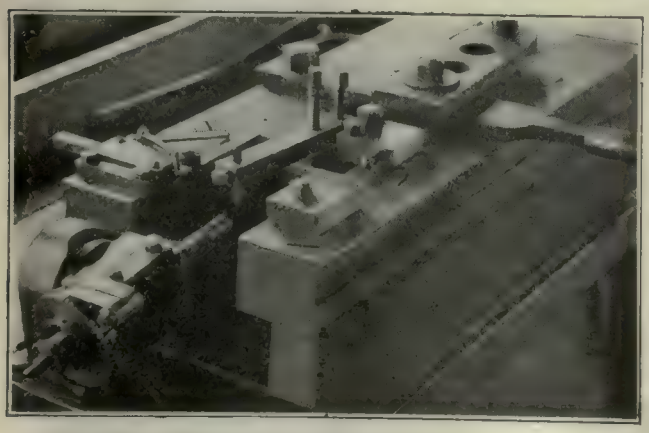


FIG. 25. GRADUATING THE BEVEL ON A BARREL

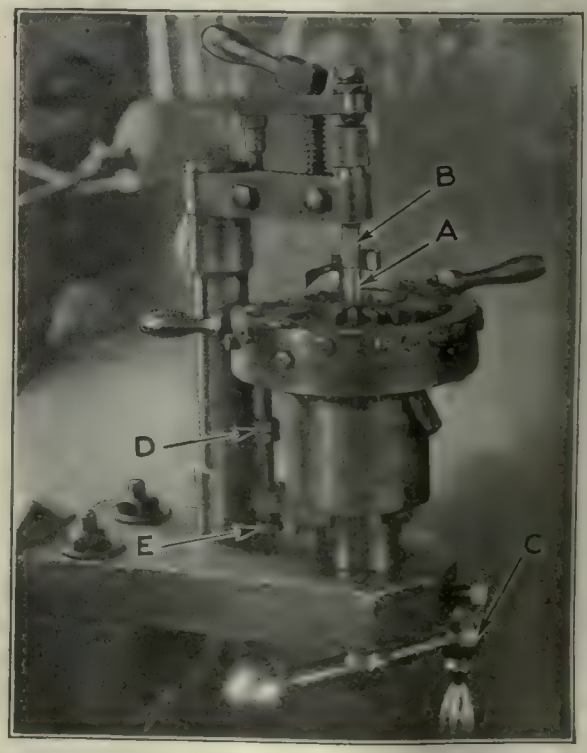


FIG. 26. CUTTING PARALLEL LINES IN A SLEEVE

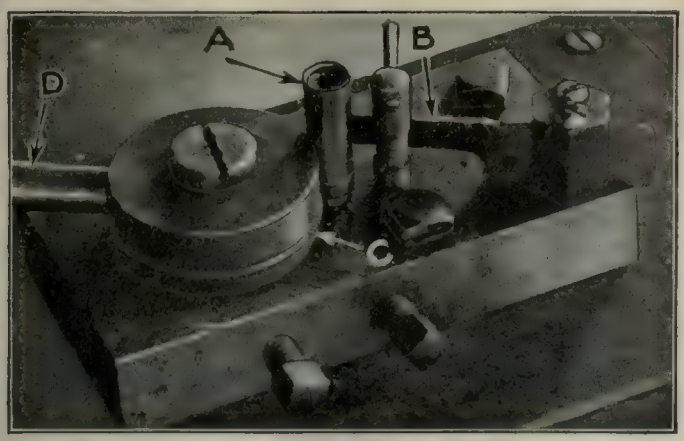


FIG. 27. ROLLING IN FIGURE ON SLEEVES FOR "TEN-THOUSANDTHS" MICROMETERS

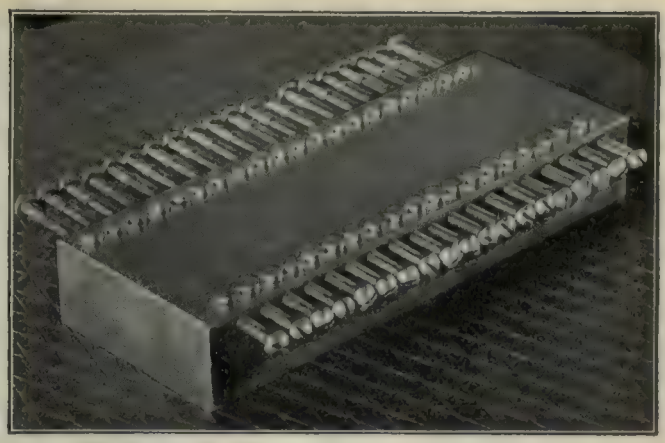


FIG. 28. ANVIL GRINDING AND LAPPING JIG

on a mandrel and finish turn, as shown in Fig. 22. Following this, it is put on a plug mandrel, and the bevel turned as shown in Fig. 23. Next the numbers are stamped in, all at once, in the device illustrated in Fig. 24. In this machine the stamps are arranged radially and are forced inward by means of a cam ring operated by means of the hand lever shown.

The graduations on the end bevel, are cut on the machine, Fig. 25. The indexing is done with the left hand as the operator works the slide lever with his right.

Machining the Sleeves

Sleeves are drilled and rough turned from the bar, and are then reamed in the same way as the barrels. They are then placed on a mandrel and finish turned.

The lines running lengthwise on the sleeves are cut on the machine shown in Fig. 26. One line is cut for micrometers reading in thousandths, and eleven lines for those reading to ten-thousandths of an inch. The single line is cut the full length, but the others, stop far enough from one end to allow for numbering. In the machine, the sleeve is placed over a vertical mandrel at *A* and held in place by means of the eccentric operated hold-down *B*. The carrier for this hold-down may be swung out of the way when desired, by simply releasing the eccentric and pushing the carrier to one side. The tools for cutting the lines are fed into the cutting position by turning the outer cam ring. The whole cutter head is then fed up by turning the handle *C*. Stops at *D* and *E* limit the travel. At the end of the cut the cutters are released by reversing the cam ring, after which the cutter head may be run down and the work removed.

Figures for numbering the lines on the sleeves for the ten-thousandth micrometers are rolled in as shown in Fig. 27. The sleeve is placed over a pin or mandrel at *A* and set in correct position by means of the stop gage *B* which rests in one of the cut lines. The numbers are then rolled in by pulling on lever *D*. Cross lines and the numbers running lengthwise of the sleeves are etched in.

Anvils

Anvils are turned in a screw machine, hardened and then chucked by means of a break-off stub, and cylinder ground. Next they are placed in the jig shown in Fig. 28, and the ends ground in a surface grinding machine. This same jig is then taken to the lapping block and the ends of the anvils all rough and finish lapped at once.

After all the parts of a micrometer have been assembled, the ends of the anvil and spindle are tested for parallelism with Johansson blocks and the screw is tested every tenth of an inch for accuracy with these standard blocks. Where an error in parallelism of the surfaces of the anvil and spindle ends is detected, a special lapping machine is used to eliminate it.

Putting Punch Into "Help Wanted" Ads

By Frank H. Williams

When competition for employees is keen and when the ordinary "Help Wanted" ads in the daily papers fail to bring the desired response, it behooves the plant to put an added punch into its advertising. It is possible to inject a little "jazz" into the Help Wanted ads just as it is possible to liven up and make more interesting and forceful almost any sort of advertising. And, frequently, when a greater punch has been given to the ordinary mere announcement that so many more machinists, etc., are needed, it is found that a single insertion of such an advertisement gets a lot more results than the repeated insertion of a mere every-day announcement.

How Can Ads Be Livened Up?

But how can this added sales-punch be given to the help ads? How can these ads be livened up and made so much more attractive that they will not only attract a lot of attention but also make workmen want to secure employment with the plant that is doing the advertising?

Well, it's a simple proposition—simply examine the matter from the viewpoint of an advertiser. Pick out the big selling point about the job and play up this point in the advertising.

For instance, a Middle Western factory found itself in dire need of additional help in order to turn out the increased quantities of goods it had contracted to make. But the ordinary "Help Wanted" ads in the local daily papers failed entirely of getting all the results desired. The plant superintendent confessed himself up against a stump. He didn't know what to do and finally told the general manager that he'd have to get some help on the proposition. The general manager, in turn, was unable to offer any suggestions and called in the concern's advertising manager to whom the situation was explained.

"Huh," exclaimed the advertising manager, "there's nothing so very difficult about this proposition. This plant has one of the best sales arguments in the city for

getting more employees. I'll simply play it up in our advertising in local papers; then watch the men come."

Accordingly the advertising manager prepared an ad which appeared shortly in the local newspapers. This ad consisted of a space three columns wide by about ten inches high. The upper two-thinds of the ad was occupied by an outline map of the city showing the location of the plant. And under this map appeared this reading matter:

Playing Up Advantages

"You don't have to 'transfer' on the car lines to get to work at the A. B. Plant.

"Look at the map. Notice that this plant is located just two blocks from the transfer corner where all the street car lines of the city center. You can take the car nearest your home and come to work here without having to wait for a transfer car.

"Furthermore you will be right down town during the day—where you will be able to meet your friends during the noon hour, transact personal business and know what's going on in the city.

"This is the place for live-wire men to work—men who want to save time and expense in getting to and from work and in making trips down town to attend to their business affairs.

"We need 100 machinists. Be one of the lucky 100!

"The A. B. Factory, Main and Superior streets."

The response to this advertisement was immediate and enthusiastic. Many machinists who had been working in plants on the outskirts of the city at considerable distances from their homes jumped at the chance of getting in a place where they didn't have to transfer, and still other men who had quite a little personal business to transact during the course of a week were glad to get in a plant where they could do this during the noon hour without hurry or inconvenience and without making a special trip for it.

Of course there are but few plants so fortunately situated as this particular factory. Mighty few plants, consequently, have such sales arguments as this for securing more employees, but it is generally a fact that a careful investigation of a plant from an advertising view-point will reveal some sales arguments which can be played up to good effect in the plant's help wanted advertising.

For instance, is the plant particularly well lighted? If it is, that fact will appeal powerfully to men who have been working in factories where daylight is a mighty scarce article. Is the plant particularly well equipped in the matter of welfare work? Has it special appliances for helping the employees to enjoy themselves during the noon hour and upon occasions when there are social gatherings at the factory? If so this fact is a good talking point and can be utilized in the plant's advertising for the purpose of gaining new employees.

What are some of the financial advantages of working in the plant? Does the plant offer a bonus to employees? Does it insure employees? Is it on a profit-sharing basis? Do employees have the opportunity of purchasing stock in the concern? All of these points are of exceeding vital interest to every prospective employee. Every single thing the plant does along this line is a talking point for securing more workmen. Then why shouldn't the plant play up these things in its help wanted advertising and cash in on them to the fullest possible extent?

There is a reason why plants have not yet done any advertising of this sort to any great extent. The plant end of a concern is not concerned with advertising problems—it deals with matters of production and personnel. Perhaps if there was a closer connection between the advertising department and the factory management there would be more of this advertising. Among concerns like department stores where the whole business is frequently viewed by all the executives from a promotion and advertising angle, this form of help-wanted advertising has been in vogue for some time. Numerous instances have occurred in which the big department stores in New York and in other places went after the problem of getting more help in the same way in which they tackled the problem of selling more goods—they played up all possible sales arguments in their help advertising which would be calculated to make more people want to work for the store. And, by doing this, they secured results when the ordinary form of help-wanted advertising fell flat.

Good for Men Already Employed

In addition to getting the desired employees more quickly by using this form of advertising, such advertising also should have a distinctly good effect upon the men already working in a plant. No man is averse to hearing a recital of the many reasons why his factory is a mighty good place in which to work. He may not have summarized all the good points about his job in his own mind, but when he sees these points played up in the plant's advertising he will be apt to say:

"That's so! I hadn't thought of that! By Jove, I'm pretty fortunate, at that, to be working where I am."

Of course when workmen get in that frame of mind about their jobs, the plant's morale receives a decided boost and production soars.

Yes, it might be a good idea for almost any plant to let an advertising man have a whirl at it the next time the plant's ordinary help-wanted advertising fails to pull in the desired way.

Know What You Are Doing and Why You Do It

By A. W. Forbes

It has sometimes been said that a person shows more intelligence before he is 10 years old than ever afterward, the idea being that the most intelligent thing a person can do is to ask, why?

Today one of my employees, who has had several years' experience in toolmaking, placed a lathe tool on a level with the centers of the lathe, when it should have been slightly lower. I asked him why, and he said he always placed a lathe tool opposite the center. but had no suggestion to make as to why it should be placed there.

It was merely a rule which he always followed. Machinists have a great many such rules which they consider it best to follow but the principal difference between the first class machinist and the ordinary kind lies largely in the ability to decide when to follow a rule and when to break it.

A way that leads to knowledge, but often to various troubles also, is to break every rule and see what happens. I have often found unexpected results this way. However, it is well to use discretion in this.

Human Relations in Industry

EDITORIAL CORRESPONDENCE

The industrial conference, held at Silver Bay, N. Y., Aug. 27 to 29, brought out many evidences that the business men of the country are alive to the responsibilities of the present industrial situation. Many evinced a broad liberal attitude which will go far in preventing clashes between reactionaries on the one hand and radicals on the other.

THE conference was a rather strenuous affair, its sessions crowding each other with but little time between. It opened with an address by Fred B. Smith, assistant to the president of the H. E. Johns-Manville Co., on "The Industrial World Today," which showed keen observation and careful thought on the part of the speaker. There were a few who considered this as an alarmist view, but those who really know the world situation realize that the so-called optimist who only sees the rosy side, is first cousin to the ostrich who is supposed to bury his head in the sand at the approach of danger.

Mr. Smith pointed out some of the problems which are already here, and showed clearly that all who say everything is all right, are simply banking the fires and merely postponing the explosion. His observation leads him to believe that, while some of us are working in the right direction, we have in reality made comparatively little progress and that the fires of unrest, bitterness and conflict have not materially diminished. The problem must grow increasingly difficult, because it is becoming necessary for the nation to industrialize more and more, as the expansive borders are closed and there are no more great frontiers for those whose nature chafes at the close contact of crowded cities. We must of necessity industrialize more closely.

Dangers of "Getting Even"

Mr. Smith considers that many of our difficulties are directly due to wrong ideals in educational matters, that young men leave college to assume responsible positions with utterly wrong conceptions of their duties and responsibilities to society. He finds many of the capitalistic group bitter and evincing a desire to "get even" for being obliged to increase wages and shorten hours during the stress of the past few years. He also finds many wage earners who believe that further and more serious clashes are inevitable, and who, while knowing the resultant hardships and suffering, are steeling themselves to say "let them come." These, of course, are the extremes of both sides. Only by reconciling these extreme groups and by inaugurating once more the spirit of the Golden Rule, can the clashes of the extremes on each side be prevented.

Among the fundamental propositions which he considers inevitable as a beginning, is the adoption of some form of committee representation, the 8-hr. day and the desire on the part of both sides to discuss all questions through the committee plan. He feels that unless those who own or control capital learn to consider it as a stewardship and to use it with a community instead of a selfish spirit, that the day will come when it will be confiscated by the state.

Mr. Smith then proceeded to point out the dangers of such a contingency, particularly so long as we allow ourselves to be represented by the present kind of legislators. A state of real democracy must prevail coupled with a feeling of brotherhood which cannot be replaced by high wages and short hours. The individuality of the worker must be carefully considered.

George E. Emmons, vice president of the General Electric Co., agreed at a later session that while we had made some progress, business men needed counsel as to the future. Something is radically wrong with the industrial machinery, but we must be careful to keep our feet on the ground in proposing and making changes. The experiences of his company with Works Councils varied; though not perfect, they are undoubtedly an improvement over previous methods of dealing.

The Attitude of the Alien

Allen T. Burns, Director of Americanization Methods of the Carnegie Foundation, gave an excellent talk on this subject. He pointed out that, in order to understand the attitude of the immigrant, it was necessary to study the America of the past, when our ancestors laid the basis of a new country because they were not satisfied with their conditions at home. It is this spirit which has built the United States and all of the other newer countries. Bearing this in mind we must not expect the immigrant of the present day to consider as perfect the things which we have accomplished, any more than our ancestors were content to leave the country as they found it. We must not forget that it takes a certain type of person to be an immigrant, one with self-dependence and the pioneer spirit to be the master of his own destiny. It is this spirit which makes the American worker produce more per dollar of wage than the worker in any other country. It is this which makes co-operation difficult and which also causes the difference between European and American democracy. The former grew from a central power, while here the process is just reversed.

Responsibility and Co-operation

One of the great problems is to permeate our industrialism with a knowledge of the necessity for co-operative work. The alien must be given an opportunity to take part in the problem and normally he lacks the capacity to secure collective action.

Mr. Burns told of some of the splendid work of immigrants of various nationalities, and gave specific instances where the revolutionary spirit was transformed by co-operation and by making them feel a real relation to the work and responsibility for it. In one Finnish center they have established a chain of stores, recreation centers, community gymnasiums and other activities. The one mistake which is too often made in dealing with the alien is to overlook the fact that his independence of spirit makes it necessary for him to be a partner and not a beneficiary in any enterprise.

In closing Mr. Burns pointed out the great harm which has been done by the indiscriminate and unwarranted arrests by the Department of Justice which had shaken the faith of many aliens in our boasted democ-

racy and had tended to greatly increase radicalism instead of preventing it. It is his belief that only by being true to the best of American ideals can we get the best from the alien, who must be woven into warp and woof of the fabric of human life.

Make Every Era Great

This was discussed by Dr. Peter Roberts who thought that the immigrants did not always do their part and that they must make an effort to be part of the country in which they live. Roger W. Straus, assistant to the president of the American Smelting & Refining Co., brought out a number of extremely interesting points. The ideals of a country depend upon the character of its citizens, and this character must be capable of development. We cannot expect character in the alien unless we produce it in our own people. It must not be necessary to look *back* to eras of greatness. Character in citizenship should make every era great.

A session on mutual relations in industry was to have been opened by John Golden, president of the United Textile Workers of America, but for some reason he was unable to be present. L. P. Alford, who was to lead the discussion, first outlined the growth of industry in a very clear and concise manner and the causes which were responsible for the growth of the trade unions as well as what they have accomplished. He pointed out that one of the great weaknesses of their present attitude is that, while insisting on the right to strike and admitting a similar right on the part of the employer, labor does not commit itself as to the rights of the public. He pointed out that the workers were necessarily strategically weaker than the employer which necessitated their acting collectively. He further pointed out the need of dependable labor, persons or committees with whom to negotiate, prevention of invasion of individual rights, and the consideration of public demands for service.

The growth of shop councils is shown by the fact that over 300 establishments are now using them. From the engineering viewpoint civilization rests on industry, and the objects of industry are neither wages nor profits, but the production of goods for the benefit of the human race. He closed by quoting from one of the last utterances of H. L. Gantt, to the effect that "service at a profit, not service alone was the object of industry and business, and that this doctrine of service is not only good economics but is the basis of industrial peace."

E. H. Betts, president of the Earl & Wilson Co., spoke of the necessity of inspiration to meet industrial problems and quoted John Calder to the effect that "there are no pink pills for pale industries." No ready-made plans fit, but they may be used as a guide in evolving plans for ourselves. The use of singing in the factories was found very beneficial, the Industrial Quartet having been largely instrumental in securing the participation of the employees themselves.

Get the Right Kind of Executive

Mr. Betts also warned against the attitude of the reactionaries who were saying that "their time had come" and pointed out, as did Mr. Smith earlier in the conference, that such a state of mind was fraught with danger. A proper spirit must pervade the whole plant. Honest employment managers are necessary and all doors must be wide open. Realizing that much of the difficulty comes from the wrong attitude on the part of executives, he strongly urged that they be carefully watched and that only forward-looking men be chosen for executive positions. He ended by declaring that investments were safest in managements based on the Golden Rule, managements that have the confidence and not the suspicion of the employee.

Where Shop Committee Helped

F. J. Kingsbury, president of the Bridgeport Brass Co., and his employment manager both told how shop committees had helped in their plant. They appreciate the value of the right kind of foreman, the one who can make the men feel that they are working *with* him and not *for* him, securing the best results. Easy communication between the men and the management helped to solve the problems brought about by the armistice and increased the effort to maintain wages. The committeemen who were interviewed by representatives of the National Labor Board testified that the mutuality of the plan of readjustment which was worked out together, was a big advance over any previous experience and they pointed out how co-operation pays both sides. Whenever social service work is undertaken, the men share in both the work and their responsibility.

In the discussion it was brought out by Hugo Diemer and others that it was always better to have plans for shop committees or otherwise come from within instead of being forced in from the outside. The management should know the leaders in the shop and the more the men see and know of those higher up, the better. The average American is sincere and appreciates fellowship. It should be realized that the men want to take part and that all men are more or less alike, the main difference being in the amount of truth which they understand and appreciate.

Absentee Management

Sam A. Lewisohn of the copper interests, spoke of the problems of absentee management and the advantages and disadvantages of the old-fashioned manager who had a dogmatic view of humanity and was set in his ways.

He made a plea for the engineers who are qualified technically to handle large properties, being also educated along the line of human industrial engineering, so as to understand the personnel as well as the engineering problems. Directors who are only interested in the problems. Directors who are only interested in the price of the company's stock, absentee owners and directors, as well as resident managers came in for considerable discussion. It was generally agreed that it was better to utilize organizations as we find them as a basis for improving relations and conditions, and also the advantage of prompt action was made very clear by several specific instances.

The necessity for constant improvement was emphasized by the quotation that "revolution comes only when evolution stops."

Square Dealing Must Prevail

John Leitch, who is too well known to require introduction, gave an inspiring address on the "Constructive Adjustment of Industrial Relations," which was widely discussed. Many instances were given where men who had been extreme radicals became constructive instead of destructive when given responsibility, and everything was made open and above board.

Robert Wolf, also well known in this connection, told of his work with both union and non-union labor and the way in which it responded when convinced that everything was square. "The employer who isn't square can't put it over." He believes that industry to be successful from every point of view must give opportunity for creative ability and individuality. With a constructive outlet provided destructive tendencies disappear.

Management Must Be Energized

John Calder in his talk on "The Foreman" gave as the ideal condition "goods plentiful, men dear." The management of industry must be energized and enlightened, and their constructive ideals must be put into practice by the foremen who have direct contact with the men. Utilize the old foremen wherever possible, and there are very few cases where this cannot be done if the new ideals and new methods are presented to them in the proper way.

Some of the older foremen are jealous of the new day and must be shown. The firm must have definite policies and the foremen must know what they are. The importance of the foremen and the small shop is seen when only 2 per cent of the industrial plants of this country employ over 1,000 men. The average is 14 people to a shop, with an estimate of 400,000 opportunities for making proper or improper contact with the workers.

The Foreman's Real Job

The old attitude of the foreman acting as a buffer should give way to the broader view of industry. Fine character and spirit of the work are important factors, and the whole psychology should be studied and understood. There is no question but that injured pride leads to many shop disturbances, and the desire to get even is equally bad on either side. The foremen should be told the whole truth about the business, as it is impossible to sucessfully fool them for any length of time and this, when discovered, always breeds distrust.

The foreman's real job is in making men which is the best investment capital can make. Men are square when treated in a like manner and will respond to open dealings. The joy of the job should be restored as much as possible.

Round-table conferences followed on the various subjects brought up and the closing session was a talk by Roger W. Babson on the fundamentals of prosperity.

"An Expanding Punch for Aluminum Ware"—Discussion

By J. R. Sheppard

The article published on page 199 of the *American Machinist*, entitled An Expanding Punch for Aluminum Ware, has compelled me to inquire why the piece was not expanded by hydraulic pressure instead of the expensive punch as illustrated.

This is nothing new I am suggesting, but am forced to bring up the question of utilizing hydraulics when it is so obvious that it meets the requirements. It is possible to even expand the shell to its final shape, eliminating closing in of the top by the expensive method of spinning.

The equipment required is a simple hydraulic press, a die in two pieces (preferably split just above the flats); this top piece forming a cap through which a plunger is inserted, intensifying the water within to pressure required to expand metal to shape of die.

The cases to which the above may be applied are many, and pressure may of course be applied direct to inside of vessel to be expanded, or may be intensified therein as suggested.

Piston Clearances for Internal Combustion Engines

By C. Strom

Fitting trunk pistons of internal combustion engines is sometimes a problem to beginners; especially so in repair work. The stumbling block is the clearance—what allowance should be made so that the piston will not seize or fit too loosely for smooth running at full load?

This clearance I have found can only be determined by trial with the engine under full load; the reason being that the distortion from heat, the kind of fuel used, the method of cooling and the quality of the iron varies. The bearing of the piston is affected by these conditions and a piston that fits perfectly when cold may show a very imperfect bearing when warm.

Two Methods of Fitting Pistons

There are two methods by which pistons are fitted. One is to finish the piston to a definite size below the cylinder bore so that no amount of expansion will cause seizing, and let it wear its own bearing. This method has its faults and is the cause of many loose pistons, but it is the least expensive as far as production is concerned.

The other method, which is better, is to consider the piston as a sliding surface and fit it as such. This may be done by power or by hand fitting. When done by power the piston is "run in." The cylinder is usually mounted on a suitable fixture or stand while the piston is reciprocated in the cylinder by some crank motion device while a copious supply of grinding compound or oil is pumped over it.

When pistons are to be fitted by hand, the following method ,which I have employed for eleven years on pistons ranging from 4 to 16 in. in diameter, may be used. The piston is finish turned (not ground) with the wristpin in position, as in the final assembly. This prevents any distortion due to pin assembly. The fit of the piston to the cylinder is made snug but should not be a press fit.

To fit the piston for bearing it is forced its length into the cylinder then removed and all high spots filed down. This process is repeated until it shows a full bearing. This will make the piston out of round from 0.002 in. on a 4-in. diameter to 0.006 in. on a 16-in. diameter piston when cold.

This is the trial clearance. The final clearance is found when the engine is started under load. The load is gradually applied, the piston carefully watched, and at the least groan or pounding it is pulled out and all high spots due to the distortion by heat filed down. This process is repeated until the piston shows a full bearing and does not stick or seize at full load. The piston rings must also be spotted to full bearing at the same time.

Modern Aviation Engines—IV

By K. H. CONDIT
Managing Editor, *American Machinist*

AIRPLANE engines with radially arranged cylinders have been grouped in this installment. They are of two types, with fixed cylinders and rotating crankshaft, and with revolving cylinders and fixed crankshaft. The first type is known as the "fixed radial" or "fixed star," and the other as the "rotary."

The two great advantages of engines with this cylinder arrangement are the extremely light weight and the reduced crankshaft length with the attendant economy of fuselage space occupied. To offset these is the high head resistance which makes successful stream-lining a difficult problem.

The early engines of both types were air-cooled and the rotaries are of necessity so designed. Of the two modern fixed radials shown, however, one is water-cooled and the other air-cooled. The vogue of the rotary engine can easily be explained by the fact that the first Gnomes were not much heavier than the modern motors while at that time the best fixed-cylinder engines of conventional design were probably five times as heavy. With the low powers then in use, this was an important advantage and easily outweighed the somewhat temperamental performances of the first rotary engines. Improvements in the design and construction of vertical and V-type engines eventually evened up the discrepancy in weight and the demand for higher powers practically eliminated the rotary engine from all planes but the smallest scouts.

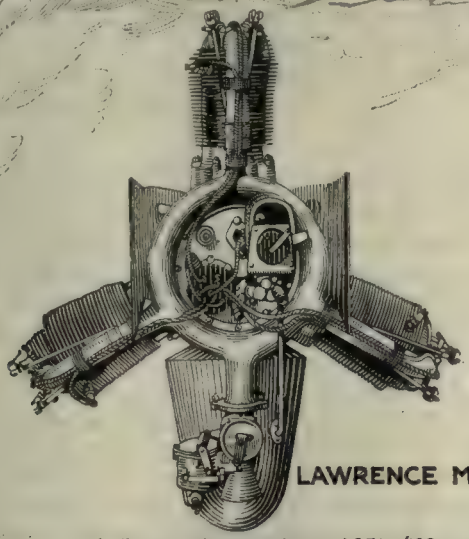
The power limitation did not hamper the development of the fixed radial engines as is shown by the construction in France of Salmson engines of more than 300 hp. and in England of ABC and Metor engines of equal performance. The English motors were not developed in time to be used in the fighting but their experimental performance was so satisfactory that more than a score of new planes had been developed to be equipped with them and were held up awaiting the production which did not materialize in time on account of minor difficulties of design and material.

The Salmson, on the contrary, was largely used in reconnaissance and artillery observation planes both in the French and American air services and was very successful. It went through various stages of development and was built with from seven to fourteen cylinders, although the most satisfactory arrangement was one with nine cylinders mounted in the same plane, as illustrated by the sketch. The crankshaft has but one throw, all the connecting-rod big ends being connected to the same crankpin through a cage which is prevented from improper rotation by gearing. The forged cylinders have corrugated welded steel jackets and the two valves are operated by rockers and push-rods coming from the crank case. The valve springs are of what is sometimes called the cantilever type, the coils being located away from the hot exhaust valves to increase their life. The exhaust gases are collected in an annular chamber surrounding the engine and forming part of the cowl, the outlets being at either side. The duplex carburetor is mounted at the base of the engine, the two intake risers leading into the circular manifold which is part of the crank case and from which the individual intake pipes lead to the intake valves.

The other fixed radial shown is a relatively new American engine which was designed for small sport planes. It is an air-cooled, V-type model with a circular intake manifold. The valve springs are made of ribbon steel wound into a spiral. The cylinders are cast from aluminum and have pressed-in steel liners and cast-bronze valve seats.

The Le Rhone rotary engine shown is probably the most satisfactory engine of this type developed. An explanation of the operation of this motor without the aid of diagrams is rather difficult but will be attempted. In the first place all existing ideas of the action of the various parts must be thrown overboard to make room for new ones. Here the crankshaft is the fixed part of the engine and provides the support for the whole structure, being attached to the fuselage by two circular plates which are bolted to it. The single crankpin provides a center about which the pistons and connecting-rods swing while the crank case and cylinders are rotating about the main journals. Thus each piston must travel from one end of its stroke in the cylinder to the other while the whole motor is making one revolution. The charge is fired just before the cylinder reaches top dead center, expansion taking place and forcing the piston out of the cylinder as the rotary motion continues. As the inner end of the connecting-rod abuts against the stationary crankpin it cannot back out of the way and the force of the expansion divides into two components, one parallel and the other perpendicular to the center line of the cylinder. The parallel component does no useful work but the perpendicular one pushes the cylinder around and induces the rotary motion which is transmitted to the crank case and propeller through the intervening parts and fastenings.

The carburetor is mounted on the end of the stationary hollow crankshaft which acts as an intake pipe and conveys the explosive mixture to the crank case whence it is drawn out through the individual intake pipes to the inlet valves as required. The exhaust is blown out into the air directly, being collected by the cowl and led off where the heat and flame can do no damage. The cycle of events is quite similar to that employed in the average conventional motor. Ignition is by high tension magneto which is mounted in the fixed back plate. The magneto itself has no distributor, its function being performed by a distributor ring mounted on the rear of the crank case and running in contact with a distributor brush fixed in the back plate. Lubrication is taken care of by pumping oil through leads in the crankshaft to the connecting-rod big ends, from which it is thrown centrifugally to the pistons and out through the exhaust. This system is naturally decidedly wasteful of oil. On account of the presence of gasoline in the crank case, it was considered essential, up to 1918, to use castor oil for lubrication because it would not mix with gasoline, but during that year experiments were made with the standard Liberty aëro oil which showed almost equally good results at a smaller cost. The Rhone cylinders are machined from steel blocks and fitted with cast-iron liners. The aluminum pistons have light steel piston rings. The two valves are operated by a single rocker and push-rod actuated by two five-



LAWRENCE MODEL L-1

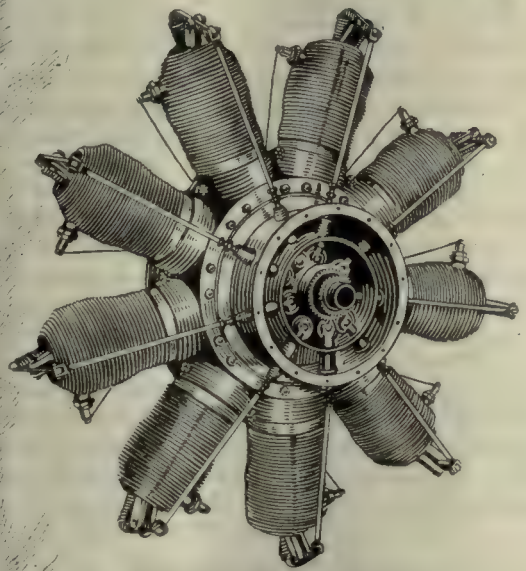
Three cylinders; bore, 4.25 in. (108 mm.); stroke, 5.25 in. (133.4 mm.); rated hp. 60 at 2100 r.p.m.; magneto or battery ignition; dry weight per hp., 2.2 lb.; cooling arrangement, air; arrangement of cylinders, Y at 120 degrees.



LE RHONE

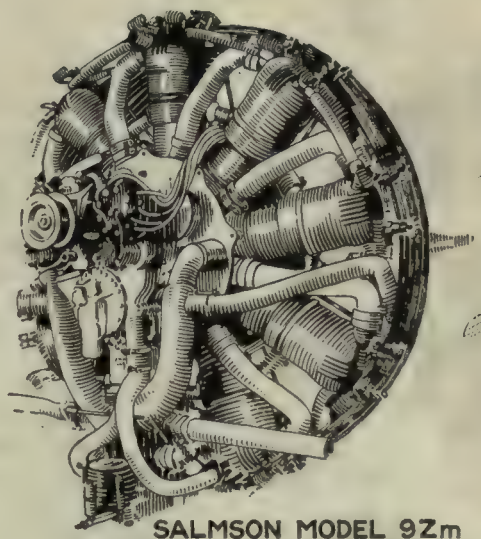
Nine cylinders; bore, 4.13 in. (105 mm.); stroke, 5.51 in. (140 mm.) compression ratio, 4.8 to 1; rated hp., 80 at 1250 r.p.m.; magneto ignition; dry weight per hp., 3.25 lb.; fuel consumption, 0.6 lb. per b.hp. = hr.





MONOSOUPAPE GNOME

Nine cylinders; bore, 4.33 in. (110 mm.); stroke, 5.9 in. (150 mm.) compression ratio, 4 to 1; rated hp., 100 at 1200 r.p.m.; magneto ignition; dry weight per hp., 2.7 lb.; fuel consumption, 0.72 lb. per b.hp. = hr.



SALMSON MODEL 9Zm

Nine cylinders; bore, 4.92 in. (125 mm.); stroke, 6.69 in. (170 mm.); rated hp., 230 at 1550 r.p.m.; magneto ignition; dry weight per hp., 1.75 lb.; fuel consumption, 0.52 lb. per b.hp. = hr.

lobed cams in contact with which are two rollers, one at either end of a rocker connected to the lower end of the push-rod. The valve rocker is pulled down to open the inlet valve and pushed up to open the exhaust valve. The cams are mounted on a cam carriage driven at nine-tenths engine speed by internal gearing.

The remaining engine is the "Monosoupage" or one-valve Gnome, also a nine-cylinder rotary and similar in general operation to the other. The principle difference lies in the substitution of inlet ports around the base of the cylinder for the inlet valve and a consequent change in the cycle of events. No carburetor is used, the fuel being sprayed from a jet into the crank case where it combines with a small amount of air entering through the hollow crankshaft to form a very rich mixture. At the beginning of the inlet stroke the single valve in the cylinder head remains open, thus permitting fresh air to be drawn into the cylinder. A little past mid-stroke the valve closes and a partial vacuum is created which is broken when the top of the piston uncovers the inlet ports and permits the rich mixture to rush into the cylinder to be diluted to an explosive mixture by the pure air already there. The rest of the cycle is quite conventional. Because of the excessive amount of gasoline in the crank case, it is necessary to use castor oil as a lubricant.

One difficulty encountered with this type of engine is the distortion of the cylinder bore due to the difference in temperature between the advancing and trailing sides of the cylinder. In the Gnome a special bronze piston ring with thin, L-shaped cross-section is used to take up the distortion. The L being in the normal position, the tendency on the power and compression strokes is for the gas to get between the ring and the piston and force the former against the cylinder wall, thus improving the seal.

Metric Trouble

By A. D. Lee

For the last year or so, I have been reading so much about the proposed "compulsory use of the metric system," and I have received so many letters and pamphlets from "pros" and "cons," that the thing is beginning to look serious to me. I feel that I ought to do something about it. In the first place, I am considerably disappointed, both at home and at the office, when I receive fat, nice-looking letters and, upon opening them, find them to be merely an argument one way or the other. It has even cost me money, because I have been compelled to buy another waste-basket.

So far, I believe the "pros" have it in volume, and the "cons" in pressure. Not that I read all arguments, or even all of some arguments; but a casual glance through the documents shows that the "cons" understand much better the art of slinging heavy words of ruination, perdition, calamity, vengeance, and so on, whereas the "pros" seem to have a surplus of paper and a more advantageous contract with the printer.

Before I go any further, let me say here that I am rather opposed to making a change; in fact, if people would be satisfied to leave the whole matter to me, I would at once proceed to forget it. However, so many of my good friends seem to be getting a case of nerves that I myself feel a trifle shaky, too, and I have actually asked some people, "What is this law that threatens us with such dire calamities?" They all agreed that they did not know exactly what the law was, but, just the same, it was one ——— of a law and should not be passed. Regardless of the arguments of the "pros" and notwithstanding the arguments of the "cons," I agree with my friends that the law should not be passed, and I would like everybody to understand that, with me, this point is settled. I think this case needs no argument, and I give none. But, human-like, I feel just a wee bit curious as to what that law is regarding the "compulsory introduction of the metric system." How does it compel, and how much does it compel, and what does it compel, and what are the proposed penalties, and what is the proposed machinery for enforcing it? There are a lot of things I want to ask, but I will be satisfied if 50 per cent of my questions are answered.

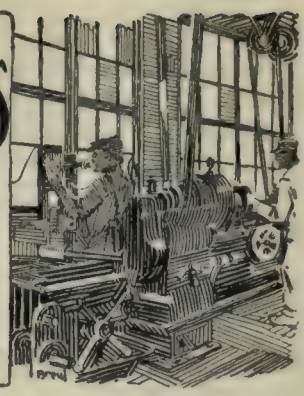
May I use nothing but metric scales and mikes and gages? May I speak nothing but metric terms? Is it a fine or the workhouse for using common fractions? Will the Federal Commissioner for the Enforcement of the Metric System in the United States have the right of house to house search for two-foot rules and other contraband? Will I still be allowed to buy wallpaper by the roll, or must it be bought by the hectare? Will eggs go by the dozen or by the cubic centimeter? We now buy granulated sugar by the grain; shall it be bought hereafter by the milligram? Will beer come by the litre instead of in the growler? (But no, no, don't answer this, please! I know it will not come at all.) Is it punishable to say there are 3 ft. in a yard or 12 in. in a foot, but permissible to say there are three pansies in my yard and five toes on my foot? Please note that in both cases a prohibited word is used. Sometimes, when I am particularly optimistic, which doesn't happen often nowadays with the High Cost of Living, Bolshevism, Prohibition, and the Spectre of the Metric System hovering over me, I think that the compulsion may be only the compulsion of offering for sale—dry-goods by the meter, groceries by the kilogram, liquids by the liter, real-estate by the hectare. It may even be compulsory to advertise the swing of a lathe in centimeters instead of in inches and, in my optimistic moments, I have the feeling that the only trouble the machine builder will meet will come when he gets a customer who insists on having everything in the metric system. Uncle Sam might be such a customer; in that case, let George take the contract, which, by the way, seems to be quite a common rule now. If any private customer insists on the metric system, tell him to go to ——— say, France, where they have that system at the present. But these moments of optimism are scarce, and when the reaction comes, I ask myself things like this: If, in the privacy of my study, I should whittle out a coffee-mill with my trusty jack-knife, a screw-driver and a 14-in. bastard file, and the diameter of the crankshaft should happen to be exactly ½ in., would I get two years in the pen? If my boss should give me some screws to turn up with a 3 mm. thread, and on inspection he found that the pitch was ⅛ in., would I be fired—also jailed?

These, and a hundred other questions, are very important to me—much more important than the fact that the manufacturers of the United States would lose hundreds of millions—or is it billions?—of dollars, because I don't happen to have that much money anyhow. Therefore, Mr. Editor, won't you please be kind enough to publish in heavy print exactly what that dreaded law proposes to do to us?



MODERN PRODUCTION METHODS

By
W R. Basset
of
Miller, Franklin, Basset & Co



I WILL grant that not even a majority of the machine shops have quantity production as does Ford, for instance. Perhaps not a large percentage of the total run quantities of a single part as high as 1,000 at a time, but most shops have lines of product on which they specialize as to general type, although they may run through only two or three or a half dozen on an order.

But the quantity run does not determine whether or not the work can be planned. It only determines how far ahead it can be planned. Planning depends upon the possibility of forecasting approximately how long an operation will take. Of course, if no operation were ever repeated—if no two similar parts were ever made, it is possible that the efforts of planning the work would not be worth while. But that condition, I believe, need not exist. Even a repair shop has enough jobs of similar nature to warrant at least crude planning, even though its efforts be only to keep machines busy and the work progressing without delays. We have successfully planned repair work in several machine shops of industries where the shops were maintained solely to make repairs on the factory equipment. The results in such shops have invariably been to expedite the repairs and to maintain an even force of mechanics, all of whom are reasonably busy most of the time.

IX. Planning in the Ordinary Shop

Mention the planning of production to most machine shop executives—outside of the automotive industry—and they will each spring the good old alibi—"That's great stuff for the fellow who has quantity production, but my business is different." They will then go on to elaborate that they run shops where two orders are hardly ever the same and that their production consequently cannot be planned.

(*Part VIII was published July 29.*)

The truth is that most shops have a much more uniform product than they realize. One may specialize on lathes and drill presses, making several standard types and sizes with slight changes to meet the customer's requirements, and take special work occasionally. Another may make waterwheels principally, each one designed to meet special conditions.

Management is Sometimes Skeptical

The executives of one large shop which turns out a variety of heavy and fairly complex assemblies, were unanimously skeptical of our ability to plan the work. They admitted that, if their production could be planned, the output could be increased, costs lowered and much of the money tied up in goods in process, released. But they pointed to the special machines which they made, seldom more than six of a kind to an order. And they also pointed out that nearly every customer demanded slight changes from normal. They said with assurance that they made 30,000 parts. The seeming complexity of their product made them doubtful, but they were in so much trouble from broken promises and slow production that they decided to see if planning could do anything for them.

Now the first thing to do, as I have shown in a previous article, is to find out exactly what the shop *does* make. An analysis of 10 years' output showed that this concern had made five widely different machines. Counting the variations in slight or great degree from the standard, we found that several hundred types had been made. Many of these variations, however, consisted only in slight dimensional variations in a part or two—many of them unnecessary. Instead of 30,000 parts, we found that but a trifle more than 15,000 had ever been made; more than 5,000 had not been made in 5 years and less than 6,000 could not be called at all usual—much less standard.

A still further analysis showed that when two machines of the same kind, but perhaps of a different size, were made, it was unusual to use any of the same parts on both machines. This deviation was often most slight, yet it precluded manufacturing in even small lots of stock. Variations from standard are not only tremendously expensive, but usually are wholly unnecessary. The customer who wants a whim gratified may think that a difference in dimension is essential. His particular desires at the time seem of surpassing importance to him and to the manufacturer who is after his order. But five years later when the sales urge is forgotten, and the variations from standard can be seen in perspective, most of them are ridiculously trivial. It is then easy to see that the standard machine would nine times in ten, have served the purpose.

The whims of the customer are not alone to blame for this condition—a thoughtless engineer will often design a different part for each size of a machine of the same type where a single part, perhaps of compromise design, will often serve the purpose.

Designing for Economy

Suppose that, in designing two machines of different capacities, the heavier one demands certain parts to be heavier. To save metal, this part may be redesigned

Date Routing is issued. Made out in the Production Department. ROUTE CARD FILE BY NEW PART NOS. PART
Material e.g. Cast Iron or Brass. New No. Dwg. Old No. Dwg.
Unit Name Field Saw Ex. L. PART
Part or Part. Name e.g. Double Flange Wheel New No. Dwg. Old No. Dwg.

SPECIAL TOOLS JIGS OR FIXTURES	OPERATION No.	OPERATION NAME	SHOP	MACHINE NO Preferred	MACHINE NO Optional	PRICE Set Up	PRICE Piece	Set Up Time	Time Per Pc.
Number of Jig or Fixture used to perform operation.	Number of operations, two spaces left to provide for additional possible operations.	Brief description of Operations.	Shop in which is to be performed.	Machine best adapted to perform operation.	Other machines on which it is possible to do the work.	Information Originates in Time Keeping Department.	"	Time estimated to start with but to be taken from performance later on.	To be estimated at first and taken from performance later on.
		Layout included in operation if at machine by same man. If at bench by different man, make out seperate operation.		100	110-252	10	.05	.2	.1

FIG. 48. THE ROUTE SHEET

for the smaller machine. And yet economy would often result if the heavier part were used for both machines; the economical manufacture more than offsetting the excess material.

So much has been said about standardization that it is not necessary to prove its case in detail. Any one will admit its advantages—for the other fellow. But few can apply the lessons to their own product. The problem is too close—the demands of customers too insistent.

However, it is this that stands between many concerns and economical manufacturing. It prevents planning in many shops which might use it. That is why I have given time to a discussion of so hackneyed a subject. For the first step in planning in a shop, is to study the product and eliminate needless variations of design, so that ultimately more parts of a single design may be put into process.

This settled, the next step is to study the demand to the end that some parts may be manufactured for stock. The more of this that can be done the better, for certain parts in shops of the type under consideration will admittedly always have to be made on sales order. If some parts may safely be made in anticipation of future orders, they can not only be economically produced on a single set-up, but they can be put on machines which would otherwise be idle, thus increasing the machine activity. It is just such points as these that make the difference between skillful management and unskillful. They are generally admitted, but seldom practiced, because most men think they face peculiar conditions. The change in methods will assuredly show up at the year's end in the company's statement. It will show up more markedly in the cost system if a good one is in use.

Now, as with quantity production, the time of starting a job depends upon the time taken for each operation. Time is the essence of planning; accurate knowledge of time is the key. If standardization has been carried out to a reasonable degree, time studies of the various operations on each part are well worth making, even if an operation is performed only a few hundred times a year. Perhaps in the ordinary shop only 50 per cent or so of the operations will be reduced to definite time studies, although I believe it is usually possible, and profitable, to get time on 90 per cent of the operations.

When an absolutely new job comes up, the time may be fairly accurately forecast by reference to the tables which are described farther on in this article.

In analyzing the product, it is essential to analyze the operations to be performed down to their elements. What may be considered at first glance to be an operation is thus found to comprise several less complex ones. In this way times for each elemental operation may be set, often by actual time study, from which times on nearly any series of operations, no matter how new or complex, may be built up synthetically.

We have recently had to set price rates for various operations in this way in an industry where literally no two orders are identical. Yet we have been able to analyze the operations to a point where a piece rate may be fairly set for any conceivable product, no matter

Machine No. 167
Type Colburn Drill
Speed Ranges R.P.M. of Spindle 45-509
Max. H.P. Available 7 H.P.
Method of Gear Change Quick gear shift
Max. safe cut C.I.
" " " Steel
Max. dia. of work handled 18"
" Height of " " 42"
Method of handling work Electric crane
Remarks Feed Range .019-.061-.032 -.013-.043-.019 Per Rev. of spindle
Speeds 45-63-90-126-182-254 -362-509 R.P.M.
17" Spindle Travel.
Boring Mills & Drills

FIG. 49. MACHINE DATA SHEET

how complicated. And about 1,000 elemental times had to be set. With 1,000 elemental operations, a good many million combinations may be set up.

I believe that that shop would indeed be an exception which required more than 2,000 or 3,000 or so such elemental times. It is all a matter of intelligent analysis by a man thoroughly familiar with shop practice and the equipment of the specific shop which is being studied.

The schedule-control graph which was described in Article VII may be used with minor changes. In the first place it is not feasible to attempt to plan the work into the shop so far ahead, nor so accurately, for the runs change more frequently and estimates of the time needed must to a degree take the place of known, accurate standards.

Furthermore, we do not plan the work of the shop to machines. The machine tools of such a shop as we are considering may best be arranged in batteries, keeping similar machines together. The unit lineup is economical only when similar parts go through the same series of operation year in and year out.

DATE Feb 24 1917 TIME 10 A.M. STUDY NO. PART 32" Gear Planer

MACHINE NO. R.P.M. OPERATION

MAN A RATE TOOL

MAN B RATE SPEED Cut 38' Ret 66' R.P.M.

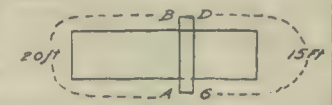
MAN C RATE FEED

MAN D RATE DEPTH

MAN E RATE MATERIAL

MAN F RATE DEPT.

SKETCH



NO.	PERFORMANCE NAME	STOPPING POINT	PERFORMANCE TIMES	REMARKS	STD.
1	Start or Stop Machine				2
2	Tool in in Clapper Box				30
3	Tool out of Clapper Box				16 7/10
4	Move Heads - Right or Left			4 t	1/10 Sec per in
5	Move Heads - up or Down			4 t	2 Sec per in
6	Swing Clapper Box				13
7	Swing Head (10°)				53
8	Adjust Automatic Table Stops				15
9	Movement of Rail - Up or Down			33/10 t	2 Sec per in
10	Put on one feed gear				4
11	Take off one feed gear				3 1/10
12	Put on two feed gears				84
13	Take off two feed gears				43
14	Start or Stop Table				12
15	Walk to opposite Controls				5

FIG. 51. TIME STUDY OF ELEMENTARY MOVEMENTS

While the routine of planning must vary to fit the needs of each shop, it seems advisable to describe the methods which we installed in a shop which is, I believe, fairly typical of most shops not engaged in quantity production. This shop employs about 150 men. It has a well developed engineering department and the machine tools are assorted in different sizes, such as lathes, drill presses, together with the other usual tools found in machine shops. The company specializes in conveyor machinery, offering to the trade certain standard models in standard dimensions. However, orders are taken for special machinery, which cause variations from the standard, so that you will see that the shop we are considering conforms with the conditions which I mentioned earlier in the article.

Let us see how this shop handles an order for a coal conveyor, the physical location of which necessitates changes from standard in height, width and pitch of chain, and dimensions of the buckets.

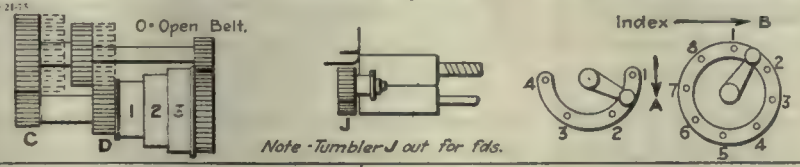
When this order is received it is turned over to the engineering department which prepares drawings of the complete assembly as a whole of the different minor assemblies; and detailed drawings of each part. At the same time the engineering department prepares from these drawings a parts list or bill of material, showing the number of the different parts required in the different assemblies and the dimensions of the rough stock, together with the information as to whether the part in question is to be manufactured or purchased. This bill of material may be similar to the one shown in Article IV, "Engineering the Product." A copy of the bill of material, together with a blueprint of the drawing is then turned over to the shop superintendent.

The next step is to deter-

Machine No. 204 Machine Name 28" Lathe Location Dept 6

Type Double Back Gear Maker's Name Schumacher & Boye Serial No. Lot-130-8453

Form No. 184—Magee 21-15



Speeds in Feet per Minute — Diameters

Gear Pos.	Belt Pos.	R.P.M.	4"	6"	8"	10"	12"	16"	20"	24"	28"
O	1	164	171	257							
O	2	124	130	194	259						
O	3	88	92	138	184	230					
C	1	14	14	22	29	36	43	58	73	88	102
C	2	10	10	15	20	26	31	41	52	62	73
C	3	8	8	12	16	20	25	33	41	50	58
D	1	40	41	62	83	104	125	167	209	251	
D	2	30	31	47	62	78	94	125	157	188	219
D	3	22	23	34	46	57	69	92	115	138	161

Feeds in Inches

	A 1	A 2	A 3	A 4
B	1.200	1.100	1.050	1.025
" 2	1.177	1.088	1.044	1.022
" 3	1.160	1.080	1.040	1.020
" 4	1.145	1.072	1.036	1.018
" 5	1.139	1.069	1.034	1.017
" 6	1.133	1.066	1.033	1.016
" 7	1.122	1.061	1.030	1.015
" 8	1.114	1.057	1.028	1.014

Longitudinal cross feed are same.

FIG. 50. SPEED AND FEED DATA

mine how to make the different parts and through what machine tools they shall pass. Whether you operate a job shop, or the repetitive operation shop, someone must, in the beginning, decide just what operations are to be performed upon the piece. So you see, as pointed out earlier in the article, your problem is fundamentally no different from the repetitive operation shop.

So, on a route sheet for each part, the different operations are listed together with the machine tool which is best adapted to do the work in question. A route sheet was described in Article VI. One especially designed for this shop is shown in Fig. 48. So far we have developed the same information as we did for the

FORM 187 1 2 3 4 5 6 7 8 9 10 11 12 13

DETAILED OPERATION CARD

Dept. No. _____ Mch. No. _____ Order No. _____

Dr. No. _____ Symb. and Patt. No. _____

Operation _____ No. _____

Scheduled to start _____ Qty. on this ord. _____ Qty. on this lot _____

Piece Name _____

No. pcs. Def. _____ No. pcs. Fin. _____

SEQUENCE OF OPERATIONS	SPEED			FEED			CUT IN INCHES	LIMIT	
	F. P. M.	BELT	GEARS					HOURS	10TH

Total time limit _____

Started _____ Finished _____

When Completed return this Card to Planning Department

FIG. 52. DETAILED OPERATION CARD

Form No. 176—Magee 20-1683

TOOL CARD

Dr. No. ..... *Patt. No.* ..... *Symbol No.* .....

Piece Name .....

Used on .....

Operation .....

Operation No. ..... *Dept. No.* ..... *Mch. No.* .....

	Kept at Machine	To be Delivered from Tool Room
Tools		
Jigs Templates		
Miscellaneous		

FIG. 53. TOOL CARD

Warner Gear Co.'s repetitive work, except that on the route sheet no times are shown. It therefore is necessary to forecast, as accurately as possible, the time that these various operations will take. But first we must know the capacities of every machine in the shop. Therefore on a form similar to Fig. 49 gather the information as to the capacity and method of handling the work. From a study of the machine we also draw up a card silimar to that shown in Fig. 50, which shows the speeds and feeds for the various combinations of gear and belt positions. These two records give us the theoretical operational capacity of the various machines.

However, before we can really set any times we must know how long it takes to set up a machine and we therefore make time studies of the length of time it takes to make certain elementary moves around the machine. On a planing machine, for instance, the following operations have to be performed in some cases, i.e., the tool must be placed in the clapper box; the head of the planer raised up or down; the power turned on the machine; the power turned off; the stop motion adjusted, etc. A time study form on which the standard times for each of these motions have been recorded is shown as Fig. 51.

The figures in the colum headed "Std" are the standard times in seconds. Item 4 shows that 4 sec. are allowed for adjustment plus 0.4 sec. per inch of movement. The same method is used for showing the standards for items 5 and 9.

Now for each operation on a part we are able to set a time, simply by picking out the elementary motions that the man will have to make at the machine tool to place the piece in a position to be cut. Knowing, from the forms, Figs. 49 and 50, the speed and feed, we can easily figure out the length of time that the actual cutting of the metal will take, which will be close enough for all practical purposes of planning. This estimated time will actually be close enough to enable us to set a bonus if we desire.

This synthetic time which we have built up from the known elemental times, gives the time for the operation as a whole, which time is placed on the routing sheet, Fig. 48. The same procedure is followed for each operation. Thus, we have developed for the unknown piece coming into our shop, a routing showing the operations, machine tools and times.

We have now determined the time which each opera-

tion *should* take. We will make an effort to see that conditions are such that the workman can do the work in the estimated time.

To that end we give to the workman a detailed operation card for each operation, showing him the speed, the feed and the cut in inches, and also the time limit that we have assigned for each operation. This is shown in Fig. 52.

Also, at the same time that the routing is made out, the superintendent places upon the route sheet the number of the tool which is to be used. A copy of this information is noted upon the tool card, Fig. 53, for the operation in question, which is sent to the toolroom by the planning department when the work is released to the shop.

We now come to the actual planning by means of a schedule-control graph the same in principle as the one shown in Article VII, although in practice it may appear differently for every shop.

The schedule-control graph is made up from the routings, all operations on each part being drawn backwards and producing a series of lines ending at irregular points.

We have made no attempt, at this time, to assign a definite delivery date to our article. Before we do that, there are one or two points that must be considered. For example, if new castings are required, we must plan to get out the patterns and to get the castings from the foundry. The duration of time allowed for this should also be drawn on the schedule control.

You will note here, a slight difference from the procedure described in Article VII. At plant of the Warner Gear Co. the manufacture of castings, say, was not shown on this schedule-control graph for the material used there was coming in in a constant flow from raw stores. Each new job that came into the shop did not require a special pattern and castings.

It is also desirable to be able to speed the work up in case the delivery requirements of the customer are pressing. It can readily be seen that if we can roughly estimate the piece which will take the longest time in the shop, that the drawing for that piece should be given precedence, and it is well to indicate this fact on the schedule control.

So we then have this marked difference between the Warner Gear Co.'s schedule-control graph and the control for this particular shop. The control graph for this shop shows when the drawings, patterns and castings are required. Of course, sufficient time should be left between each one of these dates for the drawing to get to the pattern shop, to allow the pattern to get to the foundry, and to allow the foundry time to deliver the casting to the machine shop.

Assembly Floor the Objective Point

As I have said so often before in these articles, it is not so important that some of the parts land at the assembly floor on a given date, as it is that all of the parts land on the assembly floor at nearly the same date. It is better to have all of the parts for one assembly done on time than to have some parts for three machines done, and certain parts for all three lacking.

We can then, by taking the number of hours that the shop works, ascertain the different dates when any operation should be completed. In other words, we can determine when the drawing should be started to be prepared; the date the pattern should be started to be made; the date delivery should be made to the foundry; and the date the castings should be delivered to the shop. Now that we have prepared the schedule-control graph we next have to see how it serves as a guide in producing the work. Therefore let us see how this is done by the production manager who has under his jurisdiction the making of the conveyor that we are discussing. As he sits at his desk, on a rack behind him hang the various schedule-control graphs for the different machines on which the shop is working. At his desk are a series of files which serve to represent the different machines in the shop. These files are really nothing more nor less than the production board in the booth, which was described in Article VIII with changes to meet the changed conditions.

Here we have four pockets for each machine. The first pocket is for work that is to be run; that is work scheduled but not yet released into the machine shop. The second is for work which is in the department. The third is for work at the machine. The fourth is for jobs which have been released to the booth in the shop.

The Production Board

Note here the difference between the use of the Warner Gear production board in the shop and the production board in this shop in regards to the scheduling of the work in the department and the work in the machine pockets. The tickets in these three pockets have not yet been sent into the shop, but are kept in the central planning department. The fourth pocket simply shows the jobs that have been released to the shop. It does not show whether the jobs are running or not, but simply the jobs that can be best assigned to the different machine tools by the foreman.

Let us see how the production department controls one part through the shop by following its records through the various stages.

Service cards, requisitions, in-slips, move orders and routings are prepared in advance, just as they were for the repetitive shop described in Articles VII and VIII. Also in the central control there is a file of requisitions to be issued. The jobs are written up in advance, the requisitions, in-slips, etc., are filed by manufacturing order number and in turn by part number under manufacturing order number. These are withdrawn from this file and placed in the second pocket as the date shown on the schedule-control graph draws near. When the date itself actually arrives, the production manager turns over to the booth man the file of requisitions actually to be issued and draws out the two copies of the requisition from the requisitions to be issued, by file.

The booth man files all of these under the heading of the machine which performs the primary operation. As he sees that his machine is beginning to run out of work, he places the requisition on the move board and draws from the stores the material, landing it at the machine which performs the primary operation. The copy of the requisition is then returned to the booth and from there is returned to the central control. The central control can then move the service cards for that particular piece forward into the work at the machine pocket.

On the service cards, the estimated time of the jobs is noted, and on the edge of the fourth pocket, evenly spaced marks are placed, indicative of two-hour periods. A movable pointer is arranged to indicate any mark, which, shows the number of hours work ahead of a given machine or group of machines in the shop. As

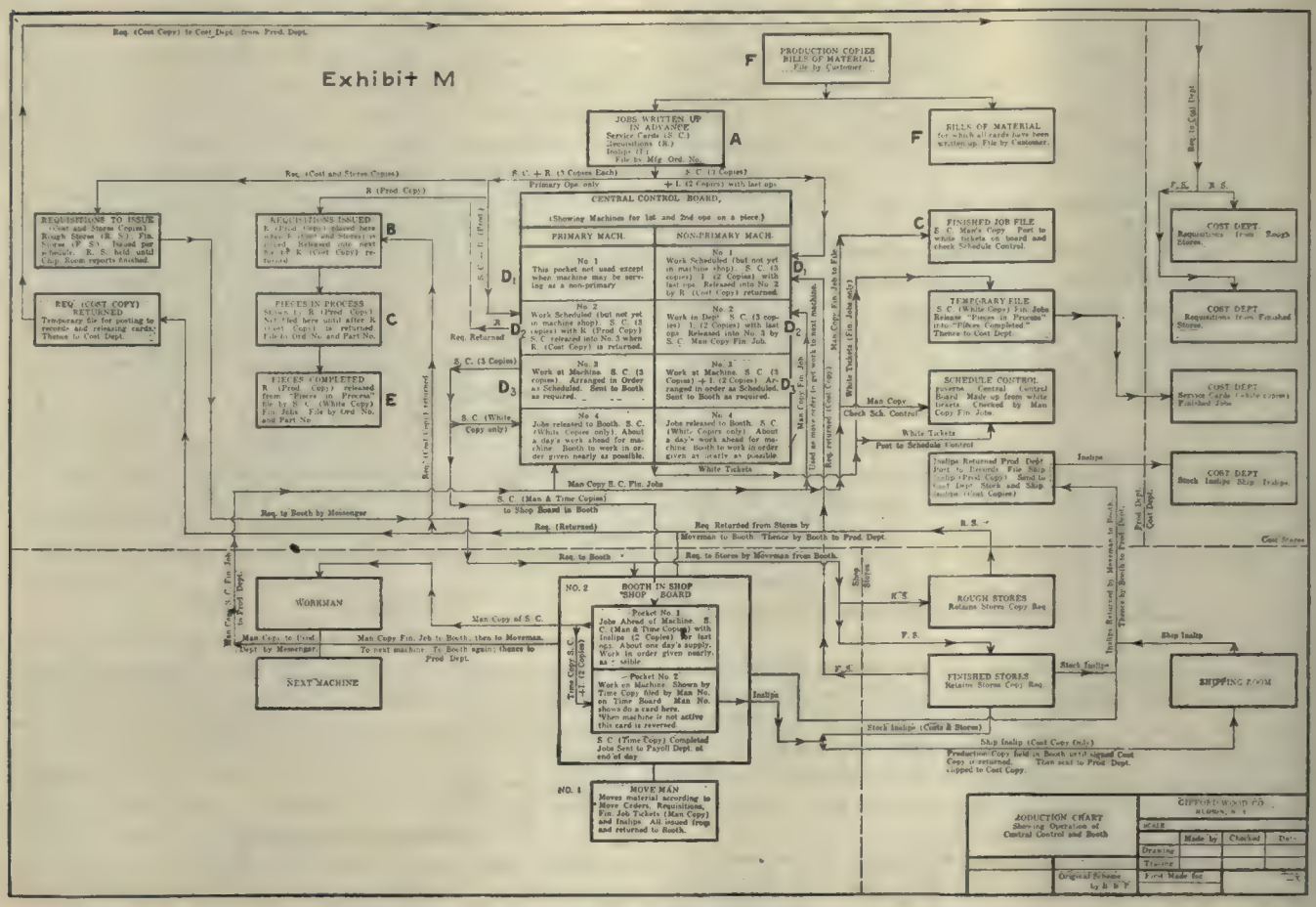


FIG. 54. CHART OF CENTRAL CONTROL AND BOOTH OPERATIONS

work is completed, the pointer is moved back so that by a glance at the board, the production man can ascertain how many hours work are ahead of any machine.

Procedure on Completion of Job

As the jobs are completed in the shop, the service cards are returned to the central control man, who releases to the booth the corresponding ticket in the fourth pocket and moves back his pointer to the number of hours shown as standard on the return job ticket. It is easy to see that by following the pointer carefully and releasing the tickets to the booth as required by the schedule control, that the booth man can at any time see how much work there is ahead of any machine or group of machines.

There is a distinct difference between the production board in the booth in this type of shop from that in the Warner Gear Co., as the booth in this shop has only two pockets, one being used for jobs ahead of the machine, and the other for work on the machine. The reason for this is that no jobs are released to the booth until the jobs are actually at the machine.

A careful study of the chart, Fig. 54, illustrating the various moves of the service cards, in-slips, requisitions, etc., will show that we have provided a means of telling just where each job is in the shop; that is, from the file of requisitions issued, pieces in process and pieces completed, we can tell just the status of any given piece in the assembly.

The main difference between this method of plan-

Accomplishment Control Chart.

Part Name	Pieces Wanted	Part No.	Drawings Finished	Patterns Finished	Materials or Castings Received	Special Tools Received	Date Started in Shop	Labor Estimate. 50 45 40 35 30 25 20 15 10 5
Housing	1	a22.	4/15	5/3	5/26		6/15	
Shaft	1	a222	4/15		4/30		5/3	
Bushing	2	a223	4/16	5/9	6/1			

FIG. 55. ACCOMPLISHMENT-CONTROL CHART

ning and that described in Article VII and VIII is that the central control has a much closer relation to the shop and there is not the same attempt made to line up the work so far in advance. After the service cards for the different operations have been returned to the central control, the performance is noted on the schedule control chart card just as in the case of the Warner Gear Co. and the same information as to the standing of our job can be read from it. This same method, it can readily be seen, is adopted whether you are making as we suggested in the beginning, a complete conveyor, a single piece, or any number of pieces. It is particularly useful where work is not repetitive except at extremely long intervals, and where the parts are coming through the shop in small quantities.

We would suggest also that there should be maintained as an executive record, Fig. 55, the accomplishment chart, which shows at a glance what percentage of the labor estimated has been performed upon each piece. This would naturally be gotten at by taking the total number of hours required for each piece and then drawing them in, and then as the work is completed, drawing the line from left to right, indicating the percentage of the estimated time that had been expended upon the piece in question. The value of this record is that it serves at a glance to show the executive how the various orders are coming through the shop.

It will be seen that the shop depends for its information on a system of filing rather than on a system of written records. This again is governed by the fact that the job that is done today is done and may not be done again, so that it would be extremely foolish to set up the elaborate type of records that are essential to the repetitive shop. In this way considerable clerical labor is saved and it brings down the planning and production method to the minimum amount of clerical help.

Because there must be such close contact between the central planning department and the shop, we recommend the use of pneumatic tubes. Another very practical method of sending the service cards back and forth between the central control and the different points desired to be reached in the shop, is the old style hollow rolling-ball. Barring these mechanical conveyors, an efficient messenger service will have to be established, but this should prove no draw-back as any boy or girl at low cost can perform this function, if closely supervised.

It is readily seen that the principles and methods of planning are fundamentally the same, whether the shop be on repetitive production or job orders. In both, the way must be smoothed for the work, definite knowledge must be available as to when, how, and what to make, and finally close contact with the shop must be maintained.

The principal differences between the two kinds of planning lie in the closeness of control and the length of time the work can be planned ahead.

Selling the Sales Force to the Plant Employees

By William Frank

It is quite often the case in large manufacturing institutions that there is mighty little co-operation between plant employees and sales force and mighty little contact between them, too, for that matter. The plant employees are inclined to think that the salesmen are a bunch of white-shirted nuts who are getting by with murder by putting out a big bluff. And the salesmen, on the other hand. are quite apt to think that the plant employees are a bunch of brainless boobs whose work isn't worth what they're paid and who are much beneath the notice of such a superior being as a man who actually makes the sales and therefore keeps the plant running.

Of course where plant workers and salesmen can be made to see how mutually necessary they are to the business and how each of them has problems which the other is unfamiliar with and which he might not be able to handle, then there is certain to be greater co-operation and a consequent increase in morale all along the line.

S. F. Bowser & Co., Inc., of Fort Wayne, Indiana, appreciates the existence of this problem and of the further fact that a satisfactory solution of the problem will everywhere be a good thing for business. And recently this concern took a unique method of solving the problem.

Every year during the summer months the company stages a convention of its salesmen at the home office in Fort Wayne. Usually this convention consists only of "pacemakers"—salesmen who have attained a certain standing by reason of selling the quota fixed for their territory. But this year it was determined to bring all the salesmen into the home office, ordinary salesmen as well as pacemakers, and this determination brought to the home office several hundred salesmen from all parts of the country.

It was felt by officials of the company that the presence of the salesmen at the home office offered a splendid opportunity for creating a better feeling of friendliness and co-operation between factory employees and the sales force so the following plan for doing this was adopted:

Each salesman was given the names of three plant employees, the departments where these workers were to be found, the nature of the work done by each of the employees and some further data. Then the salesmen were given badges which were appropriately inscribed for the wearing of workers during the convention, and were sent out into the factory to look up the workers and to pin the badges on them. Of course, as this was part of the salesmen's jobs at the convention, all of them did as directed. In so doing the salesmen came into personal contact with the factory workers, and upon talking to them, found that they were regular human beings and worth while cultivating. Also the salesmen discovered that the factory workers were doing things the salesmen couldn't do and the workers found that the salesmen were working just as hard as they themselves although in a different way.

All of this had a splendid effect on the force of factory workers and gave a distinct boost to the morale of the plant. It made the workers more enthusiastic boosters for the plant and made them take a more lively interest in the convention and in the salesmen. All the way through it was a very successful stunt.

Isn't there a hint in this for other concerns who find that there is a distinct antagonism between the sales and factory branches?

Isn't it always well worth while to create the best possible feeling of understanding and friendliness between all factors in the enterprise?

Machine Design Again

By ENTROPY

No, this is not an article on sizes of shafts and pulley arms. It is an attempt to analyze the fundamental reasons why some machines are too well built and others not built well enough.

WHEN a man buys a machine, whether it be a power sewing machine, an engine lathe or a tractor, it is usually for the very definite purpose of enabling him to make a profit from the output of the machine. There is no sentiment about it. He may say that he has always bought of So-and-So and prefers to keep on trading there, but what he means is that he has learned by experience that machinery which they build can be depended on to do his work. It may be more highly polished than is necesasry, but he has come to associate that degree of polish with an efficient machine. He looks on the finish just as he does the nameplate, as evidence of authenticity. He will not change merely for a lower price, even though he may concede that some of the frills for which he is paying might well be omitted.

Then, too, his quest for machinery is influenced by the permanence of the market for his own goods. It may apparently be very stable, sufficiently so as to justify the purchase of much special or single-purpose machinery, and yet he may have in mind certain changes which he would like to make which would throw out all such machines. He may not make these changes until he has taken all the possible profit from his present style and kind of product, but he does not wish to take a chance that he will not soon make the change. If he could so design his product that he could start with it five years ahead of the times and keep it on the market five years after the times have caught up to it, he could well afford the special machinery. If he does this he is in danger of finding that his five-year-in-advance-of-the times product is ten years off at one side, and at the best if he has sensed the coming market, he has a long hard sales job to educate purchasers up to the point where they can see that he is on the right track. History is too full of instances where one man invents a machine or a method and loses all his money trying to market it, only to see someone else pick it up later and make a fortune out of it.

It costs a great deal of money to design even a very simple machine, make the patterns, build it without jigs or fixtures, and then perfect it so that it will do the work required. It may be that designers have made original drawings in which every movement of a rocker arm had clear play, every effect of inertia was foreseen, and every part was strong enough and no part so inelastic that it interfered with the working of the other parts, but this is so seldom accomplished that such an accident need not be expected. Certain businesses, however, have to have entirely special machinery. Envelope machines, for example, are mostly indigenous to the factory in which they are used. Second-hand ones are broken up rather than sold so that the secrets of their construction shall not leak out even after they have outlived their usefulness. At the other extreme is the business which can go out any afternoon and pick up enough new and second-hand machine tools to equip its shop before night and have the machines backed up to the door the next day. The effect in both cases is the same. The man who has to have all his machinery built to order, changes his product as seldom as possible consistent with the advances his competitors are making, and the man who depends on stock machinery finds the readiness with which he can enlarge or contract his plant a real asset.

To determine just what machine design should be under different conditions, let us see what factors enter into costs of production which are affected by machine design. There is machinery for speeding up production, which may reduce the proportionate overhead charges for rent and the time during which materials must be carried before they are sold. Then there is that which reduces the labor cost for attendance either by lowering the quality of labor required or by speeding up or by making it possible for one man to attend a number of machines instead of one. Then there is the third and possibly most important way by which machine design may make a better product or one which is more dependable as to quality or quantity.

In the first case there may be required nothing more than a re-design of the machinery in use at present, adding to its strength where needed with due respect to the increase in stresses due to greater acceleration of reciprocating parts, or it may be found wise to re-design from the very beginning. Usually the former is more likely because the man who furnishes the capital can more readily see its possibilities, or rather he likes to more nearly play a sure thing.

Under the second head come automatic machines, and machines of the continuous production type, in which the actual machine operation is automatic, and the workman has only to set the work, which may require skill, and remove it, which seldom does. Such machinery is only justifiable when the returns from its use will pay for it in a comparatively short period of time, and that in turn depends on the optimism of the management as to the length of time it can market the product without change, and on the designer, as to how far he can go in designing such machinery and yet keep it flexible enough to be usable for other than its single purpose.

The third head is the one under which the truly capable designer is most apt to shine above the mediocre man. It is in this kind of design that a man can make use of the forces of nature rather than of man, as for example using the force of gravity in place of gibs. Using weights instead of springs, proportioning slides so that wear will be as constant as possible and distort the movement of slides and carriages as little as possible, making the takeup for wear bring the moving part constantly up to the side which is least subject to wear, and in general making the machine like the old "one-hoss shay" in that it will work to its best up to the last minute of its usefulness.

All these methods couple up machine design with finance, with business and with human nature, and make it just as necessary for the designer to become a student of all three, as of strength of materials, dynamics and kinematics.

The Calibration and Dimensional Changes of Precision Gage Blocks

By C. G. PETERS and H. S. BOYD
U. S. Bureau of Standards

With the interference methods described in this article, the planeness and parallelism errors of precision surfaces can be measured and the length of standard gages determined by direct comparison with the standard light waves to an accuracy of a few millionths of an inch. The errors of other gages can be determined by comparison with these calibrated standards with equal precision. Measurements to this degree of refinement are not easily made; careful manipulation and well controlled conditions are required. They are important, however, and must be made when establishing the precision standards for the testing laboratory.

PRECISION gages, which are blocks of metal, usually steel, having two opposite faces plane, parallel, and a specified distance apart, are used in the shop as length standards for checking micrometers and other measuring instruments, and as distance pieces or size blocks for precise mechanical work. The development in recent years of the art of manufacturing these gages has met with remarkable success, and C. E. Johansson, the pioneer in this field, has for some time been making them with errors that seldom amount to 0.00002 in., while in most cases they are not more than 0.00001 in. Extreme accuracy in construction can however be of but little practical value without at least an equally accurate method of testing. It is impossible to measure irregularities of the surface of such gages with any micrometric apparatus, to make comparisons with standard gages by any contact apparatus, or to discover errors in length by comparison with line standards because the errors in such measurements are larger than the errors of construction. The method of testing should be more accurate than the gage, not less accurate—to the sixth decimal place, if, as here, the error of construction is in the fifth. In December, 1917, we undertook to develop an optical method for accomplishing this; and, in a short time, by applying methods which make use of the interference of light waves, we succeeded in solving the problem.

With perfect gages the accuracy of the interference method would be equal to that with which light waves are measured, namely, about three ten-millionths of an inch. In actual practice we are able to measure the surface errors of gages, to determine the length of our standards, and to compare gages with these standards to an accuracy of one to three millionths of an inch. The method thus possesses the desired virtue of being decidedly more accurate than the gages are made.

Commercial Production

Shortly after the optical method of measurement was put in operation the Gage Section of the Bureau of Standards undertook to develop the process of manufacturing precision gages which up to that time had not been successfully made in this country. The effort met with such remarkable success that within a few months gages with errors of 0.00001 in. or less were being produced on a commercial scale.

Following upon the development at the Bureau of Standards, production was undertaken by manufacturing concerns of this country, notably the Pratt & Whitney Co., Hartford, Conn., and the Wilton Tool and Manufacturing Co., Boston, Mass., who were instructed in the process of manufacture and methods of measurements. These concerns are now producing gages of good quality on a commercial scale.

Requirements and Tolerances

Contradictory to much that has been said and written of late regarding gages "good to the millionth" we have not found one gage whose two working surfaces were plane, parallel, and the designated distance apart within one millionth of an inch, even though we have tested more than 30,000 gages. This record which includes products of all the principal manufacturers should not reflect unfavorably upon the quality of their work. It merely shows that a tolerance of one-millionth of an inch is too small. The tolerance or allowable error should naturally be governed by the precision desired in the use of the gage, by the actual necessity for this precision, and by the effort necessary to attain it.

Since the method of measurement as well as most of the uses of a gage require that its end surfaces adhere to a plane surface (or to another gage), this quality of adherence becomes the first requirement of a gage. We find that for satisfactory adherence to plane surfaces, the gage surface must be plane within a hundred-thousandth of an inch. Obviously, no burrs on the edges are permissible because any minute projection will not only hold two surfaces apart but also cause serious damage to the surface when they are rubbed together.

To take full advantage of the accuracy demanded for adherence the second requirement that the two opposite surfaces should be parallel within at least 0.00001 in. is a practical consequence. It is ridiculous to claim as some do that the length of a gage, meaning the distance between the end faces, is correct to a millionth of an inch if the end surfaces are out of plane or out of parallel by more than that amount. Balanced performance demands that the tolerance in the first two requirements should not be more than 0.00001 in., and with reasonable care the manufacturer can keep within that limit.

Permissible Error

The permissible error in the length, however, should, of course, be governed by the use to which the gage is put. If it is to serve as a standard in a testing laboratory or for the production of precision gages, the length should be determined as accurately as possible. Since gages used as standards have appreciable surface errors we may increase their precision by specifying the distances between the end surfaces near the center of each edge. It is by this method of using a relatively small portion of the surfaces that we are able to determine the

length of our standards within one to three-millionths of an inch. For practically all the other uses such high precision is of little value. A tolerance in length of at least 0.00001 in. for gages one inch or less in length and 0.00001 in. per inch for longer ones should be allowed because it is very doubtful if for various reasons this precision is ever made use of in the shop.

The thermal expansion coefficient of steel is about 0.000012, therefore a gage that is 1 in. long at 20 deg. C. will be 0.00006 in. longer at 25 deg.—six times the suggested tolerance. Furthermore, our measurements on the expansion of gage steel show that the coefficient varies from 0.000010 for annealed steel to 0.0000135 for hardened steel; consequently, two 1-in. gages of exactly the same length at 20 deg. C. might differ by 0.000015 in. at 25 deg. In practice the gage is usually held in the hand and this renders the length uncertain to at least a few hundred-thousandths of an inch per inch of length. Furthermore, all of the instruments tested with these gages are insensitive to a hundred-thousandth of an inch; hence, these instruments would not respond to variations of that amount in the gage. This is true of micrometers as well as all other contact measuring devices. Then too, unless the gage is very thoroughly cleaned, a film of grease or a particle of dust may be present on the surface, which will increase the length at least 0.00001 in. Finally there is the wear on the surfaces through use, and changes of one or two hundred-thousandths of an inch through ageing may take place. Considering all these facts, it seems that, from the standpoint of measurement, but little benefit can be gained by having gages whose lengths were originally correct within a few millionths of an inch. From the manufacturers' standpoint, we find only about one-half of the submitted product falls within 0.00001 in. of the nominal length, while most of the other half falls within 0.00002 in. It results that sets of gages with errors within a few millionths of an inch can be furnished only through very careful testing and sorting. and a needless rejection of a large number of good gages.

We may consider the sensation of light produced in our eyes to be due to transverse waves sent out by the luminous body. These waves vary in length, giving rise to different color sensations. The range of the wave lengths visible to the eye is from about 0.000016 in. for blue light to 0.000028 in. for red. If two trains of waves from one point in a source having traversed different paths fall upon a point on the retina of the eye, the resultant vibration determines the brightness. If they are "in step" maximum brightness results; if, however, the troughs of the one arrive with the crests of the other, destructive interference takes place resulting in relative darkness. If the two trains travel different distances so that the difference in path is some whole number of wave lengths, then the waves will

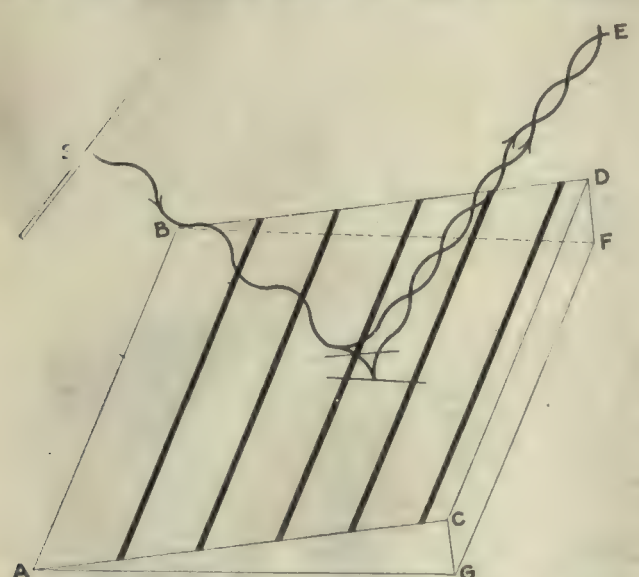


FIG. 1. CONDITION OF INTERFERENCE WITH LIGHT FROM AN EXTENDED SOURCE

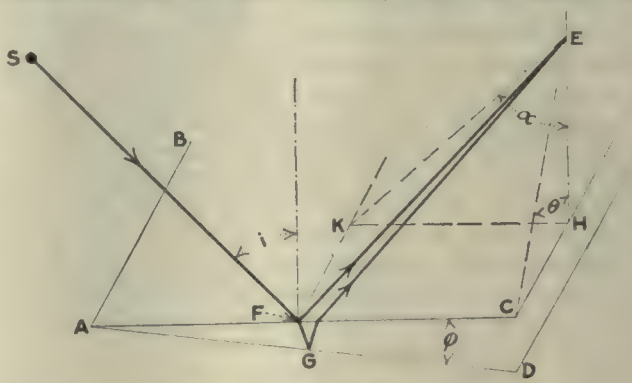


FIG. 2. TEST FOR PLANENESS

reach the eye in phase. If the difference in path is equal to some whole number of wave lengths plus one-half wave length, the waves in the two trains will be out of phase so that destructive interference takes place. The conditions for interference are realized when light from an extended source *S*, Fig. 1, falls on a thin transparent film. Part of the light is reflected from the first surface, *A B C D*, and the remainder is transmitted to the second surface *A B F G* where partial reflection again takes place. Since the wave trains reaching the eye *E* from these two reflections have traveled over different distances, reinforcement or destructive interference can therefore occur. When white light is used and the film is thin, brightly colored bands are seen across the surface. If monochromatic light, that is, light of one color or of very limited spectral extent is employed, alternate light and dark bands or interference fringes extend across the film.

Test for Planeness of Surfaces

The test for planeness is made by means of the fringes due to light reflected from the two surfaces of a thin transparent film. Suppose we have two plane surfaces *A C* and *A D*, Fig. 2, which are in contact along the line *A B* and inclined at a slight angle ø. A ray of light from a point in the source *S* reaches the point *F* making an angle of incidence *i* with the normal to the surface *A C*. At *F* this ray is split into two parts, one of which reaches the eye *E* along the path *F E*, while the other, reflected at *G*, travels along the path *F G E*. The effect produced at the eye by these two rays will depend upon the difference in length of these two paths which can be expressed by $N\lambda$ where λ is the wave length of the light and *N* the number of waves. If *N* is any integer the waves will be out of phase, due to half a wave phase change[1] by reflection at the denser medium, and the point *F* will in that case appear dark.

The difference in length of path of these two rays coming from *F* is given by the equation[2]

[1]Only under special cases is this phase change exactly a half wave length. It is seldom necessary, as in the present case, to determine its exact rule.

[2]Michelson, Phil. Mag., 13, 1882.

$$N\lambda = 2\frac{T + P\tan\phi\tan\alpha}{\sqrt{1 + \tan^2\alpha + \tan^2\theta}} \quad (1)$$

where P is the perpendicular distance E H from the eye to the surfaces; T, the distance between the surfaces at H; and α and θ the respective projections of the incidence angle on the planes through E H perpendicular and parallel to A B.

In the case of normal incidence, that is, when the light coming from the source to the surfaces and reflected to the eye passes along the perpendicular to, say, the first surface, the angles α and θ are both zero. In that case tan α and tan θ are zero, giving for equation (1) the simple expression

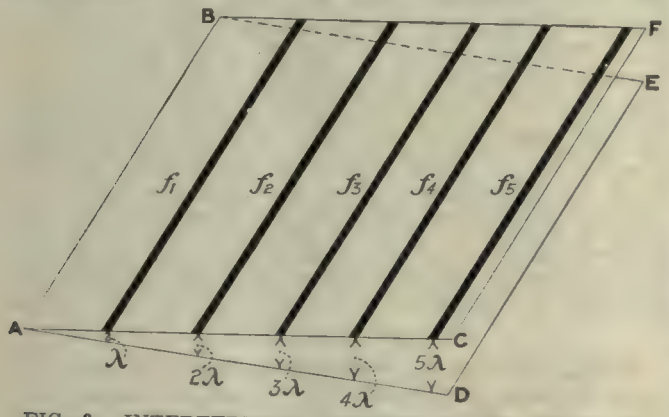


FIG. 3. INTERFERENCE FRINGES, PLANE SURFACE

$$N\lambda = 2T$$

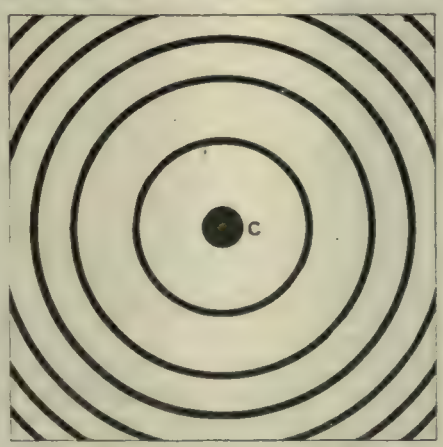
which states that the difference in path of the two interfering trains is simply equal to the double thickness of the wedge (the double distance is used because the light travels down and back through the film). From this equation it is evident that where N is constant, that is along any one fringe, T is also constant; hence, the fringes trace lines of equal separation of the two surfaces.[3] Starting from the line of contact A B of the two plane surfaces, Fig. 3, and moving to a wider part of the wedge, when $2T = \lambda$ interference takes place and the first dark fringe f_1 will be a straight line parallel to A B. When $2T = \frac{1}{2}(3\lambda)$ the wave trains reinforce and a light fringe is produced. Moving to a still thicker part of the wedge where $2T = 2\lambda$ a second dark fringe f_2 will occur, etc. From this, it is evident that if the surfaces are plane the fringes will be straight lines, equally spaced and parallel to the line of intersection of the surfaces. The next dark fringe always occurs on passing to where the double separation increases by λ, hence, the distance between fringes depends on the inclination of the surfaces. If a plane surface be brought in contact with a convex spherical surface, Fig. 4, then at the point of contact $2T$ is equal to zero. Radially from this point the separation of the surfaces increases uniformly in all directions, so the fringes, and hence the lines on which $2T = N\lambda$, are concentric circles around the point of contact C as a center. On any ring the distance of the spherical surface from the plane is equal to the number of the ring counting from the point of contact times $\frac{1}{2}$ (λ). By pressing down at A, the plane surface can be made to roll on the spherical surface shifting the point of contact and with it the center of the ring system in the direction of A, that is toward the point of application of the pressure. With a convex surface the center of the ring system lies at the point of minimum separation.

If one of the surfaces be concave and spherical, Fig. 5, a similar system of concentric circular fringes is produced, but in this case the center of the system lies at the point of maximum separation. Pressing down on A causes the center of the ring system to shift toward B, the direction of increasing separation, away from the point of application of the pressure. Thus a slight pressure on one edge of the plane surface A B serves to indicate whether the curved surface is convex or concave.

With one surface plane and the other irregular the fringes are irregular curves each of which follows the line of equal separation of the surfaces. Whether the irregularity is a projection or depression can be determined by applying a slight pressure to one edge of the upper surface and noting the direction of shift of the fringes.

The amount a curved surface deviates from a true plane can be readily estimated as follows: Draw a straight line C D, Fig. 6 across the center of the true plane surface, parallel to the line of contact H K of the surfaces.

Bring this line tangent to one of the fringes at say the point A. It is evident that this line represents the direction a fringe through A would take if the irregular surface could be converted into a plane tangent to the irregular surface at A. The fractional part of the distance between two fringes by which the fringe E F deviates from the straight line C D gives the fractional part of a half wave length by which the irregular surface deviates along C D from true plane. With



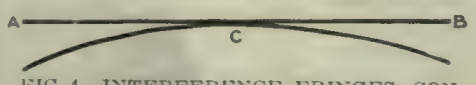


FIG. 4. INTERFERENCE FRINGES, CONVEX SPHERICAL SURFACE

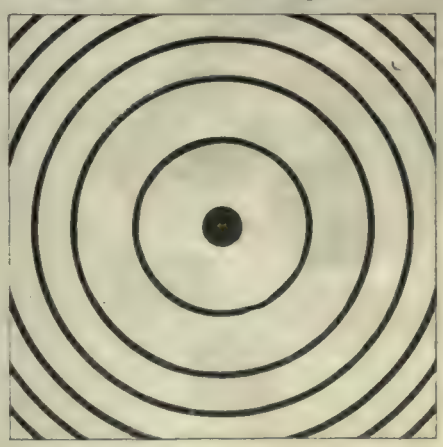




FIG. 5. INTERFERENCE FRINGES, CONCAVE SPHERICAL SURFACE

[3]The fact should be stressed here, however, that, as shown below, the fringe marks the line of constant thickness of film only when the direction of view is perpendicular to the film. Observing on the slant, straight fringes do not indicate that the tested surface is plane.

H K as the line of contact, the point *D* is estimated to be one-fourth wave length above and *C* one-half wave length below the plane surface tangent at *A*.

Testing for Planeness

For testing the planeness of a gage surface, a surface plate, micrometer anvil, or any other polished surface, a test plate is placed in quite close contact with, and slightly inclined to, the surface to be tested. This test plate is of glass one surface of which has been polished accurately true plane and tested against a master true

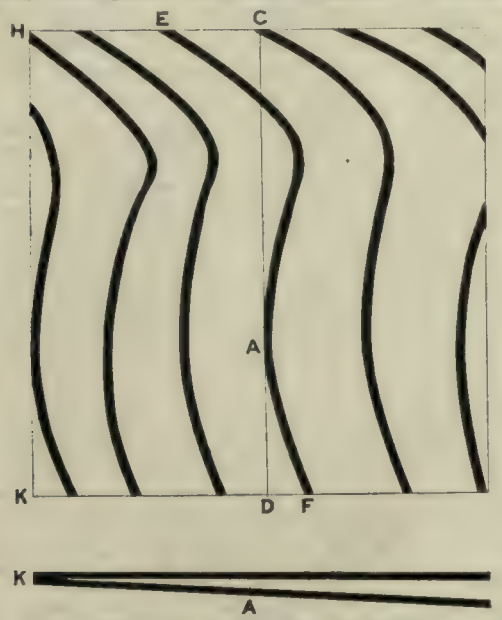


FIG. 6. INTERFERENCE FRINGES, IRREGULAR SURFACE

plane or liquid surface of large extent. The accuracy of the test is of course limited by the irregularities of the test plate surface. It is very difficult to make glass surfaces two or three inches in diameter plane within a 0.000005 in., and to reduce this error requires exceptional skill. For ordinary shop work, however, test plates of sufficient accuracy may be selected from pieces cut from plate glass and tested with a true plane.

For carrying out the test the thin film formed between the plane surface of the test plate and the gage surface is illuminated with monochromatic light. A convenient source of monochromatic light is a bunsen flame in which is inserted a piece of asbestos soaked in a salt solution. A ground glass plate illuminated either by a helium lamp operated on a 5,000-volt alternating-current circuit, or by a mercury vapor lamp is equally good. The wave lengths of the most effective visible radiation from these sources are approximately:

Sodium (yellow) = 0.0000232 in.
Helium (yellow) = 0.0000231 in.
Mercury (green) = 0.0000215 in.

With any of these sources on passing from one interference band to the next, the distance between the surfaces is increased or decreased by $\frac{1}{2}(\lambda)$ or about 0.00001 in., and if still more accurate measurement is desired, one can estimate the deviation of the fringes from a straight line as described. A colored glass screen illuminated by an incandescent lamp or ordinary daylight may be used as a source if high precision is not desired, but the light will not be sufficiently monochromatic to allow assignment of a definite value to the most effective wave length.

With a very true test plate and an illuminating and viewing instrument designed by Pulfrich,[1] we are able to measure slight variations in a surface under test with an accuracy of about 0.000001 in. This instrument, fulfilling very exactly the requirements of normal incidence of the light, permits of the use of formula (2) above.

A close approximation to this condition is obtained with the arrangement shown in Fig. 7. Light from a piece of ground glass *B* which is illuminated by the source *S* is reflected by the thin glass plate *P* set at an angle of 45 deg. down to the interferometer *A G*. The eye *E* is vertically over the center of the gage surface and the interference fringes are viewed through the plate *P*. The only point at which the light that reaches the eye makes normal incidence with the plates (that is where $N\lambda = 2T$) is at the foot of the perpendicular *E D*. At any other point *C* the incidence angle is *i*. Looking out along a fringe through the foot of the perpendicular to a point at the edge of the gage, the light makes an incident angle θ and the formula (1) becomes:

$$N\lambda = 2T \cos \theta$$

Rigidly considered, therefore, a wedge of perfectly plane surfaces would show that fringe, not where the thickness *T* is a constant, but where *T* cos θ is constant and the fringe would curve toward the region of greater separation of the surfaces. Therefore the fringes must have a definite curvature when the surface is viewed at an appreciable slant. This fact may be easily lost

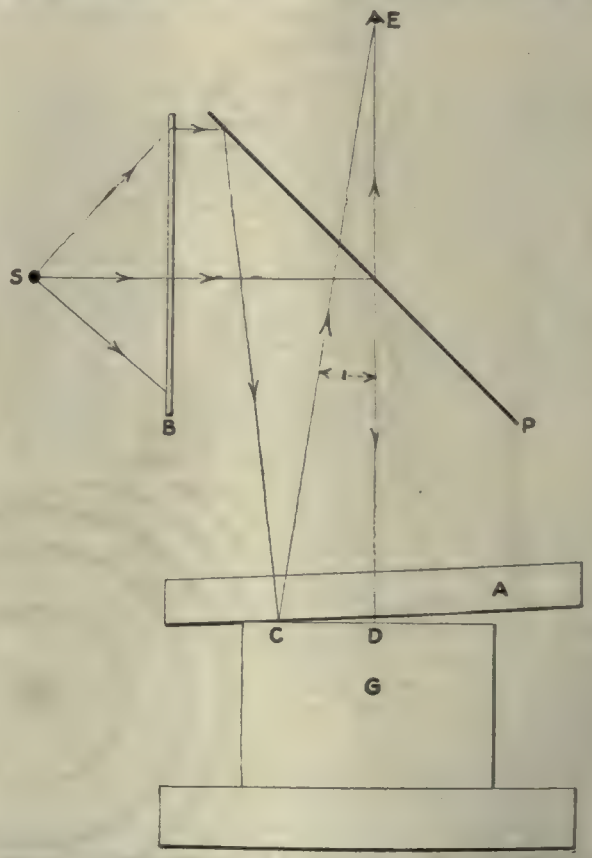


FIG. 7. CONDITIONS AS SHOWN BY THE PULFRICH INSTRUMENT

sight of in both the work-room where true planes are perfected and inspected, and in the laboratory where they are tested. With the eye 14 in. above a pair of true planes 3 in. in diameter and separated by a dis-

[1] Pulfrich, Zeits. f. Instk., Vol. 18, p. 261; 1898.

tance of 20 wave lengths the fringe will deviate from a straight line by about 0.2 the distance between the two adjacent fringes, so that, applying the criterion for perpendicular vision the plane surface would be considered to be out of plane by 0.1 wave length, or 0.000002 in. Measurements of planeness made with this arrangement on surfaces 2 in. in diameter can therefore be depended upon to about two-millionths of an inch.

The customary arrangement for testing planeness is shown in Fig. 8. Here light from the illuminated ground glass screen B falls slantingly on the surfaces of A and G and is reflected to the eye at E making a rather large angle i with the perpendicular $N\,M$. In this case, with the observer looking toward the point M, the rigid formula is

$$N\lambda = 2\,\frac{I + P\tan\phi\tan\alpha}{\sqrt{1+\tan^2\alpha+\tan^2\theta}} = \frac{2T_o}{\sqrt{1+\tan^2\alpha+\tan^2\theta}}$$

T_o representing the separation of the surfaces at M. If the edge of the wedge is perpendicular to the plane of incidence $E\,M\,B$, $\theta = o$, hence

$$N\lambda = \frac{2T_o}{\sqrt{1+\tan^2\alpha}}$$

If, further, $\alpha = i = 45$ deg., $N\lambda = \frac{2T_o}{\sqrt{2}}$ which means that the test is only $\frac{1}{\sqrt{2}} = 0.7$ as sensitive as for perpendicular vision; and, looking at points to one side which introduces an angle θ, it is even less sensitive. If, therefore, an accuracy of 0.000002 in. is desired in the estimation of planeness, the arrangement of Fig. 8 should not be used unless the fringes can be observed from a point very close to the perpendicular from the

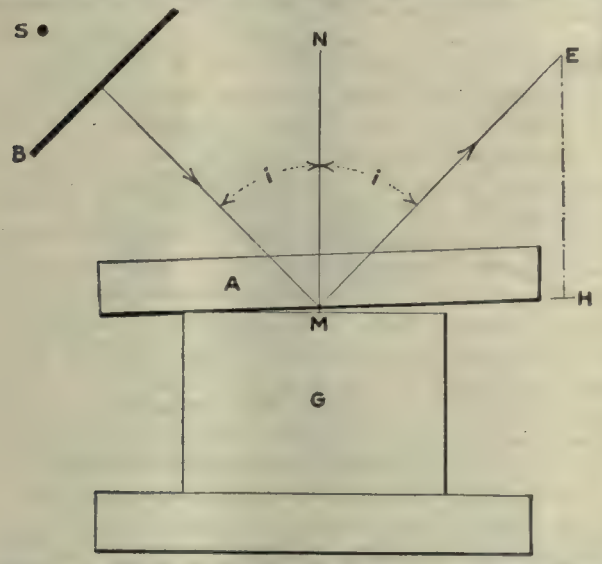


FIG. 8. ARRANGEMENT FOR TESTING PLANENESS

eye to the surface and then the eye should be at least 14 in. above the surface.

When the plane surfaces of two gages, or of a gage and a glass plate, are brought into intimate contact they adhere, necessitating considerable force to separate them. To cause this adherence, the surfaces are first washed with benzol, then with alcohol, and finally wiped with clean cotton to remove all traces of grease and dust. A drop of alcohol the size of a pin head is then placed on the gage surface and allowed to evaporate until nearly all has disappeared. The surface of the plate is then brought in contact with the gage surface, which causes the remaining trace of alcohol to spread out. Any excess of liquid can be forced out by sliding the surfaces on each other. When the two surfaces come into close contact the cohesive force causes them to grip each other and resist a considerable separating force.

A large number of measurements we have made show that when two very plane surfaces are brought into contact in this manner, the separating film is not more than 0.000001 in. thick. What really happens is that the surfaces form intimate contact at the high points,

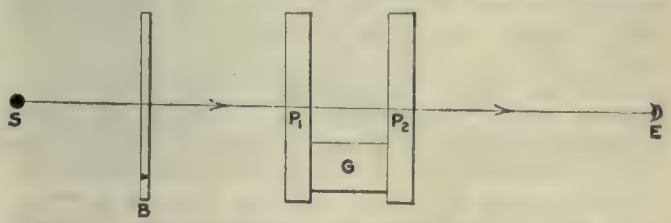


FIG. 9. ARRANGEMENT FOR TESTING PARALLELISM

the liquid filling the fine furrows or scratches left by the finishing laps. Our tests show that two gages with the ordinary lapped finish when brought in contact as described require to separate them, a pull in the direction perpendicular to the surfaces of from 35 to 40 lb. per sq.in. With gages possessing a high optical polish more intimate contact was possible, that is the capillary film was much thinner, and the required separating force ranges between 95 and 100 lb. per sq.in. Considering the extreme thinness of the separating film when good contact exists, the need of exceedingly plane surfaces is apparent. With a nick or burr on the edge or a lump on the surface which hold the two surfaces 0.00001 in. apart, adherence is almost impossible.

Two surfaces will also adhere when covered with a film of grease or with moisture from the hand. The thickness of these films, however, is a rather indefinite quantity, in most cases about 0.000003 in., and while considerable force is required to slide the gages on each other, they can be pulled apart by a force of 5 to 10 lb. For the ordinary uses of gages the existence of the oil or grease film introduces no appreciable error but in making accurate calibration of the gages themselves, it should be eliminated. With gages having slight surface imperfections, the oil film is a decided advantage in holding them together.

Test for Parallelism of Surfaces

The arrangement of the apparatus used to test the parallelism of the surfaces of a standard gage is shown in Fig. 9. Two accurately plane interferometer plates P_1 and P_2 are half silvered on their inner faces. Near one edge of each, a strip of the silver about $\frac{1}{2}$ in. wide is removed. This clear area on P is brought in contact with one end of the gage, G, and that of P_2 with the other end of the gage. This combination of plates and gage constitutes a Fabry and Perot Interferometer. When this interferometer is placed in front of the ground glass screen B illuminated with monochromatic light from the source S, and viewed from E along a line $S\,E$, perpendicular to the silvered surfaces, concentric interference rings known as "Haidinger rings" are seen. When the eye, E, is moved in a direction perpendicular to the line of sight $S\,E$, the system of rings moves across the plates in the same direction, the center of the system always remaining on the per-

pendicular from the eye to the surfaces. If now the interferometer surfaces are parallel to each other, which means that the two gage surfaces which are in contact with them must also be parallel, each ring will retain its original diameter when the eye is moved. If the plates are not parallel the rings expand on moving to points of greater separation, and contract when the eye is moved in the direction of smaller separation. Suppose that when the eye is shifted so that the center of the ring system moves across the plates from one edge to the other the first central ring expands and takes the place originally occupied by the second (a new ring forming within), then the distance between the two interferometer plates has increased by one-half wave length, which for yellow helium light is about 0.000011 in. If the width of the gage is one-fourth that of the silvered space, this would mean a slant of about 0.000003 in between the gage surfaces. Since an expansion of the rings can be estimated to one-fourth of the diameter of the first ring, an error of 0.000001 in. in the parallelism of the gage surfaces can be detected. To realize this precision, however, special care must be taken to have the surfaces of the gage in very close contact with the plates.

Determination of the Lengths of Standards

The lengths of gages which are to be used as standards must first be determined by comparison with some invariable primary standard of length, and redetermined occasionally to insure permanency.

The standard light waves, the most permanent length units known, were chosen as the fundamental standard. The wave lengths of red, yellow and green radiations from cadmium were determined by direct comparison with the standard meter, by Michelson[5] in 1893 and redetermined by Fabry and Benoit[6] in 1907. The values for the wave lengths obtained from these two independent determinations agreed to about one part in fifteen million. The wave lengths of the radiations from other luminous substances have been measured by comparison with these fundamental wave lengths.

For standardizing gages the waves emitted by incandescent neon gas, of lengths ranging from 0.50 to 0.75 microms, were used. These were determined with an accuracy of about one part in four or five million by Meggers,[7] and found to be so accurately reproducible under similar conditions that variations cannot be detected. Therefore, for making measurements with an accuracy of one-millionth of an inch, a comparison with these waves is exactly equivalent to a comparison with the standard meter.

Actual Measurements

The arrangement of the apparatus used to measure gages in wave lengths is shown in Fig. 10. The interferometer formed by the gage and plates of Fig. 9 is placed in front of the slit of a grating or prism spectrograph. Light from the neon lamp N is focussed by the lens L_1 upon a point beyond the interferometer P_1 P_2. Part of the light is transmitted directly through the interferometer, part is reflected by the silvered surface of P_2 to the silvered surface of P_1 where it is again reflected, and then passes on through P_2. The reflected and directly transmitted parts when combined produce a system of interference rings which is focussed by the lens L_2 upon the slit S of the spectrograph. The images of the slit corresponding to the different radiations from neon are separated by the grating B and recorded on the photographic plate C. Since the slit

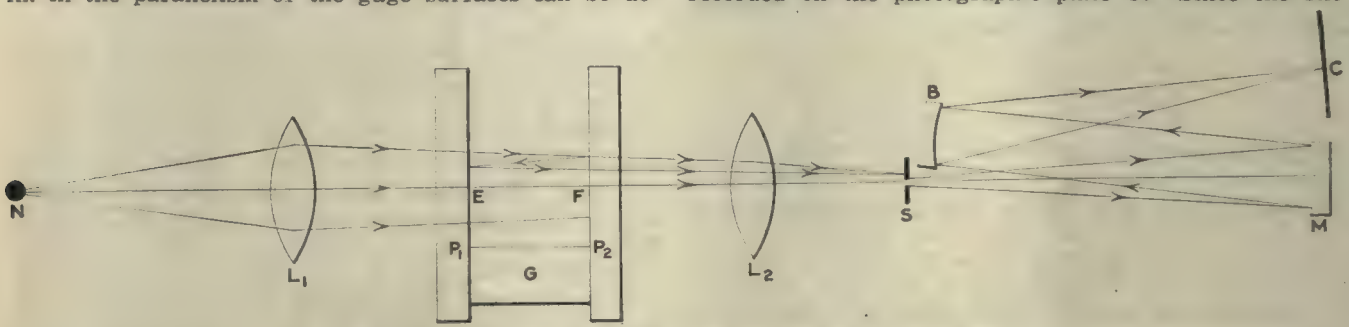


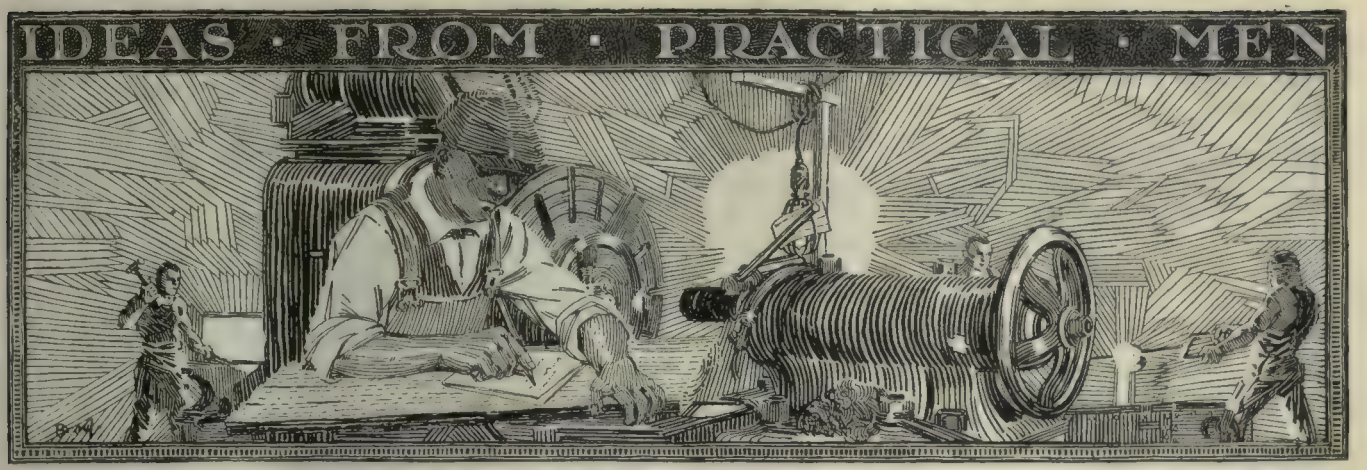
FIG. 10. APPARATUS FOR MEASURING BY WAVE LENGTHS

is illuminated by the ring system, each slit image is crossed by the arcs of its own system of interference rings. By measuring the diameters of these rings the number of wave lengths of any color in the double distance between the plates, which is the path difference of the two interfering trains, is obtained.[8] One-half this number of waves multiplied by the wave length of the light gives the perpendicular distance between the two plates at EF, the center of the ring systems. For the accuracy sought the wave lengths must be corrected for the existing conditions of temperature and pressure of the air.[9] Having the perpendicular distance between the two plates it is necessary to add to this the thickness of the silver films, about 0.000003 in., to obtain the length of the gage, providing of course the gage surfaces are parallel. This is seldom the case, for even after careful selection most of our standards have surface or parallelism errors of about 0.000005 in. A correction for the slope of the plates between EF and the center of each edge of the gage must therefore be applied. These surface irregularities are the greatest sources of error in the determination. Where they are small, different measurements made on the same gage on the same day agree within about 0.000001 in. Of course, to obtain this high accuracy the gage and interferometer are placed in a chamber where the temperature is carefully controlled at 20 deg. C., the temperature at which the length is supposed to be correct.

The length obtained from wave lengths which are expressed in metric units is transformed into inches by using the relation $M/39.37 = 1$ inch.

(To be continued in our next issue)

[5]Michelson, Traveaux et Memoires du Bureau International des Poids et Mesures, Vol. 11, 1895.
[6]Fabry and Benoit, Traveaux et Memoires, 15, 1913.
[7]Meggers, B. S. Sci. Papers No. 329, 1918.
[8]Meggers, B. S. Sci. Papers No. 251, 1915.
[9]Meggers and Peters, B. S. Sci. Papers, No. 327, 1918.



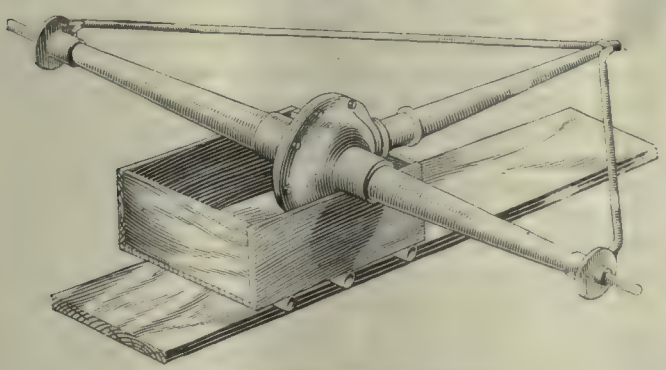
Repair Kink for Ford Owners

By H. W. Johnson

One of the must common repair jobs on a Ford is that of overhauling the rear axle. I have no suggestion to offer regarding the repairs to the axle, but I have worked out a simple trick which makes it much easier to replace the rear-axle assembly under the chassis.

The difficulty most people encounter lies in entering the square shank of the universal joint into the square hole in the transmission. It is quite likely to be a two-man job before it is finished.

Unless your floor is good and smooth, it is best to start out by laying down a board, about 10 in. wide and 2 or 3 ft. long, under the rear of the chassis. Put three or four small pieces of pipe on this board



IMPROVISED ROLLER JACK

for rollers. Then set a small wooden box, preferably about 8 in. deep, 12 in. wide and 16 in. long, on the rollers.

The axle assembly, without the wheels, is placed on this box, as shown in the illustration, and pushed under the car by running the box on the rollers. You can now go to the front door of the car, remove the floor board and couple up the drive shaft to the engine easily.

The rollers permit the axle assembly to be pushed back and forth easily, and leaving the wheels off leaves the drive shaft free to turn, so the squares can be matched. After the front end is coupled to the engine, the axle can be jacked up until the spring shackles match.

Here, too, the work is made easier by the absence of the wheels.

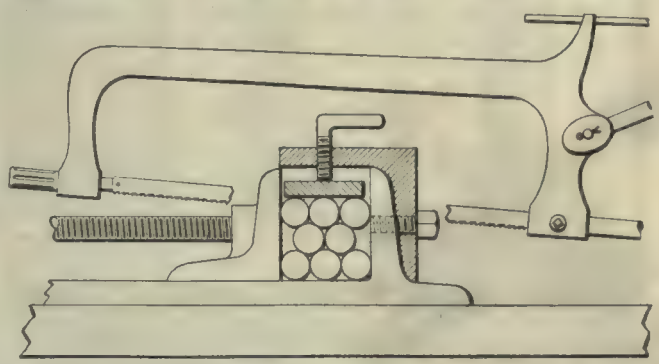
Finally the wheels are put on and the axle jacked high enough to allow the box to be removed. Some garages are equipped with a roller jack device for this work, but for the man who has none, it would be hard to beat the soap box and pipe combination.

A Power Saw Clamp

By E. F. Tuttle, Jr.

Having a number of pieces to cut off of small rod ($\frac{1}{4}$ in. to $\frac{1}{2}$ in. in diameter) we rigged up the power saw as shown in the sketch to do the job.

A piece of 4 x 4 x $\frac{1}{2}$ in. angle iron was cut off the same length as the width of the vise jaws of the machine and two holes were drilled in the angle iron. Two holes were drilled and tapped in the stationary jaw to hold the angle iron. Later the holes in the angle iron were slotted to the edge so it could be removed easily.



THE CLAMP IN USE

In the other leg of the angle iron a $\frac{1}{2}$-in. hole was drilled and tapped through which could be run a screw to bear on the block of soft steel. This piece of steel enabled us to tighten up on a number of rods and thus cut off all at one cut.

Laying Out Angles

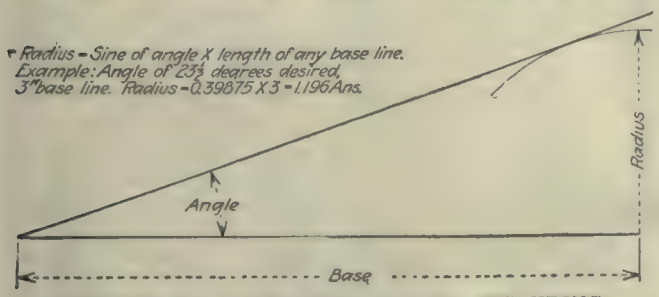
By Chester E. Josselyn

A pattern maker informed me sometime ago he had a large pattern to make that required some angular work which the blueprint specified in degrees.

He said giving the angle to him in this case was almost useless as he could not depend upon plotting it with a protractor with any degree of accuracy and desired to know how to lay out an angle by measurement. I showed him how to lay out an angle by scribing an arc (equal in radius to the sine of the angle wanted, multiplied by the length of the base line in inches)

from one end of the base line and drawing a line tangent to the arc and joining the base line at the other end.

I have since arranged a table of sines which I think



METHOD OF LAYING OUT ANGLES, INCLUDING TABLE OF SINES

handy for both designers and mechanics. It includes sines for each one-half degree up to 45 degrees.

For large work a drawing should not only specify the angle but a means for its practical development.

METHOD OF LAYING OUT ANGLES, INCLUDING TABLES OF SINES

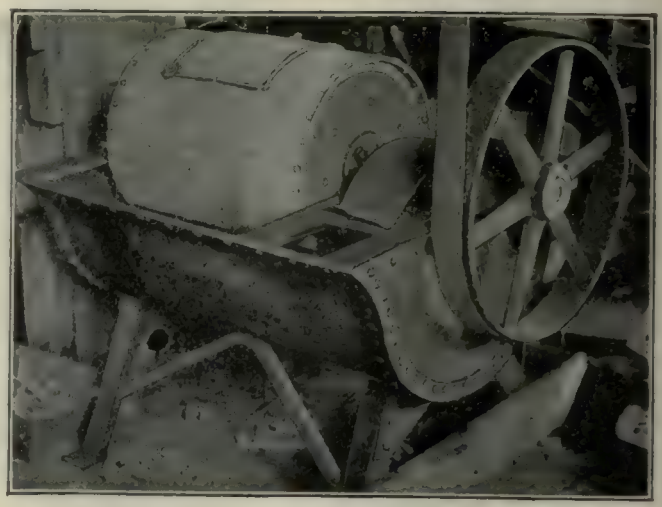
Degrees	Sine	Degrees	Sine	Degrees	Sine
½	0.00873	15½	0.26724	30½	0.50754
1	0.01745	16	0.27564	31	0.51504
1½	0.02618	16½	0.28402	31½	0.52250
2	0.03490	17	0.29237	32	0.52992
2½	0.04362	17½	0.30070	32½	0.53730
3	0.05234	18	0.30902	33	0.54464
3½	0.06105	18½	0.31730	33½	0.55194
4	0.06976	19	0.32557	34	0.55919
4½	0.07846	19½	0.33381	34½	0.56641
5	0.08716	20	0.34202	35	0.57358
5½	0.09585	20½	0.35021	35½	0.58070
6	0.10453	21	0.35837	36	0.58779
6½	0.11320	21½	0.36650	36½	0.59482
7	0.12187	22	0.37461	37	0.60181
7½	0.13053	22½	0.38268	37½	0.60876
8	0.13917	23	0.39073	38	0.61566
8½	0.14781	23½	0.39875	38½	0.62251
9	0.15643	24	0.40674	39	0.62932
9½	0.16505	24½	0.41469	39½	0.63608
10	0.17365	25	0.42262	40	0.64279
10½	0.18224	25½	0.43051	40½	0.64945
11	0.19081	26	0.43837	41	0.65606
11½	0.19937	26½	0.44620	41½	0.66262
12	0.20791	27	0.45399	42	0.66913
12½	0.21644	27½	0.46175	42½	0.67559
13	0.22495	28	0.46947	43	0.68200
13½	0.23345	28½	0.47716	43½	0.68835
14	0.24192	29	0.48481	44	0.69466
14½	0.25038	29½	0.49242	44½	0.70091
15	0.25882	30	0.50000	45	0.70711

A Home-Made Water Tumbling Barrel

By John Vincent

Brass castings are frequently tumbled in a barrel with water in order to remove the sand and to give them a brighter, cleaner finish than can be obtained by tumbling them dry. The illustration shows a home-made water tumbling barrel which was built by the Illinois Pattern and Foundry Co., Chicago, Ill., for use in its cleaning room.

The trough was made of scrap from an old oil barrel riveted to angle iron at the joints, and made with a flaring front so that the accumulation of sand and dirt in the bottom could be more readily scraped out. The top edge was reinforced to give it strength to carry the weight of the rotating barrel. The barrel itself was made from an old heavy-weight oil drum reinforced on the ends and fitted with trunnions. The cover plate shown on its side is bolted on and can be quickly removed for filling the barrel with castings. There are a number of holes in the end of the drum which permit the water to enter and circulate through it, carrying out the dirt and sediment. The tank itself is kept about half full of water and is provided with a drain at the bottom so that the water can be drawn off before cleaning out the sediment.



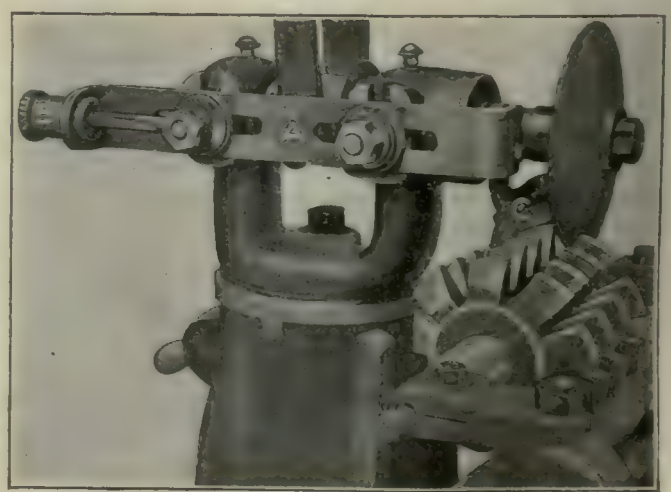
A HOME-MADE WATER TUMBLING BARREL

Grinding Hobs

By Eugene E. Henry

The accompanying illustration shows an arrangement for holding gear-cutting hobs while sharpening them. This method is adapted to use on all spiral hobs regardless of the number of teeth or the amount of twist, as the guide or stop acts directly on the backs of the teeth that are being ground. The device is here shown attached to a No. 1 Le Blonde cutter grinder.

It should be noted that the hob is mounted between low center posts, so as to get it low enough to pass under the wheel, a swing of 3½ in. over the table being used. On the front of the grinder head a ⅜ x 1¼-in. bar *A* is fastened. It is adjustable horizontally, being mounted on the studs with a slight clearance so that it can be moved by turning the thumbnut *B* on the eye-bolt. The end of the bar near the grinder wheel carries the guide *C*, which has a vertical adjustment. The lower edge of *C* is faced with a piece of hardened steel, so that it is not cut by the teeth of the hob being ground. The hob is held by hand against the guide or stop *C*, and the table is moved with long strokes the full length of the hob while light cuts are taken. A 5-in. alundum saucer wheel, No. 38-46 K, is used.



METHOD OF GRINDING GEAR-CUTTING HOBS

SHOP EQUIPMENT NEWS

-Edited by-
S. A. HAND

SHOP EQUIPMENT • NEWS •
A weekly review of modern designs and • equipment •

Descriptions of shop equipment in this section constitute editorial service for which there is no charge. To be eligible for presentation, the article must not have been on the market more than six months and must not have been advertised in this or any previous issue. Owing to the news character of these descriptions it will be impossible to submit them to the manufacturer for approval.

• CONDENSED • CLIPPING INDEX
A continuous record of modern designs • and equipment •

Norton "Multipurpose" Grinding Machine

A machine just completed and ready to be delivered by the Norton Co., of Worcester, Mass., is the "Multipurpose" grinding machine, shown in the accompanying illustrations, of which Fig. 1 is a front view and Fig. 2 a back view.

The machine is intended to serve all the purposes of the so-called "universal" machine in grinding parallel and tapered work, cutters, reamers, etc.

This machine is entirely self contained and requires no overhead works. As shown in the illustration, it is arranged for a "single belt constant speed" drive and may be belted direct from the line shaft. There are no other exposed belts, and if arranged for direct motor drive even this one is eliminated.

Capacity of the Machine

The machine will swing work up to 12 in. in diameter and 36 in. long. Both the headstock and wheelhead have swivel bases, graduated in degrees. The work spindle is hollow and will pass a ¾-in. bar. The drive to the headstock is all geared, the power being transmitted from the main drive shaft in the base through splined shafts, the upper one of which also swivels to accommodate itself to angular positions of the head or of the upper table when grinding tapers or bevels.

The gears in the headstock run in oil. By the movement of a lever the rotative speed of the work spindle may be varied from 53 to 320 r.p.m. in six steps. Spindle speeds are entirely independent of table speeds. The center may be either "live" or "dead" as required.

The tail spindle has a quick lever-movement for mounting and demounting work and a screw movement for fine adjustment. The upper table swivels at the center and a triple graduated scale at one end enables a setting to be made in degrees, taper per foot, or percentages.

The table traverse mechanism is similar to that previously used on the Norton machines. There are eight changes of speed ranging from 2 ft. to 11½ ft. per minute. Speeds are changed by means of a four-step cone and back gears on the front of the base.

Spindle-Drive Belt Inclosed

The drive to the wheel spindle is by inclosed belt running through the hollow swiveling head, and by an ingenious arrangement of spring loaded idlers, the head may be turned completely around without interfering with the freedom of its movement.

The wheel spindle is double ended and arranged to carry a 12-in. diameter wheel on either end. An internal grinding fixture attaches to the back end of the wheelhead, which is turned 180 deg. to bring the internal grinding spindle into action, and is driven by belt from a pulley mounted in place of one of the grinding wheels.

The spindle runs in hard bronze bearings with tapered sleeves for taking up wear. The end thrust is borne by a collar.

The Wheel Feed

The wheel feed may be either automatic or by hand. The automatic feed operates at each reversal of the table and may be adjusted to increments of one-quarter thousandth.

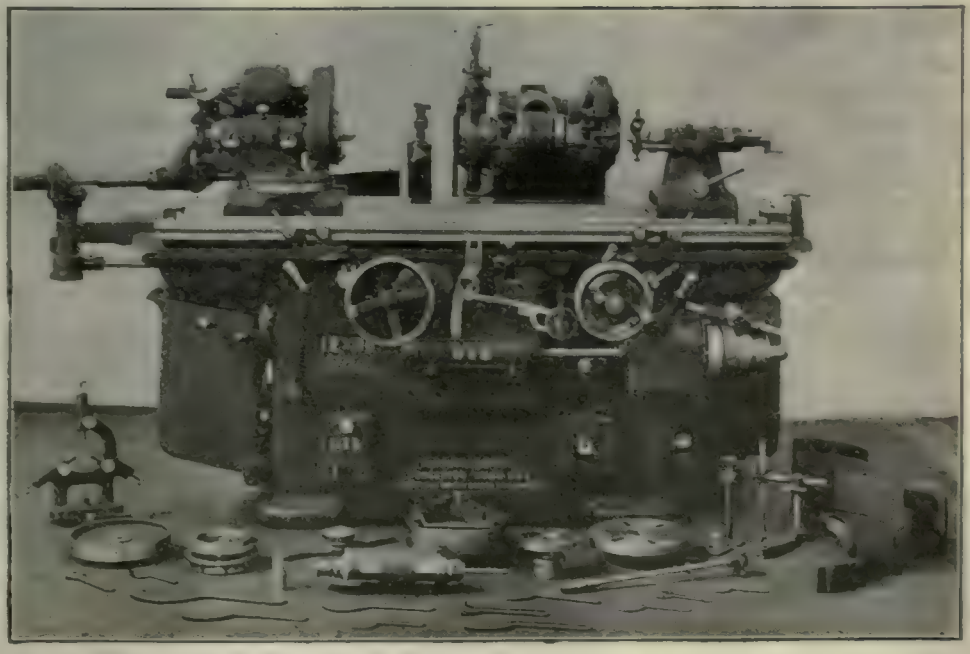


FIG. 1. NORTON "MULTIPURPOSE" GRINDING MACHINE (FRONT)

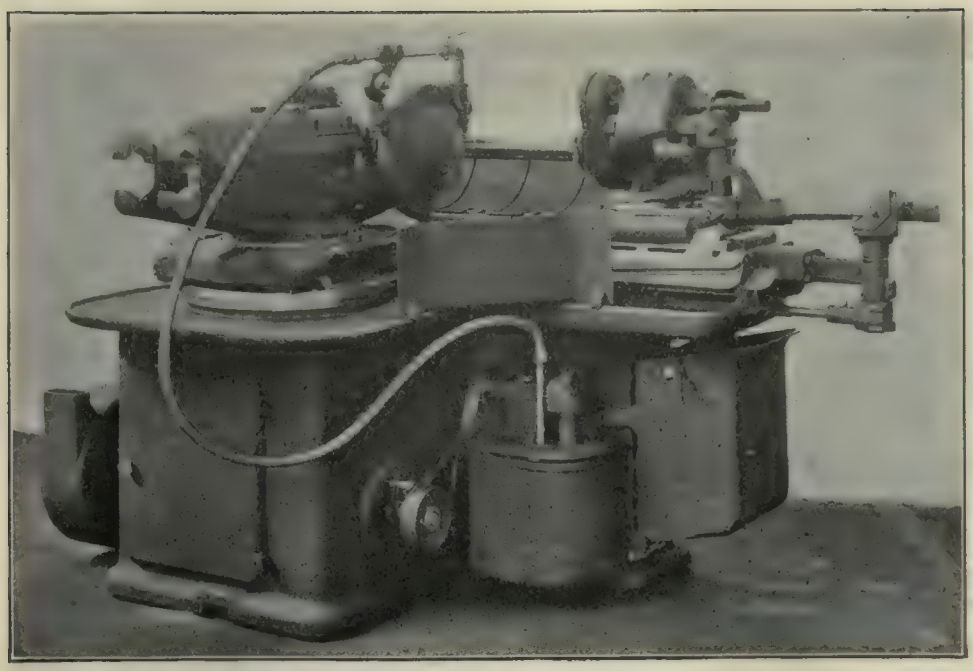
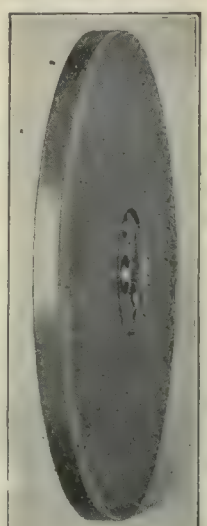


FIG. 2. NORTON "MULTIPURPOSE" GRINDING MACHINE (BACK)

The machine is supplied with a complete set of accessories. Approximate weight of machine with regular equipment is 4,950 lb. Floor space required 11 ft. 8 in. x 5 ft. 5 in.

Gardner Improved Abrasive Disks

The Gardner Machine Co., Beloit, Wis., has developed an improved type of abrasive disk for use on disk grinding machines. The illustration shows a disk mounted on the steel disk-wheel of a grinding machine. Among the features of the improved disk are its increased thickness, its corrugated surface, and the bond used in its construction. It has more than twice the thickness of the ordinary glue-bond disk. The corrugated surface is said to tilt the abrasive grains into the best position for cutting. The bond is a special cement which powders away during the grinding operation, presenting new cutting points to the work. It is claimed that the improved disk will last longer, cut faster and cooler than the glue-bond disk, and will materially reduce the maintenance expense of the grinding machine proper.



IMPROVED ABRASIVE DISK

Ever-Hot Soldering Iron

The soldering iron shown in the illustration is made by the Peterson-Plummer Manufacturing Co., and sold through Belfrey & Craighead, Tribune Building, Chicago, Ill.



EVER-HOT GASOLINE SOLDERING IRON

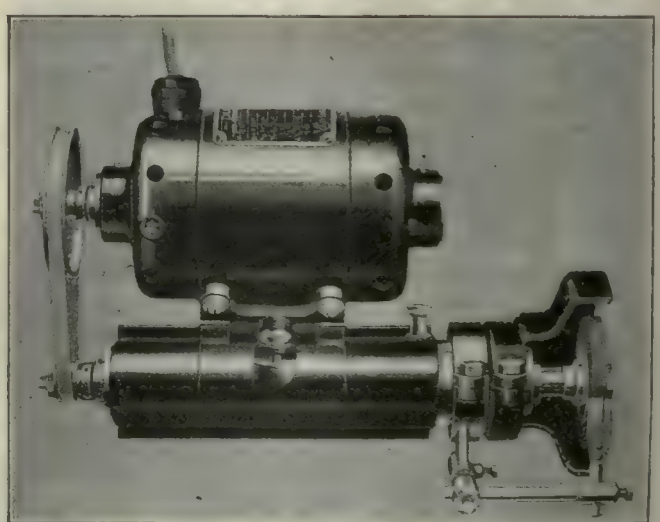
This soldering iron is light in weight and of convenient size to suit the requirements of the user for both light and heavy work. The gasoline reservoir is contained in the handle which is made of seamless brass tubing. The pump unit is placed at the end and is easily removed for refilling.

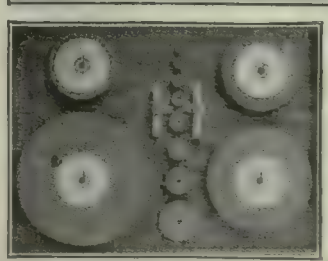
A rust-proof iron pipe connects the handle with the burner and contains cotton wicking to insure a continuous flow of gasoline. The burner is a one-piece brass casting arranged to preheat the gas and its design permits the use of the iron in any position in both extreme cold and high winds.

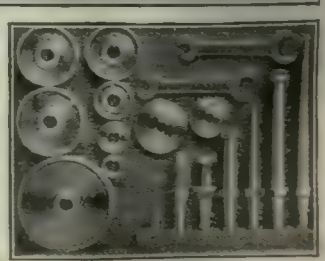
One large and one small point are furnished with the iron.

Dumore No. 3 Multi-Speed Grinding Machine

The Wisconsin Electric Co., Racine, Wis., has added to its line of Dumore grinding machines the No. 3 multi-speed machine shown in the illustration. The device is adapted to both production and toolroom work, and is







DUMORE NO. 3 MULTI-SPEED GRINDING MACHINE AND EQUIPMENT

Specifications: Motor, ¼ hp. Universal, for d.c. and a.c. current. Seven spindle speeds, 3,600 to 50,000 r.p.m. Spindle adjustment, 5½ in. Net weight, without equipment, 25 lb.; with equipment, 35 lb. Shipping weight, 45 lb.

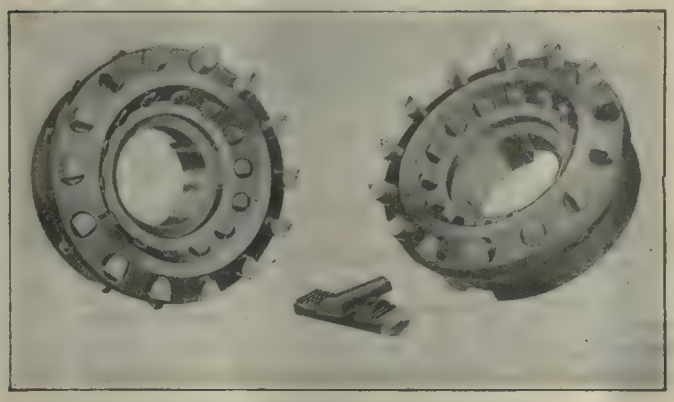
provided with a set of interchangeable spindles and pulleys so that a wide range of spindle speed is obtainable.

The spindle is tool steel and mounted in adjustable, dust-proof ball bearings. Four extension spindles for use on internal work, together with wheel arbors for light and heavy grinding, are furnished with the machine. The armature bearings of the motor are mounted on rubber insulators to eliminate vibration that could be carried to the spindle. The device can be swiveled to any angle necessary in practice. When used for light tool grinding, the toolrest and shield for the wheel can be attached.

Lovejoy Face-Milling Cutter

The cutter shown in the illustration is recommended by its manufacturer, the Lovejoy Tool Co., Inc., Springfield, Vt., for all face milling where the depth of cut does not exceed $\frac{9}{16}$ inches.

The teeth of this face-milling cutter are positively



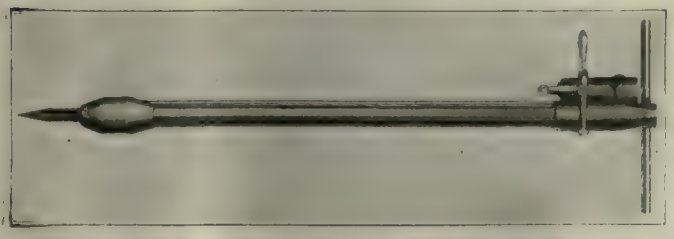
LOVEJOY FACE-MILLING CUTTER

locked by the arrangement shown in the insert between the two views of the cutter. This is said to insure against the possibility of slipping or loosening under heavy or intermittent cuts. The teeth are easily adjustable when they become worn and it is possible to set the cutters at the best angle for the work in hand.

The body is made of hardened steel and is ideal for holding Stellite teeth, which are supplied if so ordered. The cutter is made in sizes ranging from 6½ to 18 in. in diameter.

Keller "Rivet-Busting" Tool

The Keller Pneumatic Tool Co., Grand Haven, Mich., is placing on the market the tool shown in the illustration, which is called the Keller "Iron Mule" "rivet buster." This is an air-operated tool designed for cutting off and backing out steel rivets in the shop. It



KELLER "IRON MULE" "RIVET BUSTER"

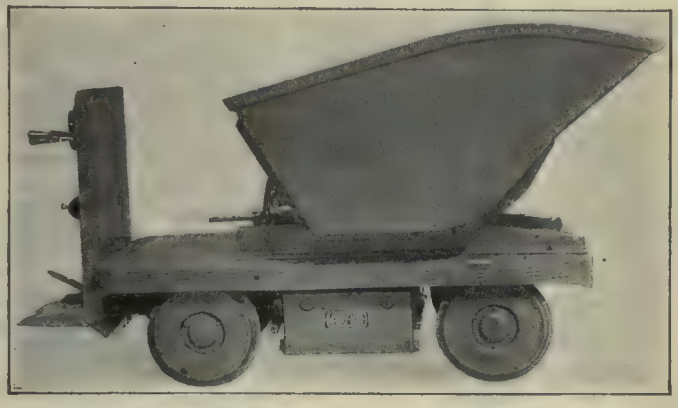
Specifications: Dimensions of piston, 1¾ x 9 in. Length of stroke, 41 in. Length of chisel, outside of tool, 7 in. Length of tool, overall, 67 in. Net weight, 75 lb. Weight of chisel, 7 lb. Operating weight, 82 lb. Shipping weight, 135 lb.

is simple in operation, requiring no special skill. Three men are needed to operate the tool to the best advantage, two being at the throttle end while the third supports the chisel end and holds the chisel to the rivet. The air-control handle is located under the operator's right hand and the force of the blow is entirely under his control. It is claimed that ⅞-in. and 1-in. rivet heads can be cut off in from four to six blows.

Dumping Body on Karry-Lode Industrial Truck

The all-steel dumping body illustrated can be mounted on the electric truck made by the Karry-Lode Industrial Truck Co., Inc., 98-100 Nott Ave., Long Island City, N. Y. The body has a capacity of 40 cu.ft. and dumps over the end of the truck, being especially adapted for coal handling.

The mounting of such a body is possible because of the fact that the truck is so constructed that it is not necessary to raise the platform to gain access to the



DUMPING BODY ON KARRY-LODE INDUSTRIAL TRUCK

battery. The steel platform serves as the frame of the truck, and the battery is so suspended that it can be removed without disturbing the platform.

Torchweld Gas Cutting-Torch

The gas cutting-torch shown in Fig. 1 is made by the Torchweld Equipment Co., Fulton and Carpenter Sts., Chicago, and is known as their style 15 MC. It is designed to use oxy-acetylene, oxy-hydrogen, or oxy-hydrocarbon gases, such as butane, calorene, and the like. Special tips, however, are needed for the various gas combinations. An 85-deg. torch-head angle is standard but 70, 50, 35 deg. and straight heads can be furnished when desired.

A one-piece cutting tip is used and the mixing chamber is just back of the torch head. A novel feature of the construction is that an annular space is provided around the mixer in which a small amount of gases accumulate. Drill holes connect this space with the gas passage-way leading to the tip and, in case of



FIG. 1. TORCHWELD GAS CUTTING-TORCH

back-fire to the mixing chamber, the ignited mixture in the annular space is designed to blow out the back-fire and eliminate the hazard of flash backs into the flexible connecting hose.

All the gas-tight seats in tips, needle valves and connections, are of the line-contact type: In other words, a convex surface is brought into contact against either

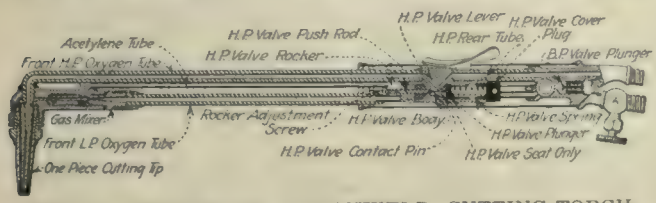


FIG. 2. DETAILS OF TORCHWELD CUTTING-TORCH

a flat surface or another convex surface. A tight seating is thereby much more easily obtained than by using two flat surface contacts.

One of the difficulties experienced with two-hose type cutting torches is the back pressure of the acetylene into the oxygen hose. Under certain conditions this results in the oxygen hose becoming filled with mixed gases which ignite at the tip and a more or less serious flash back into the oxygen hose is unavoidable.

The Torchweld back-pressure valve is claimed to prevent the acetylene from entering the oxygen hose, since a certain pressure on the oxygen is necessary in order to open this valve, and as the acetylene pressure also tends to close the valve still tighter. Details of the construction of this torch are shown in Fig. 2.

Ransom No. 109 Tool Grinding Machine

The motor-driven ball-bearing tool-grinding machine illustrated is manufactured by the Ransom Manufacturing Co., Oshkosh, Wis. It was designed as a utility grinder to be placed in any convenient place and does not require a great deal of floor space. The motor is a General Electric ¾-hp., alternating current, 60 cycle, 2 or 3 phase, any voltage. A quick make and break oil switch is used. The machine is started by stepping upon either of the two pedals at the base. When the foot pressure is released the machine automatically stops. The bearings are SKF self-aligning and the arbor is of high carbon steel. Cast-iron guards as shown are included in the regular equipment.

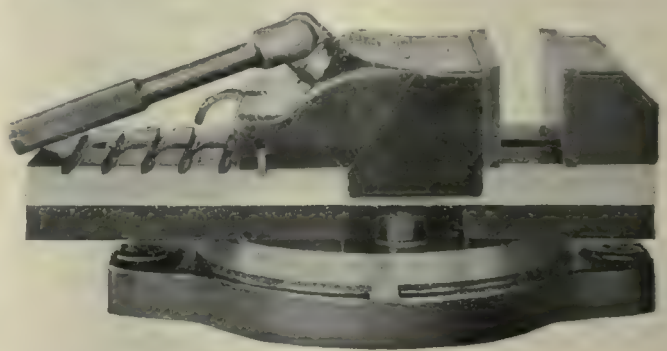


RANSOM NO. 109 TOOL-GRINDING MACHINE

Specifications: Abrasive wheels, 12 x 1 in. Wheel flanges, 6 in. Diameter of arbor where wheels go on, 1¼ in. Distance from floor to center of arbor, 38½ in. Length of arbor, 19⅝ in. Size of base on floor, 17½ in. Weight complete, 489 lb. Speed, 1,800 r.p.m.

Nelson Quick-Acting Machine Vise

The Nelson Tool and Machine Co., Inc., 82-88 Llewellen Ave., Bloomfield, N. J., has brought out the machine vise illustrated. The screw operating the sliding jaw is set at an angle so that when pressure is exerted in

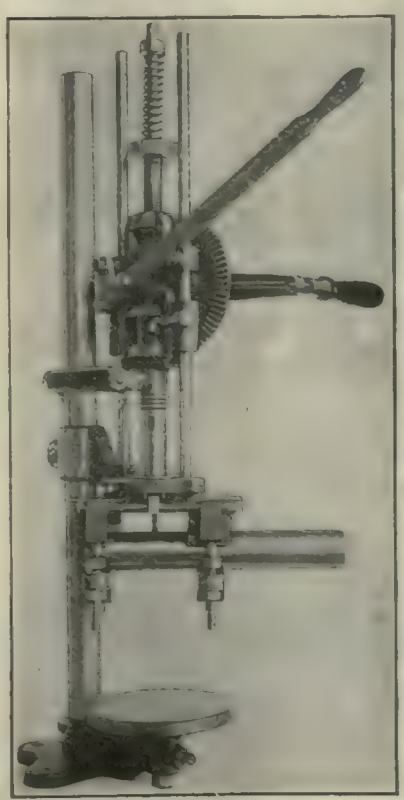


NELSON QUICK-ACTING MACHINE VISE

holding work the wedge block forces the jaw against the bottom of the vise, making it impossible for the jaw to tilt upward. It is claimed that a hammer is not required to bed work down on either the vise bottom or on parallels. The vise is made in two sizes. No. 1 has jaws 6 in. wide and 2 in. deep; opening 5⅞ in. No. 2 has jaws 4 in. wide and 1½ in. deep; opening 4 inches.

Glaude Universal Portable Drilling Machine

Leopold F. Glaude, 930 N. Washtenaw Ave., Chicago, Ill., has brought out the drilling machine illustrated herewith. All the working parts of the machine are mounted on a 1½-in. tubular-steel column from which they can be readily removed and clamped to the flat surface of any work that is to be drilled. The machine is operated by hand, has a two-speed change gear, and both screw and lever feed. A centering chuck and a V-block chuck are provided. By clamping a shaft in the outer V-block and having the inner V-block slightly loose, keyways can be cut in the shaft by means of a two-lip tool, the feeding being accomplished by means of a right- and left-hand screw that actuates the V-blocks. Power can be applied to the machine through a flexible shaft.

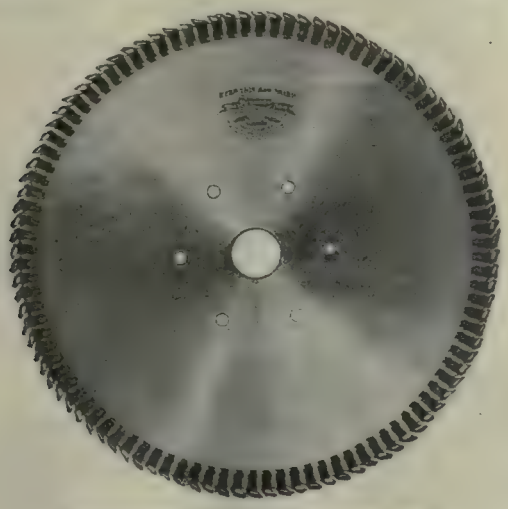


GLAUDE UNIVERSAL PORTABLE DRILLING MACHINE

Specifications: Column, 1⅞ x 30 in. Will drill to center of 7-in. circle. Capacity, 0 to ⅝ in. drill. Table, 6 in. diameter. Hole in spindle, No. 2 Morse taper. Weight, 45 lb.

Simonds No. 000 Inserted Tooth Metal Saw

An inserted-tooth metal saw designated as No. 000 is being placed on the market by the Simonds Manufacturing Co. of Fitchburg, Mass. This saw was especially designed to meet the requirements for a saw to cut structural iron, I-beams, channels and stock with thin walls that could not be cut as successfully with other saws of similar design, because the pitch or spacing of the teeth was not fine enough to keep two teeth in the cut at all times in this work. Through its arrangement and closer spacing of teeth this saw provides for smoother running and is claimed to eliminate the chatter often noted where the teeth are placed further apart in the plate.



SIMONDS METAL-CUTTING SAW

These saws are being made from 10 in. in diameter, having a maximum of 40 teeth to cut a ¼-in. kerf, to 50 in. in diameter having a maximum of 240 teeth to cut $\frac{15}{32}$- or $\frac{7}{16}$-in. kerfs.

Newman Knurling Tool

The knurling-tool shown in the illustration has been placed on the market by the Newman Manufacturing Co., 717 Sycamore St., Cincinnati, Ohio. The tool carries two knurls, placed on opposite sides of the work. It is claimed that, since there is no side-thrust on the work, it is not necessary to use the tailstock center and that very high speeds are obtainable.

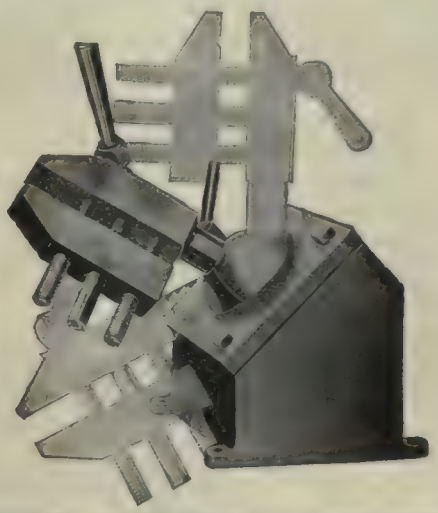
The tool is furnished with one set of standard knurls, cut either checkered, helical or straight with pitches of either 32, 20 or 14 lines per inch. All parts are of steel. The knurls are easily removable and the distance between them can be varied by means of a screw adjustment. The tool is made in two sizes, one for knurling stock up to 1 in., the other for stock between 1 and 2 in. in diameter.



NEWMAN KNURLING TOOL

Newman "Handi-Vise"

The device shown is being marketed by the Newman Manufacturing Co., 717 Sycamore St., Cincinnati, Ohio. It is intended for holding all sorts of small parts when drilling or machining them, being applicable to general shop use as well as tool and die work.



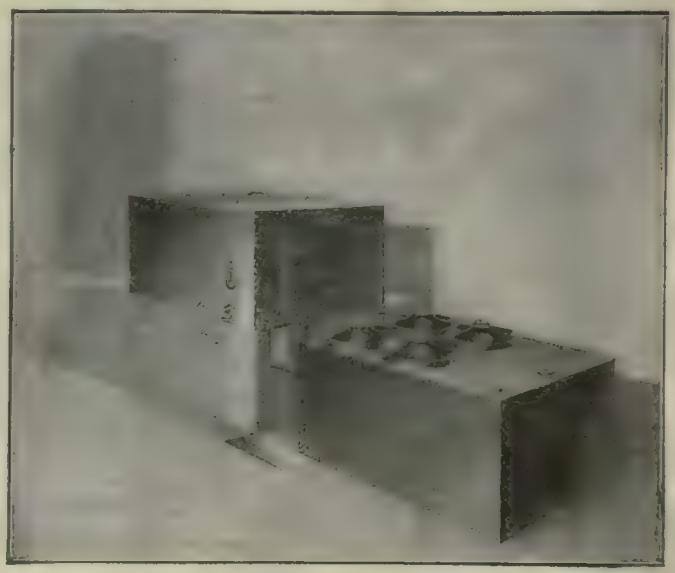
NEWMAN GIANT "HANDI-VISE" AND "GRIP-TITE" HOLDER

The jaws are opened and closed by turning the small lever, the two screws being geared together so that they operate simultaneously and keep the jaws parallel. One jaw is provided with a V for gripping round work. The parts are case-hardened. The overall length of the vise with the handle is 9½ in., the jaws are 1 in. wide and the maximum distance between them is 2¼ in.

The jaws can be used as a separate unit and held in a bench vise, but the base shown is known as the "grip-tite" and is intended for holding the jaws so that they can be adjusted to any position. The handle of the vise can be inserted in the ball, which is mounted in a socket. All parts of the base are made of steel.

Bowser 9-F Oil Filter

The filter shown in the accompanying illustration is a late addition to the line of S. F. Bowser & Co., Inc., Fort Wayne, Ind.

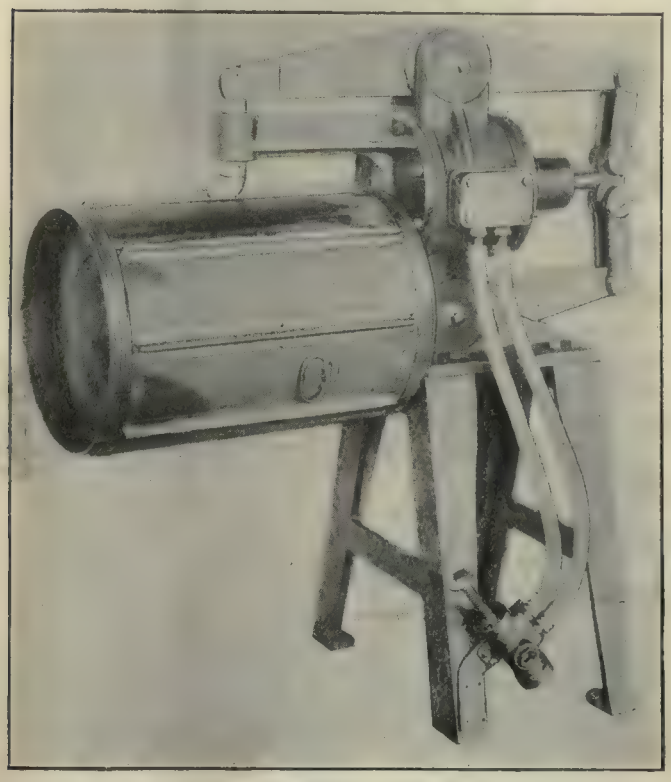


BOWSER 9-F OIL FILTER

The filter is intended for filtering and sterilizing oil used as a lubricant or coolant in metal cutting. The oil from the machines or chip separators is delivered to the filter, which automatically removes the foreign matter and sterilizes the fluid. After passing through a series of compartments, screens, filtering devices, etc., the oil is delivered to the filter tank which acts as a temporary storage. From this tank the oil can be returned to the machines, the same as new oil, and used again. Filters can be specially designed to fit individual conditions.

Baird Ash-Can Riveter

A riveter designed for riveting ash cans and shown in the accompanying illustration is being placed on the market by the Baird Pneumatic Tool Co., Kansas City, Mo. The machine has a four-way valve for operation by workman's foot, so that his hands will be left



BAIRD ASH-CAN RIVETER

free in placing and holding the work to be riveted. The dies are wide enough to bridge the reinforcing ribs on the side of an ash can and will drive two rivets, one on each side of a rib, at a single stroke.

It is claimed that a pressure of 35 tons is exerted on the dies with an air pressure of 100 lb. per square inch. The machine can be removed from the stand and mounted on a bench if desired. Weight, with stand, 740 pounds.

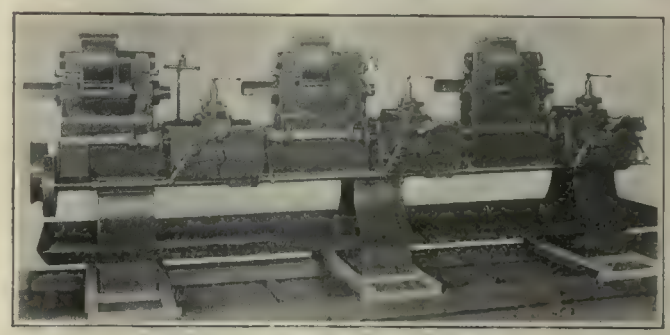
Seneca Falls Multi-Head Lathe

The multi-head lathe shown in the accompanying illustration has been brought out by the Seneca Falls Manufacturing Co., 387 Fall St., Seneca Falls, N. Y.

This machine is intended for turning such short work as can be held on an expansion arbor or in a chuck and that does not require the use of a tailstock or other form of outboard support. Three heads and carriages are mounted on one bed, the feed of all the carriages being driven from the same feed shaft. The lever at the right of each apron advances the tool to the work and at the same time engages the clutch for the longitudinal feed. When the carriage has traveled the proper distance the short lever at the upper left hand of the apron engages with a cam on the Vs of the bed throwing out the latch holding the tool to the work, allowing the tool to be withdrawn and at the same time engaging the quick-return clutch. The carriage then automatically returns to its starting position, where it is stopped by the engagement of the starting lever with another cam on the bed.

The machine can be furnished with heads having plain pulleys and back gears as shown or with two-step cone pulleys without back gears.

The apron is of double wall construction, and the clutches and practically all of the gears are made of heat-treated alloy steel. The rack is made of tool steel.



SENECA FALLS MULTI-HEAD LATHE

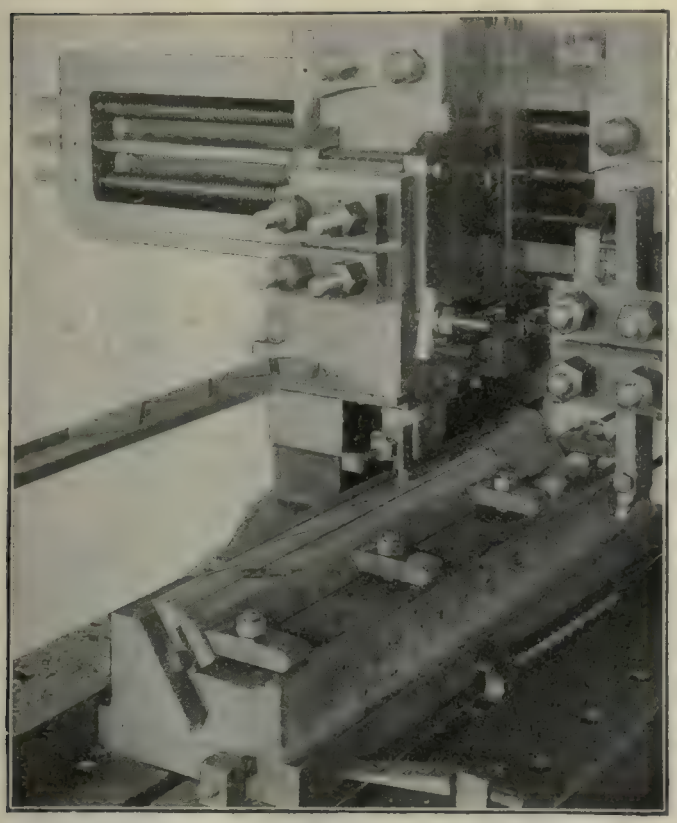
Specifications: Swing: over bed, 18¼ in.; over carriage, 11¼ in. Spindle: front bearing, 3¾ x 5½ in.; back bearing, 2¾ x 4½ in. Drive pulley, 6 in. face; 10½ in. diameter.

The feed drive is taken direct from the countershaft to a pulley at the end of the machine and from there to the feed shaft by silent chain. An oil pump is provided and ample provision has been made for returning used lubricant to the reservoir. The machine is thoroughly guarded.

Hanson-Whitney Oil-Groove Planing Tool

The Hanson-Whitney Machine Co., Hartford, Conn., has placed on the market the oil-grooving device shown in the illustration. It is intended for cutting oil grooves in slides, being used as an attachment on any standard planer. With it, zig-zag oil-grooves of regular and uniform character can be cut in plane surfaces. A V-shaped groove having a total angle of 120 deg. is made. It is claimed that this form of groove is superior to the half-round section groove, because it makes it easier to produce grooves of different widths with the same tool and also because it gives the oil an opportunity to wedge itself between the wearing surfaces.

The device proper is mounted on the clapper of the planer, and suitable means are provided for locking the clapper so that it cannot be lifted. The device itself has a small clapper box carrying the grooving tool and mounted on a cross-slide, its position on the cross-slide being adjustable. A bar cam is fitted in the body of the device, one end of the bar being attached to an upright strapped to the planer table, so that it moves with the work. The connection is made through both horizontal and vertical slides, so that considerable freedom of movement of the planer head carrying the device is possible.



HANSON-WHITNEY OIL-GROOVE PLANING TOOL

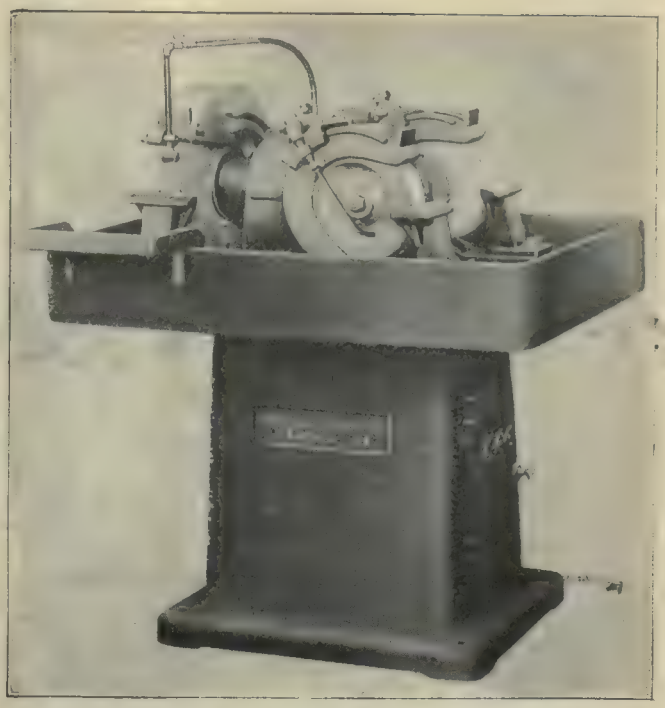
As the planer table travels, the follower in the cam groove is caused to reciprocate, its motion being transmitted to the grooving tool. Suitable means are provided for varying the stroke of the tool, so that the width of the zig-zag can be varied from $\frac{3}{8}$ to $1\frac{1}{4}$ in., its maximum length being 30 in. with the standard length cam-bar.

Grooving tools of three shapes are furnished. The one shown is used for most work. When cutting on an angle, as in V-shaped slides, the whole device is swung and a side tool is used. In order that the tools may be sharpened quickly and correctly, a block is furnished for holding them while they are ground on a cutter grinding machine.

Mummert-Dixon Oilstone Wet Tool Grinding Machine

The Mummert-Dixon Co., Hanover, Pa., has added to its line the wet tool grinding machine shown in the illustration. The machine is intended for general tool grinding in both toolrooms and machine shops, and is provided with three wheels of different grades. It is thus possible to rough and finish a tool on the same machine, and for three men to be grinding at the same time. The wheel arbors are carried in ball bearings provided with oil retainers. The arbor carrying two wheels runs at half the speed of that carrying the single wheel, being driven from it through bevel gears enclosed in an oil-tight case. The machine can be driven either by motor or by belt, a countershaft being furnished in the latter case. For individual-motor drive, the motor is mounted in the base of the machine and belted to the driving pulley, a belt-tightener being provided.

Kerosene is used as a coolant, being distributed to the wheels by a small centrifugal pump located at the bottom of the oil reservoir. A large pan is provided to catch the kerosene thrown from the wheels. It is claimed that the use of kerosene keeps the wheels clean and sharp, as well as preventing over-heating of the tools being ground.



MUMMERT-DIXON OILSTONE WET TOOL GRINDING MACHINE

Specifications: Size of wheels; coarse, 16 x 2 in.; medium and fine, 10 x $2\frac{1}{2}$ in. Speed; coarse wheel and pulley, 1,350 r.p.m.; medium and fine wheels, 675 r.p.m.; countershaft, 450 r.p.m. Driving pulley, 6 x $4\frac{1}{2}$ in. Countershaft; length, 24 in.; drop, 12 in. Motor, 3 hp., 1,800 r.p.m. Floor space, 33 x 41 in. Net weight, 1,075 lb.; with countershaft, 1,285 lb.; with motor, 1,300 lb. Gross weight; crated, about 1,400 lb.; boxed for export, about 1,500 lb. Export box, 36 x 44 x 48 in.

Williams-White Tie-Rod Presses

The two large presses illustrated herewith have been recently completed by Williams, White & Co., Moline, Ill. Both machines were designed for blanking out side

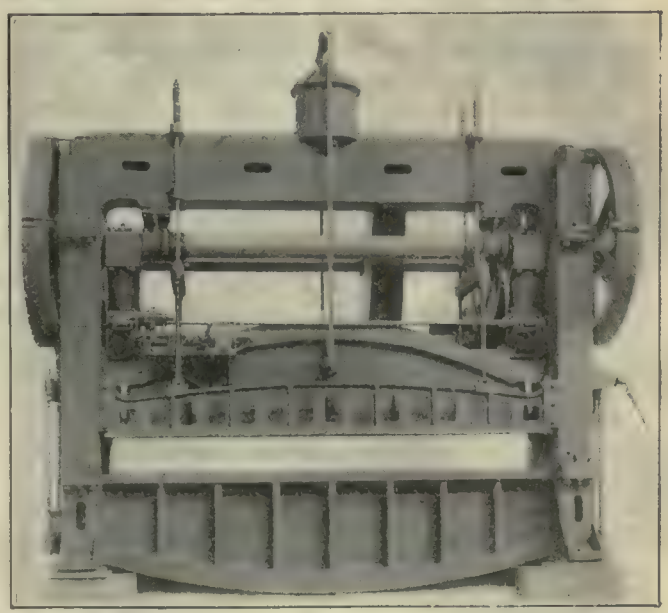


FIG. 1. WILLIAMS-WHITE 500-TON PRESS

Specifications: Capacity, 500 tons. Distance between housings, 16 ft. Width: table, 30 in.; ram face, 30 in. Die space: Maximum, 23 in.; minimum, 11 in. Stroke, 7 in. Openings in housings, 24 in. Height, 21 ft. Length, 21 ft. 10 in. Width, 10 ft. 6 in. Stroke per min., 12. Motor, 75 hp.

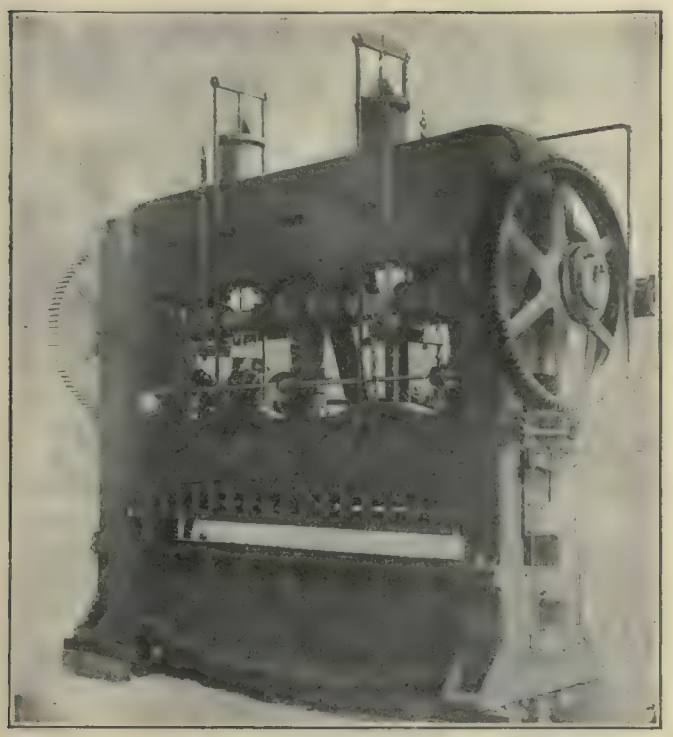


FIG. 2. WILLIAMS-WHITE 800-TON PRESS

Specifications: Capacity, 800 tons. Distance bet. housings, 18 ft. Width: table, 30 in.; ram face, 30 in. Die space: Maximum, 23 in.; minimum, 11 in. Stroke, 7 in. Openings in housings, 24 in. Height, 24 ft. 7 in. Length, 24 ft. 9 in. Width, 13 ft. 2 in. Strokes per min., 8. Motor, 100 hp.

rails for motor vehicles, the press shown in Fig. 1 for pleasure cars, and that in Fig. 2 for trucks.

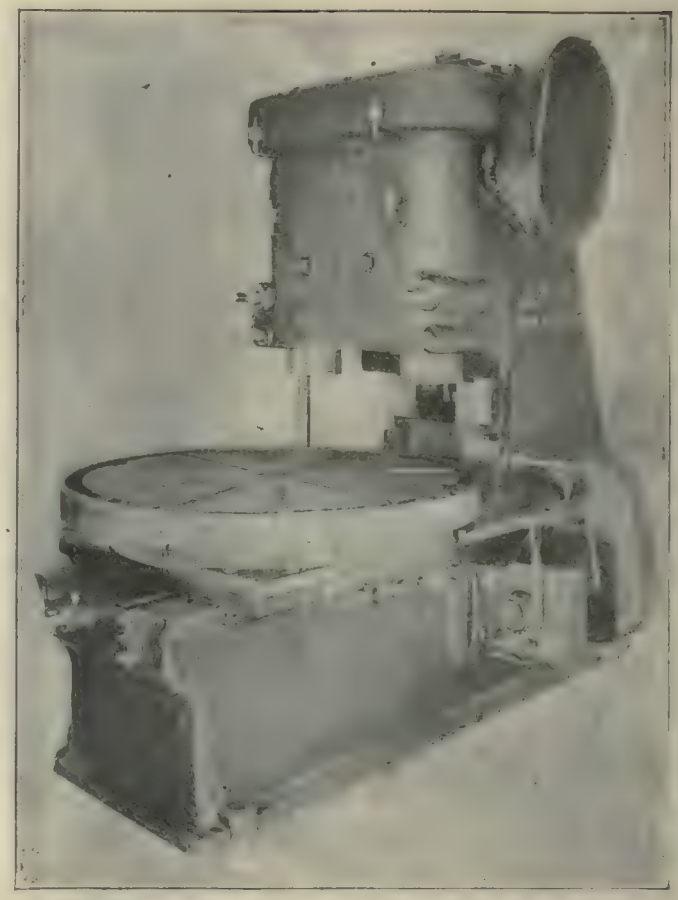
All gears and operating parts are located overhead so that the work can be placed in and removed from the machine from the front, back or either end. For this purpose the uprights have ample openings between the tie-rods. The ram adjustment is by screws in the pitmans, operated through worm gearing by a motor mounted on the ram. The strippers are operated by cams on the crankshaft. The table has four T-slots and an opening 6 in. wide in the center of its length. The ram face has five T-slots. The clutch is of the friction type and an automatic stop and brake are provided. The crankshaft is driven from both ends to equalize the drive and eliminate torsional lag. An automatic knockout is connected to, and operated by, the ram.

Newton Continuous Milling Machine

The illustration shows a rotating-table type of continuous milling machine built by the Newton Machine Tool Works, Inc., 23rd and Vine Sts., Philadelphia, Pa. This is the first of the continuous milling machine models brought out by the concern.

The column and base are cast in one piece, in order to eliminate a bolted joint between them. The table is circular in form, with provision for mounting the fixtures necessary for holding the work; and it is adjustable upon the base, in order to provide for the proper positioning of the fixtures. Tables can be furnished either 24, 36 or 48 in. in diameter on their working surfaces. A pan for draining the lubricant when working on steel surrounds the table.

A fixed feed controls the rotative movement of the table, so that it is not possible for the operator to change the production of the machine without attracting the attention of the man in charge. There is, however, provision for changing the rate of feed.



NEWTON CONTINUOUS MILLING MACHINE

The spindle head is equipped with two spindles, the height of each being independently adjustable for setting the cutters. The left-hand spindle is used for the roughing operation, and the right-hand spindle for finishing. The distance between the centers of the spindles varies from 13 to 22½ in., depending upon the size of the table used, so that long pieces can be completely machined in the roughing operation before the finishing cutter starts on them. It is claimed that, owing to the small amount of work performed by the finishing cutter, accuracy of both finish and dimension is maintained with only infrequent grinding of the cutters, and that high cutting speeds and feeds can be employed.

The machine is driven through worm gearing by an individual motor mounted on the side of the column. The head carrying the spindles is adjustable on the column, in order that the holding device for the work may set as flat or low on the table as the castings will permit. All driving gears are hardened, enclosed and run in oil. The bearing surfaces are large both on the slides and on the rotating shafts.

The eleventh annual convention of the American Manufacturers' Export Association will be held at the Waldorf-Astoria, New York, Oct. 14, 1920. This convention will be limited to a one-day session, followed by a banquet in the evening. The keynote of the convention will be: "To obtain permanent world trade, American manufacturers must now take a leading part themselves." The part that they must take to obtain this permanent world trade will be discussed by the President, W. L. Saunders.

What the Steel Industry Thinks of the Compulsory Metric System

THE total annual ingot capacity of the steel producers of the United States is estimated at approximately 55,930,940 tons.

The Association of American Steel manufacturers, the membership of which is composed of forty of the leading concerns in the steel industry, represents an approximate total annual steel ingot capacity of 47,106,460 tons.

The principal class of materials manufactured by the members of this Association, from the ingot tonnage referred to (which does not include castings), is as follows:

> Structural steel shapes for bridges, buildings, cars, ships; plates for all structural purposes; boiler plate; hot and cold rolled bars for automobile, agricultural and general trade; small and special rolled shapes; bars for concrete reinforcement; hoop, band and strip steel; sheets and tin plate; welded pipe; seamless tubing; wire rails and track accessories; forgings of all kinds; wrought steel wheels; etc., etc.

During the month of March, 1920, a canvass of the members of this Association was made on the subject of the metric system. In reference to this the Secretary writes as follows:

Association of American Steel Manufacturers,
Pittsburgh, Pa., Aug. 13, 1920

It was decided to ascertain definitely the present attitude of our member companies on the *compulsory adoption* of the metric system in the U. S. without prejudice to their opinions as to the merits of the system. The result was:

Thirty-seven companies voted *against* the *compulsory adoption* of the metric system in the United States.

One company having an ingot capacity of approximately 0.5 per cent of the total capacity represented in the Association of American Steel Manufacturers, voted neutral.

One company having an ingot capacity of approximately 0.7 per cent of the total capacity, voted in favor.

One company having an ingot capacity of approximately 2.5 per cent of the total capacity, did not reply.

J. O. Leech, Secretary.

From the above the following figures are of interest:

96.3 per cent *against compulsory use* of *metric system*
0.5 per cent neutral
0.7 per cent in favor of metric system
2.5 per cent no preference expressed

The importance of the steel industry in the life of the nation is indicated by the fact that conditions prevailing in it are considered the best available business barometer. When the steel industry is prosperous, the country at large is prosperous. The stand taken therefore by this industry on the important subject of weights and measures is most significant and compels attention.

In connection with the foregoing we wish to call attention to the fact that last February the Pittsburgh Chamber of Commerce voted *unanimously* against making the use of the metric system compulsory.

Thos. Viall
Editor

WHAT to READ —for the man in a hurry



Suggested by the Managing Editor

What to read was not a difficult matter to decide two hundred years ago when books were few and magazines unheard of. It is far different now when so much reading matter is offered to pass the time pleasantly or profitably as the reader chooses. We are doing our utmost to make the "American Machinist" not only profitable but indispensable as a clearing house of ideas and news of the machinery world. This page is the editors' advertisement of their section of the paper. It gives the high spots.

HOW much is a thousandth of an inch? Some people look with scorn upon this insignificant quantity and scoff at its usefulness while others apparently think only in such units. As to the respective merits of these divergent views we have nothing to offer just now although we have our own opinion on the subject. It is sufficient that the above-mentioned unit seems to have come to stay and consequently must be measured. For this purpose the micrometer is without doubt the best known device. Its manufacture, in view of the fact that any measuring device must be made to a higher degree of accuracy than the part which it is to measure, involves problems that interest all mechanics, theoretical, practical or "near." The first article in this issue goes into the matter in some detail.

While we are discussing this subject of splitting hairs it will be well to mention that a thousandth of an inch is a big, clumsy thing to the experts at the Bureau of Standards. They actually work with millionths and aspire to ten-millionths, values quite beyond the comprehension of the average citizen.

For testing micrometers we usually employ the more accurate modern gage blocks. When it comes to testing the gage blocks something still more accurate is necessary and we must pass to the methods of the laboratory. These methods are explained by C. G. Peters and H. S. Boyd, of the Bureau, in an easily understandable article which begins on page 627 and will be concluded in our next issue.

The production and planning section of Mr. Basset's "Modern Production Methods" ends with Part IX which appears on page 619. Part X which we expect to publish two weeks hence serves as an introduction to the second section of this important series, in which the subject of cost accounting will be taken up. Mr. Basset in this article calls attention to the fact that the fixing of the sales price by basing it upon a cost analysis is only one of the many uses to which sensible cost accounting may be put.

On page 613 we have an account of the Y. M. C. A. industrial conference at Silver Bay by a member of the staff.

We feel that a word of explanation is in order concerning the material on pages 616 and 617. The word "modern" in the title of this brief description of four aviation engines was strictly correct when the story was written. We regret to say that the drawings were held up so long in our drafting room that the use of "modern" is open to question. With this word of explanation, however, we are going to let it go.

The season for "new tools" has opened with a bang. After the usual dull summer (dull so far as announcements were concerned) we have a regular rush on new machines, tools, and devices which begins on page 635 and is still being added to as this page is written. Production in our shops may have been running along at a reduced rate per shop and per man but the hard-working designers and engineers who never heard of a forty-four-hour week, have apparently been running true to form and doing their usual bit to supply the improved machinery with which to increase our lagging output.

On page 650 is a letter from our London editor written during the first week of September. He discusses the impending coal strike in England and points out the possible grave results to industry in general. It is not a cheerful picture. And to make it worse the price of petrol has suddenly been jumped. We feel aggrieved at being charged thirty-five cents for gas but what would we do if the price went to a dollar? Yet that is what it costs John Bull for joy-rides.

Another adverse view of the advisability of switching from English to Metric units is supplied by our Washington correspondent on page 647. This one comes from the Committee on Technical Standards of the Bureau of Surveys and Maps.

For the benefit of the engineers who read the *American Machinist*, L. C. Morrow, our assistant who occasionally takes a hand in the construction of this page, has prepared a list of all the references made in this paper to the Federated American Engineering Societies.

EDITORIALS

A Very Important Meeting

A MEETING of importance to everybody is to be held in Washington, in November—of importance to everybody because it will be the first meeting of the American Engineering Council, which is the managing body of the Federated American Engineering Societies.

We may safely assume that the Federated American Engineering Societies will act along the lines for which it was organized, namely, "to further the public welfare wherever technical knowledge and engineering experience are involved and to consider and act upon matters of common concern in the engineering and allied technical profession." Hence the importance to *everybody*, who, of course, are the public, and who are concerned, day in and day out with things in which technical knowledge and engineering experience are involved. As the relation of the engineer to the public has been aptly expressed, *"Everywhere you look you see what the engineer has done.'* Try it.

The engineer is going to continue to do things everywhere to benefit the public, and he is going to do more of these against less resistance. This is going to be possible because of the Federated American Engineering Societies, which, again let it be said, has for its object, "to further the public welfare." As a concomitant result the engineer himself will benefit—will at last receive that recognition for service which he has long merited.

The American Engineering Council will have many or few (comparatively) members when it meets November 18, depending upon the action of engineering and allied technical societies between now and that time. Delegates to the organization conference, officers and just plain members of societies should at once do all they can to get their societies to apply for membership in the Federation. To help them get together ammunition for this task, should any be needed, we are publishing, page 646, a complete list of articles on the Federated American Engineering Societies that have appeared in *American Machinist*—articles that tell the why and the wherefore of the Federation and of its objects, purposes and progress.

Engineers, this is to be a great meeting, of the greatest engineering organization in the world—and it is to deal with the future work of the organization and determine the more important problems that should receive immediate attention. Is your society going to be a member, with its representative at the Washington meeting on November 18? L. C. M.

Technical Map Committee Recommends English Measuring System

ON page 647 will be found extracts from the report of the committee on Technical Standards, Bureau of Surveys and Maps.

This report shows that the committee *unanimously* recommends the use of the English measuring system for map work. The reasons advanced by the committee for its stand, are clearly given and furnish several more nails for the coffin of the compulsory metric advocates.

To the unthinking mind the metric scaling of maps might seem the better way, but these map experts know their business.

Keeping Contracts

AFTER the late Kaiser had declared his most solemn contracts and treaties to be "mere scraps of paper" to be repudiated when he felt strong enough to do so, and could force them down the throats of the other parties—

And—after this same late Kaiser had been relegated to the scrap pile for his uncivilized views, one would think the world in general would have considerable respect for deliberately drawn contracts.

However, numerous organizations, as well as some individuals, still have the "kultur" streak that showed so yellow in the Kaiser's spine.

A recent instance is the threat of the "outlaw" anthracite coal miners to violate their pledge to stand by the decision of the Joint Commission when the wage award was made.

President Wilson, for once, has made the proper stand in insisting that the miners abide by the decision, as they had agreed to do.

Either these miners must mine coal as they contracted to mine it, or be branded as outlaws who have no respect for their pledged word or the rights of others.

Contracts deliberately made must be kept, and this applies impartially to both parties to them.

We hold no brief for the coal operators, for had they refused to abide by the decision we would be as prompt to criticize them, but a contract is a pledge made to be kept and the miners are trying to welch on theirs.

We all despise a "welcher" and the scorn of the American people is on those radical leaders who are misleading the miners into an unsportsmanlike stand on the issue.

Outlaw methods will fail in America as surely as they did along the Rhine. E. V.

What Is An Open Shop?

THE Jersey City Chamber of Commerce recently asked its members to indicate their views regarding the "open shop." The result was 827 to 0 in favor of the "open" and against the "closed" shop. Of the 116 manufacturing plants at present operating in Jersey City, 96 are open and 20 are closed.

A "closed shop" as it is understood today only permits the employment of members of a Union. This is unsound economically and absolutely un-American, and as such cannot possibly succeed.

However, the so-called "open" shop is often in reality a "closed" shop, inasmuch as only strictly non-union men will be employed. Is not this type of open shop just as un-American as the other?

It must be admitted that unfair methods of outside agitators are largely responsible for this, since many employers feel that union workmen furnish a vantage point for the agitator to work from.

Whatever the cause, an "open" shop that discriminates against a man solely because he belongs to some organization is putting itself in the same class as the closed shop, and is on the wrong track.

E. V.

Some of the Advantages of the Left-Hand Lathe Carriage

By Francis W. Shaw
Manchester, England

The venerable lathe that figured in the story of F. M. A'Hearn on page 1243, Vol. 52, of *American Machinist* was probably a Britisher. Anyway, that is the way the normal British lathe is built (the abnormal ones being those that are obvious copies of American machines) and I would suggest to Mr. A'Hearn that from our point of view the "left hand" (we should call it "right-hand") carriage is right.

Most British lathes have coarse-pitch lead screws; four threads per inch up to 13 in. swing and two threads per inch above that size. American lead screws are comparatively fine pitch; six and eight threads per inch being common. Whereas the American "turnist" almost invariably employs a backing belt when cutting a thread, his British cousin backs his lathe only upon the exceptional fractional pitches. Indeed, few British lathes are equipped with a reversing countershaft.

But, really, I don't see how the position of the traversing handwheel causes the "uninitiated victim to get balled up," for the cross-feed handle is in the same position whatever the arrangement—about central with the cross-feed slide.

How would Mr. A'Hearn manage in a British shop where the lathes are half and half?

Let us inquire into the advantages of what Mr. A'Hearn calls the "left-hand carriage." "First, when the carriage is returned by hand it is easier for the man who is not left-handed or ambidextrous to do the traversing with the right hand while disengaging the nut is a light job and easily accomplished with the left hand. It must be remembered that both hands are employed as the tool approaches the end of the cut, one in withdrawing the cross-slide and the other in disengaging the nut. One hand must then be transferred to the traversing handwheel.

Second, the majority of screws are right-handed; hence during the cut the traverse is toward the headstock and toward the operator if he is standing in such position that the cross-slide handle is convenient to his hand, whether that hand be right or left. I submit that from this position it is easier to traverse the saddle back with the right hand because the handwheel is then receding from him, and it is easier to stretch out the right arm to the right than it is to allow the handwheel to pull the left hand in the same direction, past the operator's body. When the work is long it is easier for the workman to follow up the handwheel than it is to have it follow *him* up.

Third, the right hand of the average man is more sensitive than the left. The handwheel to the right is, therefore, better when one is feeding the cut along toward a finish under a shoulder after the power feed has been tripped for the reason that the action of the tool can be better judged from the feel by the sensitive right hand than by the left. The right hand too has more power over the shipper; hence, when the reversing belt is in use it appears more natural to stand with the right hand on the shipper-bar ready to reverse immediately the tool is withdrawn by the left.

A far worse condition than the disposition of the traverse wheel is, in my opinion, imposed by having part of the footstock screws of right-hand lead and others of left-hand. The writer was at one time operating two lathes, one British and the other American. A heavy job was swung between the centers of one of them, and going from one to the other to note how the job was coming along, I noticed that the centers had worn loose. Giving the handwheel a quick turn to, as I supposed, tighten up the centers, the heavy piece dropped out of the lathe with disastrous results.

Articles Concerning the Federated American Engineering Societies Which Have Appeared in the "American Machinist"

The following list is an index of all articles, editorial, news and general, concerning the Federated American Engineering Societies, which have appeared in the *American Machinist* since the organizing conference held in Washington, D. C., June 3 and 4. It is published to enable our readers to refer without undue trouble in searching through back numbers, to any or all of our articles on the Federation, which we believe, furnish a complete and accurate report of the inception, organization, objects and progress of that federation of societies.

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Committee on Technical Standards, Bureau of Surveys and Maps, Recommends Use of English Measuring System

A VIGOROUS stand for the English system of measurements was taken Sept. 14 by the Committee on Technical Standards of the Bureau of Surveys and Maps. A portion of the report made on that occasion by the committee is as follows:

A review of the answers of the various Bureaus to a questionnaire develops an outstanding feature which it is believed should have the attention of the Board without delay. This is the question of whether maps should be published on standard scales of metric or English measurement. By metric measurement is meant the practice of employment of "ratio" scales evenly divisible into one million, such as 1:62,500, 1:250,000, etc. By English measurement is meant the scales upon which one inch on the map bears an integral relation to feet or miles on the ground, as for example, 1,000 ft. to 1 in., 2 miles to 1 in., etc.

Four of the reporting Bureaus evidently employ the metric scales almost exclusively, while eight, on the other hand, use the English system. Two use both, and three agencies report that they do not make maps. From this it would seem the weight of opinion inclines heavily to the English system, but it must be pointed out in this connection that two of the largest map-making organizations, namely, the Geological Survey and the Coast and Geodetic Survey, employ the metric system. All the commercial map concerns of the country and the state, county and municipal governments use the English system, except in rare instances. Practically all maps dealing with the public land surveys of the country are made on the English measurement scales, since the metric scales do not lend themselves at all readily to the chain unit employed on cadastral surveys.

In the opinion of the committee, there is no reasonable argument opposed to the desirability of all government map-making organizations uniting upon one system or the other and after due consideration of the various phases of the question the committee has reached a unanimous conclusion to recommend to the board that the English system be adopted as standard practice. The committee is not prepared to recommend the various scales in the system which should be chosen as standard, but merely suggests the acceptance of the general principle.

This decision was made not only from the standpoint of securing uniformity in government maps, but also because the advantages of the English system over the metric are so apparently overwhelming that there seems little excuse for continuing the latter system.

Naturally, the greatest objection to the change is that so many of the maps are already published on the metric scales that great inconvenience would result in fitting new work to that existing, and great expense would be involved in ultimately making the old maps over. Probably the greatest difficulty would occur in the Geological Survey, but since only about 40 per cent of the country has been mapped so far by that organization, and admittedly half of this work must be re-surveyed to higher standards eventually, it would seem that it is not yet too late to make the change if it is clearly advantageous from other standpoints.

The widespread practice of using such scales as 1:62,500, 1:125,000 and 1:250,000 and 1:250,000 on the maps of the Geological Survey, the Coast Survey and the Lake Survey is of long standing, and while the reasons leading to the adoption of such scales are not entirely clear to the committee, it is surmised that the idea largely was to conform with European practice and to accord with opinions of scientific interests. It is believed, however, that the trend of scientific and professional opinion toward the adoption of the metric system in this country is not nearly so strong as it was 20 or 30 years ago. As an example in this connection, it seems desirable to draw the attention of the Board to the recent action of the Society of Automotive Engineers in adopting a resolution opposing the adoption of the metric system of measurement at a convention attended by 1,000 delegates from all over the United States. The opinions expressed to the convention on the question by prominent professional men are particularly interesting and pertinent in connection with consideration of the subject as far as it relates to maps.

Thomas E. Butterworth, associate professor of mechanical engineering at Lehigh University, stated:

"My college enthusiasm for the metric system did not survive my employment as an engineer in Germany, the chief metric country. I found the metric system was not in universal use there after a generation of compulsory legislation, and also found the use of the metric system was of no advantage in engineering computation.

"Further careful study for years has convinced me that the fancied logical advantages of the metric system are illusory and that the agitation in favor of its adoption is *harmful* to American industry and engineering education."

Dr. Humphreys, president of the Stevens Institute of Technology, expressed the view, based on his wide experience as an engineer and manager of industrial plants, that a compulsory law favoring the adoption of the metric system would be a fatal mistake, placing a tremendously heavy burden upon the industrial interests and involving millions and millions of dollars of expenditure. Dr. Humphreys stated further:

"To representatives of educational associations and institutions who may have been led into an endorsement of the metric system, I would say that, while naturally appealing to the workers in the laboratory as I am in a position to appreciate, I feel sure that to make a metric law compulsory would be a great *misfortune* to the country."

L. P. Breckenridge, professor of mechanical engineering at Yale University, emphatically declared that it was distinctly harmful to instill into the minds of college students ideas favoring impracticable changes in our basic standards instead of co-operating with the country's industrial interests.

It is believed that these expressions are timely and indicate a trend of opinion disposing of the theory that

we are approaching the time when our standard units such as the foot, the mile, the pound and the gallon will be supplanted respectively by the meter, the kilometer, the kilogram and the liter. In fact, it seems to the committee that the English system is so thoroughly interwoven into our lives that a change may perhaps never come about, and consequently there seems no occasion to hamper the present use of our maps by the employment of scales sympathetic to the metric system. As a matter of fact, such scales as 1: 62,500 and the 1: 125,000 are not even truly metric, but are a compromise between the strictly metric and the English measurement which possesses the advantages of neither. It is true that the two above-mentioned scales approximate the popular English scales of 1 mile to 1 inch and 2 miles to 1 inch, but the confusion, doubts and difficulties caused by the slight difference are so much a part of the experience of all engineers, not to mention the laymen, that it scarcely seems necessary to point out this objection. Apparently, the Geological Survey fully recognizes that such scales are not expressed in terms of popular understanding when it finds it advisable to print the following explanation on the back of each topographic sheet:

"The smallest scale is 1:250,000, or very nearly 4 miles to an inch. For the greater part of the country a large scale, 1: 125,000, or about 2 miles to an inch is employed."

It is true that, with the aid of specially made measuring scales, the maps can be readily used, but when it is realized that the common old foot rule divided into inches is the only implement available to probably 99 per cent of the map users, even including the engineers, it would seem that the scale of the map should be made accordingly. In other words, the map users in general will employ the inch as a unit of measurement on the map, so it seems unmistakably desirable to have this unit represent a definite number of the feet or miles which are the common units of measurement on the ground.

Convention of American Society for Steel Treating

THE Commercial Museum, Philadelphia, Pa., was the scene of the second annual meeting of the American Society for Steel Treating, from Sept. 14th to 18th, inclusive. This was the first meeting, however, of the society under its present name, as the organization is now a consolidation of the American Steel Treaters' Society and the Steel Treating Research Society. It was stated that the total attendances at the convention was in the neighborhood of 15,000.

In connection with the convention, an exhibit of appliances and products of interest to steel treaters was held under the auspices of the society. The number of exhibitors and the floor space occupied were both about three times as large as last year at the very successful convention held in Chicago under the auspices of the American Steel Treaters' Society. The exhibit contained not only heat-treating equipment of all sorts from furnaces to pyrometers, but also displays by steel manufacturers showing their products and their processes.

The officers elected for the coming year are as follows: Colonel A. E. White, president; T. E. Barker, first vice president; T. D. Lynch, second vice president; W. H. Eisenman, secretary; and W. S. Bidle, treasurer. The Board of Directors consists of H. J. Stagg, E. J. Janitzky, F. P. Fahy and W. C. Peterson.

Technical sessions were held in the morning, afternoon and evening. The opening session on Tuesday was devoted largely to announcing the results of the election of officers, a letter ballot having been previously held, and to the report of the amalgamation committee. Thursday evening was devoted to a banquet and ball at the Bellevue-Stratford Hotel. On Friday, inspection trips were made to various Philadelphia manufacturing plants, as well as to the Navy Yards. No sessions were held on the closing day, so as to allow an opportunity for everyone to visit the exhibits.

It is not amiss to note that a very complete program of entertainment was provided for the visiting ladies, of whom there were about one hundred. From the headquarters at the Bellevue-Stratford, sight-seeing trips were made to the principal objects of interest in Philadelphia. The exhibits at the Commercial Museum also were visited, so as to show the women where their husbands were spending their time.

The success of the meeting and of the exhibition is due chiefly to the efforts of the committees managing the affair. The chairmen of the various committees in charge of the convention were as follows: A. W. F. Green, program and papers; H. H. Clark, exhibition; F. A. Hall, entertainment; W. M. Mitchell, plant visitation, and Mrs. D. K. Bullens, ladies' entertainment.

As for the technical sessions, it is interesting to note the wide variety of the papers, although all were strictly in the field of heat-treating. About seventy-five papers were presented, embracing such topics as hardening, pyrometry, laboratories, furnace design and fuel, and heat-treatment in many phases.

A few of the papers presented are here given in abstract. The first one, by Prof. Larkin, is of general interest to engineers, and caused much favorable comment.

Lessons Learned in the Manufacture of Munitions and Ordnance That Can Be Applied to the Peace-Time Pursuits of Industry

By F. V. Larkin
Head of Department of Mechanical Engineering, Lehigh University, South Bethlehem, Pa.

The object of this paper is to point out some lessons that can be learned from the industrial activities in this country during the period from 1915 to 1919. During that time the author was associated with the manufacture of some 3,000,000 projectiles and approximately 500,000 high-pressure seamless cylinders. The viewpoint is that of one in charge of production.

The lessons learned are of two types, those occurring in the realm of steel and those in the realm of human nature. Under the former heading, the problems found in the mill, forge shop and the heat-treating and testing departments are of especial interest.

It was found desirable to keep a complete history of each heat made in an open-hearth furnace, one of the reasons for this being the fact that the steel workers are usually very secretive about their processes and their work, especially when a heat turns out badly. Another very important point was that the chipping of the ingots at the rolling mill could be almost eliminated by the use of proper molds and proper methods of rolling. Pyrometers were found to be very valuable in the forge shops. In the heat-treating department, by using the proper educational methods, the workers were made to like recording pyrometers and to look upon them as aids in their work. In heat treating, time is the most important element, and it was found desirable to standardize the length of time required in all opera-

tions, such as charging, drawing and quenching, and not rely upon the judgment of the worker.

In the realm of human nature two things seemed to be particularly important, that is, trade secrets and specifications. Before the war a few companies had a monopoly on the manufacture of munitions of war; and the arts of systematic production, inspection and manufacture were considered as trade secrets. This made it necessary that vast and independent developments be carried on by the government when it decided to manufacture munitions on a large scale upon its entry into the war. "We soon realized that, knowing the fundamental principles which serve as a foundation for any secret or process, we had only to bring into operation a sufficient amount of logically directed and persistently applied energy and ability in order to duplicate or outstrip the achievements of our competitors." It is chiefly the spirit existing in an organization that counts in this regard.

It was found that the more strict the specifications set for the manufacturer, provided that they were fair and accurate, the better it was for all concerned. The requirement of very high-grade work not only allows the worker to take pride in the class of work that he is turning out, but it insures satisfactory results. In the case of the manufacturing concern under consideration, work was rejected by the plant's inspectors that was actually of a high enough grade to be passed by the government inspectors who reviewed the job finally.

Carburizing, Hardening and Tempering High-Carbon Alloy Steels in 130 Minutes

By R. L. Gilman
Experimental Heat Treater, Standard Steel and Bearing Co., New Haven, Conn.

In developing this title, the author proposes a correlation of metallurgy, mechanics and economics to the end that better, faster, and cheaper production may be obtained. Reference is made to a complete set of heat-treatments for either hot or cold shaped objects of high-carbon alloy steel, especially chrome-vanadium alloys requiring maximum hardness and strength and, above all, the greatest possible uniformity of both. It is assumed that the stock has been thoroughly annealed previous to working. The practice upon which the results are based is well beyond the experimental stage. It is possible to carburize eutectoid or hyper-eutectoid steel on condition that the very hard case produced be not detrimental to the product. Carburizing insures uniformity in carbon content and in hardness.

In the operations described, 130 minutes includes all the time during which a load of 130 lb. of steel is subjected to heating, carburizing, reheating for hardening, and tempering. Of this time, 120 minutes is required in the carburizing furnace, 7 minutes in the hardening furnace and 3 minutes in the tempering furnace. The work is handled only in charging the carburizer. Quenching, conveying and feeding are functions of gravity and mechanics, and are not assumed as requiring any time.

All furnaces are of the gas-fired, rotary, automatically controlled type. The character of the equipment insures uniformity of treatment as regards speed, length of treatment and temperature. It is thus possible to use high temperatures in the furnaces, the carburizer being charged at 1,620 deg. or even higher. The mass of the work insures slow heating and the tumbling or rolling insures uniform heating.

After two hours in the carburizing furnace, the work is dumped into oil and brought out in a few seconds by an endless chain of buckets, at a smoking heat. This partial cooling tends to eliminate the danger of cracking between carburizing and hardening. The work then passes through boiling hot soda solution to remove oil and to give a uniform temperature. The hardening furnace operates at a temperature of from 1,600 to 1,740 deg., depending upon the size and grade of steel. The feed or speed of travel is varied so as to get the work out with the proper temperature, this being determined by means of optical pyrometers. After the work is quenched, it is removed from the vat by a chain of buckets and fed automatically to the tempering furnace, which is of the same type as the hardening furnace and operates at a temperature of 600 to 800 deg. The speed is again varied to give the proper temperature to the work, which falls out at the proper time and accumulates in large boxes, where its mass insures slow cooling.

The quenching medium is cooled by circulation through an external cooling system and is delivered into the hopper with the work. A close inspection of the work is held after each quenching.

This method has produced excellent results, being suited for such work as ball races. A deep case is produced without showing any sharp lines. The advantages of the system are that it saves labor, gives uniformity of surface hardness and finish, and also saves time.

The Selection of High-Speed Steel for Tools

By Henry Traphagen
Metallurgist, Fastfeed Drill and Tool Corp., Toledo, Ohio

One of the problems confronting the tool manufacturer today is to obtain a steady supply of physically uniform high-speed steel. By physically uniform high-speed steel we mean steel that is free from pipes, seams, cracks, segregated carbides, decarbonizations and fiber; steel that will harden quickly and uniformly with a smooth velvety grain that is almost amorphous.

For a long time every shipment to our plant was carefully analyzed chemically. I have records covering over a thousand consecutive samples, and I believe there were just two samples that did not check up to the standard specifications. Such performance is a remarkable tribute to the efficiency of chemical analysis. But, about 30 per cent of all steel received was rejected for physical reasons.

Hardness testing by the sceleroscope and Brinnell machine on both annealed and hardened samples showed nothing, for we found very little connection between hardness and machine-shop performance. It seemed that ordinary routine testing would not solve the problem. You know the old adage about judging the pudding by eating it. Why not test steel by actually hardening it? This was found to be the solution to the problem. The procedure is as follows: A piece from each bar is hardened by pre-heating slowly and thoroughly at 1,650 deg. F. and then heating quickly in a furnace maintained at 2,400 deg., after which the piece is quenched in oil until cool. The hardened piece is broken transversely and longitudinally and the fracture examined with a small low-power pocket lense.

If the piece breaks evenly, we look for either fiber or excessive carbides and generally find one or the other in brittle steel. If the steel is decarbonized, the shiny crystalline ring is so apparent that it is found at a glance. A pipe may be uncertain in the transverse fracture, but the longitudinal break quickly shows it up. If the tungsten content is low, we generally find that the structure is coarse and crystalline. Woody fibrous structures are very common, but always show up in the longitudinal fracture. We never reject on a single test. The test must be fair and no amount of retesting is spared if there is the slightest doubt.

Is a clean, smooth, uniform structure any index of a tool's value? To answer this question we made up dozens of drills from what appeared to be excellent steel. These drills were tested, not in the laboratory, but in a heavy-duty drill press. They were jammed through foot after foot of heat-treated forgings, using very little lubricant. Then they were taken out of the press, bounced on a concrete floor time and again to test for toughness, placed in the drill again and the whole performance repeated. Such tests and others have proved many times the value of fracture tests in selecting high-speed steel for drills and other tools.

I am not under the delusion that fracture testing is anything new or novel, but I do know that this simple method of testing has not been given the consideration it deserves.

Business Conditions in England

By OUR LONDON CORRESPONDENT

LONDON, Sept. 3, 1920.

THE British coal miners' strike is scheduled to take place on Sept. 25. These columns have stated that the demand is ostensibly for an increase of 2s. a shift in wages with also a reduction of 14s. 2d. a ton on the price of coal to the household consumer, but there is more in the dispute than this. The mining workpeople and their advisers are clearly dissatisfied with the way in which the industry is being managed by the government and some are intent on nationalization. As to the voting, there can be no doubt about the figures, even if they do include a considerable number of lads of 14 or 15 years of age and upward—the necessary two-thirds majority was obtained. Of the total number of votes recorded—namely, 845,647—606,782 were for the strike and but 238,865 against. In no area was there a definite majority against striking.

Many of the mines are working at a loss, the areas where this is clearly the case being Cumberland and Westmoreland, Lancashire and North Wales, and the Midland district. A large profit per ton is being made in South Wales, Northumberland and Durham, and a very small profit in Yorkshire. The explanation in the last case is that South Yorkshire received permission to export 50,000 tons out of a total of about 20,000,000 tons mined annually, and Great Britain is making a profit out of the export of coal. However, the miners are asking for half of this profit.

Coal owners' profits are fixed by law at the pre-war standard plus one-tenth of any excess available. As the result of the export trade this excess is estimated to reach £66,000,000, and of the £6,600,000 thus accruing to the mine owners, half will be divided in certain proportion among collieries making excess profits, the remaining half being divided among the collieries in Great Britain according to their outputs. The £60,000,000 or so left is intended to be applied to the reduction of the national debt, but according to a rough estimate made the 2s. extra demanded per shift will absorb about £30,000,000 for the miners, while a reduction of 14s. 2d. a ton on household coal would account for the other half.

Coal Strike Results on Industry Would Be Hazardous

The result of a coal strike on industry can be guessed. Estimates vary according to the particular circumstances. Many works will close down within a week, though some could of course struggle on for a month or two. There is some evidence that preparations have already been made by the government to insure a sufficient supply of coal to industries on which the actual life of the country depends. According to present signs the miners will not act by themselves. They form part of what is known as the triple alliance, including transport workers and railwaymen, and nothing is less unlikely than combined action, although this is not at the moment absolutely certain. In engineering there will probably be no such attempt to struggle on and keep as many men going such as occurred during the molders' strike; according to appearances most works will simply shut down. Even now, one leading machine-tool firm is in receipt of no more than one important order a week and the report is of steady discharges at another well-known firm.

An inquiry has been made which suggests that given a coal strike, within a week half the cotton industry will be shut down, so that more than a million and a half of workpeople will be unemployed, including, of course, the coal miners. By the end of two weeks the remainder of the cotton industry and most of the shipbuilders may close down, and after, say four weeks from the beginning, another half million workpeople will be unemployed, including, according to this estimate, 40,000 engaged in the machine-tool trade and 80,000 in the motor industries.

By apologists for the miners the strike has been described as unselfish. However, more people would believe this if the demand for an increase in wages were withdrawn, for reduction in the price of coal would not affect the miners—they get their supplies either free or at nominal rates whereas the household consumer pays according to locality and quality at the rate of £3 and more a ton. In London the price has lately risen owing to the increased railway rates for transport. As regards wages, the miner has already received increases greater than the present increase in living costs, even leaving out of account the reduction in their hours. The cost of living is, it must be added, steadily rising and will soon, according to estimates, be 170 per cent above the pre-war rate.

Price of Petrol Increased

Industry has received another shock, relatively of a minor character, in the sudden increase in the price of petrol. All sorts of dire results have been prophesied. Petrol (gasoline) has been suddenly raised in price by 7d. a gallon, the price of first quality being from 4s. 3½d., the ruling price, to 4s. 7d. a gallon. According to predictions, by the beginning of next year when the duty of 6d. a gallon is removed, the price will be 5s. a gallon. Taxation (new) of pleasure cars will then be at the rate of £1 per horsepower. As is not unnatural, the increased price has led to a demand for a government scheme by which Great Britain shall be rendered independent of America for petrol supplies. But it is pretty clearly recognized that not for some years can supplies be raised in this country of sufficient quantity, if available. Consumers of petrol have noted, too, the curious fact that petrol being increased in price, benzol has also been raised in price. Indeed a special committee appointed by the Board of Trade reported at the beginning of the year that the National Benzol Association simply regulated its prices according to the price of petrol and not by the cost of production.

Iron and Steel Trades Slow

In the circumstances it was not surprising that at the last market of the London iron and steel trades very little business was transacted and it was reported that "the export trade shows a further falling off, there being further cancellations by eastern traders." The financial disturbance in Japan some time ago caused the cancellation of orders, and now India, of late no bad customer to the British machine-tool trade, is moving in much the same direction and the next few weeks may bring much anxiety to British exporters to that area.

Nearly three years ago at a meeting in the hall of the Institution of Civil Engineers here an attempt was made to regulate the training of engineers through a central organization. Not only were scholarships and so on to be awarded but apprenticeship was to be supported and in particular parents and guardians were to be informed and advised as to the best means by which their wards might enter the engineering trade or profession. A fund of about £1,200 was formed, chiefly by grants from engineering institutions, but proved insufficient, having been expended in printing, etc. Appeals were therefore made to about 250 firms, who were asked for subscriptions of say 10 guineas yearly; in response, about 30 firms agreed. The subscriptions received having been spent, a meeting was again called and held two days ago. As the result, the organization will probably be merged in the Federation of British Industries or the engineering employers' federation.

Two unrelated items may be added. The first is to the effect that a Leipzig correspondent reports that, business being bad, the Technical Fair of Leipzig which preceded the General Fair was nevertheless continued into that Fair, and the machine-tool and other exhibits were to be on view until Sept. 4. The other relates to a British firm concerned not

quite indirectly with motor cars. Several weeks ago information was given to the papers and well spread to the effect that, owing to foreign competition, nearly 2,000 workpeople would have to be discharged. The shares fell in market value very rapidly. Soon after the fall an announcement was made that a very considerable issue of bonus shares would be effected, and of course the shares rose again. No moral is added.

Finding Decimal Equivalents on the Slide Rule

By William H. Kellogg

The numerous and diversified methods employed for keeping decimal equivalent tables in a handy and conspicuous place only tend to emphasize their importance. The application of the slide rule in this connection has been found very useful to the writer, inasmuch as at some times and places tables do not happen to be conveniently posted.

It is to be supposed that everyone making frequent use of the equivalents will have memorized the decimal values of all of the fractions as small as the eighths, and possibly some of the sixteenths and thirty-seconds. It will be noted that the fourths have two figures after the decimal point, the eighths three, the sixteenths four, the thirty-seconds five and the sixty-fourths six. To further aid the memory, observe that all of the decimal equivalents end with 5, and that the last two figures must either be 25 or 75. The last three figures will always be arranged as follows: Preceding 7 will be 3 or 8 and preceding 2 will be 1 or 6. If this rule be remembered, it will be observed that in obtaining the result on the slide rule the last or end figures can be supplied mentally.

For example, to find the decimal value of $\frac{13}{16}$, set the runner on 13, bring 16 on the slide to coincide and read the result, which is 0.8125. The 0.81 of course, appears plainly and the 25, the end figures, are supplied. Taking $\frac{19}{32}$, the result reads 0.59+, and the third figure looks as though it might be three or four. Knowing that all thirty-second equivalents have five places, if the third figure in this case were four, the final two figures would not follow in the sequence, as explained by the foregoing rule; but if the third figure is 3, then the rule is complied with and the last three figures are 375, making the decimal 0.59375.

To obtain results in sixty-fourths, it is necessary to follow the first rule concerning the three figures and to know another preceding figure, which may be memorized or not. The ending sequence run as follows:

0625	5625
1875	6875
3125	8125
4375	9375

To find $\frac{37}{64}$, read the result on the slide rule, it being 0.57+, the third figure appearing so close to 8 that we must conclude from the table that the end to be supplied is 8,125, hence the complete decimal 0.578125. If you do not remember the figures of the table here given, all you have to do is to find the equivalents of the sixteenths by reading from the slide rule, the same as in the first case. It will be noticed that the sequence of four figures given correspond to the decimal equivalents of the sixteenths, as $\frac{13}{16} = 0.8125$. The equivalent of $\frac{41}{64}$ would appear on the slide rule to be 0.64, but by following the method given the result will be 0.640625.

Another very useful application of the slide rule to decimal equivalents is the inverse of the usual procedure. Suppose a calculation has been made for a shaft of a certain diameter, the final result being a decimal. The nearest size in sixteenths of an inch is usually desired. Setting the index of the slide to the decimal given, the numerator of the fraction can be read under 16. If the decimal of the calculation is 0.67, the result opposite 16 on the slide rule is approximately 10.7, the nearest integer being 11, so that $\frac{11}{16}$ would be the fraction used. Or, if it is desired to get the closest result down to a sixty-fourth, the result, read under 64 on the slide, would then be $\frac{43}{64}$.

Standard Catalogs from the Engineer's Point of View

By C. V. Lovell

At the catalog conference of the National Association of Purchasing Agents, held in Chicago on May 22, 1918, a recommendation was made that all catalogs meant for the use of purchasing agents be made a certain size. Strange to say, after over two years have elapsed, we find comparatively few manufacturers adopting the size recommended ($7\frac{1}{2}$ x $10\frac{5}{8}$ in.). The reason for this is quite clear; the size is too large.

According to the report issued by the association $79\frac{1}{4}$ per cent of the catalogs examined by the Standardization Committee had a page size of 6 x 9 in. or smaller. Granting that the majority of manufacturers prefer a catalog of the smaller size, what size does the engineer prefer? I wonder if the man responsible for catalogs ever considers the fact that to a very large extent the purchasing agent must get his specifications from the engineer.

Let us consider one of the existing standards: The S. A. E. data sheet is perhaps the most widely known of existing engineering standards. (The writer is not a member of the S. A. E. and, therefore, he has no mercenary motives). Naturally this standard is being adopted by manufacturers of parts used in automobile construction. (Ball bearing manufacturers for instance.) Consequently, designers of special machinery and tools used in automotive work follow suit and use the same standard for the collection of data and much prefer this size ($4\frac{1}{2}$ x $7\frac{1}{4}$ in.) for catalogs.

Imagine the convenience to the designer, who is after all the man who buys the goods in question, if he could select all of the material used in the construction of the machines or tools he is making from a loose-leaf book containing catalog sheets of the various material such as steel, bolts, screws, oiling devices shafting, gearing, clutches, couplings, pipe fittings, keys cotters, lock washers, etc. If these catalogs were published in loose-leaf form, the engineer could select the sheets most frequently used from the several catalogs and place them in his hand-book and file the remainder for future reference. Another advantage of the loose-leaf catalog is that standard goods would not have to be cataloged every year, but could be taken care of by issuing new price sheets, thus reducing advertising costs to a considerable extent.

The writer does not advocate making all catalogs to this standard, but does believe that there is a very large field especially in stock sheets which could be covered very satisfactorily by a $4\frac{1}{2}$ x $7\frac{1}{4}$ loose-leaf catalog.

SPARKS FROM THE WOR

Valentine Francis

Program of the American Foundrymen's Association Convention Announced

The annual convention of the American Foundrymen's Association will be held in Columbus, Ohio, Oct. 4 to 8. It has been announced that there will be over two hundred companies exhibiting at the convention and that there will be seven buildings to house this large number of exhibitions.

The technical and industrial relations sessions of the convention are very attractive; among the papers to be read at these sessions are the following:

"Foundry Methods and Equipment for Producing Machine Tool Castings," by A. N. Kelley, Cincinnati, Ohio.

"Electrical Apparatus in a Modern Iron Foundry," by F. D. Eagan, Westinghouse Electric Manufacturing Co., East Pittsburgh, Pa.

"Report of Committee on General Specifications for Gray Iron Castings to Co-operate with A. S. T. M.," by Richard Moldenke, chairman, Watchung, N. J.

"Recent Developments in Die Casting," by Charles Pack, Doehler Die Casting Co., Brooklyn, N. Y.

"Heat Treatment of Steel Tractor Castings," by Fred Grotts, Holt Manufacturing Co., Peoria, Ill.

"Electric Steel Making," by James W. Galvin, Ohio Steel Foundry Co., Springfield, Ohio.

"Training Foundry Executives," by R. E. Kennedy and Bruce W. Benedict, Shop Laboratories, University of Illinois, Urbana, Ill.

"The Right Man on the Right Job," by Arthur H. Young, manager, Industrial Relation, International Harvester Co., Chicago, Ill.

"The Triplex Process of Making Malleable Iron," by H. A. Schwartz, National Malleable Castings Co., Indianapolis, Ind.

"Important Considerations in the Design of Modern Foundries," by J. H. Hopp, Chas. C. Kawin Co., Chicago, Ill.

"Arc Welding Machines for the Foundry," by A. M. Candy, Westinghouse Electric and Manufacturing Co., East Pittsburgh, Pa.

A business meeting will be held on Oct. 7, and on Oct. 7 and 8 there will be general sessions.

1920 New York Electrical Show

The 1920 New York Electrical Show will be held at the Grand Central Palace from Oct. 6 to 16. A record variety of exhibits has been arranged for, representing a forty-eight per cent increase over the 1919 show, and three floors of the big Palace will be filled with displays and demonstrations of a thousand and one uses of electricity. The number of exhibits will be 141, representing as many individual manufacturers.

This year the entire third floor of the Palace has been given over to a series of working exhibits where the employment of electricity in a score of industries will be demonstrated. One will be material handling, with industrial trucks, conveyors and hoists all in operation. The Material Handling Machinery Manufacturers' Association and the Electric Hoist Manufacturers' Association are co-operating with different makers in this particular exhibit. Among the processes of manufacture to be seen in actual operation are welding, japanning, heat treating, rivet heating, oil tempering and heating with vacuum furnaces. Three types of machine shops will be operated and there will be a special exhibit showing factory lighting.

Am I an American?

THE time has come when every citizen of this Nation should halt in his daily doings and, searching his soul, ask himself the question: "Am I an American? In my actions, am I squaring myself with the great American principles of Liberty, Justice and Equality, which have been the great constructive forces for the advancement and uplift of Humanity?"

The man who would subject the national life and all of its interest to the will of his group is an unrighteous and a disloyal citizen. He is unrighteous because he would substitute selfish aggrandizement for fixed principles of justice. He is disloyal because he denies his allegiance to his country and gives it to the particular class to which he belongs and beyond which his narrow vision and perverted purpose do not reach.

Americanism cannot live—this Nation as conceived by our fathers, cannot endure under the shackles of class control. When the laws are defied and mob violence resorted to, we must meet it with force and see to it that life and property are protected.—Governor Goodrich of Indiana.

Detroit a Progressive City—Other Cities Will Do Well To Follow Her Lead

The City of Detroit, determined to maintain its lead as a progressive aeronautical center, intends establishing its second municipal landing field in the heart of the city.

At the request of the Commissioner of Parks and Boulevards, the commanding officer of Selfridge Field, Captain N. J. Boots, flew over the proposed site and after making an additional ground inspection will recommend its establishment at the next meeting of the city council.

The field will only permit one-way landings to be made, but in the event of a strong south wind the other municipal field, located several miles away, will be available. The new field is situated along the Detroit River, very close to the heart of the city, and its water frontage makes it peculiarly adaptable for use by seaplanes. In fact, it is already being used by the United Aerial Express Co. as a home base for its seaplane flying between Detroit and Cleveland.

The commanding officer has conferred with the officials of the City of Detroit relative to the framing of an ordinance governing flying over that city. The opinions of the Chief of Air Service in this matter were given and the city authorities agreed that legislation governing aerial traffic should be enacted by the Federal Government, in order that such regulations will be universal throughout the country. They realize that haphazard legislation by separate municipalities will only result in a confusing tangle of laws. This matter is being held in abeyance for the time being.

Machinery Club of Chicago Plans Great Picnic

On Saturday of this week the Machinery Club of Chicago will hold its annual picnic at Thatcher's Woods, River Forest, Chicago. Judging from the advanced notices and the varied program arranged by the committee in charge, this will be one of the banner events in the history of the organization.

A feature of the outing will be the fried chicken lunches, put up in boxes along with the other "fixin's," which will be distributed at the grove. Races for the ladies as well as the men, a ball game between Ray Jone's "Pathfinders," and Peterson's "Ramblers," and special attractions for the kiddies will help fill up the remainder of the day's sport.

LD'S INDUSTRIAL FORGE
News Editor

Iron and Steel Electrical Engineers Hold Week's Convention at New York

For five days last week the spacious roof of the Hotel Pennsylvania in New York was the scene of the fourteenth annual convention of the Association of Iron and Steel Electrical Engineers.

One side of the garden was set aside for the convention session, while the other was turned into a veritable maze of motors, transformers, lighting fixtures, and mechanical and electrical apparatus of every description. The exhibit was one of the finest ever produced by the association.

The convention opened Monday with reports of committees, after which the election of officers took place. The balloting resulted in the following selections for the ensuing year: E. S. Jeffries, president; W. S. Hall 1st vice president; C. E.Bedell, 2nd vice president; James Farrington, treasurer; John F. Kelly, secretary. Directors elected were: Gordon Fox, F. E. Galbraith, S. L. Henderson and W. C. Suppler.

After these perfunctory numbers the convention settled down to the regular routine. The papers presented were varied and were all of great technical value. Some of these papers were:

"Practical Education of Steel Mill Electricians," by B. A. Cornwell; "Relation of Standardization in Electrical Equipment to Safety," by Walter Greenwood; "Power Transmission for Industrial Plants," by D. M. Petty; "Underground Transmission," by A. L. Freret; "Some Consideration in the Determination of Auxiliary Drives," by Gordon Fox; "Report of Electrical Development Committee for 1920," by E. S. Jeffries (chairman); "The Reversing Electric Mill Considered From the Standpoint of Tonnage," by K. A. Pauly; "Some Economic Considerations in Design of Power Plants for Steel Mills," by T. E. Keating; "Current Limit Reactance," by R. H. Keil; "Report of Electric Furnace Committee for 1920," by E. T. Moore (chairman); "Standardization Committee Report," by W. T. Snyder (chairman).

On Monday night the members of the association were treated to a first-class vaudeville show which was produced through the courtesy of the McGraw-Hill Publishing Co., of New York. The show was followed by a cotillion in which the conveners and their friends joined in the merry making till the wee hours of the mourning.

The convention adjourned Tuesday afternoon while the members enjoyed a sail up the Hudson to Bear Mountain, as the guests of the United States Steel Corporation. The annual banquet was held Wednesday night and was attended by over 1,000 persons.

The Convention Committee included: A. H. Swartz, chairman, J. H. Adkins, F. A. Annett, G. M. Baker, J. O. Corbett, J. F. Kelly, B. G. Kodjbanoff, T. B. Montgomery, H. D. Rei, A. R. Ross, T. A. Tate, F. Tresselt, R. G. Widdows.

What the Open-Shop Plan of Employment Means to the American People

IT IS a mistaken idea that the open-shop method of conducting industrial relations is a technical phase of industrialism of interest and benefit only to the employer and the employee.

The effect of the open shop, which means, in a word, the right of every man to earn a living for himself and his family regardless of his political, religious or labor affiliations, extends through every ramification of a nation's life.

The open-shop plan of employment directly influences production, as under the open shop there can be no restriction of output.

The open-shop plan of employment removes the possibility of frequent strikes, with resultant suffering, violence, loss of savings and national disturbance.

The open-shop plan of employment, *open to both union and non-union men*, makes possible the promise that "the laborer is worthy of his hire," and in its results spells prosperity for nation, family and individual.—From *Industry*.

Appointed Navy Department Sales Advisor

V. C. Kylberg has been appointed sales advisor to the Navy Department. During the period of greatest activity in the disposal of the War Department's surplus property, Mr. Kylberg was assistant chief of the machine-tool section of the Office of the Director of Sales.

Later he organized the Procurement Division for the Army's vocational training schools. More recently he has been acting head of the sales section of the U. S. Shipping Board.

Jones-Reavis Bill Indorsed by National Machine Tool Builders

The National Machine Tool Builders' Association has indorsed the work of the National Public Works Department Association as outlined in the Jones-Reavis bill, and is giving its moral and financial support to the plan to reorganize the Department of the Interior, according to a statement from Charles E. Hildreth, general manager of the association, given out by M. O. Leighton, national chairman of the National Public Works Department Association.

The resolution passed by the National Machine Tool Builders' Association, at its annual convention, endorses the Jones-Reavis bill as a measure "purporting to correlate the departments of the Government having to do with public emergency matters which would not create new Government departments but would rather eliminate the duplication of work now performed by many departments. A further object of the bill is a material reduction in Government expenditures for public works."

The public works movement has been endorsed by Senator Harding, Governor Cox, Ex-Secretary Lane, General Wood, Herbert Hoover, Governor Coolidge, Hugh Frayne, Samuel Gompers, Franklin D. Roosevelt and many governors, bankers and engineering societies throughout the country. It is expected that the next Congress will take definite action on the Jones Reavis bill.

McCrosky Tool Corporation Outing

The annual field day and picnic of the McCrosky Tool Corporation, Meadville, Pa., was held this year at Conneaut Lake Park, Pa. A fair, cool day favored the outing, and consequently the field events were all vigorously contested. A baseball game, in which the McCrosky team of the Meadville Industrial League was divided between the opposing nines, formed the climax of the athletic program. Dinner was served at the Oakland Hotel and was followed by a list of snappy toasts. Boating, swimming, and the amusements at Conneaut Lake Park completed a most successful day.

The International Machinists' Association has protested to the President against Secretary Baker's "shop organization" plan.

Annual Convention of the International Railway General Foremen's Association

The annual convention conducted by the Railway General Foremen's Association was held in the Hotel Sherman, Chicago, from Sept. 9 to 10, 1920. The officers in charge of the meeting were president, W. T. Gale, C. & N. W. Ry., Chicago; secretary, William Hall, C. & N. W. Ry., Winona, Minn. Prepared addresses were presented on previously assigned topics, including, "Standardization of Engine Failures and Terminal Delays," "The Best Methods of Repairing Superheater Units," and "How to Reduce the Cost of Repairs in Locomotive and Car Departments."

The officers elected for the following year are: president, J. B. Wright, general foreman, H. V. Ry., Columbus, Ohio; first vice president, Geo. H. Logan, C. & N. W. Ry., Chicago, Ill.; second vice president, H. E. Warner, N. Y. C. Ry., Elkhart, Ind.; secretary-treasurer, William Hall, C. & N. W. Ry., Winona, Minn.

An elaborate exhibition of tools and specialties for locomotive and car construction had been arranged by the Association of Railway Supply Men. This occupied all available space in the lobbies and halls of two floors of the hotel, and was attended with marked interest by the visitors. Officers in charge of the Supply Men included, chairman, H. A. Varney, Sunbeam Electric Manufacturing Co., Chicago; and secretary-treasurer, Clarence L. Mellor, Barco Manufacturing Co., Chicago.

Belgium Honors Colonel LaMar

In recognition of the assistance extended the Belgian Government and Belgian industries, the King of the Belgians has named Colonel Alfred LaMar an officer of the Order of Leopold II. The insignia of the order was presented to Colonel LaMar on the occasion of his recent visit to Belgium. E. C. Morse, the Director of Sales, and others of his lieutenants will be decorated at the earliest opportunity.

Colonel LaMar was in immediate charge of the negotations between the War Department and the Belgian Government, in arranging for the sale of surplus machine tools. He has just returned to his desk after having looked carefully into the machine-tool situation in Belgium. Just as soon as the exchange situation is restored to anything like normal, he predicts that a large number of orders for machine tools will be placed in this country. There is a great shortage of tools, he said, but everyone is trying to get along with the minimum amount of equipment until the present prohibitive rate of exchange is overcome. Any manufacturer of machine tools who desires to extend a long-time credit will be able to do a great deal of business in Belgium even at this time, Colonel LaMar declares.

Colonel LaMar was in Belgium a year ago. He expresses astonishment at the progress which has been made in that country during the period between his visits. He finds that the Belgian manufacturers and machine-shop men are very grateful for the assistance which they received from America. The fact that they were able to obtain American-made machine tools has been the most important single factor enabling these activities to reconstruct so rapidly.

A bas-relief map of the world has been made at the naval gun factory at the Washington Navy Yard for use at the marine exposition which is to held in Chicago. The map is fashioned from aluminum plates. In its completed form it is 42 feet long and 15 feet wide.

Business Items

The Delion Tire and Rubber Co., Trenton, N. J., has bought the plant and equipment of the Dreadnaught Tire and Rubber Co., Orangeville, Baltimore, Md. The company will install additional machinery. J. W. Price is the president.

At a meeting of the stockholders of the Plymouth Motor and Machine Co., Plymouth, Wis., it was voted to change the firm's name to the Plymouth Metal Products Co. It also will increase its capital from $60,000 to $100,000. The officers of the new concern are: president, George W. Brickbauer; vice president, L. E. Schwab; secretary and treasurer, (Miss) Martha Merget.

A. F. Way & Co., Inc., Hartford, Conn., has just completed its new factory in East Hartford. This is much larger than its present plant and will give this company increased facilities for the building of special machinery, tools, etc., on contract, as well as manufacturing its line of utility size blocks, sine bars, stock supports and machines.

The O. R. Adams Manufacturing Co., Inc., of Rochester, N. Y., has been taken over by the Seneca Falls Manufacturing Co., Seneca Falls, N. Y. This firm will continue to manufacture the Adams Short-Cut Lathe. Ogden R. Adams is severing his connection with the Short-Cut Lathe business, and will give his entire time and interests to his regular machine-tool business at the St. Paul St. store.

The Gilbert & Bennett Manufacturing Co., Georgetown, Conn., manufacturer of wire and wire goods, etc., will erect a large recreation building at its plant for the use of employees. The building will be of brick and steel construction, two stories high and 40 x 60, and will contain a large restaurant, recreational features, etc.

The Crofoot Gear Works, Inc., has announced the opening of its new factory in the Hyde Park section of Boston, Mass.

Personals

C. A. Willard, formerly with the M. S. Wright Co., Worcester, Mass., in the capacity of plant engineer, has taken up new duties in charge of the research work for the Bridgeport, Conn., Chamber of Commerce.

Colonel Paul R. Hawkins has been appointed district manager of the Pittsburgh office of the Norton Co., grinding machinery manufacturer, of Worcester, Mass.

Dr. E. F. Northrup has resigned his professorship at Princeton University in order to devote his entire time to his work with the Ajax Electrothermic Corporation, Trenton, N. J., manufacturer of the Ajax-Northrup high frequency induction furnaces. Dr. Northrup has recently been elected vice president of this company and is now engaged in perfecting for them a brass-melting furnace of this Ajax-Northrup type.

James Dellage, of the Hart-Parr Co., Charles City, Ia., has gone to England to take charge of the Hart-Parr tractor at the Lincoln trials. He will then go to France to be in attendance at the French semi-annual trials.

J. H. Kreidler, for several years an executive in various automobile plants, has joined the sales organization of the J. R. Stone Tool and Supply Co., Detroit, Mich.

L. W. Harston, who has been with the sales department of the Elyria Iron and Steel Co., of Cleveland, Ohio, for the past three years, has succeeded F. R. Guyon as assistant manager of sales.

Forthcoming Meetings

The American Foundrymen's Association will hold its annual convention and exhibit at Columbus, Ohio, on Oct. 4 to 9. C. E. Hoyt, 1401 Harris Trust Building, Chicago, Ill., is secretary.

The 1920 New York Electrical Show will be held in the Grand Central Palace from Oct. 6 to 10.

The Standardization Conference of the National Association of Purchasing Agents will be held at the Congress Hotel, Chicago, Ill., on Oct. 9.

An exposition of U. S. manufacturers at Buenos Aires, Argentine Republic, S. A., has been arranged for the month beginning Nov. 15. Information can be obtained from the American National Exhibition, Inc., Bush Terminal Sales Building, 132 West 42nd St., New York.

The Federated American Engineering Societies will hold its first meeting at the Hotel New Willard, Washington, D. C., on Nov. 18 to 20 inclusive.

The National Machine Tool Builders' Association will hold its 19th annual Fall convention at the Hotel Astor, New York City, on Thursday and Friday, Dec. 2 and 3, 1920. C. Wood Walter, care of the association at Worcester, Mass., is secretary.

The 1920 annual meeting of the American Society of Mechanical Engineers will be held in the Engineering Societies Building, 29 West 39th Street, New York City, from Dec. 7 to Dec. 10.

Condensed-Clipping Index of Equipment

Patented Aug. 20, 1918

Countersinking Machine, Opposed-Spindle

Langelier Manufacturing Co., Arlington, Cranston, R. I.

"American Machinist," Sept. 9, 1920



This machine is intended for countersinking or centering both ends of pins simultaneously. Pins from 1⅛ to 4½ in. long and ⅜ to ⅝ in. in diameter can be handled; production, eight pins per minute. Each drilling head contains a hardened spindle running in phosphor-bronze bearings; drilling speed, 2,000 r.p.m. Each spindle carries a No. 2A Jacobs chuck having a maximum capacity of ⅜ in. The spindles can be fed simultaneously by a hand lever, which acts through racks and a pinion. The feeding yokes are so attached to the spindles by clamps that the position of the tools may be adjusted to suit the work. The depth of the feed is controlled by means of adjustable stops. The work-holding fixture is adjustable for different sizes of work, the pins to be countersunk being held between beveled bushings in the two jig-heads.

Bench Legs, Steel

Angle Steel Stool Co., Otsego, Mich.

"American Machinist," Sept. 9, 1920



These steel legs are made in various heights and styles, style 5-26 being shown in the illustration. The tops of the legs are flat, so that boards of any width may be laid on them. If desired, heavy planks can be used along the front edge with light ones in the rear where the wear is less severe. The top member and shelf support are furnished with from three to five holes for bolting on the planks. To form a wider table two legs may be used back to back. All legs are finished with a baked-on green enamel.

Grinding and Buffing Machines, Heavy-Duty

Van Dorn Electric Tool Co., Cleveland, Ohio.

"American Machinist," Sept. 16, 1920

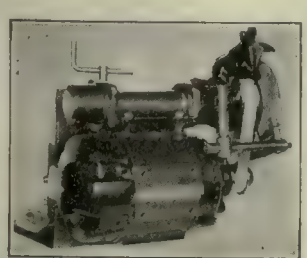


The 1-hp. heavy-duty electric grinding machine shown is of the floor type. The motor is built to A. I. E. E. standards and has a momentary overload capacity of 2½ hp. An a.c. stator and a d.c. field assembly are made interchangeable in the motor frame. Specifications: Height of spindle, 39 in. Base, 17 x 18 in. Spindle diameter at wheel, ¾ in. Weight of machine with one guarded wheel and one extension, as shown; net, 345 lb.; crated, 450 lb.; boxed for export, 500 lb. Contents export box, 21 cu.ft. Arrangement is made for attaching exhaust system, and extensions for carrying brushes or wheels can be furnished. Bench and aerial types of this machine are also manufactured.

Grinding Machine, Portable, Electric

Electro-Magnetic Tool Co., 2902 Carroll Ave., Chicago, Ill.

"American Machinist," Sept. 16, 1920



The machine shown is known as type 2UA. Interchangeability of the pulleys permits its use either for internal grinding with a high-speed spindle or external grinding, with slower speed and larger wheel. The wheel can be carried on an extension of the armature shaft. Slides are provided for vertical and horizontal adjustments. The motor body has flats finished on its outside faces, so that the spindle may be shifted. Spindle extensions 5, 10 or 15 in. long may be attached for internal grinding. The armature speed is about 5,200 r.p.m. A 5½- to 6- in. wheel can be used when operating at the slower speed. The motor is about ¼ hp., and the total weight of the tool, without equipment, is 25 lb.

Generator, Acetylene, Automatic

Imperial Brass Manufacturing Co., 1200 West Harrison St., Chicago, Ill.

"American Machinist," Sept. 9, 1920

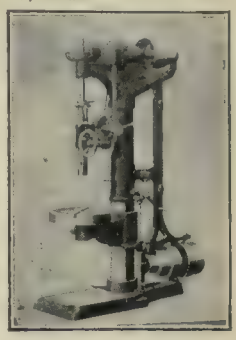


This generator is intended for use in oxy-acetylene welding, cutting and lead burning. It is of the medium-pressure, carbide-to-water type. The pressure in the generator is controlled by a spring in a diaphragm governor, which, operating in conjunction with the automatic feed, maintains a uniform pressure. No acetylene regulator is required in the service line unless a number of torches are being fed from it. A 15-lb. per-square-inch blowoff is provided. The levers for operating are interlocked so that it is necessary to follow the proper sequence of operations. It will run for five hours on one filling of carbide. It is made in four sizes; carbide capacities, 15, 25, 50 and 100 lb. respectively. Generating capacities respectively, 15, 25, 50 and 100 cu.ft. of gas per hour. The largest size will supply eight torches on medium-duty. Weights, from 140 to 350 lb.

Drilling Machines, Stationary-Head, 24-, 26- and 28-In.

Sibley Machine Co., South Bend, Ind.

"American Machinist," Sept. 9, 1920

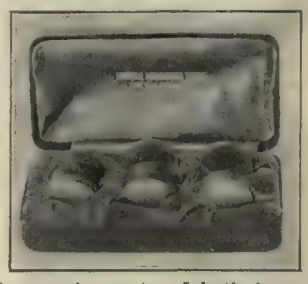


These machines are intended for production work. Specifications: Height, top of cone pulley, 86 in. Spindle to base, maximum, 44½ in. Spindle to table, maximum 27½ in. Traverse of table, 13 in. Travel of spindle, 12 in. Feed per rev. of spindle, 0.006, 0.010, 0.015 and 0.020 in. for 24-in. machine; 0.008, 0.012, 0.016 and 0.024 in. for 26- and 28-in. machines. Diameter of table, 21, 23 and 25 in. for 24-, 26- and 28-in. machines, respectively. Diameter of columns, 8 in. Hole in spindle, No. 4 Morse taper. Ratio of back gears, 4½ to 1. Speed of countershaft, 500 r.p.m. Spindle speeds, 29 to 495 r.p.m. for 24-in. machine; 26 to 403 r.p.m. for 26- and 28-in. machines. Floor space, 23 x 63 in. Weight; net, 1,600 lb. for 24-in. machine, 1,650 lb. for 26-in., and 1,700 lb. for 28-in.; boxed for export, 2,000, 2,050 and 2,100 lb., respectively. Size, boxed for export, 76 cu.ft.

Gages, Combination, Blocks, Reference

Van Keuren Co., 362 Cambridge St., Allston, Boston, Mass.

"American Machinist," Sept. 16, 1920

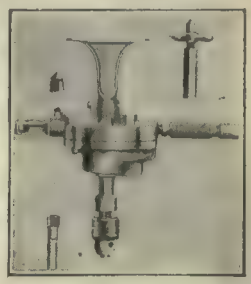


These sets of combination precision-gage blocks are intended as reference standards. It is said that the gages are made cylindrical to give the proper distribution of metal, so that temperature changes will affect the blocks uniformly. The gaging surfaces are lapped to a mirror finish, and the blocks are guaranteed to be correct in size, flatness and parallelism within 0.00001 in. of the nominal marked dimensions. The gages are standardized by light-wave measurement with standards certified by the National Bureau of Standards, and are arranged in various sets to meet the requirements of both large manufacturing concerns and individual mechanics. The set shown contains five sizes in the binary fractions of an inch; namley, 1, ½, ¼, ⅛ and $\frac{1}{16}$ in.

Drilling Machine, Pneumatic, Portable

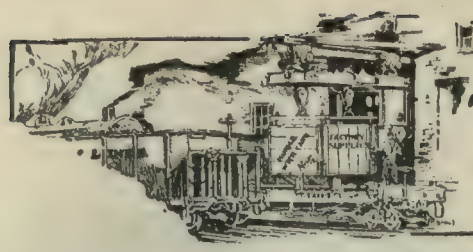
Turbine Air Tool Co., 710 Huron Road, Cleveland, Ohio.

"American Machinist," Sept. 16, 1920



The machine operates on the turbine principle; it will drill holes up to ½ in. in diameter in steel, and bore holes up to 1 in. in diameter in wood. It can be furnished with a screw feed, top point, breast plate and spade grip which are detachable and interchangeable, also screw chucks and No. 1 Morse taper socket. The housing and the turbine are made of aluminum, while nickel steel gears and vanadium steel pinions are employed. The weight is 9 lb. The air consumption is given as 20 cu.ft. per minute. The drill will operate on a pressure of 60 lb. per square inch, although maximum efficiency is obtained at 100 lb. The speed is controlled by a valve on the inlet.

Clip, paste on 3 x 5-in. cards and file as desired



THE WEEKLY PRICE GUIDE

IRON AND STEEL

PIG IRON—Quotations compiled by The Matthew Addy Co.:

CINCINNATI	Current	One Year Ago
No. 2 Southern	$45.60	$30.35
Northern Basic	51.30	27.55
Southern Ohio No. 2	47.80	28.55
NEW YORK—TIDEWATER DELIVERY		
2X Virginia (Silicon 2.25 to 2.75)	54.30	32.40
Southern No. 2 (Silicon 2.25 to 2.75)	49.70	36.20
BIRMINGHAM		
No. 2 Foundry	42.00@44.00	25.75
PHILADELPHIA		
Eastern Pa., No. 2x, 2.25-2.75 sil.	50.00	29.00–30.00
Virginia No. 2	50.00*	33.10
Basic	48.00†	26.75
Grey Forge	45.00*	26.75
CHICAGO		
No. 2 Foundry local	46.00	26.75
No. 2 Foundry, Southern	48.00	28.00
PITTSBURGH, INCLUDING FREIGHT CHARGE FROM VALLEY		
No. 2 Foundry	49.00	28.15
Basic	48.50	27.15
Bessemer	50.00	29.35
MONTREAL		
Silicon 2.25 to 2.75%	43.25	.....

* F.o.b. furnace. † Delivered.

STEEL SHAPES—The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses at the cities named:

	New York			Cleveland		Chicago	
	Current	One Month Ago	One Year Ago	Current	One Year Ago	Current	One Year Ago
Structural shapes	$4.58	$4.47	$3.47	$5.00	$3.37	$4.08	$3.47
Soft steel bars	4.73	4.62	3.37	4.50	3.27	3.98	3.37
Soft steel bar shapes	4.73	4.62	3.37	....	3.27	3.98	3.37
Soft steel bands	6.43	6.32	4.07	6.25	.....	.....	.....
Plates, ¼ to 1 in. thick	4.78	4.67	3.67	4.50	3.57	4.28	3.67

BAR IRON—Prices per 100 lb. at the places named are as follows:

	Current	One Year Ago
Mill, Pittsburgh	$4.25	$2.77
Warehouse, New York	4.57	3.37
Warehouse, Cleveland	3.52	3.27
Warehouse, Chicago	4.12	3.37

SHEETS—Quotations are in cents per pound in various cities from warehouse; also the base quotations from mill:

Blue Annealed	Large Mill Lots Pittsburgh	New York Current	New York One Year Ago	Cleveland	Chicago
No. 10	3.55–7.00	7.23@8.00	5.50	8.10	7.90
No. 12	3.60–7.05	7.28@8.05	5.40	8.15	7.95
No. 14	3.65–7.10	7.33@8.10	5.35	8.20	8.00
No. 16	3.75–7.20	7.43@8.20	5.30	8.30	8.10
Black					
Nos. 18 and 20	4.20–6.20	8.41@9.80	4.77	8.70	7.13
Nos. 22 and 24	4.25–6.25	8.46@9.85	4.67	8.75	7.18
No. 26	4.30–6.30	8.51@9.90	4.57	8.80	7.23
No. 28	4.35–6.35	8.61@10.00	6.75	8.90	7.33
Galvanized					
No. 10	4.70 8.00	8.91@11.50	6.45	9.00	8.25
No. 12	4.80 8.10	9.01@11.50	6.30	9.10	8.30
No. 14	4.80–8.10	9.01@11.60	6.30	9.10	8.45
Nos. 18 and 20	5.10–8.40	9.26@11.90	6.60	9.40	8.75
Nos. 22 and 24	5.25 8.55	9.41@12.05	6.75	9.55	9.15
No. 26	5.40 8.70	9.56@12.20	6.90	9.70	9.30
No. 28	5.70–9.00	9.86@12.50	7.20	10.00	9.60

Acute scarcity in sheets, particularly black, galvanized and No. 16 blue enameled. Automobile sheets are unavailable except in fugitive instances, when prices are 9.45c per lb. for No. 16; 9.50 for Nos. 18 and 20, and 9.55c for Nos. 22 and 24.

COLD FINISHED STEEL—Warehouse prices are as follows:

	New York	Chicago	Cleveland
Round shafting or screw stock, per 100 lb. base	$6.36	$5.90	$6.00
Flats, square and hexagons, per 100 lb. base	6.86	6.40	6.50

DRILL ROD—Discounts from list price are as follows at the places named:

	Per Cent.
New York	50
Cleveland	50
Chicago	50

NICKEL AND MONEL METAL—Base prices in cents per pound F. O. B. Bayonne, N. J.

Nickel	
Ingot and shot	43
Electrolytic	45

Monel Metal			
Shot and blocks	35	Hot rolled rods (base)	40
Ingots	38	Cold rolled rods (base)	56
Sheet bars	40	Hot rolled sheets (base)	55
Special Nickel and Alloys			
Malleable nickel ingots			42
Malleable nickel sheet bars			47
Hot rolled rods, Grades "A" and "C" (base)			60
Cold drawn rods, grades "A" and "C" (base)			72
Copper nickel ingots			45
Hot rolled copper nickel rods (base)			54
Manganese nickel hot rolled (base) rods "D" — low manganese			62
Manganese nickel hot rolled (base) rods "D"— high manganese			67

Domestic Welding Material (Swedish Analysis)—Welding wire in 100-lb lots sells as follows, f. o. b. New York: ⅛, 8½c. per lb.; ¼, 8c.; ⅝ to ½, 7½c Domestic iron sells at 12c. per lb.

MISCELLANEOUS STEEL—The following quotations in cents per pound are from warehouse at the places named:

	New York Current	Cleveland Current	Chicago Current
Openhearth spring steel (heavy)	7.00	8.00	9.15
Spring steel (light)	10.00	11.00	12.50
Coppered bessemer rods	9.00	8.00	6.86
Hoop steel	6.68	6.50	5.43
Cold-rolled strip steel	12.50	8.25	11.00
Floor plates	6.91	6.00	6.88

WROUGHT PIPE—The following discounts are to jobbers for carload lots on the Pittsburgh basing card:

BUTT WELD

Inches	Steel Black	Steel Galvanized	Inches	Iron Black	Iron Galvanized
¼ to 3	54–57½%	41½–44%	⅛	15½–25½%	+1½–11½%
			¼	19½–29½%	1½–11½%
			⅜ to 1½	24½–34½%	8 –18½%

LAP WELD

2	47 –50½%	34½–38%	1¼		
2½ to 6	50 –53½%	37½–41%	1½		
7 to 12	47 –50½%	33½–37%	2	20½–28½%	6½–14½%
13 to 14	37½–41 %		2½ to 6	22½–30½%	9½–17½%
15	35 –38½%		7 to 8	22½–30½%	9½–17½%
			9 to 12	19½–27½%	6½–14½%

BUTT WELD, EXTRA STRONG PLAIN ENDS

¾ to 1½	52 –55½%	39½–43%	¼ to 1½	24½–34½%	9½–19½%
2 to 3	53 –56½%	40½–44%			

LAP WELD, EXTRA STRONG PLAIN ENDS

2	45 –48½%	33½–37%	1¼		
2½ to 4	48 –51½%	36½–40%	1½		
4½ to 6	47 –50½%	35½–39%	2	21½–29½%	8½–16½%
7 to 8	43 –46½%	29½–33%	2½ to 4	23½–31½%	11½–19½%
9 to 12	38 –41½%	24½–28%	4½ to 6	22½–30½%	10½–18½%
			7 to 8	14½–22½%	2½–10½%
			9 to 12	9½–17½%	5½ +2½%

	New York Black	New York Galv.	Cleveland Black	Cleveland Galv.	Chicago Black	Chicago Galv.
¼ to 3 in. steel butt welded	38%	22%	39%	30%	54%40%	40½@30 %
2½ to 6 in. steel lap welded	33%	18%	41%	26%	50@40%	37½@27½%

Malleable fittings. Classes B and C, banded, from New York stock sell at plus 45%. Cast iron, standard sizes, plus 5%.

METALS

MISCELLANEOUS METALS—Present and past New York quotations in cents per pound, in carload lots:

	Current	Month Ago	Year Ago
Copper, electrolytic	18.50	19.00	22.50
Tin in 5-ton lots	44.50	49.00	56.50
Lead	8.50	9.50	6.25
Zinc	8.50	8.35	7.60
ST. LOUIS			
Lead	8.00	8.90	6.00
Zinc	7.70@8.05	7.70@8.40	7.15

At the places named, the following prices in cents per pound prevail, for 1 ton or more:

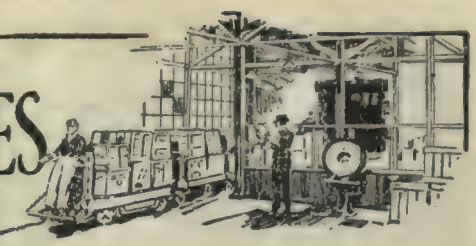
	New York Current	New York Month Ago	New York Year Ago	Cleveland Current	Cleveland Year Ago	Chicago Current	Chicago Year Ago
Copper sheets, base	29.50	33.50	33.50	34.00	35.50	36.00	36.50
Copper wire (carload lots)	31.25	31.25	30.75	29.00	30.50	29.00	25.00
Brass sheets	28.50	28.50	32.00	36.00	33.00	27.00	28.00
Brass pipe	33.00	33.00	36.00	34.00	39.00	34.00	37.00
Solder (half and half) (case lots)	35.00	33.00	45.00	40.50	41.00	38.00	41.00

Copper sheets quoted above hot rolled 16 oz., cold rolled 14 oz. and heavier, add 2c.; polished takes 5c. per sq.ft. extra for 20-in. widths and under; over 20 in., 7½c.

BRASS RODS—The following quotations are for large lots, mill. 100 lb. and over, warehouse; net extra:

	Current	One Year Ago
Mill	25.00	24.00
New York	27.00	28.00@29.75
Cleveland	27.00	29.00
Chicago	30.00	27.00

SHOP MATERIALS AND SUPPLIES



ZINC SHEETS—The following prices in cents per pound are f.o.b. mill + less 8% for carload lots..... 12.50

	Warehouse			
	In Casks		Broken Lots	
	Current	One Year Ago	Current	One Year Ago
Cleveland	15.30	12.50	14.70	13.00
New York	14.00	11.50	14.50	12.50
Chicago	15.00	16.50	15.00	16.00

ANTIMONY—Chinese and Japanese brands in cents per pound, in ton lots for spot delivery, duty paid:

	Current	One Year Ago
New York	7.25	9.50
Chicago	9.00	9.75

OLD METALS—The following are the dealers' purchasing prices in cents per pound:

	New York			
	Current	One Year Ago	Cleveland	Chicago
Copper, heavy, and crucible	15.00	17.00	14.00	15.00
Copper, heavy, and wire	14.00	16.00	13.50	14.50
Copper, light, and bottoms	12.50	14.00	12.00	13.00
Lead, heavy	7.00	4.75	7.00	7.00
Lead, tea	5.00	3.75	4.00	6.00
Brass, heavy	9.50	10.50	10.00	14.50
Brass, light	7.00	7.50	7.00	8.00
No. 1 yellow brass turnings	8.50	10.00	7.50	8.00
Zinc	5.00	5.00	4.50	5.50

ALUMINUM—The following prices are from warehouse at places named:

	New York	Cleveland	Chicago
No. 1 aluminum, 98 to 99% pure, in ingots for remelting (1-15 ton lots), per lb	$33.00	$33.00	$33.50

COPPER BARS—From warehouse sell as follows in cents per pound, for ton lots and over:

	Current	One Year Ago
New York (round)	38.00	33.00
Chicago	29.00	31.00
Cleveland	34.00	35.00

BABBITT METAL—Warehouse price per pound:

	New York		Cleveland		Chicago	
	Current	One Year Ago	Current	One Year Ago	Current	One Year Ago
Best grade	90.00	90.00	54.00	70.00	60.00	60.00
Commercial	50.00	50.50	20.50	16.50	15.00	13.00

SHOP SUPPLIES

NUTS—From warehouse at the places named, on fair-sized orders, the following amount is deducted from list:

	New York		Cleveland		Chicago	
	Current	One Year Ago	Current	One Year Ago	Current	One Year Ago
Hot pressed square	+ $6.00	$1.50	List net	$2.25	+1.15	1.85
Hot pressed hexagon	+ 6.00	1.50	List net	2.25	+1.15	1.85
Cold punched hexagon	+ 6.00	1.50	List net	2.25	+1.15	1.30
Cold punched square	+ 6.00	1.50	List net	2 25	+1.15	1.30

Semi-finished nuts, ⅞ and smaller, sell at the following discounts from list price:

	Current	One Year Ago
New York	30%	50-10%
Chicago	40%	50%
Cleveland	50%	60-10-10%

MACHINE BOLTS—Warehouse discounts in the following cities:

	New York	Cleveland	Chicago
½ by 4 in. and smaller	+ 20%	25%	20%
Larger and longer up to 1½ in. by 30 in.	+ 20%	25%	10%

WASHERS—From warehouses at the places named the following amount is deducted from list price:

For wrought-iron washers:
New York..... list Cleveland..... $2.00 Chicago..... $1.90
For cast-iron washers, ⅜ and larger, the base price per 100 lb. is as follows:
New York..... $7.00 Cleveland..... $4.50 Chicago..... $5.50

CARRIAGE BOLTS—From warehouses at the places named the following discounts from list are in effect:

	New York	Cleveland	Chicago
½ by 6 in. and smaller	+ 20%	25%	10%
Larger and longer up to 1 in. by 30 in.	+ 20%	20%	5%

COPPER RIVETS AND BURS sell at the following rate from warehouse:

	Rivets		Burs	
	Current	One Year Ago	Current	One Year Ago
Cleveland	20%	20%	10%	10%
Chicago	net	20%	net	20%
New York	25%	40%	net	20%

RIVETS—The following quotations are allowed for fair-sized orders from warehouse:

	New York	Cleveland	Chicago
Steel ⅞ and smaller	List Net	40%	30%
Tinned	List Net	40%	30%

Boiler, ¾, ⅞, 1 in. diameter by 2 to 5 in. sell as follows per 100 lb.:
New York..... $6.00 Chicago..... $5.73 Pittsburgh..... $4.5
Structural, same sizes:
New York..... $7.10 Chicago..... $5.83 Pittsburgh..... $4.60

MISCELLANEOUS

SEAMLESS DRAWN TUBING—The base price in cents per pound from warehouse in 100-lb. lots is as follows:

	New York	Cleveland	Chicago
Copper	$34 00	$36.00	$35.00
Brass	33.00	36.00	34.00

The prices, of course, vary with the quantity purchased. For lots of less than 100 lb., but not less than 75 lb., the advance is 1 c.; for lots of less than 75 lb., but not less than 50 lb., 2½c. over base (100-lb. lots); less than 50 lb., but not less than 25 lb., 5c. should be added to base price; quantities from 10-25 lb., extra is 10c.; less than 10 lb., add .15-20c.

Double above extras will be charged for angles, channels and sheet metal mouldings if ordered in above quantities. Above extras also apply to brass rod other than standard stock sizes—stock sizes being considered as ⅛-2 in. inclusive in rounds, and ⅛-1½ in., inclusive, in square and hexagon—all varying by thirty seconds up to 1 in. by sixteenths over 1 in. On shipments aggregating less than 100 lb., there is usually a boxing charge of $1.50.

LONG TERNE PLATE—In Chicago No. 28 primes from stock sell, nominally, for $12.50 per 100 lbs.

In Cleveland—$10 per 100 lbs.

COTTON WASTE—The following prices are in cents per pound:

	New York		Cleveland	Chicago
	Current	One Year Ago		
White	15.00@17.00	13.00	16.00	11.00 to 14.00
Colored mixed	9.00@14.00	9.00-12.00	12.00	9.50 to 12.00

WIPING CLOTHS—Jobbers' price per 1000 is as follows:

	13½x13½	13½x20½
Cleveland	55.00	65.00
Chicago	41.00	43.50

SAL SODA sells as follows per 100 lb.:

	Current	One Month Ago	One Year Ago
New York	$2.00	$2.00	$1.75
Philadelphia	2.75	2.75	1.75
Cleveland	3.00	3.00	2.75
Chicago	2.00	2.75	2.00

ROLL SULPHUR in 360-lb. bbl. sells as follows per 100 lb.:

	Current	One Month Ago	One Year Ago
New York	$3.90	$3.90	$3.65
Philadelphia	3.65	3.65	3.62
Chicago	4.10	5.00	4.12½

COKE—The following are prices per net ton at ovens, Connellsville:

	September 27	September 20	September 13
Prompt furnace	$17.00@$18.00	$17.00@$18.00	$17.00@$18.00
Prompt foundry	18.00@ 20.00	18.00@ 20.00	18.00@ 20.00

FIRE CLAY—The following prices prevail:

		Current
Ottawa, bulk in carloads	Per Ton	$8.00
Cleveland	100-lb. bag	1.00

LINSEED OIL—These prices are per gallon:

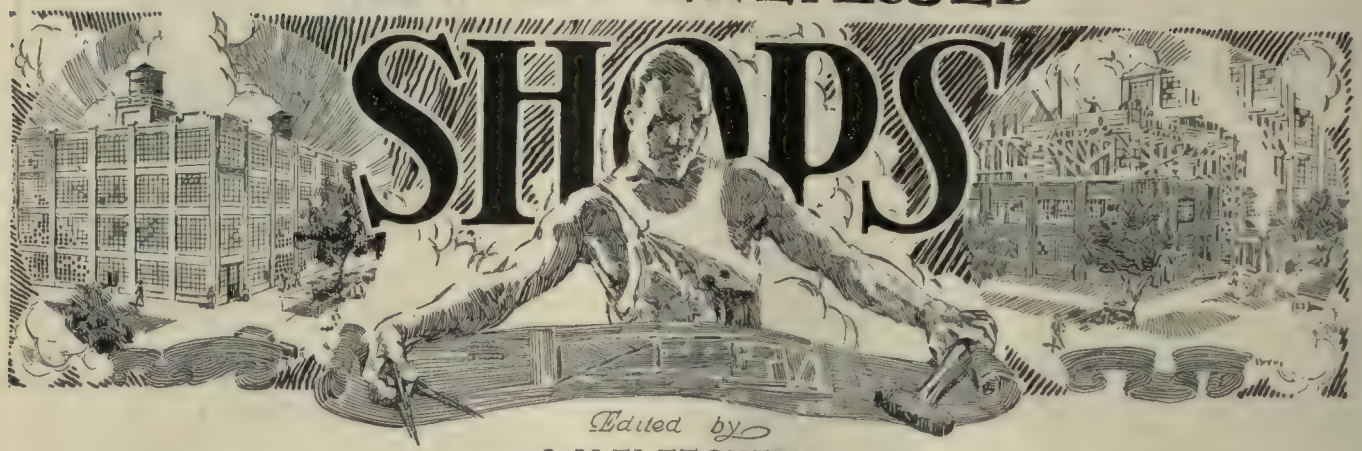
	New York		Cleveland		Chicago	
	Current	One Year Ago	Current	One Year Ago	Current	One Year Ago
Raw in barrels, (5 bbl. lots	$1.25	$2.15	$1.55	$2.50	$1.40	$2.37
5-gal cans	1.40	2.30	1.75	2.75	1.65	2.57
1-gal cans (6 to case)	1.45	....	....	....	....	....

WHITE AND RED LEAD—Base price per pound:

	Red				White	
	Current		One Year Ago		One Year Ago	
	Dry	In Oil	Dry	In Oil	Dry and In Oil	Dry and In Oil
100 lb. keg	15.50	17.00	13.00	14.50	15.50	13 00
25 and 50-lb. kegs	15.75	17.25	13.25	14.75	15.75	13 25
12½-lb. keg	16.00	17.50	13.50	15.00	16.00	13.50
5-lb. cans	18 50	20 00	15.00	16.50	18.50	15.00
1-lb. cans	20.50	22.00	16 00	17.50	20.50	16.00

500 lb. lots less 10% discount 2000 lb. lots less 10-2½% discount.

NEW and ENLARGED



Edited by
L·V·FLETCHER

Machine Tools Wanted

If in need of machine tools send us a list for publication in this column

Conn., West Hartford (Hartford P. O.)—The Hartford Tube Products Co., Elmwood Ave.—punch press, ¾ in capacity, 4 in. pipe machinery and shears, ¾ in. capacity.

Md., Baltimore—The Supt. of Lighthouses—3 step cone double back geared engine lathes for machine shop.

N. Y., New York (Borough of Manhattan)—The Amer. Book Bindery, 406 West 31st St.—one Cleveland drill.

N. Y., New York (Borough of Manhattan)—The Amer. Brake Shoe and Fdry. Co., 30 Church St.—punches, drill presses, engine lathe, boring machine and riveting machine.

N. Y., Buffalo—The Buffalo Fdry. & Machine Co., 1543 Fillmore Ave.—miscellaneous equipment for pattern shop.

N. Y., Buffalo—The Martin Sheet Metal Wks., 878 Hertel Ave.—one stove pipe folder.

N. Y., Buffalo—L. Michael & Co., 560 Elk St.—acetylene cutter.

N. Y., Buffalo—The Pengot Co. of Amer., Colgate and Hopkins Sts., D. W. Healy, Iroquois Hotel, Purch. Agt.—equipment for automobile plant.

N. Y., Rochester—The Alent Machine Tool Co., 479 St. Paul St., N. Alent, Mgr.—one 8 ft. planer.

N. Y., Rochester—The Harrison Machine Co., 144 and 146 Platt St., J. Harrison, Purch. Agt.—one 42 in. lathe and one 16 in. lathe.

N. Y., Rochester—The Hauser Machine Co., 245 Mill St., L. Hauser, Purch. Agt.—one 32 in. lathe.

N. Y., Rochester—G. C. Humbert, 301-303 Cornwall Bldg., manufacturer of jewelry—die sinker's tool with flexible shaft, controlled by hand.

N. Y., Rochester—The Kneeland Co., Inc., Lincoln Park, L. W. Kneeland, Purch. Agt.—medium size brazing machine.

N. Y., Summerville—S. Ban, Stop 26—small power lathe.

N. Y., Syracuse—The Bd. of Educ., c/o Bd. Contract and Supply—complete equipment for machine shop at Continuation School, including engine lathes, milling machines, shapers, bench grinders and bench tools. About $5,000 available for above equipment. No date set for close of bids.

N. Y., Utica—The Eureka Mower Co., 1005 Hickory St.—one 18 in. lathe.

Pa., Bradford—The Cyclone Brush Co., 106 Elm St.—various screw machines.

Pa., Philadelphia—Morton & Murphy, 841 South 51st St.—bench lathe.

Pa., Philadelphia—The Tioga Iron and Steel Co., 52d and Gray Sts.—machine tools.

Pa., Pittsburgh—The National Casket Co., Reedsdale St.—miscellaneous machine tools.

Pa., Williamsport—J. A. Shoemaker, Chn. Supply Com., Williamsport School Bd.—
One 26 in. x 26 in. x 8 ft. electric driven planer.
One 16 in. shaper.
One No. 2 electric driven universal milling machine.
One 24 in. electric driven drill press.
One 1 ton portable crane.
One No. 4 Arbor press.
One 15 hp. motor.
Miscellaneous equipment, including hangers, line shafting, pulleys, chucks and small tools for machine shop.

Va., Richmond—P. H. Blaska, 908 Louisanna St.—small speed lathe.

Va., Richmond—J. E. Childress, 306 Louisanna St.—cornice machine.

Va., Richmond—A. S. Kellam, 18 East Broad St.—small machine lathe (new or used).

Va., Richmond—The Kersey & Co., Williamsburg Ave. and Denney Sts.—mechanical outfit for repairing automobiles.

Va., Richmond—G. B. Mrock, R. F. D. No. 5—18 to 24 in. lathe, short bed preferred (new or used).

Va., Richmond—Viaduct Motor Co., J. S. Savage, Purch. Agt.—tire rim stretcher and gear press.

Va., Richmond—L. M. Walton, 514 Louisanna St.—mechanical outfit for repairing automobiles.

Ill., Chicago—The Ford Roofing Products Co., 520 Conway Bldg.—one lathe, 16 in. center to center, 36 in. swing roll clear of tool carriage.

Ill., Chicago—The Illinois Felt Co., 2501 West 48th St.—machine tool equipment for making automobile seats.

Ill., Chicago—The Parisian Novelty Co., 151 West 22d St.—squaring shear 36 in. for 18 in. gage.

Ill., Chicago—The Unity Equipment Co., 127 North Dearborn St.—double head bolt threader for ⅜ and ⅞ in. bolts.

Ill., Mendota—Black Bros. Co.—one small bench centering machine, 2½ in. round capacity.

Ill., Peoria—The Bartholomew Co.—3 spindle high duty drill press, with compound table, capacity up to 2 in.

Mich., Detroit—The Detroit Municipal St. Ry. Comn., c/o G. J. Finn, Comr. Purchases and Supplies, Municipal Courts Bldg.—one track welding machine and equipment for welding street railway rails.

Mich., Port Huron—The Great Lakes Fdry. Co., Moar St.—miscellaneous foundry equipment.

O., Cincinnati—The Howe Auto Jack Co., 1520 Race St., J. C. Howe, Purch. Agt.—machine tools, including lathe, drill press and threading machine.

O., Cleveland—The Sterling-Knight Co., Ajax Bldg.—No. 2 Cincinnati or Brown & Sharpe Universal miller with dividing head and all attachments (used).

O., Cleveland—The Waite Taxi and Livery Co., H. F. Hauserman, 1618 Walnut Ave.—one 16 in. x 8 ft. lathe and 16 in. drill press (used).

O., Columbus—The Hayden Automobile Block Machine Co., 891 Michigan Ave.—C. H. Minor, Supt.—additional equipment.

O., Fostoria—The Fostoria Building Supply Co.—
One 48 in. brake.
One 48 in. roller.
One shear.
One ¾ in. beader.
One large hammer.
One welding outfit.

Wis., Fond du Lac—The Bd. of Educ., c/o A. M. Hunter, Secy.—tools and machinery for vocational school machine shop.

Wis., Milwaukee—The Liberty Vulcanizer Mfg. Co., 656 Madison St.—milling machine and lathe.

Wis., Milwaukee—The Milwaukee Tank Wks., Fratney and Becker Sts.—one set 74 in. bending rolls of ⅝ in. capacity, diam. top roll 7 in., lower roll 6¼ in. (new).

Wis., Milwaukee—The Nissen Mfg. Co., 223 Reed St., C. Nissen, Purch. Agt.—drill press.

Wis., Milwaukee—Ramstock & Sons Mfg. Co., 1826 Brown St., F. Ramstock, Purch. Agt.—automatic screw machine.

Wis., Milwaukee—The Res Mfg. Co., 2907 Meinecke Ave., A. Kaufman, Purch. Agt.—punch presses.

Tex., Dallas—The School Bd., C. M. Moore, Secy.—manual training equipment.

Ont., Toronto—Wilson-McGovern, Ltd., Lumsden Bldg.—56 in. or 60 in. x 160 in. grinder for grinding hot mill shear blades.

Machinery Wanted

Md., Baltimore—The Maryland Equipment & Supply Co., Equitable Bldg., H. G. Clark, Purch. Agt.—15 ton locomotive crane with 52 in. magnet and 50 ft. boom, also 7 x 10 Ledgewood or Munday double cylinder with drum (used).

N. Y., New York (Borough of Manhattan)—The Coin Device and Signal Co., Inc., 409 8th Ave.—mach. catalogs on supplies and general equipment.

Pa., Philadelphia—J. F. Shellenberger, Front and Race Sts.—machinery for the manufacture of confectionery.

Va., Richmond—A. Meyer & Son, 114 South 8th St., A. Meyer, Purch. Agt.—one small wood planer (new or used).

Mich., Detroit—The Dept. of Buildings and Safety Engineering, c/o G. J. Finn, Comr. of Purchases and Supplies, Municipal Courts Bldg.—300,000 lb. testing machine for testing structural materials in laboratory of Dept. of Buildings and Safety Engineering.

Wis., Janesville—The Parker Pen Co., East Milwaukee and North Bluff Sts.—oil extractor for removing oil from hard rubber shavings.

Wis., Kenosha—The Morse Granite Co., 310 Church St.—traveling crane.

Wis., Seymour — The Seymour Woodenware Co.—woodworking machinery.

Ariz., Douglas — The Arizona Carpentry and Cabinet Co., 634-40 13th St. — Pony planer and two-slide 12 in. sticker (first class condition, second-hand machinery preferred).

Man., Weston—The Owl Metal Co.—$6,000 worth of machinery.

Ont., Brigden — The Brigden Printing Press—machinery.

Ont., Courtland—I. M. Howe—equipment for sawmill.

Ont., Tilbury—The Tilbury Auto Truck Co.—iron working machinery.

Ont., Timmins—D. Strong—planing mill equipment.

Que., Tartigon—The B. & S. Lumber Co., Fort Plain—machinery.

Metal Working

NEW ENGLAND STATES

Conn., Hartford—M. Delaney, 1075 Main St., plans to build a 1 story, 75 x 100 ft. garage on Albany Ave. Estimated cost, $30,000. F. C. Walz, 407 Trumbull St., Archt.

Conn., Hartford — The Dell Service Station, 266 Wethersfield Ave., will soon award the contract for the construction of a 1 story, 70 x 140 ft. addition to its garage. Estimated cost, $30,000.

Conn., Hartford—A. Goldstein, 593 Windsor St., will build a 1 story, 100 x 110 ft. garage on Maple Ave. Estimated cost, $75,000. Noted Aug. 12.

Conn., Union City (Naugatuck P. O.)—The Eastern Malleable Iron Co. has awarded dthe contract for altering and building additions to its plant. Estimated cost, $50,000.

Conn., West Hartford (Hartford P. O.)—The Hartford Tube Products Co. has awarded the contract for the construction of a 1 story factory with 2 wings, one 30 x 90 ft. and other 30 x 100 ft., on Elmwood St. Estimated cost, $15,000.

Mass., Attleboro—C. L. Rogers, 157 So. Main St., has awarded the contrac for the construction of a 1 story, 60 x 200 ft. garage on Wall St. Estimated cost, $50,000.

Mass., Lawrence—C. W. Dillon, 17 Oxford St., has awarded the contract for the construction of a 1 story addition to his garage. Estimated cost, $10,000. Noted Sept. 9.

Mass., New Bedford — A. Chervais, 54 Sycamore St., will soon award the contract for the construction of a 1 story garage. Estimated cost, $20,000. Private plans.

Mass., New Bedford—E. Colbec, 137 Tinkham St., plans to build a 1 story, 65 x 100 ft. garage, etc., on Bowditch St. Cost between $20,000 and $25,000. O. Crapo, 514 Bowditch St., Archt.

Mass., Springfield—A. Freedman, c/o B. E. Geckler, Archt., 335 St. James Ave., will soon award the contract for the construction of a 1 story, 50 x 60 x 100 ft. garage on Summer Ave. Estimated cost, $35,000.

Mass., Springfield — J. G. Schwenger, 34 Summer Ave., has awarded the contract for the construction of a 1 story garage. Estimated cost, $10,000.

Mass., Whitinsville—The Whitin Machine Wks. plans to build a 4 story, 75 x 200 ft. garage, etc. Estimated cost, $150,000. J. D. Leland, 185 Devonshire St., Boston, Archt.

Mass., Worcester — J. Kennedy, 3 Wentworth St., has awarded the contract for the construction of a 1 story garage, etc., on Portland St. Estimated cost, $25,000.

Mass., Worcester — J. Rice, Archt., 306 Main St., is preparing plans for a 2 story, 150 x 180 ft. garage on Pleasant St. Estimated cost, $200,000.

R. I., Providence — The Diamond Land Co., 425 Fountain St., has awarded the contract for the construction of a 1 story addition to its garage on Battery St. Estimated cost, $25,000.

R. I., Providence—W. H. Farrell, Lockwood and Haskins Sts., will soon award the contract for the construction of a 1 story garage and service station. Cost between $12,000 and $15,000.

R. I., Providence—R. T. Slade, 547 Elmwood Ave., has awarded the contract for the construction of a 1 story addition to his garage. Estimated cost, $50,000. Noted Sept. 23.

MIDDLE ATLANTIC STATES

Md., South Baltimore (Baltimore P. O.)—The Baltimore Malleable Iron & Steel Castings Co., Charles and Wells Sts., plans to build additional blast furnaces and install other equipment. Estimated cost, $100,000.

Md., Baltimore — The Del-Mar-Va-Nash-Motors Co., 134 West Mt. Royal Ave., will soon award the contract for the construction of a 3 story, 60 x 150 ft. sales and service station on Maryland Ave. and Oliver St. Estimated cost, $200,000.

N. J., Newark—The Ellis Motor Car Co., 416 Central Ave., has awarded the contract for the construction of a 1 story, 75 x 203 ft. garage on North 6th St. and 1st Ave.

N. Y., New York (Borough of Bronx)—Rubin and Cohn, 406 East 149th St., will build a 1 story, 150 x 220 ft. garage on Jerome Ave. Estimated cost, $50,000.

N. Y., New York (Borough of Brooklyn)—F. B. Lynch, 1049 Washington Ave., will build a 1 story, 100 x 125 ft. garage on Montgomery St. Estimated cost, $60,000.

N. Y., New York (Borough of Brooklyn)—M. Moskowitz, c/o J. M. Felson, Archt. and Engr., 1133 Bway., will build a 1 story, 50 x 100 ft. garage on 12th St. Estimated cost, $50,000.

N. Y., New York (Borough of Brooklyn)—J. Siris, 206 Bway., will build a 1 story garage on Nostrand and Willoughby Aves. Estimated cost, $35,000.

N. Y., New York (Borough of Manhattan)—J. Bernstein, 1430 Madison Ave., will build a 1 story, 100 x 165 ft. garage on Boston Post Rd. Estimated cost, $75,000.

N. Y., New York (Borough of Manhattan)—The Coin Device & Signal Co., Inc., 409 8th Ave., plans to enlarge its factory.

N. Y., New York (Borough of Manhattan)—J. Ruppert, Inc., 1639 3d Ave., is having plans prepared for the construction of a 2 story, 50 x 200 ft. auto repair shop at 243 East 90th St. Estimated cost, $50,000. Maynecke & Franke, 25 East 26th St., Engrs. and Archts.

N. Y., New York (Borough of Manhattan)—The Transit Comn., 49 Lafayette St., will soon award the contract for the construction of additional shops at Lenox Ave. and 148th St. yards.

N. Y., New York (Borough of Manhattan)—J. Zimmerman, 557 East 160th St., will build a 1 story, 100 x 130 ft. garage on Fordham Rd. Estimated cost, $50,000.

N. Y., Buffalo—The Amer. Car & Fdry. Co., 370 Babcock St., has awarded the contract for the construction of a 2 story, 35 x 46 x 74 ft. addition to its factory. Estimated cost, $40,000.

N. Y., Buffalo—The Buffalo Fdry. & Machine Co., 1543 Fillmore Ave., has awarded the contract for the construction of a 2 story, 50 x 70 ft. pattern shop. Estimated cost, $25,000.

Pa., Tabor (Philadelphia P. O.)—The Fox Motor Car Co., Broad and Huntingdon Ave., has awarded the contract for the construction of a 3 story, 60 x 400 ft. automobile plant on Grange Ave. along tracks of Reading R.R. Estimated cost, $500,000.

Pa., Reading—The Gray Iron Fdry. Co. is building a 60 x 360 ft. factory for the manufacture of "Keystone" concrete machinery.

MIDDLE WEST

Ind., Marion—The Marion Insulated Wire & Rubber Co. is building a 30 x 50 ft. rubber insulated wire plant. J. F. Auten, Gen. Mgr.

Mich., Detroit—The Blodgett Engineering and Tool Co., Kerr Bldg., has awarded the contract for the construction of a 4 story factory on Dalzelle St. Noted Aug. 19.

Mich., Marysville—The Aluminum Castings Co., 2800 Harvard Ave., Cleveland, Ohio, plans to build a 2 story factory here. Estimated cost, $75,000. E. E. Allyne, Pres. Private plans.

Mich., Port Huron — The Great Lakes Fdry. Co., Moar St., has awarded the contract for the construction of a 1 story, 50 x 95 ft. foundry. Estimated cost, $15,000.

O., Cleveland — The Fageol Motors Co., c/o S. Regar, of Chandler Motor Co., East 131st St. and St. Clair Ave., plans to build a 3 story factory. Estimated cost, $200,000.

O., Cleveland — The Natl. Refining Co., Rose Bldg., has awarded the contract for the construction of a 1 story, 60 x 121 ft. machine shop and service building at 3330 East 87th St. Estimated cost, $30,000.

O., Dayton—The Central Motor Co., Main and Apple Sts., plans to build a 2 story, 80 x 145 ft. factory on 3d and Horace Sts. Estimated cost, $100,000.

Wis., Cedarburg — The Auto-Life Chain Co., c/o F. Hoya, 231 37th St., Milwaukee, has awarded the contract for the construction of a 1 story, 60 x 120 ft. factory on Main St. here for the manufacture of tire chains. Estimated cost, $50,000.

Wis., Fond du Lac — The Bd. of Educ., c/o A. M. Hunter, Secy., will soon award the contract for the construction of a 3 story, 66 x 261 ft. senior-junior high school, to contain a machine shop. Estimated cost, $500,000.

Wis., Kenosha—City will soon award the contract for the construction of a 1 story, 60 x 107 ft. garage on Strong St.

Wis., Kohler—The Kohler Co. will build a 3 story, 62 x 148 ft. factory and foundry.

Wis., Manitowoc—The Clark Oil Co., 10th St., has awarded the contract for the construction of a 1 story, 60 x 100 ft. garage, filling station, etc., on 10th and York Sts. Estimated cost, $100,000. Noted Aug. 19.

Wis., Milwaukee—The Natl. Brake and Electric Co., Belleview Pl., has awarded the contract for the construction of a 1 story, 164 x 180 ft. addition to its foundry. Estimated cost, $250,000. Noted May 6.

Wis., Neillsville—The Neillsville Auto Co. will soon award the contract for the construction of a 1 story, 90 x 120 ft. garage. Balch & Lippert, Madison, Archts.

WEST OF THE MISSISSIPPI

Kan., Columbus—Cherokee County plans election to vote on $60,000 bonds to build and equip a machine shop addition to high school. G. Cooper, County Engr.

Kan., Topeka — The Topeka Fdry. and Iron Co., 318-22 Jackson St., plans to construct a foundry, machine shop and structural shops. Estimated cost, $100,000.

Kan., Wichita—The Wichita Clear Vision Pump Co., 1107 East Douglas Ave., plans to build a 70 x 320 ft. gasoline pump factory on Harry St. between Mosley and Mead Aves. Estimated cost, $500,000. E. Crouse, Pres.

Kan., Wichita—The Wichita Visible Gasoline Pump Co., 701-15 Gilbert St., plans to construct a pump plant, to include a complete machine shop and tank construction building. Estimated cost, $100,000. R. A. Jacobs, Pres.

Minn., Buffalo—E. T. Schmidt plans to build a 1 story, 60 x 95 ft. garage. Estimated cost, $20,000. Graham & Swain, 1227 Plymouth Bldg., Minneapolis, Archts.

Minn., Northfield—Melounek & Machacek are building a 1 story, 40 x 150 ft. foundry and machine shop on North Water St.

Mo., Springfield—The Wood Everett Stove Co. plans to build a 2 story foundry. Estimated cost, $100,000.

S. D., Woorsocket—Staake Bros., Mitchell, plan to build a 1 story, 50 x 142 ft. garage here. Estimated cost, $20,000. H. C. Gabele, Mitchell, Archt.

CANADA

Ont., London—The London Concrete Machinery Co., Cabell Ave., will soon award the contract for the construction of a 3 story, 70 x 100 ft. factory. Estimated cost, $100,000. Private plans.

Ont., Tilbury—The Tilbury Auto Truck Co. will soon award the contract for the construction of a 3 story, 60 x 135 ft. factory. Estimated cost, $80,000.

Que., Montreal — The Canada Motor and Machinery Co., Laganchitiere St., has awarded the contract for the construction of a garage and repair shop. Estimated cost, $42,000.

Que., Montreal — T. Davidson Mfg. Co., Deslisle St., manufacturers of tinware, plans to build a 4 story, brick and steel extension on Deslisle, Workman and Albert Sts.

General Manufacturing

NEW ENGLAND STATES

Conn., Bridgeport—The La Resista Corset Co., 32 Norman St., will build a 1 story garage. Estimated cost, $10,000.

Conn., Newtown—H. Curtiss & Sons Co., Sandy Hook, will soon award the contract for the construction of a 1 story, 30 x 40 ft. and a 1 story, 50 x 80 ft. factory, with 30 x 40 ft. ell, on Foot Rd. for the manufacture of paper boxes. Estimated cost, $30,000. Sunderland & Watson, 248 Main St., Danbury, Archts. Noted Sept. 2.

Conn., Versailles—The Versailles Sanitary Fibre Mills has awarded the contract for the construction of an addition to its paper factory. Estimated cost, $100,000.

Conn., Waterbury—The Waterbury Lumber Co., Inc., 107 Meadow St., has awarded the contract for the construction of additions to its plant. Estimated cost, $50,000.

Maine, Lisbon Falls—The Worumbo Mfg. Co. plans to build an addition to its textile factory. Estimated cost, $100,000.

Maine, Waterville—The Keyes Fibre Co. has awarded the contract for the construction of a 1 story paper factory. Estimated cost, $100,000.

Mass., Boston—S. Simmonds, 21 Bromfield St., will build a 2 story, 26 x 50 ft. factory on Washington St. for the manufacture of wool. Estimated cost, $15,000.

Mass., Cherry Valley (Leicester P. O.)—The Chapel Mills Mfg. Co. has awarded the contract for the construction of a 2 story, 43 x 112 ft. factory for the manufacture of flannels. Estimated cost, $50,000.

Mass., East Pepperell—The Nashua River Paper Co. plans to build an addition to its plant. Estimated cost, $100,000.

Mass., Fall River — The Amer. Printing Co., 56 Water St., will construct a 2 story, 80 x 87 ft. cloth building on Water St. Estimated cost, $50,000.

Mass., Holyoke — The Perfect Safety Paper Co., Winter St., plans to build a 60 x 100 ft. addition to its paper factory on Appleton and Winter Sts. Cost between $75,000 and $100,000. Howes & Howes, 243 High St., Archts.

Mass., Norwood — The Holliston Mills, Lenox Ave., has awarded the contract for the construction of a 2 story, 136 x 280 ft. textile factory and 1 story, 50 x 70 ft. boiler house. Estimated cost, $300,000. Noted Sept. 9.

Mass., South Barre — The Barre Wool Combing Co. has awarded the contract for the construction of a wool factory. Estimated cost, $50,000.

N. H., Salem — C. O. Siegert, 12 White St., Haverhill, Mass., plans to build a 1 and 2 story, 50 x 100 ft. bottling plant here. Estimated cost, $25,000. J. E. Allen, 283 Essex St., Lawrence, Mass., Archt.

R. I., Pawtucket — The Hope Webbing Co., 1005 Main St., will soon award the contract for the construction of a 1 story addition to its textile mill. Estimated cost, $100,000. Perry & Whipple, Rhode Island Hospital Trust Bldg., Providence, Engrs. and Archts.

Vt., Northfield—The Northfield Creamery has awarded the contract for the construction of a 2 story, 55 x 62 ft. creamery. Estimated cost, $25,000.

MIDDLE ATLANTIC STATES

Del., Wilmington—The Wilmington Sugar Refinery Co. plans to build a refinery. Estimated cost, $2,000,000. W. Higginson, 18 East 41st St., New York City, Engr. and Archt.

Md., Baltimore — The U. S. Printing & Lithographing Co., 429 East Cross St., has awarded the contract for the construction of a 3 story, 128 x 129 ft. addition to its plant on Cross and Covington Sts. Estimated cost, $150,000.

N. J., Hoboken — The Chocolate Mainer, 1127 Clinton St., will build a 2 story factory. Estimated cost, $100,000. Noted Aug. 16.

N. Y., Lockport—The Lockport Felt Co. has awarded the contract for the construction of a 1 story, 80 x 200 ft. factory. Estimated cost, $80,000.

Pa., Philadelphia — E. Hubschman, Orianna and Willow Sts., has awarded the contract for the construction of a 1 story, 60 x 90 ft. addition to its leather factory. Noted July 27.

Pa., Philadelphia — McIlvain Bros., 15th and Hamilton Sts., will soon award the contract for altering their drug factory.

Pa., Philadelphia — Rinald Bros., 1142 Hancock St., have awarded the contract for the construction of a 2 story, 46 x 55 ft. varnish factory on Grove and Wharton Sts. Noted Sept. 16.

Pa., Philadelphia — J. F. Shellenberger, Front and Race Sts., will soon award the contract for the construction of a 5 story, 57 x 66 ft. confectionery factory at 107 Race St. A. B. Lacey, 1012 Walnut St., Archt.

Pa., Pittsburgh — The Rieck McJunkins Co., 1345 Forbes St., has awarded the contract for the construction of a 4 story, 30 x 100 ft. dairy on Stevenson and Forbes Aves. Estimated cost, $100,000.

Pa., Pittsburgh—The Weinstein Beverage Co., 646 5th Ave., has awarded the contract for the construction of a 3 story, 48 x 110 ft. warehouse and factory on Hamilton Ave. Estimated cost, $100,000.

SOUTHERN STATES

La., Pontchatoula—The Universal Folding Crate Co., Inc., 601 Bourbon St., New Orleans, is having plans prepared for the construction of a 2 story, 50 x 100 ft. factory here for the manufacture of folding crates and boxes. Estimated cost, $30,000. J. J. Dahlstrom, Vice-Pres. and Archt.

MIDDLE WEST

Mich., Detroit — The Consolidated Cigar Co., St. Aubin Ave., has had plans prepared for the construction of a 3 story, 92 x 100 ft. cigar factory. Estimated cost, $90,000. A. Kahn, Marquette Bldg., Archt.

Mich., Ontonagon — The Northern Fibre Co. has awarded the contract for the construction of a 2 story pulp mill. Estimated cost, $350,000.

O., Akron—The Miller Rubber Co., South High St., will build a 3 story, 60 x 210 ft. factory. Estimated cost, $100,000. J. A. Stevens Co., Frederick Bldg., Cleveland, Engrs. and Archts.

O., Cleveland—Aetna Provision Co., c/o Best & Hoefer, Archts., Vickers Bldg., is having plans prepared for the construction of a 2 story, 36 x 76 ft. factory on Aetna Rd. Estimated cost, $30,000.

O., Cleveland — The Peerless Motor Car Co., East 93d St. and Quincy Ave., plans to construct a 1 story, 60 x 100 ft. japaning building. Estimated cost, $100,000.

O., Lorain — J. C. Newman Cigar Co., 3830 Woodland Ave., Cleveland, has awarded the contract for the construction of a 3 story, 30 x 62 ft. addition to its factory here. Estimated cost, $30,000.

O., Toledo—The Maumee Tire and Rubber Co., 705 Madison Ave., is having plans prepared for the construction of a 3 story, 100 x 300 ft. rubber tire factory on Lackey Rd. Estimated cost, $300,000. S. S. Morrison, Pres. Osborn Eng. Co., 2848 Prospect Ave., Cleveland, Engrs. and Archts.

Wis., Fond du Lac—The Fountain City Ice Cream Co., 218 South Main St., is having plans prepared for a 2 story, 60 x 180 ft. dairy plant on Division St. Estimated cost, $80,000. B. E. Mehner, 6 East Division St., Archt.

Wis., Marathon — The Wausau Canning Co., Wausau, plans to build a 4 story canning factory on Main St. here. Estimated cost, $50,000.

Wis., Merton—The Merton Dairy Products Mfg. Co. has awarded the contract for the construction of a 2 story, 30 x 200 ft. dairy products factory on Main St. Estimated cost, $30,000. Noted Sept. 23.

Wis., Muscoda—The Muscoda Mfg. Co. will soon award the contract for the construction of a 2 story, 75 x 100 ft. furniture factory on Main St. Estimated cost, $50,000. Noted April 22.

Wis., Sheboygan—The Columbia Rubber Mills, 176 16th St., has awarded the contract for the construction of a 2 story, 60 and 70 x 100 ft. factory. Estimated cost, $60,000. Noted Aug. 19.

Wis., West Bend — The Schmidt & Storck Wagon Co. will soon award the contract for the construction of 1 story, 100 x 300 ft. factory. Buemming & Guth, 521 Jackson St., Milwaukee, Archts. Noted Sept. 16.

WEST OF THE MISSISSIPPI

Kan., Chanute—The Mutual Oil Co., Mutual Bldg., Kansas City, Mo., will build a 3 story, 35 x 90 ft. wax and lubricating oil plant here to replace one which was recently destroyed by fire. Estimated cost, $100,000.

Minn., Hamline — The Minnesota State Agricultural Society, c/o T. Canfield, Secy., Como Ave. near Snelling Ave., St. Paul, Minn., plans to build a 2 story addition to its dairy on State Fair Grounds here. Estimated cost, $200,000. C. H. Johnston, 715 Capitol Bank Bldg., St. Paul, Archt.

Mo., St. Louis—The Scott Dyeing and Cleaning Co., 3928 Olive St., is having plans prepared for the construction of a 2 story, 58 x 160 ft. cleaning plant. Estimated cost, $50,000. H. P. Hess, 4811 Cote Brilliante Ave., Archt.

Mo., Webb City—The Rock Paint & Cloth Co. is having plans prepared for the construction of a 2 story, 61 x 150 ft. paint factory. Estimated cost, $150,000. Bucy-Miller Eng. Co., Joplin, Mo., Engrs.

Iowa, Cedar Rapids—The Dysort Nickol Candy Co. has awarded the contract for the construction of a 3 story, 40 x 70 ft. factory. Estimated cost, $30,000.

Minn., Minneapolis — The Franklin Co-operative Creamery Co., c/o E. Solem, 11½ Western Ave., will build a 1 story, 64 x 85 ft. creamery on 26th St. and Franklin Ave. Estimated cost, $50,000.

N. D., Minot—The Minot Steam Laundry plans to build a 2 story, 87 x 140 ft. steam laundry. Estimated cost, $85,000.

Okla., Daugherty—The Continental Asphalt & Refining Co., Oklahoma City, will build a refinery here. Estimated cost, $1,000,000.

Tex., Dallas—The School Bd. will soon award the contract for the construction of a 3 story high school on Haskell and McKinney Sts. to contain a manual training department. Estimated cost, $600,000. C. M. Moore, Secy. W. B. Ittner, Bd. of Educ. Bldg., St. Louis, Mo., Archt.

WESTERN STATES

Cal., San Francisco—The Federal Rubber Co., Cudahy, Wis., will soon award the contract for the construction of a 5 story factory here for the manufacture of tires, etc.

CANADA

B. C., Howe Sound—The Western Canada Pulp & Paper Co. will soon award the contract for the construction of a plant for the manufacture of lumber, shingles and wood products.

Ont., Courtland — I. M. Howe plans to build a sawmill.

Ont., Ottawa — The Ottawa Paint Wks., 687 Wellington St., has awarded the contract for the construction of a 3 story factory. Estimated cost, $50,000.

Ont., Stratford—The Kindel Bed Co., Ontario St., has awarded the contract for the construction of a 3 story furniture factory. Estimated cost, $30,000.

Que., Montreal—The National Drug and Chemical Co., 34 St. Paul Ave., has awarded the contract for the construction of a factory on De Courcelles St. Estimated cost, $75,000. Noted July 1.

Que., Montreal—The Rena Footwear Co., Ltd., 611 Beaudry St., plans to build an addition to its plant.

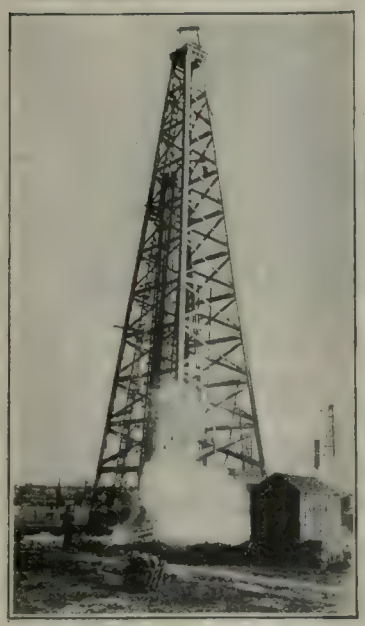
Que., Montreal—The Simond Canada Co., Ltd., 95 St. Remi St., has awarded the contract for the construction of a 2 story sawmill on Acorn St. Estimated cost, $29,000.

Que., Tartigon — The E. and S. Lumber Co., Fort Plain, will erect two mills here, one 47 x 140 ft. and other 30 x 60 ft.

MEN THAT FIT JOBS THAT FIT **SEARCHLIGHT SECTION**

See Pages 278 to 305 *"For Every Business Want"* See Pages 278 to 305

October 7, 1920 American Machinist Vol. 53, No. 15



The MECHANICS Of the OIL FIELDS

By FRED H. COLVIN • Editor American Machinist





THE mechanics of the oil fields are both varied and interesting, and, aside from the lure of oil prospecting which seems to get under a man's skin the same as mining, the actual mechanics of the job are of especial interest. Through the kindness of C. E. Reed, vice president and general manager of the Reed Roller Bit Co., Houston, Texas, I was able to visit the well-known Humble field and watch some of the operations at first hand and at the same time have the benefit of Mr. Reed's experience in oil well work. From the minute it is decided to drill a well, money begins to flow out of the treasury with remarkable ease and regularity. The erection of the derrick or frame, averaging about 100 ft. in height, gets away with the first thousand dollars, on which there is usually no salvage as the derrick is always left standing unless it is destroyed by being blown to pieces or by fire. Then comes the drilling machinery, which usually has a steam engine and boiler of from 50 to 60 hp. capacity, a goodly array of chain reduction gearing between the engine and the driving head of what is practically a vertical boring machine. The center view in headpiece shows a little of this. Bevel gears that transmit the motion from horizontal to vertical, drive the toolhead (called a rotary table) that turns the boring tools and the string of pipe which must reach to the bottom of the hole.

Then there is a good-sized water or slush pump (two are usually connected) which forces water or slush down the drill stem and as it returns, coats the side of the hole with mud and also floats out the dirt and pulverized rock as the boring head descends. The driving of the toolhead which turns the drilling bar naturally requires considerable power and is subjected to hard usage, owing to the irregularity in the hardness of the earth and the rocks which are encountered. This necessitates the use of material which will not only be strong enough to resist the stresses, but which can stand an increasing amount of punishment as the hole becomes deeper. The tool is connected to the driving pipe by a rigid socket which is made of a steel forging pierced from the solid. Some idea of the sockets and the quantities in which they are used can be had from Fig. 1, which is a view taken outside the forge shop of the Lucey Manufacturing Co., Houston, Texas. The quantity shown is, in fact, below the normal supply. As the tool goes down, lengths of pipe are added. Only one joint

The drilling of oil wells, and the pumping and handling of oil after it is found, present many mechanical problems, some of which are very closely akin to the work of the machine shop. These include boring and milling, together with sundry other machining operations, in which the cutting tool may be several thousand feet below the earth's surface. The mechanism used in pumping also involves interesting problems in power transmission.

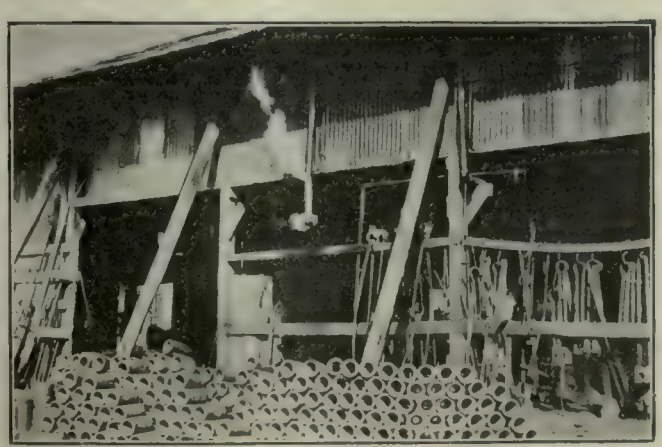


FIG. 1. A PILE OF TOOL JOINTS

can be added at a time. While this is not such a difficult matter at the beginning of the hole, it is increasingly serious as the hole goes down. When we consider that many of these wells reach a depth of over 3,000 ft. (with 4,000 ft. by no means uncommon) the weight of pipe which must be handled becomes an increasingly important figure. The tools are handled by a heavy block and a steel cable, power beng obtained from the engine of the power plant. This cost of handling the pipe makes it all the more important that the boring tools remain sharp as long as possible in order to avoid the cost of pulling them out of the well for sharpening. The pulling out process means stopping the drilling or productive work while 3,000 or 4,000 ft. of pipe are pulled out, uncoupled at every 60 or 80 ft. and replaced after the new or sharpened tool has been put in place, before the boring can continue. Here is where more of the treasury fund melts away. Roughly speaking, the cost of drilling may be estimated at a minimum of $5 per ft., which of itself means a tidy little sum on a 4,000- or 5,000-ft. well for only a hole in the ground.



FIG. 2. REAMER FOR SIDE CUTTING

Drilling a well is bad enough when all goes well, but when things begin to happen there is more excitement and uncertainty, not to mention expense, than the average shopman dreams of.

Just before we reached this field, this particular well, which was approximately 2,200 ft. deep, had struck a gas pocket of sufficient pressure to blow the tools out of the well for a considerable distance and to fill the casing which had followed the boring tool down, with rock and all kinds of debris. This obstruction has been jammed in so tightly by the gas pressure that the ordinary drilling head or bit made very little impression on it. Mr. Reed sent for one of his special boring heads to go through this rock. The boring head was successfully used, and after continuing the boring for about 300 ft. more, oil was encountered. It then became necessary to put in a strainer to keep out the sand.

The oil strainers are usually made by drilling a pipe fairly full of holes and then wrapping the outside of it with a wire, winding it around the pipe so as to leave a very slight space between the wires, an opening of only a few thousandths of an inch being the usual practice. The wires are then soldered at intervals so as to retain them in the relative position and after a pointed cap has been placed on the lower end the strainer is complete. Strainers are very necessary to prevent sand from clogging the pipe and also to keep sand out of the pump which forces the oil to the surface.

In the setting of the strainer at this well further difficulties were encountered, due to the end of one of the pipes in the collar being slightly cupped. An attempt to mill off this obstruction, by putting down a 6-in. milling cutter on the end of the pipe, resulted in the loss of the milling tool in the well. Grappling failed to recover it, and, being of hardened steel, it was almost impossible to cut it away with any tools which could be sent down.

Side Tracking

The next step out of the difficulty is what is known as "side tracking" which is done by milling out the side of the pipe for a considerable distance above the obstruction. The operation of side-tracking is usually performed by lodging in the well, above the obstruction, what is known as a "whip stock." This is round at the bottom end and of a diameter slightly under the inside of the pipe and anywhere from 10 to 15 ft. long. It is bevelled off on one side so that at the top it is a thin crescent shape. The whip stock forces the milling tool against the side of pipe to be cut. The tool most frequently used is shown in Fig. 2.

This tool is screwed on the lower joint of the drill stem and cuts out the side of the pipe for a considerable distance, so as to make a comparatively slight angle for the new hole. Through this long hole milled through the side of the casing, a new well-hole is drilled as far down as necessary. This hole through the side of the casing is usually $5\frac{7}{8}$ or $7\frac{7}{8}$ in. in diameter, but may be any size; and through it the drilling bit is operated by the drill stem, which is usually 4 in.-pipe. This operation is a very common one in drilling wells by the rotary process.

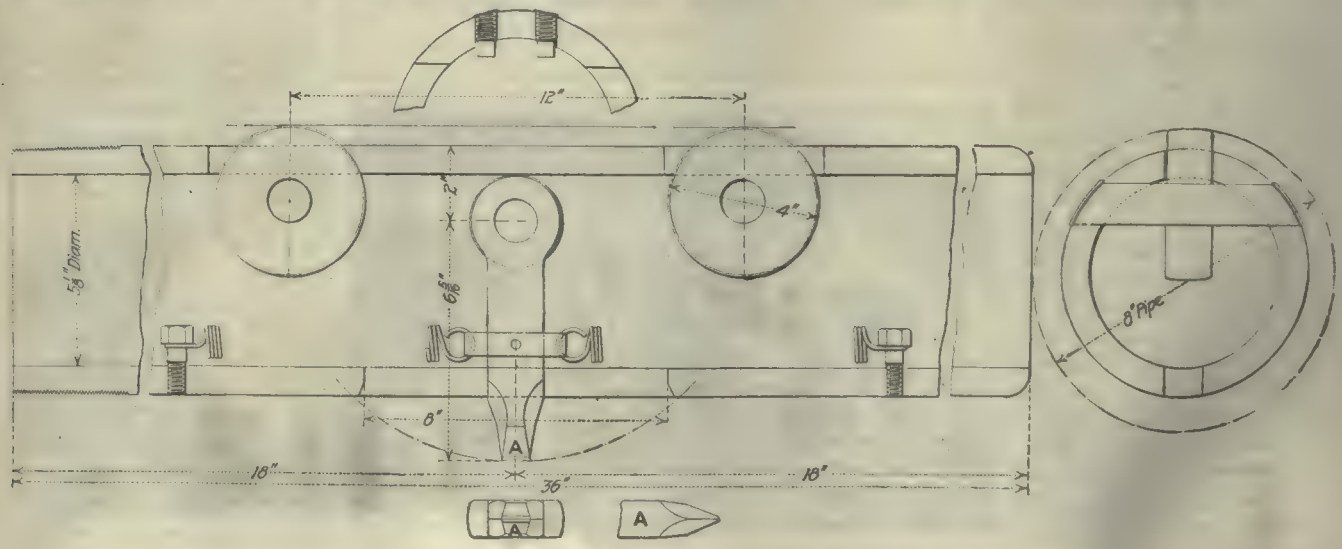


FIG. 3. TOOL FOR PERFORATING CASE UNDERGROUND



FIG. 4. THE OIL WELL PUMP

Milling cutters of various sizes, shapes and kinds, both internal, external and ends, are used at various times as necessity arises. It also occasionally happens that it is desired to pull out an old casing, and, if this has been in the ground any length of time, it is almost impossible to do so, owing to the pressure. In such cases, a tool, of the type shown in Fig. 3, is lowered into the pipe, and holes are punched in the walls at intervals, so as to allow water to be forced down the pipe and through the holes, washing the outside and loosening the earth which is holding it firmly in place. A little examination will show that, as this tool is lowered into the pipe, the cutter *A* drags or trails, and offers no resistance to its passage. When however, it is desired to punch a hole, the motion of the tool is simply reversed. As it is pulled up the point of the cutter catches the side of the pipe and forces a hole through it. The tool is then raised a short distance with the cutter trailing once more, and, by simply reversing the motion, or forcing it down, another hole is punched, leaving the tool in position to be pushed down the pipe as far as may seem desirable. By this means, it is easy to perforate pipes at any desired depth and many have been recovered by its use.

After the oil well has ceased to gush or flow, the question of pumping has to be looked after. Vast quantities of oil are obtained in this manner after the gas pressure is reduced so the oil will not flow. The pump is a simple affair, usually having a barrel about 6 ft. long, this being sometimes made in 12-in. sections but usually made in one piece. The plunger carries a ball valve top and bottom, the whole thing being very simply constructed. The pump as a whole is shown in Fig. 4 and consists of a skeleton frame fastened to the floor of the derrick. The pump rod *A* is moved up and down by the bell crank, the usual stroke being about 12 in. Suitable linkages connect the end of the bell crank with the pump rod and avoid any tendency to cramping. The pump cylinder and plunger are lowered nearly to the bottom of the well and located with regard to the depth of oil. Motion is imparted to it by means of the connecting cables.

The problem of getting the power to the pump involves considerable rough and ready engineering, which is extremely interesting. At this particular field the method of transmitting power is that of the Joseph Reid Gas Engine, of Oil City, Pa., which consist of a large wheel, Fig. 5, mounted on a vertical shaft and carrying two large eccentrics beneath. From the straps on these eccentrics, cables radiate in as many directions as may be necessary to reach the various oil wells. The throws of the eccentrics are approximately the same as the stroke of the pump and the various methods of getting the cables from the source of power to the pumps, which may be half a mile away across the field, are interesting.

Power in All Directions

Fig. 6, shows a few of these cables coming out from the power house, those shown being only a small portion of the number in actual use. The cables are

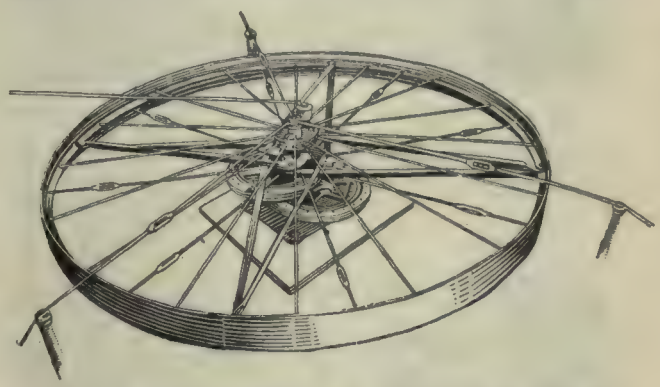


FIG. 5. BAND WHEEL FOR POWER PUMP DRIVE

fastened to the eccentric straps by means of clevises and suitable pins, and if then for any reason it is desired to stop any particular pump, it is only necessary to disconnect one of the cables at a convenient point and fasten it to a short stationary cable which holds it in position ready to be again coupled when desired.

In some instances it is possible to run the cables directly from the power to the pump, even though this be half a mile or more away. In such cases, timbers which are usually somewhat larger than railroad ties are set into the ground and holes bored through them at the proper places to guide the cables and allow them to work freely. The cables are then threaded through these holes and connected to the power wheel.



FIG. 6. CABLES COMING OUT OF POWER HOUSE

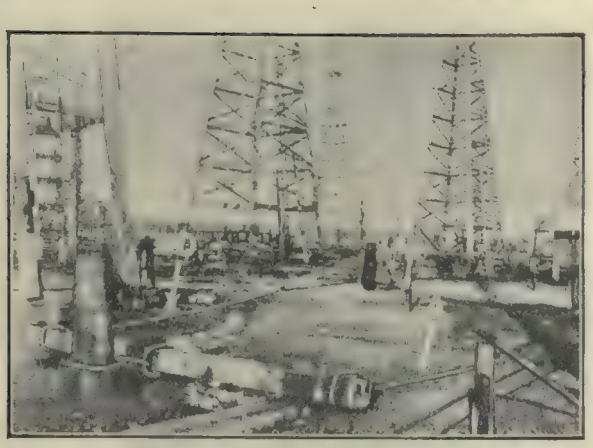


FIG. 7. CROSSBEAM FOR REVERSING MOTION

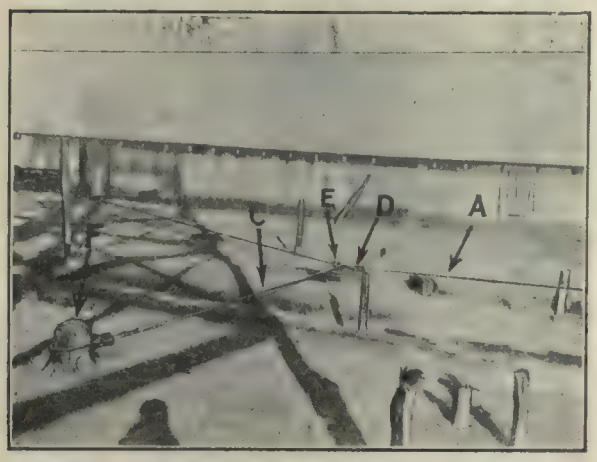


FIG. 8. GETTING AROUND AN OBSTRUCTION

Frequent application of crude oil to the cables as they pass through these supports reduces friction and also delays wear of the hole. The cables are usually kept about 18 in. from the ground.

Figs. 7, 8 and 9 show cases where it has been necessary to transmit power "around the corner" and the method used for so doing. In Fig. 7, the power is brought out on the cable *A*, coupled to the large crossbeam *B*, which is fastened to the post *C* by a wire rope and a cable *D* run from the other end in the direction of the arrow to a well which could hardly be reached in any other way. Each end of the crossbeam rests on timbers as shown, crude oil again supplying the necessary lubricant.

In another case, the well was so located that while a direct line could not be used, the obstruction only required a small deviation. This was secured as shown in Fig. 8. The power line comes out at *A*, coupled into a shackle at *D*. The shackle is held in position by the cable *C*, and moves in a radius from the post *F*. The pump line *E* couples in the other end of the shackle and is almost a direct continuation of the cable *A*.

This swinging slightly reduces the length of the stroke which is restored by the connection shown in Fig. 9. The power line *A* is the lower coupling on the post *B*. The post vibrates and, as the pump line *C* runs off the upper end, the pump receives an increased stroke. These are only a few of the devices used, but give a good idea of the ingenuity displayed in this kind of work.

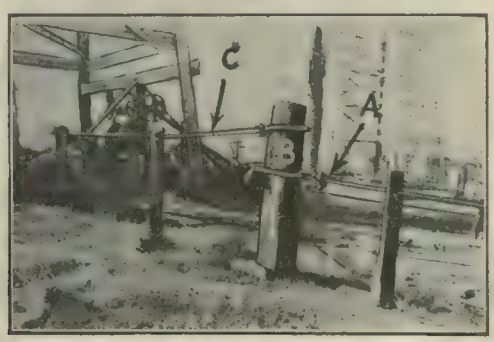


FIG. 9. INCREASING THE STROKE

Device for Grinding Clearance Angles on Tools for the Automatic

By F. P. Rogers

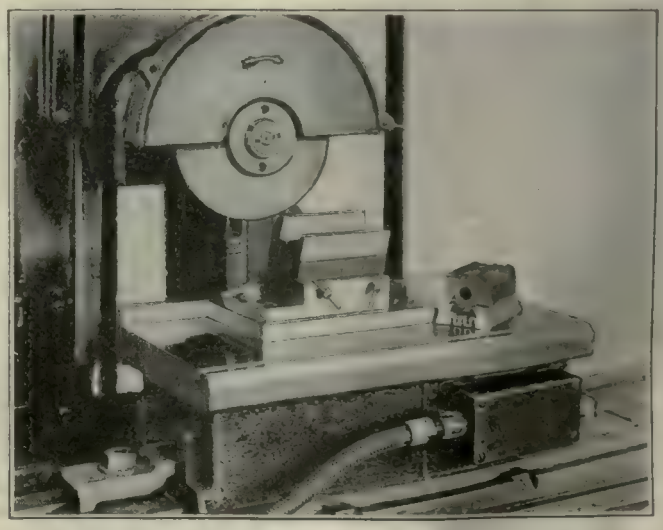
The halftone presented herewith shows a holder for grinding the forming tools commonly used on automatic machines, enabling the operator to produce definite clearance angles with certainty, even though he may remove the tool from the grinding machine many times.

The device consists of carefully finished base with edges ground exactly parallel; a swinging dovetail holder, pivoted at one end on the center line of the base, and graduated at the other end to facilitate setting to any desired angle; and a spring packing piece, or shoe to adapt the holder to smaller sizes of dovetail.

The device is to be used in conjunction with the magnetic chuck, the base being placed against the aligning bar of the chuck to locate it. After the correct setting is once obtained the device may be removed from the machine or the work released from the holder and replaced at any time with certainty of maintaining the angle.

This feature renders it of value for the reason that in the production of tools of the nature for which this device is intended it is frequently desirable to remove the work from the grinding machine for various reasons and during such periods the grinding machine is not "tied up," but may be used for other purposes or by other operators. When the grinding of the tool is to be resumed the holder is replaced on the magnetic chuck with one side against the aligning bar and no "setting up" or trial cuts are necessary.

Besides the work for which it was originally intended the device is useful for grinding keys, wedges, or other pieces upon which a definite angle must be obtained.



HOLDER FOR GRINDING CLEARANCE ANGLES

Programs of Apprenticeship and Special Training In Representative Corporations

By J.V.L. Morris



II. R. Hoe & Co., New York, N. Y.

An apprenticeship system which has withstood the test of time and which is well adapted to use in most machine-building plants, is described here. This system is the traditional form of apprenticeship modernized to meet existing conditions, a school meeting after working hours being the chief feature.

(Part I was published in the Sept. 23 issue.)

THE firm of R. Hoe & Co. is a long-established manufacturer of printing presses in New York City. For forty-eight years, since 1872, it has maintained an apprentice school as a supplement to the ordinary apprenticeship system in which a skilled trade is taught by the traditional method of working by the side of journeymen on regular factory production. Ninety per cent of the manufacturing administrative force of the plant are said to be graduates of the school, as well as all of the forty to sixty high-grade men employed outside the factory in installing the presses. Thus, the school has high favor with the management of the company, a factor which greatly lessens the danger of exploiting the apprentices by keeping them at machines or processes long after they have learned them, as is frequently the case where foremen and managers are not themselves apprentice trained. It is said that overtime production is not allowed to interfere with attendance at the school, and that apprentices are never laid off during even the dullest seasons.

To be accepted as an apprentice a boy must be sixteen to eighteen years of age and a graduate of the elementary school, with the preference that he come directly from school rather than after a series of casual employments, during which his experiences lead him too frequently to contract habits of insubordination and shiftlessness. In addition to educational requirements, a simple test for mechanical deftness is imposed by requiring the candidate to put together a mechanical construction toy. A ratio of one apprentice to five journeymen can not be exceeded by agreement with the machinists' union. On this basis there were on April 16, 1920, when the investigation was made, 173 apprentices. About sixty apprentices are taken on each year.

Apprenticeship is offered in the following trades:

Foundry	with 3-year course and	2 enrolled
Machinist	with 4-year course and	160 enrolled
Electrician	with 4 year course and	1 enrolled
Sawsmith	with 3-year course and	5 enrolled
Patternmaker	with 5-year course and	5 enrolled
Total		173 enrolled



FIG. 8. APPRENTICES IN A CLASS IN MATHEMATICS



FIG. 9. LIBRARY PROVIDED FOR APPRENTICES

Over 90 per cent of the enrollment is seen to be in the machinists' trade.

Rates of pay for machinist apprentices are as follows:

First year—1 c. per hour	$7.04 per wk.
Second year—24c. per hour	10.56 per wk.
Third year—42c. per hour	18.48 per wk.
First six months, fourth year—56c. per hr.	24.64 per wk.
Second six months, fourth year—70c. per hr.	30.80 per wk.

The shop schedule of the foundry apprentices is outlined as follows: 6 months helping molder on the floor, tempering sand, etc.; 6 months coremaking; 6 months on bench; 9 months on the floor; and 9 months on dry-sand work; a total of 3 years.

For the machinists the schedule is divided into four groups. Group 1 is for one month at general work, tool room or cutting-off machines. Group 2 calls for work at drill press, two months; vise, two months; boring mill, two months; and keying machine and hand monitor, two months, or slotter, two months. Group 3 schedules work at planer, six months; gear cutter, six months; miller, five months; lathe, ten months. The



FIG. 10. APPRENTICES IN A DRAWING CLASS

work of group 4 is done at erecting for twelve months. This is a total of 48 months.

Sawmaking is to be considered a special phase of smithing and an interesting example of hand craftsmanship still surviving in industry. The apprentices spend the following periods on the various classes of work: Anvil, six months; punching, 3 months; repairing saws, 3 months; shanks, 3 months; bit room, 3 months; setting and filing, 6 months; hardening, 6 months; anvil, 2 years 6 months. This implies that five years are required before reaching full journeyman's standing.

The patternmakers serve for two years at various classes of work under a master patternmaker, followed by nine months in the foundry to learn the difficulties encountered in casting from a pattern, in order that their later work may be so constructed as to meet foundry requirements. They then return to the pattern shop to complete their time.

School Work of Apprentices

At considerable expense the apprentice school has been installed in a section loft and equipped with three classrooms, a drafting room and a library, besides a lunch room. Views of the school are shown in Figs. 8, 9 and 10. The lunch room was installed so that coffee and sandwiches could be given the boys in the intermission between the closing of the shop at 5 p.m. and the classes, which begin at 5:20 and end at 6:45.

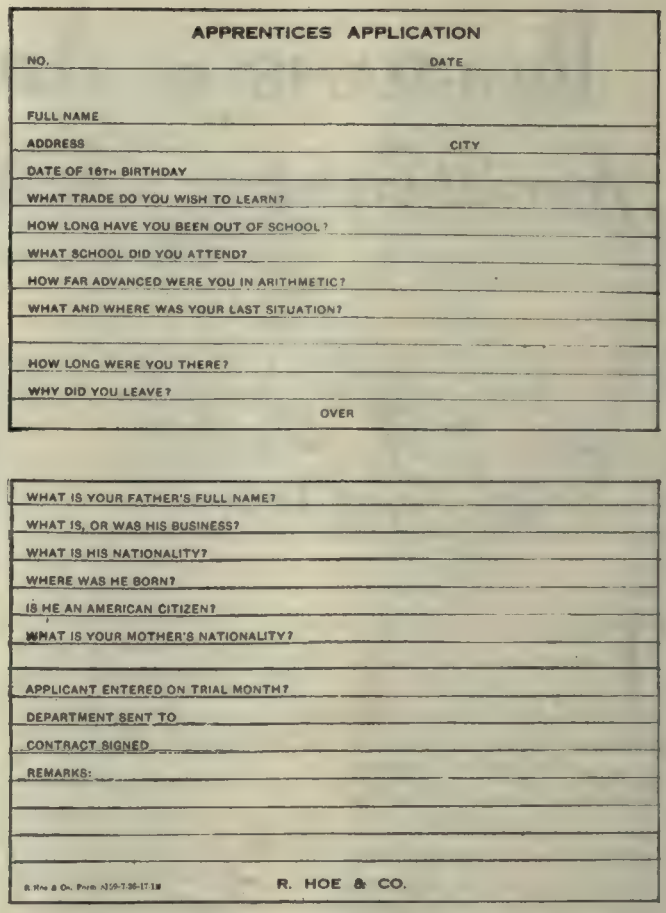


FIG. 11. FRONT AND REAR SIDES OF THE APPLICATION CARD

The school personnel consists of a supervisor, a drafting instructor and three teachers who handle the mathematics, English and mechanics. The supervisor, who divides his time between directing the school and office work, is himself a graduate of the school. The drafting instructor is drawn from the company's drafting-room staff and the other instructors are technical graduates with positions in the city, but not otherwise in the company's employ.

Owing to the relatively large size of the school and the fact that all students pursue a uniform course, instruction can be graded to suit the previous training of each apprentice and to provide instruction suited to his attainments no matter at what time of the year he may enter the school. For this reason the curriculum is divided into seven units designated as C-3, C-2, C-1, B-3, B-2, B-1, and A. Ordinary students are expected to complete this in three years, the C units being taken in the first year, B units in the second, and A in the third.

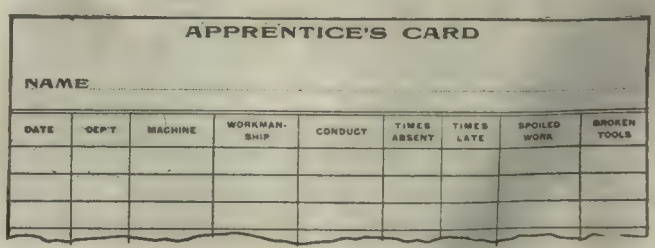


FIG. 12. SHOP-WORK RECORD CARD

The weekly time division or schedule of classes is as follows:

		Class C-3	
First	night	Freehand drawing	1 hr.
		Mathematics—Review of fractions, decimals, ratio, square root, etc.	½ hr.
Second	night	Mathematics	1 hr.
		English—Oral and written composition, punctuation and general expression of thought	½ hr.
Third	night	English	1 hr.
		Mathematics	½ hr.
		Class C-2	
First	night	Freehand drawing	1 hr.
		Mathematics—Mensuration, simple equations in algebra, problems illustrated by freehand sketches	½ hr.
Second	night	Mathematics	1 hr.
		English—Continuation of C-3	½ hr.
Third	night	English	1 hr.
		Mathematics	½ hr.

R. H. & Co. Form 5141-717-100

R. HOE & CO.'S
Evening School for Apprentices

REPORT FOR TERM ENDING

DATE.....

.....CLASS.....

Attendance .....
Deportment .....
Arithmetic .....
English .....
Geometry .....
Mechanics .....
Mechanical Drawing .....
Average in Studies .....

In order to be advanced, the apprentice's average in Studies must be at least 65.

Shop Rating based on Workmanship
Attendance and Conduct.....

.....FOREMAN

.....HEAD MASTER

FIG. 13. TERM-REPORT CARD FOR APPRENTICE WORK

		Class C-1	
First	night	Drawing—Mechanical drawing commenced	1 hr.
		Mathematics—Constructive geometry. Only such problems considered as can be done with the aid of compass and straight edge	½ hr.
Second	night	Mechanics—Heat, air, liquid, power and work with problems and experiments requiring simple apparatus	1½ hr.
Third	night	English	1 hr.
		Mathematics	½ hr.
		Class B-3	
First	night	Mechanical Drawing; continued	1½ hr.
Second	night	Geometry—Theoretical, with proofs of simpler problems; trigonometry of the right triangle; use of tables of natural functions	1 hr.
		English—Written work, description and exposition	½ hr.
Third	night	Mechanics—Mechanical forces and friction	1½ hr.
		Class B-2	
First	night	Mechanics—Gear teeth and gearing	1½ hr.
Second	night	Mechanical drawing—Gears, showing characteristics of involute and cycloidal teeth	1½ hr.
Third	night	Mathematics—Strength of materials, especially applied to proper proportions and materials for machine parts	1 hr.
		English, continued	½ hr.
		Class B-1	
First	night	Mechanical drawing—Free hand sketching and dimensioning and lettering of plans, sketches, and data for making prints	1½ hr.
Second	night	Mechanics—Power transmission as used in a factory. Pulleys, shafting, belting, gearing. Electricity, what it is and how it operates	½ hr.
		English—Report writing and similar work	1 hr.
Third	night	Mechanics	1½ hr.
		Class A	
First	night	Mechanical Drawing—Free hand detail drawings for the different parts of a simple machine, such as belt-shifter arrangement, and from these to make up a general Assembly	1½ hr.
Second	night	Mechanics—Essentials of machine designing	1½ hr.

Careful records are kept of the progress of the apprentice both in his shopwork and in the apprentice school, term reports being sent to the parent and prizes being conferred on those with the best records in both shopwork and school at the annual closing exercises held in June.

Apprentice Records

The forms in use by this company for handling the records of its apprentice department seem well adapted to the purposes intended. There is, first, the application form, both front and reverse of which are shown in Fig. 11, which is filled out and filed in the employment department when the boy first seeks entrance into the training school. There is, also, the card, Fig. 12, on which a cumulative record is kept of the apprentice and his work in the different departments of the plant. This is transferred with the apprentice from one department to another as he progresses from one machine or type of work to another. Finally, there is the term report card, shown in Fig. 13, which is filled out and sent to the apprentice's parents each term.

The apparent high quality of the apprentices in this plant and the generous provisions for their instruction, both in the shop and school, would lead one to believe that the management is employing considerable effort in the training of its future mechanics. The program may be commended as an example of satisfactory modernized apprenticeship.

Molding a Drum With Deep Sand Pockets

By M. E. Duggan

An interesting article under the above title appeared on page 1,056, Vol. 52, of *American Machinist*. There are some points in the description of the molding operation that I do not quite understand and therefore I am going to ask some questions; not with intent to be sarcastic, but to add to my fund of knowledge concerning practical pattern making and foundry practice.

From the description I would infer that the pattern was made to mold in green sand, using a core for the central hole. Is this correct?

The depth of the pockets is given in paragraph four as 9 in., but nothing is said about the length and diameter of the drum; thickness of wall; thickness of the web at the bottom of the arms, etc. I would like to know these figures.

When the alterations on the pattern were made that enabled unskilled labor to produce 10 castings per day against 3 castings in the same time with the original pattern and the services of a skilled molder, were the alterations made by the same patternmaker that made the original pattern? If not, was his attention called to the alterations and their result so that he would not make the same mistake a second time?

If I were to make this pattern I would construct it to be molded with the ribs in the drag in green sand, provided there was body enough to the sand to support itself. However, if it was made to mold in green sand with the ribs in the cope no alterations would be necessary to enable the molder to mold the ribs in core; the pattern could still be used as a core box. All that would be necessary in this case would be to suspend the core from the cope with wires.

Motor-Flywheel Drive for Merchant Mill

By J. B. VARELA
Captain Coast Artillery, Fort Monroe, Va.

Designing flywheels for rolling-mill use is not a simple matter; but the author gives in this discussion a treatment of the problem which is concise, yet quite sufficient for ordinary needs, and in such a form that it may be readily adapted to use in actual design work.

IT IS our purpose to present in this article an outline of the calculations necessary to check the electric drive for a 22-in. merchant mill.

The mill is a 22-in., three-high, merchant mill of four stands. It is driven by an induction motor of 1,800 rated horsepower, taking three-phase, 25-cycle, alternating current at 6,600 volts, in connection with a heavy flywheel coupled to the motor shaft and a herringbone gear and pinion, as shown in Fig. 1. In checking this drive two distinct steps must be taken:

First: An investigation must be made of the interaction of the motor and flywheel when the mill is running at maximum capacity, in order to determine the sufficiency of the motor to perform the work required.

Second: An investigation of the stresses induced in the flywheel rim and arms.

I. Formulas for Motor-Flywheel Interaction

(a) Drop in Speed due to load.

The following notation and formula are used in the calculations:

hp = Horsepower of motor;
hp_1 = Friction horsepower;
hp_2 = Maximum horsepower at peak load;
R = R.p.m. at no load (synchronous speed);
R_1 = R.p.m. at full load;
R_2 = R.p.m. at friction load (flywheel speed);
T = Full-load torque at full-load speed;
T_1 = Friction-load torque at friction speed R_2;
T_2 = Maximum torque at friction speed R_1;
T_3 = Maximum torque above T_1;
T_4 = Full-load torque at speed R_2;
T_5 = Maximum torque exerted by flywheel in per cent of full load;
T_6 = Actual torque exerted by flywheel;
S = Per cent of slip at full load;
S_1 = Per cent of slip at friction load;
S_2 = Total slip in per cent;
S_3 = Total slip in r.p.m.;
S_4 = Per cent drop below initial speed with flywheel assisting motor;
S_5 = Per cent drop below friction speed with flywheel assisting motor;
S_6 = Drop in r.p.m. with flywheel assisting motor;
S_7 = R.p.m. drop in speed below synchronous speed;
S_8 = Per cent total actual drop below synchronous speed with flywheel assisting motor;
L = Maximum load above friction in per cent;
Wr^2 = Total inertia effect of motor and flywheel;
t = Length of peak in seconds;
t_1 = Length of interval between peaks in seconds;

Using the above notation we have the following formulas:

$$T = \frac{hp \times 5{,}250}{R_1} \quad (1)$$

$$S = \frac{R - R_1}{R} \quad (2)$$

$$S_1 = \frac{hp_1 \times S}{hp} \quad (3)$$

$$R_2 = R - S_1 R \quad (4)$$

$$T_1 = \frac{hp_1 \times 5{,}250}{R_2} \quad (5)$$

$$T_2 = \frac{hp_2 \times 5{,}250}{R_2} \quad (6)$$

$$T_3 = T_2 - T_1 \quad (7)$$

$$T_4 = \frac{hp \times 5{,}250}{R_2} \quad (8)$$

$$L = \frac{T_3}{T_4} \quad (9)$$

$$S_3 = S_2 R_2 \quad (10)$$

The formulas for calculating the drop below initial speed which takes place with the flywheel assisting the motor are exceedingly complicated. This drop in speed is represented in our notation by S_4; but its value may be readily found without any calculations by using the following factors from the charts published in the *American Machinist* for Mar. 7, 1912, in an article by Messrs. Riker and Fletcher:

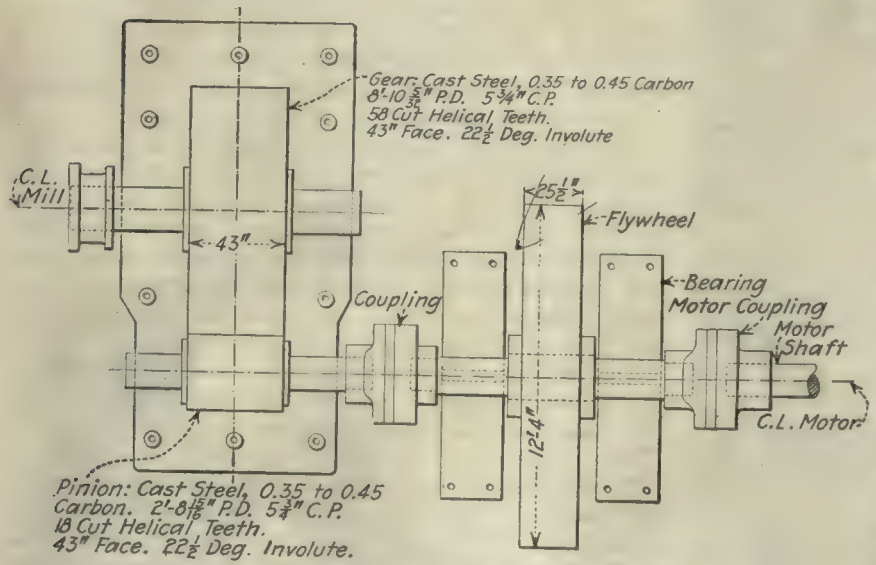


FIG. 1. GENERAL ARRANGEMENT OF THE DRIVE FOR 22-IN. MERCHANT MILL

$$\frac{T_3}{Wr^2}\ ;\ S_3;\ \text{and}\ t$$

The results given here were obtained by that method.

$$S_5 = S_4 \times S_2 \quad (11)$$
$$S_6 = S_5 \times R_2 \quad (12)$$
$$S_7 = S_1 + S_5$$

No attempt is made here to give the derivation of the equations used; but those who care to study the theory are referred to the various papers on the subject published in the transactions of the American Institute of Electrical Engineers.

I (b) Recovery of Speed.

$T_5 = L$ — Friction horsepower in per cent (13)
$T_6 = T_4 T_5$ (14)
$S_7 = S_6 R_2$ (15)

SOLUTION FOR SPEED DROP

In our particular case we proceed as follows, the specifications and conditions of operation being:

1,800-hp. motor;
250 r.p.m. (synchronous speed);
243 r.p.m. at full load;
Slip = 10 per cent of full-load speed when carrying 175 per cent overload;
Friction hp. = 20 per cent of full-load hp., or 360 hp.
Peak load = 6,534 hp.;
Duration of peak load = 0.87 seconds;
Interval between peaks = 2.0 seconds.

Substituting these values in the above formulas we have:

Full-load torque at full-load speed = T =

$$\frac{1{,}800 \times 5{,}250}{243} = 38{,}889 \text{ ft.-lb.} \quad (1)$$

$$\text{Slip at full load} = S = \frac{250 - 243}{250} = 0.028, \text{ or } 2.8 \text{ per cent} \quad (2)$$

$$\text{Slip at friction load} = S_1 = \frac{360 \times 2.8}{1{,}800} = 0.56 \text{ per cent} \quad (3)$$

$$\text{Friction-load speed} = \text{flywheel speed} = R_2 = 250 - 0.0056 \times 250 = 248.6 \text{ r.p.m.} \quad (4)$$

Friction-load torque at flywheel speed =

$$T_1 = \frac{360 \times 5{,}250}{248.6} = 7{,}603 \text{ ft.-lb.} \quad (5)$$

Maximum torque at flywheel speed =

$$T_2 = \frac{6{,}534 \times 5{,}250}{248.6} = 137{,}986 \text{ ft.-lb.} \quad (6)$$

Maximum torque above friction = T_3 = 137,986 − 7,603 = 130,383 ft.-lb. (7)

Total intertia effect of rotor and flywheel = Wr^2 = 2,260,000, since,

$$\left\{\begin{matrix} Wr^2 \text{ of rotor} = 460{,}000 \\ Wr^2 \text{ of flywheel} = 1{,}800{,}000 \end{matrix}\right\}$$

Full-load torque at flywheel speed =

$$T_4 = \frac{1{,}800 \times 5{,}250}{248.6} = 38{,}013 \text{ ft.-lb.} \quad (8)$$

Maximum load above friction in per cent =

$$L = \frac{130{,}383}{38{,}013} = 3.429, \text{ or } 343 \text{ per cent} \quad (9)$$

Since an overload of 175 per cent causes a drop in speed of 10 per cent of the full-load speed, and we have an overload of 343 per cent, we find that 343 − 175, or 168 per cent additional overload, will cause a further drop in speed of $168 \times 0.028 = 4.7$ per cent. Consequently, the total drop is $10 + 4.7 = 14.7$ per cent, which is the value of S_2.

Total slip below flywheel speed in r.p.m. = S_3 =

$$248.6 \times 0.147 = 36.54 \text{ r.p.m.} \quad (10)$$

In order to find S_4, the drop below initial speed which takes place with the flywheel assisting the motor, we enter the previously mentioned chart, using the following factors:

$$\frac{T_3}{Wr^2} = \frac{130{,}383}{2{,}260{,}000} = 0.0576$$

$S_3 = 36.54$ and $t = 0.87$ seconds,

and we find that $S_4 = 36$ per cent of S_3.

$$S_5 = 0.36 \times 14.7 = 5.29 \text{ per cent below friction speed} \quad (11)$$

$$\text{Drop in r.p.m.} = S_6 = 0.0529 \times 248.6 = 13.15 \text{ r.p.m.} \quad (12)$$

$$\text{or, } \frac{13.15}{60} = 0.219 \text{ revolutions per second}$$

But we have already found from (3) that the drop in speed due to friction was 0.56 per cent. Hence, the total actual drop in speed is $S_8 = 0.56 + 5.29 = 5.85$ per cent.

Now, since the slip at full load has been found to be 2.8 per cent, the load corresponding to a slip of 5.85 per cent is $\frac{5.85}{2.8} = 2.089$, say 209 per cent. Since the rated overload capacity of the motor is 275 per cent for short intervals, we see that we are well within the safe limit.

SOLUTION FOR RECOVERY OF SPEED

$$T_5 = 343 - 20 = 323 \text{ per cent} \quad (13)$$
$$T_6 = 3.23 \times 38{,}013 = 122{,}782 \text{ ft.-lb.} \quad (14)$$

In order to determine the per cent of speed recovered we have:

$$\frac{T_6}{Wr^2} = \frac{122{,}782}{2{,}260{,}000} = 0.0543$$
$$S_7 = 0.0585 \times 248.6 = 14.54$$
$$t_1 = 2 \text{ seconds}$$

Entering the chart with the above values it is found that the motor will recover about 90 per cent of its speed.

II. FORMULAS FOR STRESSES IN FLYWHEEL RIM AND ARMS

The flywheel used for this drive is shown in Fig. 2. The high speed at which the motor runs made it necessary to reduce the diameter of the wheel as much as possible, the requirements of a high inertia effect being met by making the wheel very heavy, as shown. The flywheel was made of cast steel with solid rim and

split hub and was carefully balanced. In the investigation of the stresses occurring in the rim and arms, the formulas developed by Von J. Gobel and published in the *Zeitscheift des Vereines Deutchen Ingenieures*, March 26, 1898, were used. These formulas were adapted to the English system and they appear in English units in the following work:

NOTATION

dx = Stress in rim, pounds per square inch;
da = Stress in arm at rim, pounds per square inch;
di = Stress in arm at hub, pounds per square inch;
R = Mean radius in inches;
r = Radius of hub in inches;
α = ½ of angle between arms;
F = Area of rim in square inches;
W = Section modulus of rim;
l = Length of arm in inches;
y = Weight of 1 cu.in. of material (hub);
u = Weight of 1 cu.in. of material (rim);
g = 32.16 × 12 = 385.92 in. per second per second acceleration.
p = Retardation in inches per second per second;
w_a = Section modulus of arm at rim;
w_i = Section modulus of arm at hub;
E = Modulus of elasticity (28,000,000 lb. per square square inch for cast steel);
f = Area of arm in square inches $\{f_i$ at hub$\}$ $\{f_a$ at rim$\}$;
I = Moment of inertia of rim;
i = Moment of inertia of arm (at center)
v = Velocity in inches per second.

Then,

$$X = \frac{2 - \frac{2}{3}\sin^2\alpha - \frac{l^2(2l-3r)}{3R^3}}{\frac{\alpha}{\sin\alpha} + \cos\alpha + \frac{R^2F}{I}\left(\frac{\alpha}{\sin\alpha} + \cos\alpha - \frac{2\sin\alpha}{\alpha}\right) + 4\frac{l}{R}\cdot\frac{F}{f}\sin\alpha} \quad (1)$$

$$dx = \left[\frac{XR}{W}\left(\frac{\sin\alpha}{\alpha} - \cos\alpha\right) + \frac{\cos\alpha\,(\cos\alpha - X)}{F}\right] F\frac{u}{g}v^2 \quad (2)$$

$$da = \frac{1}{f_a}\cdot 2X\sin\alpha\left(F\frac{u}{g}v^2\right) \quad (3)$$

$$di = \frac{1}{f_i}\left[2X\sin\alpha + \frac{f}{F}\cdot\frac{y}{u}\cdot\frac{l(2r+l)}{2R^2}\right] F\frac{u}{g}v^2 \quad (4)$$

$$f = \frac{1}{2}(f_i + f_a), \text{ or } \sqrt{f_i f_a}$$

$$d_2 = \left[\frac{R\sin\alpha}{F} + \frac{R^2}{W}(\alpha - \sin\alpha) + \frac{Rl}{W}\sin\alpha + \frac{l^2(4r+3l)}{24R}\cdot\frac{f}{F}\cdot\frac{y}{u}\right] F\frac{u}{g}p \quad (5)$$

$$d_3 = \frac{1}{w_i}\left[Rl\sin\alpha + \frac{l^2(4r+3l)}{24R}\cdot\frac{f}{F}\cdot\frac{y}{u}\right] F\frac{u}{g}p \quad (6)$$

$$d_4 = \frac{1}{w_i}\left[Rl\sin\alpha + \frac{l^2(8r+5l)}{24R}\cdot\frac{f}{F}\cdot\frac{y}{u}\right] F\cdot\frac{u}{g}p \quad (7)$$

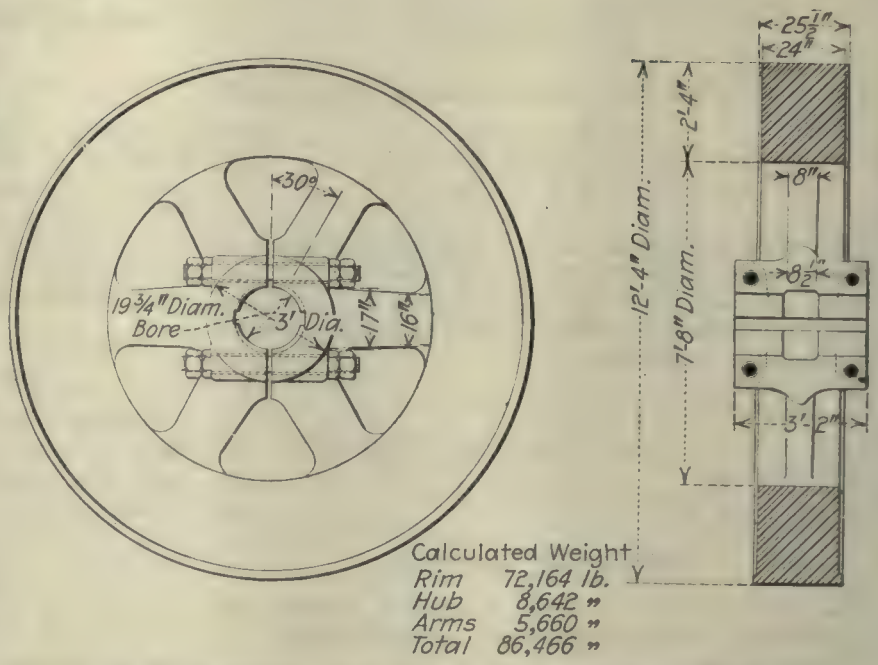


FIG. 2. FLYWHEEL USED FOR 22-IN. ROLLING MILL DRIVE

Formulas (1), (2), (3) and (4) are to be used in the case of wheels running at a constant speed. For wheels running at variable speed we have:

The stress in rim = $dx + d_2$.
The stress in arm at rim = $da + d_2$.
The stress in arm at hub = $di + d_2$.

In order to simplify the calculations when applying these formulas, the following table has been computed for wheels having 4, 6, 8 and 10 arms.

Number of arms, n.	4	6	8	10
$\alpha = \frac{\pi}{n}$	0.78540	0.52360	0.39270	0.31416
$\sin\alpha$	0.70711	0.50000	0.38268	0.30902
$\cos\alpha$	0.70711	0.86602	0.92388	0.95106
$2 - 2/3\sin^2\alpha$	1.66667	1.83333	1.90237	1.93634
$\frac{\alpha}{\sin\alpha} + \cos\alpha$	1.81783	1.91323	1.95005	1.96770
$\frac{\alpha}{\sin\alpha} + \cos\alpha - 2\frac{\sin\alpha}{\alpha}$	0.01719	0.00337	0.00107	0.00054
$\frac{\sin\alpha}{\alpha} - \cos\alpha$	0.19320	0.08990	0.05061	0.03257
$\alpha - \sin\alpha$	0.07829	0.02360	0.01002	0.00514

SOLUTION FOR STRESSES IN WHEEL

In this particular case we have the following values:

R = 60	p = 83	I = 4,390
r = 18	w_a = 200	i = 1,816
F = 672	w_i = 240	v = 1,562
W = 3,136	f = 107	g = 385.92
l = 28	f_a = 100	n = 6 arms
y = 0.283	f_i = 113	α = 30 deg.
u = 0.283		

Substituting these values in the above formulas we obtain:

$$X = \frac{1.83333 - (28)^2\frac{(2\times 28 + 3\times 18)}{3\times(60)^3}}{1.91323 + \frac{(60)^2\times 672}{4{,}390}\times 0.00337 + \frac{4\times 28\times 672}{60\times 107\times 2}} = \frac{1.70025}{9.843} = 0.172 \quad (1)$$

$$dx = \left[\frac{0.172 \times 60}{3{,}136} \times 0.0899 + \frac{0.86603 \times 0.69403}{672}\right] \frac{672 \times 0.283}{385.92} \times (1{,}562)^2 = 1{,}390 \quad (2)$$

$$da = \frac{1}{100} \times 2 \times 0.172 \times 0.5 \times 672 \times 0.00073 \times 2{,}439{,}844 = 2{,}049 \quad (3)$$

$$di = \frac{1}{113}\left(2 \times 0.172 \times 0.5 + \frac{107}{672} \times \frac{28\,(2 \times 18 + 28)}{2 \times (60)^2}\right) \frac{672 \times 0.283 \times 2{,}439{,}844}{385.92} = 2{,}732 \quad (4)$$

$$d_2 = \left(\frac{60 \times 0.5}{672} + \frac{(60)^2}{3{,}136} \times 0.0236 + \frac{60 \times 28 \times 0.5}{3{,}136} + \frac{(28)^2\,(4 \times 18 + 3 \times 28)}{24 \times 60} \times \frac{107}{672}\right) 672 \times 0.00073 \times 83 = 647 \quad (5)$$

$$d_3 = \frac{1}{200}\,(60 \times 28 \times 0.5 + (28)^2 \times 85 \times 0.1592)\; 672 \times 0.00073 \times 83 = 175 \quad (6)$$

$$d_4 = \frac{1}{240}\left(60 \times 28 \times 0.5 + \frac{(28)^2\,(8 \times 18 + 5 \times 28)}{24 \times 60} \times 0.1592\right) 672 \times 0.00073 \times 83 = 150 \quad (7)$$

Since this flywheel runs at a variable speed we have:

Total stress on rim $= dx + d_2 = 1{,}390 + 647 =$ 2,037 lb. per square inch.

Total stress on arm at rim $= da + d_3 = 2{,}049 +$ 175 $=$ 2,224 lb. per square inch.

Total stress on arm at hub $= di + d_4 = 2{,}732 + 150$ $=$ 2,882 lb. per square inch.

These stresses are well within the safe limit allowable for cast steel, and afford an ample margin of security against unforeseen variations of the peak load and the resulting stresses induced in consequence thereof.

The drive just considered, which was designed by the author, has been in operation since the summer of 1914, and it has withstood successfully the most exacting requirements met in modern American mill practice.

Sheet Metal Arc-Welding Machine

By E. A. Thanton

The machine shown in Fig. 1 is used by the General Electric Co., Schenectady, N. Y., for arc-welding corrugated steel tank work. The seams are 116 in. long, and the arc is applied by means of a tapered carbon pencil 6 in. long, ½ in. in diameter at the large end and ⅛ in. at the arc end. This concentrates heat where

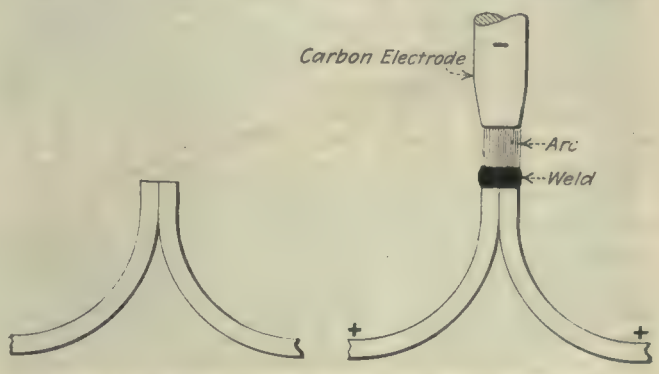


FIG. 2. HOW THE METAL EDGES ARE WELDED

wanted. No metal is supplied to the weld, as the arc is employed simply to fuse the upturned edges as shown in Fig. 2. The metal welded is 1/16 and 3/32 in. thick.

The speed on 1/16-in stock is 5½ in. per minute with a d.c. current of 45 amp., and 75 volts. On 3/32-in. stock the speed is the same but 70 amp. and 75 volts d.c. current is used.

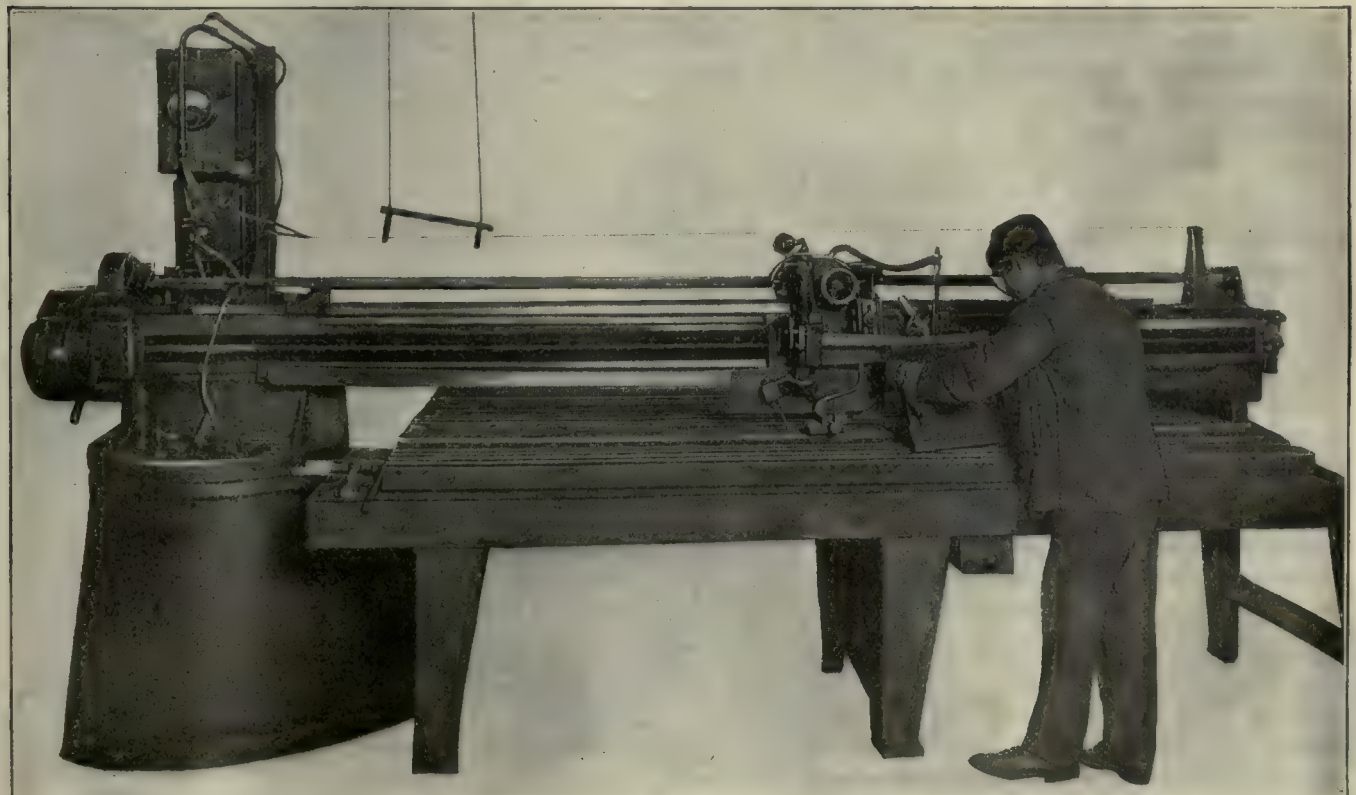


FIG. 1. CARBON ELECTRODE ARC SEAM-WELDING MACHINE

Die Sense

By Edmond Remacle

It is well known by die makers, die users and hardeners that the most critical time in the making of a die is in the hardening and tempering process. No matter whether the die is hardened by the one who made the die or by an expert hardener, there is always the element of doubt as to the successful result.

After a close study of the question for a period of over twenty-five years I have concluded that a word is due both for the relief of the hardener and to prevent the knock often given to some really excellent grade of steel.

When it so happens that a die comes from the quenching bath and is found to be cracked or badly warped, the fault is invariably traced either to the steel or the method of hardening, and while both may be to blame in a number of cases, the real fault in most of the cases may be traced to careless handling by the die maker who has really handed a lemon to the hardener.

I have several times noticed that where two workmen completed dies almost similar in shape and made of steel cut from the same bar and given identical heat treatment, that one die would come out perfect or nearly so, while the other would be cracked or warped, sometimes beyond usefulness, and have finally concluded that the greatest element of fault was in the method of the die-maker.

After having drilled within the lines to remove the core, one workman will leave so much wall between the holes that considerable drift work is necessary to break through the wall, while the other will drill so close that no difficulty is found in breaking through.

Then after the core is removed one will use a chisel to level the rough surface to the grooves left from the drill, while the careful one will rough-file to within a reasonable distance of the line, or where large enough he will remove the stock in a shaper.

We will suppose that the one who uses the chisel breaks a piece off beyond the line, or gouged too deep to clean up, and then brings out his "put-on" tool to cover the fault and then grinds or shapes off the top so the scar will not be seen, while the careful one will have filed to the line without touching with a chisel or drift. Now, when both dies are turned over to the hardener they both look alike to him until they come from the quenching bath, when one will be warped if not cracked, and the other will be reasonably straight and solid.

Then the foreman either blames the hardener or condemns the steel, while the die maker will condemn both. But the truth is that the chipping and drifting have practically compressed the steel in places and changed the homogeniety of the mass, so that while heating, distortion took place, and when quenching a tension was caused which destroyed the shape or cracked the die, while the filed die stood a 100 per cent chance of coming out of the bath in good condition.

While we know that some steel is not fit to make a good die, the abolition of the chisel and drift will help even the poor steel, and their use will destroy the chance of good steel and worry the hardener who takes the die at its face value without a knowledge of the previous handling.

Expanding Arbors

By E. A. Dixie

The dimensioned illustrations herewith give the details of expanding arbors from $\frac{3}{4}$ to $1\frac{7}{8}$ in., rising by increments of $\frac{1}{8}$ in. It will be noted that the included angle of the taper for expanding the bushings is 16 degrees. This taper has been found to be entirely satisfactory in practice.

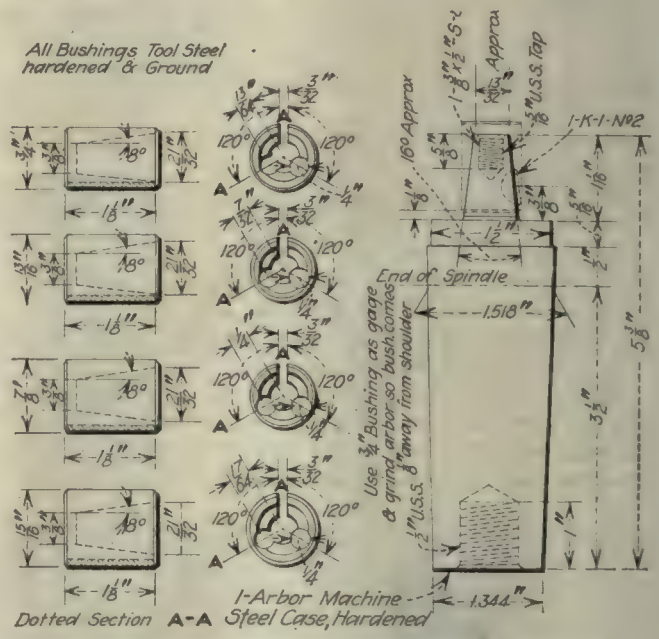


FIG. 1. EXPANDING ARBOR WITH BUSHINGS FROM $\frac{3}{4}$ TO $\frac{1}{8}$ IN.

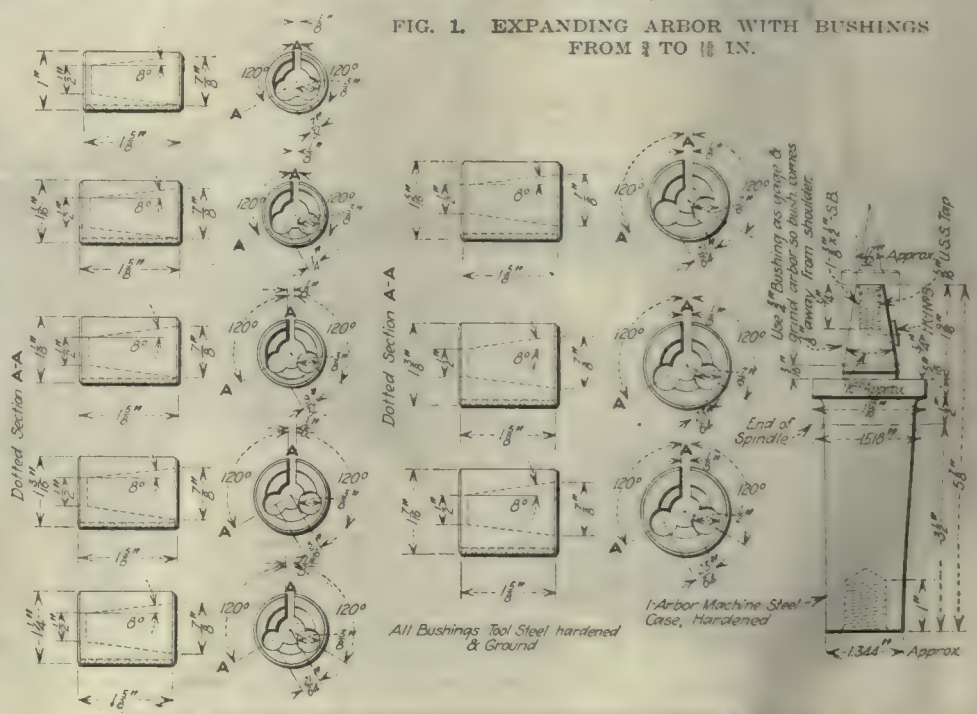


FIG. 2. EXPANDING ARBOR WITH BUSHINGS FROM 1 TO $1\frac{7}{8}$ IN.



IT IS presumed that the welder has a fair knowledge of the different processes of both carbon and metallic arc welding, gained from reading the previous articles or from actual experience. However, we will recapitulate to some extent in order to make everything as clear as possible. Then we shall give some examples of the proper procedure in making welds of various kinds. For the descriptions and drawings we are principally indebted to the Westinghouse Electric and Manufacturing Co., the Lincoln Electric Co., and the Wilson Welder and Metals Co.

XXVIII. Arc Welding Procedure*

Leading up to this article there have been two others, not listed in the series. These are "Training of Arc Welders," Vol. 52, page 837, and "Carbon Electrode Welding and Cutting," page 499. The last article of this series appeared on page 499.

(PART XXVII was published in the Sept. 23 issue.)

In order to prepare the metal for a satisfactory weld, the entire surfaces to be welded must be made readily accessible to the deposit of the new metal which is to be added. In addition, it is very essential that the surfaces are free from dirt, grease, sand, rust or other foreign matter. For this service, a sandblast, metal wire brush, or cold chisel are recommended.

During the past few years great progress has been made in the improvement of steels by the proper correlation of heat treatment and chemical composition. The characteristics of high-carbon and alloy steels, particularly have been radically improved. However, no amount of heat treatment will appreciably improve or change the characteristics of medium and low-carbon steels which comprise the greatest field of application for arc welding. Furthermore, the metal usually deposited by the arc is a low-carbon steel often approaching commercially pure iron. It must be evident therefore that the changes of steel structure due to the arc-welding process will not be appreciable and also that any subsequent heat treatment of the medium- or mild-steel material will not result in improvements commensurate with the cost.

Pre-heating of medium and mild steel before applying the arc is not necessary and will only enable the operator to make a weld with a lesser value of current.

Cast-iron welds must be annealed before machining other than grinding is done in the welded sections. This is necessary because at the boundary between the original cast iron and the deposited metal there will be formed a zone of hard, high-carbon steel produced by the union of carbon (from the cast iron) with the iron filler. This material is chilled quite suddenly after the weld is made by the dissipation of the heat into the surrounding cast iron which is usually at a comparatively low temperature.

Although it is not absolutely necessary to pre-heat cast iron previous to arc welding, this is done in some instances to produce a partial annealing of the finished weld. The pre-heating operation will raise the temperature of a large portion of the casting. When the weld is completed, the heat in the casting will flow into the welded section, thereby reducing the rate of cooling.

The maintenance of the proper arc length for the metallic electrode process is very important. With a long arc an extended surface of the work is covered probably caused by air drafts with the result that there is only a thin deposit of the new metal with poor fusion. If, however, the arc is maintained short, much

*For author's forthcoming book "Welding and Cutting." All rights reserved.

better fusion is obtained, the new metal will be confined to a smaller area, and the burning and porosity of the fused metal will be reduced by the greater protection from atmospheric oxygen afforded by the enveloping inert gases. With increase in arc length, the flame becomes harder to control, so that it is impossible to adequately protect the deposited metal from oxidation.

The arc length should be uniform and just as short as it is possible for a good welder to maintain it. Under good normal conditions the arc length is such that the arc voltage never exceeds 25 volts and the best results are obtained between 18 and 22 volts. For an arc of 175 amp. the actual gap will be about $\frac{1}{8}$ inch.

Manipulation of the Arc

The arc is established by touching the electrode to the work, and drawing it away to approximately $\frac{1}{8}$ in., in the case of the metallic electrode. This is best done by a dragging touch with the electrode slightly out of vertical. The electrode is then held approximately at right angles to the surface of the work, as the tendency is for the heat to go straight from the end of the electrode. This assures the fusing of the work, provided the proper current and arc length have been uniformly maintained.

A slight semicircular motion of the electrode, which at the same time is moved along the groove, will tend

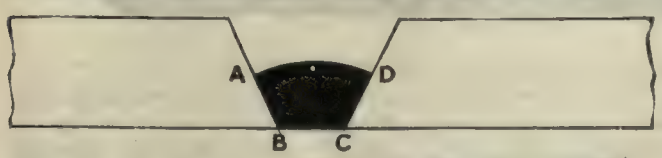


FIG. 336. DIAGRAM ILLUSTRATING FILLING SEQUENCE

to float the slag to the top better than if the electrode is moved along a straight line in one continuous direction and the best results are obtained when the welding progresses in an upward direction. It is necessary in making a good weld to "bite" into the work to create a perfect fusion along the edges of the weld, while the movement of the electrode is necessary for the removal of any mechanical impurities that may be deposited. It is the practice to collect the slag about a nucleus by this rotary movement and then float it to the edge of the weld. If this cannot be done, the slag is removed by clipping or brushing with a wire brush.

Filling Sequence

When making a long seam between plates, the operator is always confronted with the problem of expansion and contraction which cause the plates to warp and produce internal strains in both plates and deposits.

The method of welding two plates together is shown in Fig. 336. The plates are prepared for welding as previously described, and the arc is started at the point *A*. The welding then progresses to the point *B*, joining the edges together, to point *D* and back to *A*. This procedure is carried on with the first layer filling in a space of 6 or 8 in. in length, afterward returning for the additional layers necessary to fill the groove. This method allows the entire electrode to be deposited without breaking the arc, and the thin edges of the work are not fused away as might be the case if the operator should endeavor to join these edges by moving the electrode in one continuous direction. This method also prevents too rapid chilling.
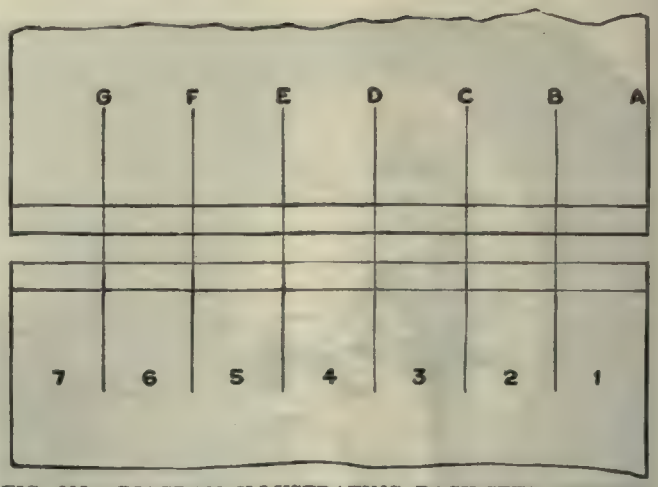


FIG. 337. DIAGRAM ILLUSTRATING BACK-STEP METHOD

When making a long seam weld, for example, a butt weld between two plates, the two pieces of metal will warp and have their relative positions distorted during the welding process, unless the proper method is used.

A method was devised and has been successfully put into operation by E. Wanamaker and H. R. Pennington, of the Chicago, Rock Island and Pacific R.R. By their method the plates are fastened together by light tack welds about 8 in. apart along the whole seam. The operator then makes a complete weld between the first two tacks as described in the preceding paragraph, and, skipping three spaces, welds between the fifth and sixth tacks and so on until the end of the seam is reached. This skipping process is repeated by starting between the second and third tacks and so on until the complete seam is welded. The adoption of this method permits the heat, in a restricted area, to be dissipated and radiated before additional welding is performed near that area. Thus the weld is made on comparatively cool sections of the plates which keeps the expansion at a minimum.

Another method very similar to the preceding one, is known as the back-step method, Fig. 337, in which the weld is performed in sections as in the skipping process. After the pieces are tacked at intervals of 6 in. or less for short seams, the arc is applied at the second tack and the groove welded back complete to the first tack. Work is then begun at the third tack and the weld carried back to the second tack, practically completing that section. Each section is finished before starting the next.

Fig. 338 shows the procedure of welding in a square sheet or patch. Work is started at *A* and carried to *B* completely welding the seam. In order that work may next be started at the coolest point, the bottom seam is completed starting at *D*, finishing at *C*. The

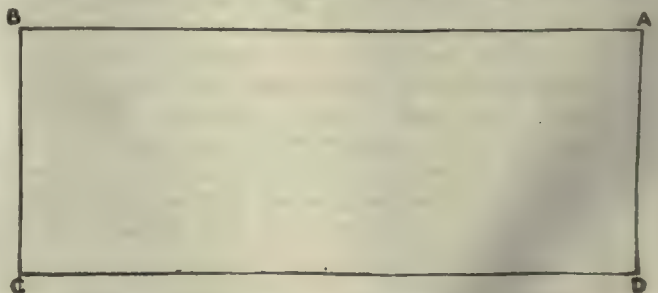


FIG. 338. DIAGRAM ILLUSTRATING SQUARE PATCH METHOD

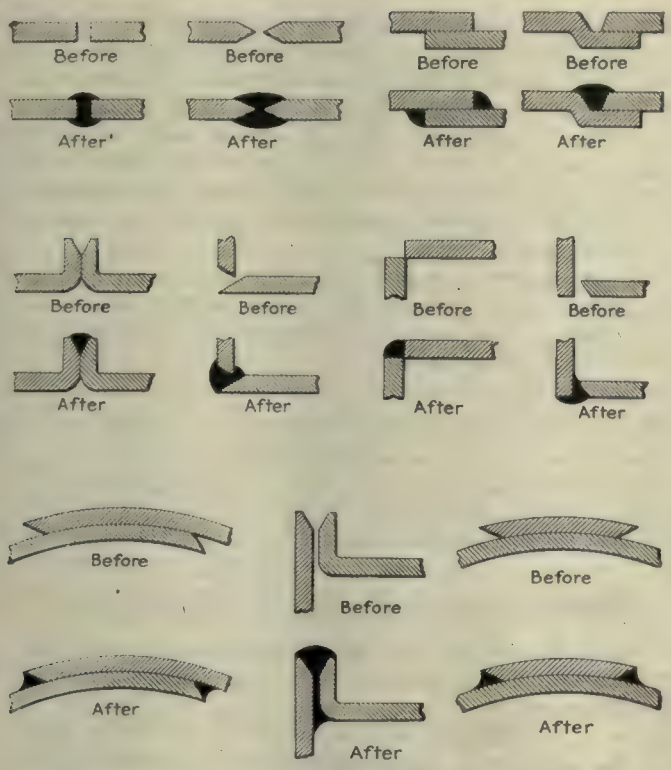


FIG. 339. TYPICAL EXAMPLES OF PREPARED AND FINISHED WORK

next seam is *A* to *D*, starting at *A*. The last seam is finished, starting at *B*, and completing the weld at *C*.

Alternating-Current Arc Welding

Direct current has been used for arc welding because of the fact that it possesses certain inherent advantages that make it especially adaptable for this class of work. However, the use of alternating current for arc welding has found a number of advocates.

When employing this form of energy, use is made of a transformer to reduce the distribution voltage to that suitable for application to the weld.

Inasmuch as the arc voltage is obtained directly from the distribution mains through a transformer, the theoretical efficiency is high compared with the direct-current process which requires the introduction of a motor-generator or resistor or both. The efficiency of the a.c. equipments now on the market ranges from 60 to 80 per cent. The transformer, however, is designed to have a large leakage reactance so as to furnish stability to the arc, which very materially reduces its efficiency when compared with that of the standard distribution transformer used by lighting companies.

It is difficult to maintain the alternating arc when using a bare electrode though this difficulty is somewhat relieved when use is made of a coated electrode.

Quasi Arc Welding

The electrodes used in quasi arc welding are made by the Quasi Arc Weldtrode Co., Brooklyn, N. Y., and are known as "weldtrodes." A mild-steel wire is used with a very small aluminum wire running lengthwise of it. Around the two is wrapped asbestos thread. This asbestos thread is held on by dipping the combination into something similar to waterglass. Either a.c. or d.c. may be used, at a pressure of about 105 volts, with a suitable resistance for regulating the current. The company's directions and claims for this process are: "The bared end of the weldtrode, held in a suitable holder, is connected to one pole of the current supply by means of a flexible cable, the return wire being connected to the work. In the case of welding small articles, the work is laid on an iron plate or bench to which the return wire is connected. Electrical contact is made by touching the work with the end of the weldtrode held vertically, thus allowing current to pass and an arc to form. The weldtrode, still kept in contact with the work, is then dropped to an angle, and a quasi-arc will be formed owing to the fact that the special covering passes into the igneous state, and as a secondary conductor maintains electrical connection between the work and the metallic core of the weldtrode. The action once started, the weldtrode melts at a uniform rate so long as it remains in contact, and leaves a seam of metal fused into the work. The covering material of the weldtrode, acting as a slag, floats and spreads over the surface of the weld as it is formed. The fused metal, being entirely covered by the slag, is protected from oxidation. The slag covering is readily chipped or brushed off when the weld cools, leaving a bright clean metallic surface. In welding do not draw the weldtrode along the seam, as it is burning away all the time, and therefore it is only necessary to feed it down, but do this with a slightly lateral movement, so as to spread the heat and deposited metal equally to both sides of the joint. Care must be taken to keep feeding down at the same rate as the weldtrode is melting. On no account draw the weldtrode away from the work to make a continuous arc as this will result in putting down bad metal. The

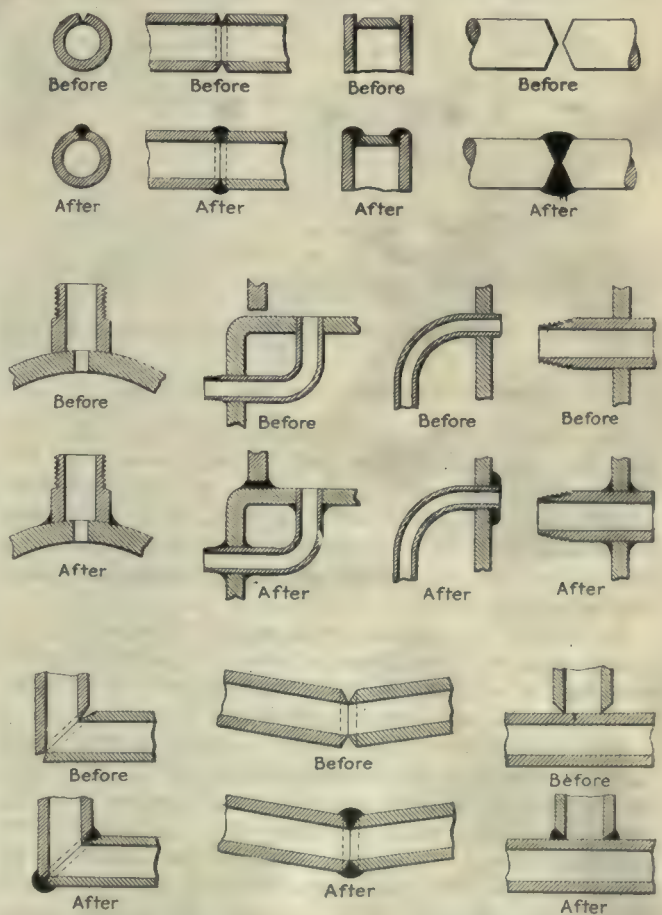


FIG. 340. EXAMPLES OF TUBE WORK

aim should be to keep the point of the weldtrode just in the molten slag by the feel of the covering just rubbing on the work. By closely observing the operation, the molten metal can easily be distinguished from the molten slag, the metal being dull red and the slag very bright red.

The weldtrodes are supplied ready for use in standard lengths of 18 in., and of various diameters, according

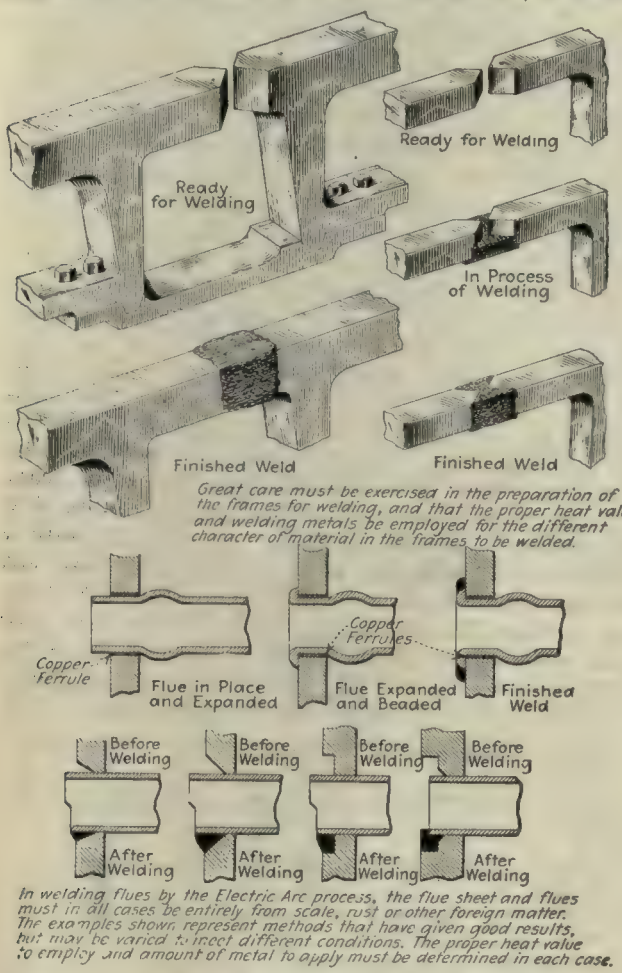


FIG. 341. EXAMPLES OF ELECTRIC WELDING OF LOCOMOTIVE FRAMES AND BOILER TUBES

to the size and nature of the work for which they are required.

Typical Examples of Arc Welding

The examples of welding shown in Figs. 339, 340 and 341 are taken from the manual issued by the Wilson Welder and Metals Co. They will be found very useful as a guide for all sorts of work. Fig. 339 shows miscellaneous plate or sheet jobs, Fig. 340 shows tube jobs, while Fig. 341 gives examples of locomotive-frame and boiler-tube welding.

As a basis for various welding calculations the following data will be found of use: On straight-away welding the ordinary operator with helper will actually weld about 75 per cent of the time.

The *average* results of a vast amount of data show that an operator can deposit about 1.8 lb. of metal per hour. This rate depends largely upon whether the work is done out in the open or in a special place provided in the shop. For outside work such as on boats, an operator will not average in general more than 1.2 lb. per hour, while in the shop the same operator could easily deposit the 1.8 lb. stated above. This loss in speed for outside work is brought about largely by the cooling action of the air and also somewhat by the added inconvenience to the operator. The value of pounds per hour given above is based on the assumption that the work has been lined up and is ready for welding. On the average 70 per cent of the weight of electrodes is deposited in the weld, 12 per cent is burned or vaporized and the remainder 18 per cent is wasted as short ends.

Other figures prepared by the Electric Welding Committee show the possible cost of a fillet weld on a ½-in. plate, using a motor generator set and bare electrodes to be as follows:

Average speed of welding on continuous straight away work	5 ft. per hour
Amount of metal deposited per running foot	.6 lb.
Current 150 amps, at 20 volts = 3 kilowatts.	
Motor generator eff. 50 per cent = 6 kw. ÷ 5 equals	1.2 k.w.h. per 1 ft. run
1.2 k.w.h. at 3 cents per k.w.h. equals	3.6 cents per ft.
Cost of electrode 10 cents per pound and allowing for waste ends, etc., equals	7.2 cents per ft.
Labor at 65 cents per hour equals	13.00 cents per ft.
	23.8 cents per ft.

Suggestions for the Design of Welded Joints

From an engineering point of view, every metallic joint whether it be riveted, bolted or welded, is designed to withstand a perfectly definite kind and amount of stress. An example of this is the longitudinal seam in the shell of a horizontal fire-tube riveted boiler. This joint is designed for tension and steam tightness only and will not stand even a small amount of transverse bending stress without failure by leaking. If a joint performs the function for which it was designed and no more, its designer has fulfilled his responsibilities and it is a good joint economically. Regardless of how the joint is made the design of joint which costs the least to make and which at the same time performs the functions required of it, with a reasonable factor of safety, is the best joint.

The limitations of the several kinds of mechanical and welded joints should be thoroughly understood.

A bolted joint is expensive, is difficult to make steam- or water-pressure tight, but has the distinguishing advantage that it can be disassembled without destruction. Bolted joints which are as strong as the pieces bolted together are usually impracticable, owing to their bulk.

Riveted joints are less expensive to make than bolted joints but cannot be disassembled without destruction to the rivets. A riveted joint, subject to bending stress sufficient to produce appreciable deformation, will not remain steam-or water-pressure tight. Riveted joints can never be made as strong as the original sections because of the metal punched out to form the rivet holes.

There is no elasticity in either riveted, bolted or fusion-welded joints which must remain steam- or water-pressure tight. Excess material is required in the jointed sections of bolted or riveted joints, owing to the weakness of the joints.

Fusion-welded joints have as a limit of tensile strength the tensile strength of cast metal of a composition identical to that of the joined pieces. The limit of the allowable bending stress is also set by the properties of cast metal of the same composition as that of the joined pieces. The reason for this limitation is that on the margin of a fusion weld adjacent to the pieces joined, the metal of the pieces was heated and cooled without change of composition.

Whatever properties the original metal had, due to heat or mechanical treatment, are removed by this action, which invariably occurs in a fusion weld. Regardless of what physical properties of the metal used to form the joint may be, the strength or ability to resist bending of the joint, as a whole, cannot exceed the corresponding properties of this metal in the margin of the weld. Thus, assuming that a fusion weld be made in boiler plate, having a tensile strength of 62,000 pounds. Assume that nickel-steel, having a tensile strength of 85,000 lb. be used to build up the joint. No advantage is gained by the excess 23,000 lb. tensile strength of the nickel-steel of the joint since the joint will fail at a point close to 62,000 lb. If appreciable bending stress be applied to the joint it will fail in the margin referred to.

The elastic limit of the built-in metal is the same as its ultimate strength for all practical purposes, but the ultimate strength is above the elastic limit of the joined sections in commercial structures.

In spite of the limitations of the fusion-welded joint it is possible and practicable to build up a joint in commercial steel which will successfully resist any stress which will be encountered in commercial work.

Strength Factor of Welded Joint

The fundamental factor in the strength of a welded joint is the strength of the material added by the welding process. This factor depends upon the nature of the stress applied. The metal added by the welding process, when subject to tension, can be relied on in commercial practice to give a tensile strength of 45,000 lb. per square inch. This is an average condition; assuming that the metal added is mild steel and that the operation is properly done, the metal will have approximately the same strength in compression as in tension. When a torsional stress is applied to a welded joint the resultant stress is produced by a combination of bending, tension and compression, as well as shear. The resistance of the metal to shear may be figured at $\frac{8}{10}$ its resistance to tensile stress. The metal added by the welding process, with the present development in the art of welding, will stand very little bending stress. A fusion-welded joint made by the electric-arc process must be made stiffer than the adjacent sections in order that the bending stress shall not come in the joint. An electric weld, when properly made, will be steam- and water-pressure tight so long as bending of members of the structure does not produce failure of the welded joint.

Little is known at the present time in regard to the resistance of an electrically welded joint to dynamic stress, but there is reason to believe that the resistance to this kind of stress is low. However, owing to the fact that in most structures there is an opportunity for the members of the structure to flex and reduce the strain upon the weld, this inherent weakness of the welded joint does not interfere seriously with its usefulness.

A few tests have been made of high-frequency alternating stresses and it has been found that using the ordinary wire electrode the welded joint fails at a comparatively small number of alternations, This is of little importance in most structures since high-frequency alternating stress is not often encountered.

The accompanying cuts show a number of typical joints and the arrows indicate the stresses brought to bear on them. The proper way to weld each example is plainly shown.

In *A*, Fig. 342, it will be noted that a reinforcing plate is welded to the joint to make the joint sufficiently stiff to throw the bending outside the weld.

B shows a joint in straight tension. Since no transverse stress occurs the heavy reinforcing of *A* is

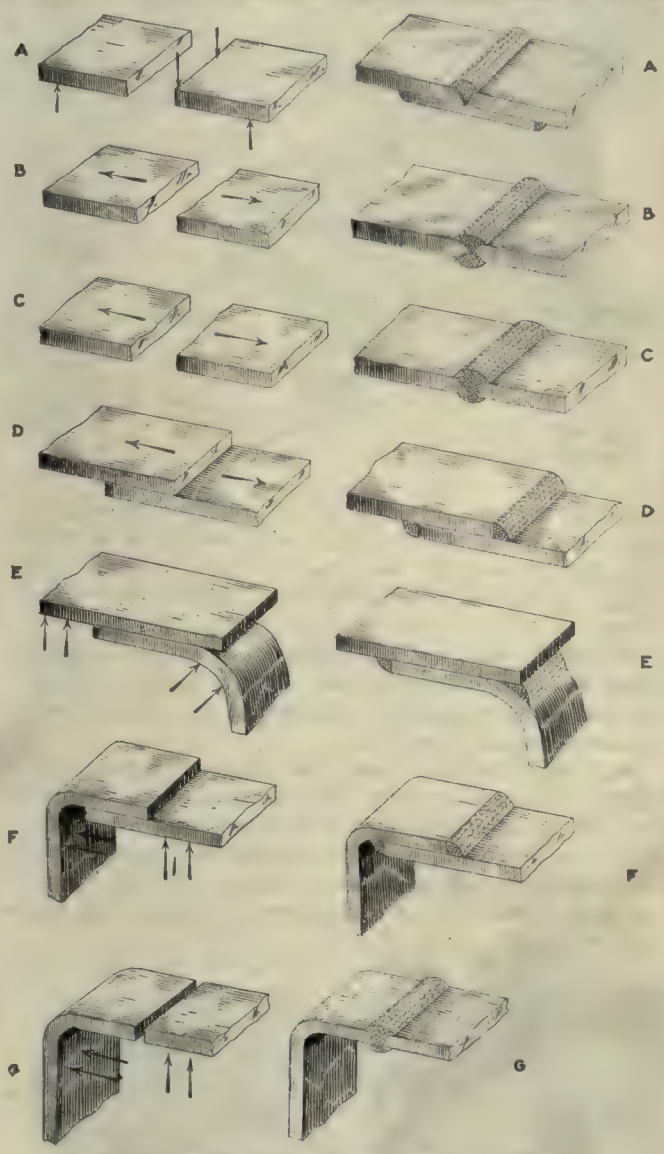


FIG. 342. JOINTS DESIGNED TO OVERCOME CERTAIN STRESSES

not required. Just enough reinforcing is given the joint to make up for the deficiency in tensile strength of the metal of the weld.

C shows another method of building up a joint that is in straight tension. It should be noted that in both *B* and *C* as much reinforcing is placed on one side of a center line through the plates as is placed on the other.

The original form of lap joint such as is used in riveting is shown at *D*. The method shown for welding this joint is the only method which can be used. It cannot be recommended because such a joint, when in straight tension, tends to bring the center line of the plate into coincidence with the center line of the stress. In so doing an excessive stress is placed on the welded material.

E shows the construction used in certain large tanks

where a flanged head is backed into a cylindrical shell. The principal stress to be resisted by the welded joint is that tending to push the head out of the shell. The welding process indicated in the figure will successfully do this. Owing to the friction between the weld and the shell, the outer weld would be sufficient to hold the weld in place for ordinary pressure. For higher pressures the inside weld should be made in addition.

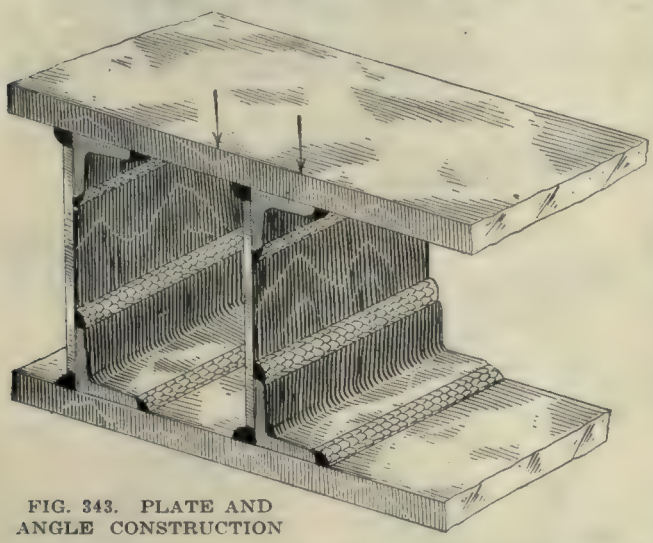


FIG. 343. PLATE AND ANGLE CONSTRUCTION

F and *G* show another method of welding a flanged head to the cylindrical shell. These methods are preferable to the method indicated in *E*. *G* represents the recommended practice.

Fig. 343 shows a plate and angle structure which might be used in ship construction. The particular feature to notice in the welding practice indicated, is that the vertical plates do not reach the entire distance between the horizontal plates. This is merely a method of eliminating difficulties in welding the plates to the angle.

A in Fig. 344 shows a method of welding a head into a cylindrical pipe. The thickness of the head should be approximately twice the thickness of the wall of the pipe. The extra thickness plate is to gain sufficient stiffness in the head to make the stress on the welded material purely shear. The pressure from the inside tends to make the head assume a hemispherical shape. This would place a bending stress on the welded material if the head were thin enough to give at the proper pressure.

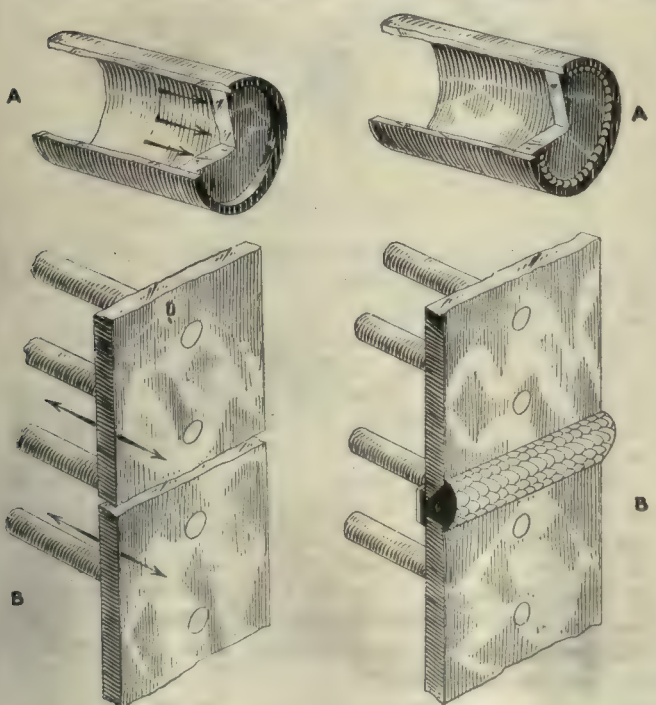


FIG. 344. PIPE HEADING AND FIREBOX SHEET WORK

B shows a method of welding a crack in a fire-box sheet. The thin plate backing introduced at the weld makes the operation very much easier for the operator and produces the reinforcing of the water side of the fire-box sheet which is most desirable.

Section Moduli of Rectangles

By H. M. Shandles

Referring to the article, under the above title by John S. Watts, on page 410 of the *American Machinist*:

The last paragraph of his article indicates that the section modulus of the hollow rectangular section may be obtained from the chart by deducting from the section modulus of the outside rectangle, the section modulus of the interior rectangle. This is seen to be incorrect, because the formula $(BH^3 - bh^3)/6H$ gives the correct section modulus, while the method proposed would give a result $BH^3/6H - bh^3/6h$ which is not the section modulus of a hollow rectangle.

If Mr. Watt intends this as an approximate method only, the results will vary from the exact, an amount depending on the values of h and H.

To illustrate, assume a rectangle of outside dimensions 10 x 4 in. and inside dimensions 8 x 2 in. From the chart 66 — 21 = 45 is the section modulus; from the formula 49.6, showing that in this case the method is approximate within 10 per cent.

Recognition of Individuality in the Shop

The Bullard Machine Tool Co., Bridgeport, Conn., has been a leader in all questions relating to personal relations with the men, and as a result this company has a remarkable spirit of loyalty and co-operation. The latest development is a distinct novelty and one which should have a good effect in promoting individual initiative and increasing the feeling of responsibility.

When the men returned from their week's vacation (with pay) early in September, they found a neat brass frame attached to each machine, containing a waterproof and oil-resisting card as shown herewith.

THIS MACHINE IS IN CHARGE OF

.....

WHO, AS A MATTER OF PERSONAL PRIDE IN FURTHERANCE OF THE BULLARD SQUARE DEAL POLICY, UNDERTAKES TO KEEP IT CLEANED, WELL OILED AND IN FIRST CLASS CONDITION; AND TO IMMEDIATELY REPORT TO HIS FOREMAN ANY INDICATION OF UNDUE WEAR OR REQUIRED REPAIRS.

This is another step away from the plan where men are known only by numbers.

This is a recognition of individuality and a placing of responsibility which cannot fail to further the harmonious relations which already exist.



A HOME FOR APPRENTICES

By Fred H. Colvin
Editor American Machinist

Perhaps nothing indicates our change in attitude of mind regarding the interdependence of the shop and community life more than the work which is being done to secure proper housing and in other ways improve living conditions. A move in this direction by the Brown & Sharpe Manufacturing Co. marks another step in the march of industrial progress.

THE desire to secure home-like surroundings for the apprentices who come from other localities has prompted the Brown & Sharpe Manufacturing Co. of Providence, R. I., to establish what is known as the Apprentice House in the neighborhood of its plant. While this is in a way a partial return to the old method of having the apprentice live with the proprietor, as was very common in the old days of the small shop, it differs in that it is a real community house, accommodating 27 apprentices and being much more comfortable in every way than the home of the average shop proprietor of fifty years ago.

The building, as shown in the headpiece, is a substantial three-story house and is in a good residential section even though it is only a few blocks from the shop. The ground floor contains the housekeeper's apartment, a large and cheerful living room with an adjoining closed-in sun porch and two sleeping rooms. There are a few single rooms as shown in Fig. 1, but the majority have two or three cots which are extra wide and provided with excellent springs and mattresses. Each boy has his own chiffonier even where the room is occupied by two or three, and suitable chairs and writing tables are provided for those who wish to read, study or write. The living room is shown in Fig. 2, the endeavor being to make it homelike in every way, to have no artificial restrictions and to have every boy feel as though he were at home and to conduct himself accordingly.

The boys have a Victrola, a supply of magazines, and through the extension service of the Providence Public Library, a supply of good wholesome reading matter of various kinds is constantly provided.

The lavatory has been fitted with special regard for neatness and sanitation, a corner being shown in Fig. 3. Shower baths are provided, and both bath and hand towels are supplied. These, together with the bedding, are taken care of by an electrically equipped laundry in the basement.

The house is under the supervision of the Apprentice Department, but is directed by a responsible housekeeper and an assistant. There are no set rules, the boys being simply asked on coming into the house to do as they would in their own homes. No meals are served, this being made unnecessary on account of nearby boarding houses of good quality. The charges are very low compared with the price asked for similar accommodations elsewhere.

The effect of such living conditions cannot fail to be beneficial and, in connection with the training received in the apprenticeship course, tends to promote the dis-



FIG. 1. ONE OF THE ROOMS



FIG. 2. THE LIVING ROOM



FIG. 3. THE LAVATORY

cussion of mechanical and other shop matters which cannot fail to broaden the viewpoints of the boys fortunate enough to be housed in this way. Such association, coupled with a kindly but not a patronizing interest, is bound to awaken a real shop spirit and to promote the team work which is so desirable in every way. Other homes of this kind will be established as the need for them grows.

Tap-End Sizes of Studs

By W. D. FORBES

The question as to the proper size, shape and fit of the tap-ends of studs has long been discussed from many angles. This article sets forth the views of one who has had many years' experience in the use of studs on a varied line of machines.

IN THE very interesting article on "Tap-End Sizes of Studs" on page 773, vol. 52, of the *American Machinist*, the table of sizes given is well worth a year's subscription to that paper.

I think the use of the wording "tight joint" is misleading when used as it was in connection with the fit of a stud. A tight joint in the minds of most engineers suggests at once a joint which prevents the escape of a gas, fluid, or vapor. There is nothing in a stud that conveys this idea and I should say the proper word to use is "fit," when talking about how a stud is held by its tap end.

A stud is used to hold pieces together. A bolt or capscrew will do this as well as a stud, but a bolt is not always admissable nor proper to employ and a capscrew would possibly injure or destroy an expensive part of a machine by wearing out the tapped thread.

The tap-end of the stud, often called the steam end, is made large, not to make a tight joint but a tight fit, in order to prevent the stud backing out when the nut is cast loose and there is no idea of making the fit steam-tight. There seems to be a reason for making the tap-end of a stud square and chamfering it, as to round it would take a little more length of material and as studs are made in large numbers this would add to the cost. Then, too, the chamfer makes it easier to enter the stud. The rounded end gives a nice finish, but I fail to see why the assertion in the article referred to—that the round end is easier to finish than the square end—is true. I have made thousands of studs and if the tool for parting or cutting off and chamfering was properly made, I found it a very simple job. I think perhaps the idea that the rounded end is easier to finish arises from the fact that the end is usually rounded during the cutting-off operation, so it appears to be a simpler job than cutting off and then chamfering.

A stud is made up of a steam end, cut large and of standard length, a land or plain part of varying length, and the nut end threaded to a somewhat greater length than standard, and the end rounded. To make a stud the following operations must be carried out in either an automatic or hand-screw machine. The end of the rod is cut off and chamfered with a single cross-feed tool, the tap-end thread cut, and then the stud cut off. The partly finished stud is screwed into a carrier or threaded chuck and the nut-end rounded and threaded.

Sometimes the rounded end is polished in the screw machine while at other times it is polished elsewhere. If the stud is not screwed into a carrier it is held by the land.

Now we know that a chain is no stronger than its weakest link, so a stud is no stronger than the cylinder of metal encircled by the bottom of the thread, not going into niceties.

This being so, the land between the threads adds no strength and it is only there as a matter of habit; we have always made studs that way, so we keep to it. The only value of the land is that it saves a certain amount of threading.

I put the question "Why have a large tap-end and a land at all?"

If the stud was rounded on one end, the entire length

threaded and the other end cut off with a chamfer, we would have a cheaper stud and one just as serviceable. The thread being continuous, both ends would be in line. But some one will ask, "How are you going to make a tight fit on the tap-end with such a stud?" That presents no difficulty whatever, as all that has to be done is to tap the hole for the stud with a tap which is undersize and a tight fit then can be made. But there is another way of making a straight stud tight which I will describe later.

This stud of one continuous thread of one size has but one objection, a little more threading would have to be done, but that is made up by the advantage of fewer operations. Of course, the objection which will count most against it is that it does not look right and we are not used to it. As a matter of fact, a stud is not noticed very much. When it is holding a cylinder head in place no one can tell if there is a land between the threads or not; when it is off, the cylinder head is usually wanted back in a hurry and few notice the studs. The only persons, then, who have a good look at the studs are those who set them, and they care very little nowadays what a stud looks like. Of course, a continuously threaded stud would not be advisable if the stud was very long, but for all such studs as are used about engine work I fail to see any objection to its general use.

The taper thread as suggested in the article referred to does not please me for general use. Such a thread is admirable for making a tight joint but I believe its use on stud work would not be as quick, and the tapping of the taper holes would be more troublesome.

A taper tap cuts harder and I have not found that it keeps its size any better, or as well, as a straight threaded tap. It is evident that a stud anchored by a taper thread, if slacked back even a very slight amount, would be all adrift at once. There are places, however, where the taper-end stud should be used and that is where the hole is tapped through, and even in such a position a straight-thread stud could be used if riveted over. The manufacturer of studs who gave the information as to stud making advocates the use of taper tap-ends of studs, yet I notice he states "That the first two or three threads are quite apt to be tapering." This is so, because the fit of the die in the machine is not always perfect, and from other causes. On the tap-ends these partly taper-threads are an advantage as they make it easier to enter the studs in the holes. Another statement which goes to show that one person never has all the experience there is gives the idea that a rounded end on a stud indicates a finger fit for the nut. No one who has had anything to do with studs would be likely to get confused as to which end of the stud was the tap-end, even if there were no chamfered or rounded ends, for the length of the threads (as studs are now made) would show which was which. I think nearly all engineers will say the rounded end is a neater finish than a square one but that it indicates nothing at all as to the fit of the nut.

The *American Machinist* asks the pertinent question, whether the stud should be tight on all the threads on the tap end or be made tight by bringing up on the last thread. Answering this question, I say that the threads should all fit and the stud bring up on the bottom of the tapped hole. This bottoming forces the threads into contact on their upper faces, making a good fit.

The present drill press, properly set and handled, allows a fixed depth of hole to be obtained and maintained without great skill or trouble, and the tapping attachment gives uniform results.

I have had experience in this and know that it is possible to carry out the work as I have outlined, and that a cheaper final result is obtained. If the stud is brought up on the last thread, the top thread in the cylinder, or whatever the piece may be, may be cracked off and lifted up somewhat and a sloppy looking job made of it. The tendency of the stud to be tapered for two or three threads lends itself to bottoming the stud in the hole, as can be well understood by the practical stud setter.

After all has been said and done, I have gone back in my memory and fail to recall ever having had any trouble with studs. One of the companies named in the article in question made studs and screws for me for many years and I never had to complain of any of the work. It has been a source of wonder to me how this company kept so closely to my demands and those of others, and I may add that the taps now on the market keep to standard size in a way that is a matter of astonishment to me, and the very small price asked for taps shows how well their manufacture is conducted.

In all my experience I have never found a machinist's tap in which the threads were eccentric to the shank, as is hinted at in the article.

We can count on having our stud holes tapped to a very close standard if we use our taps properly, and we can also depend on the studs we order being close to size. We have had little to complain of in the past and have little to fear in the future if stud making is carried on just as it has been. The change I propose, of a continuously threaded stud, could only improve matters by being a cheaper product, while the taper tap-end stud neither cheapens nor improves stud making.

How Can We Increase Production?

By Otto Vogetzer

The article under the above head, on page 358 of the *American Machinist*, is both timely and wise. Only the inefficient gain by collective bargaining; the efficient are left without inducement to give the best that is in them, and it is unfair to both sides. Few employers care to deal with a second or third party or go-between, they want to hear from the men direct. The former method creates discord whereas the latter tends to bring both parties closer together. On the other hand how do the men know whether or not their case is properly presented by an outsider?

Collective bargaining may be all right for lines of work that require little or no skill, but it certainly must fail miserably when applied to a trade that has practically no limit for the advancement of individuals who care to make use of the opportunities offered.

"All men are born equal" is not to be interpreted that we should all have equal shares in the distribution of wealth, it means that our shares are to be in direct proportion to our efforts. I believe that those who contrive to get more than their share are the exception rather than the rule. Take away the individual and special compensation, what is left? Certainly nothing that will induce men to produce more.

The survival of the fittest and the elimination of the weakest (and fire the dubs) holds good in the shop as well as in nature. There is no way of getting around that—it is an established truth.

The Calibration of Dimensional Changes of Precision Gage Blocks

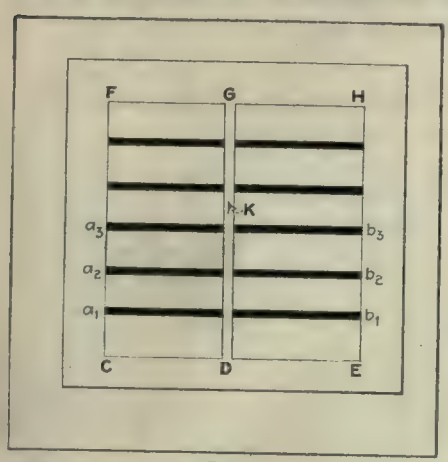
By C. G. PETERS and H. S. BOYD
U. S. Bureau of Standards

(Continued from last week's issue)

THE accurate comparison of two gages, *A* and *B*, Fig 11, front, of supposedly the same length, is made by the following method: The two gages are placed side by side in intimate contact, as described before, with the true plane surface of a glass plate *W*. This places the lower surfaces of the two gages in the same plane and the problem is then simply to determine the distance between the planes of the two upper surfaces. This is done by placing a test plate *T* in contact with the gages along the line *CDE* and somewhat inclined to these surfaces. This gives side by side two thin wedge-shaped films. When illuminated and viewed. as shown in Fig. 7, two sets of straight fringes parallel to the edge of the wedge are seen—see top view, Fig. 11. It is only necessary then to determine the difference in thickness of these films at say some adjacent position *K*, to obtain the distance at that point between the planes of the two gage surfaces. If the two gages are of the same length, their upper surfaces will lie in the same plane, so when we pass to the thicker part of the wedge from the line of contact *CDE*, the first fringe a_1 on A will coincide with the first fringe b_1 on *B*, the second with the second, etc. At the point *K* there is coincidence between the third fringes on the two gages. For perpendicular view the thickness of the film at any point is given by equation (2)

$$T_o = N\tfrac{1}{2}(\lambda)$$

In this case the distance T_o from the test plate to each gage would be $\frac{1}{2}(3\lambda)$ at point *K* which means that gages are of equal length. Suppose the gages are unequal in length, say *B* is shorter than *A*. The test plate will come in contact with *A* at the point *D* and with *B* at the point *E*, and the fringes appear, say as in Fig. 12. At *K* we have the second fringe over *A* coinciding with the fourth over *B*. The distance at that point between the test plate and *A* is $\frac{1}{2}(2\lambda)$ and between the test plate and *B* is $\frac{1}{2}(4\lambda)$. Therefore, the distance between the planes of the two gage surfaces is $\frac{1}{2}(2\lambda)$. If we are using a helium lamp for a source $\frac{1}{2}(\lambda)$ is about 0.000011 in., hence, *B* is about 0.00002 in. shorter than *A*. If *A* is a calibrated standard we immediately have the length of the unknown gage *B*. By estimating the displacement of the fringes to one or two tenths of the distance between two bands, measurements of still greater refinement can be made.



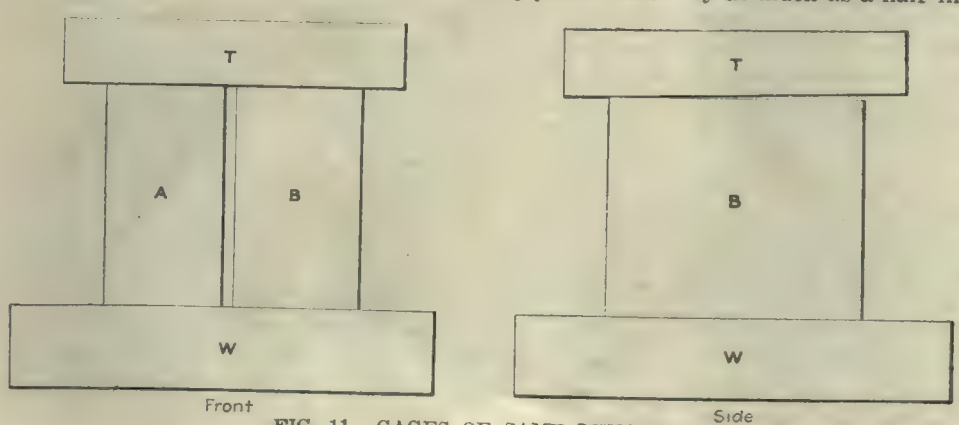


FIG. 11. GAGES OF SAME LENGTH

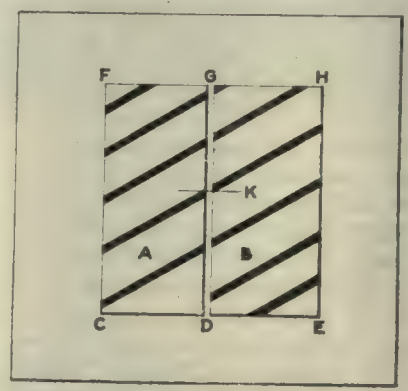


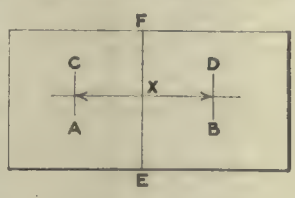
FIG. 12. GAGES OF UNEQUAL LENGTHS

Angle of View in Comparing Gages

Comparisons of this kind cannot be advisably made beyond the point where the tenth or fifteenth fringe of one gage coincides with the first of the other, that is, when the difference in length of the two gages exceeds ten or fifteen hundred-thousandths of an inch. In making these measurements it is absolutely essential that the fringes be viewed as shown in Fig. 7, that is along the perpendicular to the gage surfaces. If they are viewed at an angle to the perpendicular, then T_o is not equal to $\frac{1}{2}(N\lambda)$ but $T_o = N\frac{1}{2}(\lambda)\sqrt{1 + \tan^2\alpha + \tan^2\theta}$ so an incorrect interpretation of the distance will be made.

With the aid of the Pulfrich instrument previously referred to, comparison between two gages that differ by as much as a half inch in length may be made. With this, the exact number of waves between the test plate and each gage surface near the reference mark *K* is obtained by measuring the fractional excess over a whole wave length for each of a number of different colors and determining from these the number of whole wave lengths by the method of Meggers, which holds for straight fringes as well as Haidinger's rings. With this method the exact length of gages up to a half inch in

length may be obtained. In carrying out this measurement a plane steel surface is used for a baseplate and the distance from the test plate to the baseplate on the one hand and to the upper gage surface on the other determined. The difference in these distances is the length of the gage. The test for parallelism of the two surfaces of the unknown gage *B* is made along with the length comparison using the same arrangement as shown in Fig. 11. Assuming that the two surfaces of the standard *A* are plane and parallel, the test plate brought in contact with it along *CD* gives straight fringes over *A* which are parallel to *CD* and equally spaced. If the upper surface of the gage *B* is parallel to the plane of the upper surface of A, the fringes over *B* will be parallel to those over *A* and have the same spacing. If, however, the length of *B* at *GH* is less than at *DE*, then the wedge over *B* will be steeper than over *A* and the fringes closer together. Therefore, if seven fringes are observed over *B* and five over *A*, as in Fig. 13, *GH* is $\frac{1}{2}(2\lambda)$ below *DE* or the gage is about 0.000022 in. shorter on the *GH* side than on the *DE* side. Suppose now that the edge *GD* on *B* is parallel to the plane of the upper surface of *A* and the surface of *B* slopes slightly so that *HE* is above or below *GD*. Since the fringes lie along lines of equal thickness of the wedge, they will extend across *B* at an angle to those over *A*. If *HE* is higher than *GD* they will be deflected toward the open end of the wedge or toward *H* as shown in Fig. 14. If *HE* is below *GD* the fringes on *B* will be deflected toward the thin edge of the wedge or toward *E*, in Fig. 15. If we draw a line *KL* parallel to *CE* through the end of any fringe over *B*, the displacement from *KL* of the other end of that fringe divided by the distance between two consecutive fringes gives the difference in height between *GD* and *HE* in half wave lengths. This gives the slant between the upper surface of *A* and the upper surface of *B*. If the two surfaces of *A* are perfectly parallel, it is the slant between the two surfaces of *B*. If the two surfaces of *A* are not parallel a corresponding correction must be made to the observed slant to obtain the true slant between the surfaces of *B*. The slant between the two faces of each of three unknown gages *B*, *C*, and *D* may be accurately determined in the same way if they are brought in contact with the baseplate two at a time, and the slant between the two upper surfaces compared as described above.



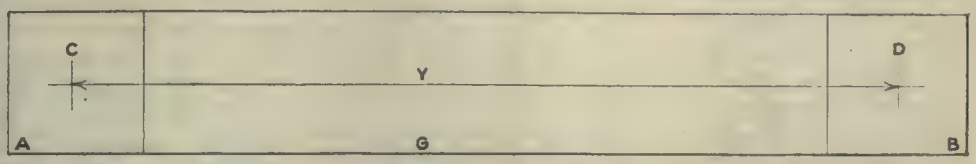


FIG. 16. CALIBRATING END STANDARDS FROM LINE STANDARDS

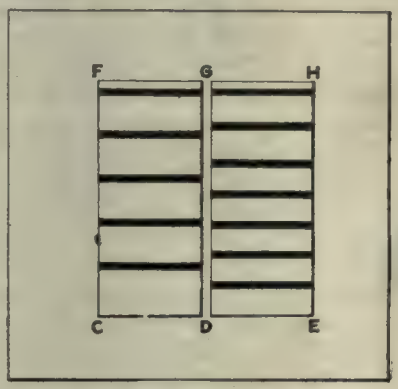


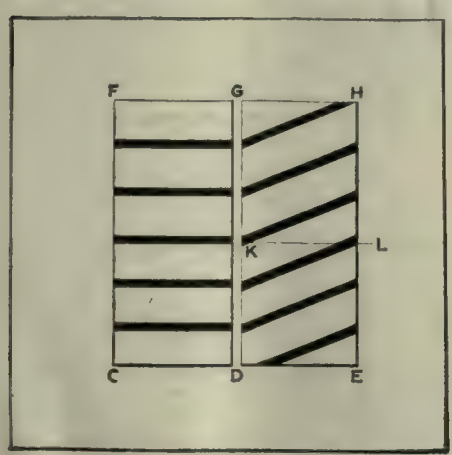
FIG. 13. GAGES HAVING PARALLEL SURFACES

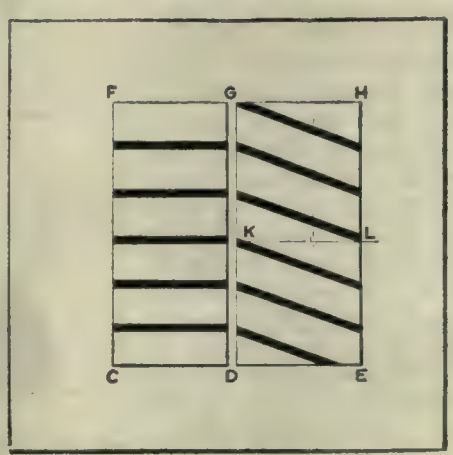
The slope of the two surfaces of *B* can also be determined by measuring the perpendicular distances between them say at the middle of all four side faces of *B* by bringing them successively contiguous to *A* at the point *K*.

Calibration of End Standards from Line Standards

Having established the fact that two plane surfaces can be brought into contact so that the separation is less than one millionth of an inch, and having the interference method for comparing two gages of nearly equal length, it is possible to calibrate end standards of various sizes from a line standard. The arrangement[10, 11] is shown in Fig. 16. Two gages *A* and *B* are brought into close contact, and two fine lines, *C* and *D*, are ruled on them parallel to their plane of contact, *EF*. The distance *X* between the line *C* and *D* is determined by comparison with the line standard. *A* is then brought into contact with one surface of the long gage G which is to be calibrated, with *B* with the opposite surface of *G*.

The distance, *Y*, between the two lines *C* and *D* is again determined by comparison with the line standard. The difference in the two distances $(Y - X)$ gives the length of the gage *G* in terms of the line standard. With careful work the error in determining the length of *G* should not be more than 0.00002 in. which is about 0.000003 in. per inch in case *G* is 6 in. long. After the length of *G* has been accurately determined by comparison with the line standard or by direct measurement with the light waves, combinations of shorter gages can be compared with it by using the interference comparator as follows. Suppose *G* is 6 in. long, and we have three gages, *A*, *B*, and *C*, each very nearly 3 in. in length.





FIGS. 14 AND 15. GAGES WITH SURFACES NOT PARALLEL

[10] Fischer, Phil. Soc., Wash., Bulletin, Vol. 13, p. 241; 1898.

[11] Perard, C. R., Vol. 154, p. 1586: 1912.

G is brought into contact with the plane baseplate W, Fig. 17; B is also placed in contact with W, and A with the upper surface of B. The difference, a, in the lengths of G and the combination of A and B is obtained from the relative displacement of the interference fringes as previously described. The length of A and B is equal to $G + a$. In the same way the b between the combined lengths of $B + C$ and that of G is obtained; likewise c for gages $C + A$.

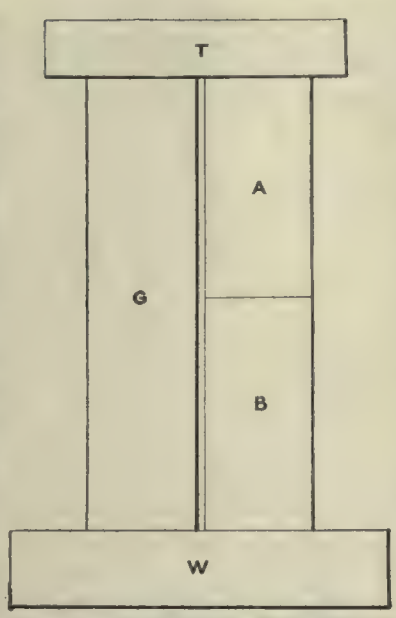


FIG. 17. COMPARING TWO SHORT GAGES WITH ONE LONG GAGE

Letting the designations of the gages also represent their lengths we have

$$A + B = G + a$$
$$B + C = G + b$$
$$C + A = G + c$$

where G is the known length of the standard, and a, b, c, are measured. These equations can be solved readily for the unknowns, A, B, and C. Similarly with four gages, A, B, C, and D, each nearly 2 in. long, we would have

$$A + B + C = G + a$$
$$B + C + D = G + b$$
$$C + D + A = G + c$$
$$D + A + B = G + d$$

Since the four independent simultaneous equations contain four unknowns, the length of each unknown gage can be computed.

In general, given $n + 1$ unknown gages of nearly equal length, n of which when combined are nearly equal to the known gage G, there will be $n + 1$ combinations which may be compared with G; hence, the length of each unknown gage can be obtained by this comparison method. Intermediate sizes may be measured by comparing the combined lengths of a known and the unknown gage with a known.

Comparisons Between Gages and Other Objects

An accurate determination of the dimensions of any body, say a sphere, can be made by comparison with a gage of nearly the same size. For this the gage A and the sphere B are placed in contact with the base plate W, Fig. 18, and the test plate T laid over them. If B is slightly smaller than A, the test plate will touch the gage along the edge E and the sphere at the point C. When illuminated and viewed as shown in Fig. 7, straight fringes parallel to E will be seen to cross the upper surface of the gage. The number of fringes N across the face of the gage from D to E multiplied by $\frac{1}{2}(\lambda)$ gives the distance betwen the cover plate and the gage surface at D. If the distance CE is equal to DE, then the point C must be $\frac{1}{2}\ N\ (\lambda)$ below the surface of the gage, and thence the diameter of the sphere $\frac{1}{2}\ N\ (\lambda)$ less than the length of the gage. If B is larger than A, the upper plate will touch the gage along the edge D and be $\frac{1}{2}\ N\ (\lambda)$ above E. C would then be $\frac{1}{2}\ 2\ N\ (\lambda)$ above the surface of the gage, and the diameter of B equal to the length of the gage plus $\frac{1}{2}\ 2\ N\ (\lambda)$.

One uncontrollable factor which changes the length of a gage is wear. The amount that the length decreases from this cause depends of course upon the hardness and use. With the surface of a gage perfectly clean, we have been able to bring it into contact with other clean surfaces several hundred times before the wear amounted to 0.000005 in. If, however, dust or grit is present the wear is greatly increased. We have tested gages that had been used in factories for some time and found they had worn away 0.0001 to 0.0002 in.

Another property which must always be recognized when considering the accurate length of gages is the thermal expansion of the material. A 1-in. steel gage increases in length about 0.000013 in. for every degree C. rise in temperature. The temperature at which the actual length of the gage equals the nominal length must therefore be specified and is usually taken as 20 deg. C. or 68 deg. F. At 25 deg. C. the length of a gage which is one inch at 20 deg. C. is about 1.000065 in. If a gage be measured at the higher temperature its length at 20 deg. C. may be computed if the expansion coefficient is known. If high precision is desired, it is not good policy to use expansion coefficients given in tables because our measurements show that the expansion coefficient of steel may vary from 0.0000105 to 0.0000135 depending on its hardness and composition.

This variation would permit an unknown steel gage that agrees exactly with a standard at 25 deg. C. to differ from it by more than 0.00001 inch at 20 deg. C. If the unknown piece that is being measured is brass or some other material having an expansion coefficient that differs greatly from that of the standard the effect of temperature change is augmented. From these considerations it is evident that to measure or use gages with an accuracy in the millionth place, the coefficient of expansion of the material must be accurately known, and also the temperature controlled and measured to at least 0.1 deg. C.

In Table I is shown the thermal expansion of several

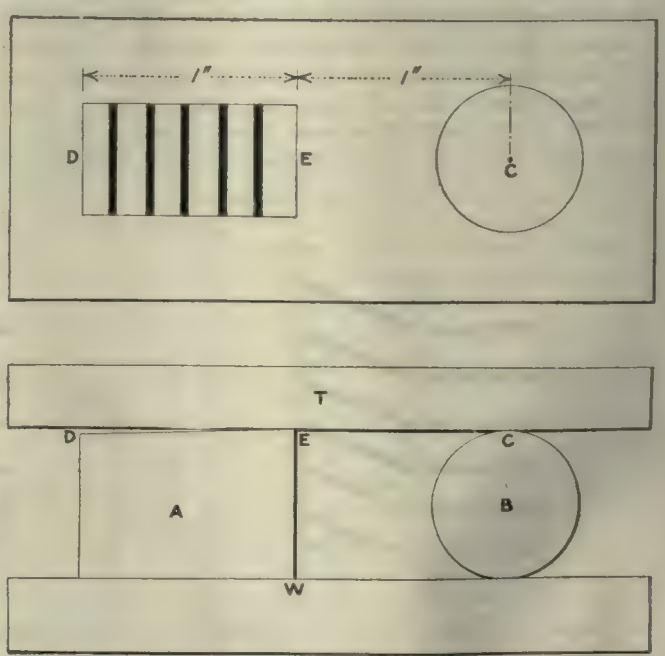


FIG. 18. COMPARING A SPHERE WITH A GAGE BLOCK

TABLE I. THERMAL EXPANSION OF SEVERAL PRECISION GAGES

Gage	Temp. Interval in Degrees C.	Coeff. of Expansion x 10-4
Johansson, Set. 5813, 10 mm	20 to 50	0.129
Johansson, Set. 5813, 10 mm	20 to 50	0.129
Johansson, Set. 5813, 9 mm	20 to 50	0.125
Johansson, Set. 5813, 9 mm	20 to 50	0.125
Johansson, Set 20, 0.4 in	19.8 to 75.5	0.124
Johansson, Set 20, 0.4 in	32.8 to 76.5	0.123
Johansson, Set 7, 0.4 in	56.3 to 79.6	0.131
Johansson, Set 7, 0.4 in	19.6 to 79.6	0.132
Johansson, Set 7, 0.35 in	21.3 to 82.4	0.128
Johansson, Set 7, 0.35 in	20.6 to 82.4	0.127
Bureau of Standards:		
Steel *A*, 0.4 in	24.0 to 76.9	0.132
Steel *B*, 0.4 in	33.0 to 82.8	0.129
Pratt & Whitney, 0.375 in	21 to 78	0.135
Schuchardt and Schutte, 0.5 in	5.8 to 46.0	0.116
Schuchardt and Schutte, 0.5 in	5.8 to 46.0	0.115

TABLE II. VARIATION IN THERMAL EXPANSION OF SOME STEELS FOR DIFFERENT DEGREES OF HARDNESS

Steel	Hardness	Coeff. of Expansion x10-4 20 Deg. to 120 Deg. C
No. 20 C, 0.83 per cent Cr 1.33 per cent	30	0.122
	36	0.123
	90	0.135
No. 21 C 0.98 per cent Cr. 0.48 per cent	40	0.113..
	45	0.117
	92	0.131
No. 22 C, 1.18 per cent Cr 0.0 per cent	36	0.110
	43	0.114
	80	0.119
No. 23 C, 0.20 per cent Cr. 14.5 per cent	30	0.103
	38	0.103
	75	0.109
No. 24 C, 1.20 per cent Cr. 16.0 per cent	38	0.103
	50	0.105
	86	0.109

precision gages. These measurements were made with the interferometer and electrical furnace previously described in our publication[12] on the dilatation of optical glass. Column 1 gives the designation of the gage under investigation; column 2 the temperature interval and column 3 the coefficient of expansion.

The composition of steel *B* which is used for precision gages at the Bureau of Standards is C. 1.00 to 1.10 per cent; Mn. 0.30 to 0.40 per cent; P. 0.025 per cent; S. 0.025 per cent; Si. 0.20 to 0.30 per cent; Cr. 1.30 to 1.50 per cent; Balance, Fe. This is almost identical with the compositions that have been published for the steels used in the Johansson and the Pratt & Whitney gages.

Table II shows the variations in thermal expansion of some steels for different degrees of hardness. Column 1 gives the carbon and chromium content, the other constituents being about the same as in steel *B*. Column 2 represents the hardness as measured with the Shore scleroscope. Column 3 gives the coefficient of expansion for the temperature interval 20 deg. to 120 deg. C.

Using steel *B*, expansion specimens were made, hardened and drawn by W. B. Topping and J. F. Draper of the Gage Section. For hardening, the samples were heated to 850 deg. C. and quenched in oil. All showed degree of hardness ranging from 99 to 102 as measured with a scleroscope. They were then heated in oil to different temperatures and allowed to cool in air. Those heated to 149 deg., 176 deg., 204 deg. C. showed no reduction in hardness, while for one heated to 232 deg. C. the hardness was reduced to 97. The thermal expansions of others that were drawn at still higher temperatures are represented by the curves shown in Fig. 19. Degrees centigrade are plotted as abscissæ and per cent increase in the length of the samples as ordinates. The rate of heating and cooling was one degree per minute. Curve 1 represents the expansion of a sample that received no treatment after hardening. It shows a nearly constant rate of expansion between 20 deg. and 225 deg. C.; an increased rate between 225 deg. and 250 deg. C., followed by a much smaller rate between 250 deg. and 380 deg. C. Beyond 380 deg. the rate of expansion increased to about the value found below 225 deg. C. At 450 deg. the heating current was reduced and samples allowed to cool. Its contraction is represented by the straight descending pas of the curve indicated by the arrow point. The original hardness was 100 while after being carried through this temperature cycle the hardness was 76.

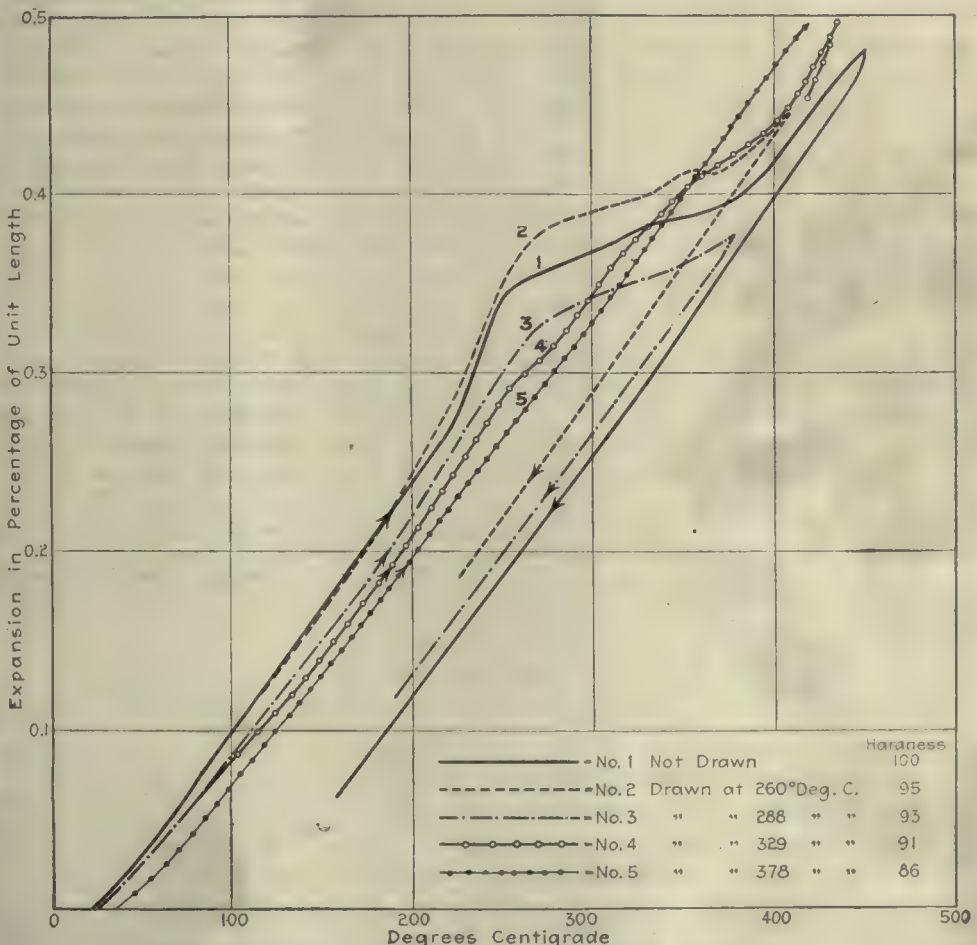


FIG. 19. THERMAL EXPANSION CURVES OF STEEL *B*

[12]Peters and Cragoe, Journal of Optical Society of America, Vol. IV, May, 1920.

Curve 2 shows the expansion of a sample hardened in the same manner and then drawn at 260 deg. C., which reduced the hardness to 95. This curve is very similar to No. 1. It is somewhat straight between 210 deg. and 260 deg. C. At 415 deg. C. the current was reduced and the sample contracted as shown by the descending curve. The hardness of the sample after the experiment was 82.

No. 3, which was drawn at 288 deg. C. had a hardness of 93. The expansion curve does not show the irregularities found in 1 and 2 between 220 deg. and 280 deg. C. but the flat position between 280 deg. and 375 deg. C. is present. The heating was stopped at 375 deg. C. and the sample showed a hardness of 86 on returning to room temperature.

No. 4 was drawn at 329 deg. C. and had a hardness of 91. The curve shows only a slight decrease in the rate of expansion between 340 deg. and 400 deg. C. This sample was taken to 435 deg. C., and showed a hardness of 81 on returning to room temperature.

Curve 5 represents the expansion of the sample that had previously been used to obtain curve 3. In that experiment, it was heated to 375 deg. C. and the final hardness was 86. Curve 5 shows that the sample expanded at a nearly constant rate and that all the irregularities shown by the other curves had been removed by previously heating the sample to 375 deg. C. The heating was continued to 790 deg. C. and on cooling to room temperature the hardness was 34. Between 780 deg. and 790 deg. C. the sample contracted, indicating the transformation point of the steel. The expansion curve above 415 deg. C. is not shown in the figure.

The reduction in the rate of expansion of the samples, represented by the flatter portion of curves 1 to 4 inclusive is probably caused by the strains introduced in the material when it was hardened by sudden cooling in oil from above 800 deg. C. Samples drawn at temperatures below 200 deg. C. showed no appreciable reduction in hardness. Above that temperature the hardness as measured with the scleroscope decreased uniformly as the drawing temperature increased, becoming about 35 for the sample heated to 790 deg. C. The irregularities in the expansion curves decreased with samples drawn at temperatures above 250 deg. C. and disappeared with those drawn at temperatures above 375 deg. C. It seems reasonable to assume that the strains are also removed by heating to 375 deg. C. It would probably be better to say the rearrangement in the material caused by heating to that temperature relieved the strains and removed the irregularities in the thermal expansion. These expansion curves are very similar to the curves we obtained for badly strained glass (loc. cit). With the glass it is possible to watch the strains disappear as the sample is heated through the temperature region in which the expansion rate decreases.

The changes of length of gages with time are doubtless caused by the strains existing in the material. For most purposes these changes are immaterial but in the case of standards they are important. During the past two years we have selected and retained several hundred gages from the products of different manufacturers and measured their length at given intervals of time. Most of these have retained their original length within 0.00001 in. Some, however, have undergone somewhat larger changes, a few examples of which are shown in Table III.

TABLE III. CHANGES OF LENGTH WITH TIME

Gage	Date	Length	Hardness
1.000 in.	3- 1-19	1.000000 in.	98
	6- 3-19	0.999998	
	7-19-19	0.999992	
	8-19-19	0.999992	
	10-16-19	0.999993	
	3-20-20	0.999988	
	5-21-20	0.999988	
1.000 in.	5-21-19	1.000000 in.	98
	5-29-19	1.000018	
	6-17-19	1.000022	
	8-19-19	1.000034	
	10-17-19	1.000038	
	1- 7-20	1.000043	
	3-20-20	1.000044	
	5-22-20	1.000047	
1.000 in.	9-26-19	1.000000 in.	92
	3-20-20	0.999999	
	5-22-20	0.999997	
2.000 in.	3- 1-19	2.000000 in.	96
	5-29-19	1.999976	
	7-19-19	1.999966	
	8-19-19	1.999963	
	10-16-19	1.999951	
	3-18-20	1.999938	
	5-21-20	1.999935	
2.000 in.	9-24-19	2.000000 in.	98
	10-16-19	0.000002	
	1- 9-20	2.000000	
	3-19-20	1.999993	
	5-22-20	1.999992	
3.000 in.	2-20-19	3.000000 in.	90
	4-28-19	2.999975	
	8-20-19	2.999900	
	9-19-19	2.999877	
	3-18-20	2.999856	
	5-21-20	2.999851	
3.00 in.	8-27-19	3.000000 in.	95
	9-18-19	2.999998	
	3-18-20	2.999998	
	5-21-20	2.999999	
4.00 in.	4-29-19	4.000000 in.	94
	6- 2-19	3.999998	
	7-19-19	3.999992	
	8-19-19	3.999980	
	10-16-19	3.999980	
	3-18-20	3.999971	
	5-21-20	3.999970	
4.00 in.	5- 7-19	4.000000 in.	96
	6- 3-19	4.000014	
	8-20-19	4.000025	
	11-26-19	4.000021	
	5-21-20	4.000025	
4.00 in.	12-22-19	4.000000 in.	92
	3-18-20	3.999999	
	5-21-20	3.999993	
4.00 in.	12-27-19	4.000000 in.	93
	3-18-20	3.999998	
	5-21-20	3.999998	

Proof of Strains

To show the existence of the strains a gage was cut as shown in Fig. 20. The gage was originally 0.7 in. long and 0.8 in. in diameter and each end face was four-millionths of an inch convex. The surface hardness measured between 97 and 103. A cut about 0.1 in. deep and 0.04 in. wide was made 0.3 in. from the upper surface with a glass saw. Measurements then showed the upper surface to be 0.00003 in. concave, the lower surface 0.00002 in. concave and the length of the gage to have increased 0.00007 in. On deepening the cut to 0.2 in. the upper surface was found to be 0.00011 in. and the lower surface 0.00006 in. concave. The outer layer must have been under quite a high tension, which was partly relieved



FIG. 20. HOW A GAGE WAS CUT TO SHOW EXISTENCE OF STRAINS

by the saw cut. If this tension is sufficient to cause a flow of the material, the length of the gage will change. It is, therefore, necessary to relieve at least part of the strain in order to make the material permanent. Alternate dipping in ice water and boiling water has been employed to produce that state. Our measurements do not show that any decided benefit is gained from this process. From the results on the thermal expansion just described it seems that more would be gained by heating the gages to 250 deg. or 300 deg. C. This, of course, would reduce the hardness, but if there is any truth in the theory that hardness is due, in part at least, to the strains it would be impossible to relieve any of the strains without reducing the hardness. The range of hardness of most of the gages we have tested is between 90 and 103. A hardness of 93 can be retained after heating to 275 deg. C. It is then a question if any of the resistance to wear resulting from extreme hardness should be sacrificed to obtain the stability of unstrained material.

Conclusions

For commercial gages, such as are used in the shop, the surface errors should not be more than 0.00001 in. since this degree of flatness is necessary to insure good adherence of gages to one another or to test plates. For the uses to which they are put a tolerance of 0.00001 or perhaps 0.00002 in. for gages 1 in. or less in length, and about 0.00001 in. per inch of length for longer ones seems satisfactory. Smaller tolerances are useless because they are soon exceeded by the errors resulting from wear or possibly from changes in the gage due to aging and also because small temperature variations not controlled under service conditions will cause changes of length which exceed the smaller tolerances.

Furthermore, the relative insensitiveness of all mechanical length-measuring instruments as compared with the optical methods makes it impossible to use the higher precision.

There is, on the other hand, no good excuse for larger tolerances than those recommended above because with reasonable care the manufacturers of gages can keep within those limits. For shop use it would appear to be more satisfactory to have available at a lower cost a large number of precision gages which are correct in length within two or three hundred-thousandths of an inch rather than the high-priced gages initially correct within a few millionths. Gages of the highest attainable precision are of value as standards in the testing laboratory.

These should be calibrated by optical methods occasionally since it is known that dimensional changes of material standards occur with wear, temperature and time.

Johnson's Philosophy on Subterfuges and Salesmen

By John R. Godfrey

One of the things that gets old man Johnson's goat is to have anyone try to get by on false pretenses. He doesn't expect perfection but he hates a bluffer and the salesman who tries to put one over on the old man, steers clear for some time thereafter.

I happened to be in the office the other day when a salesman of a war-baby machine tool tried to tell Johnson about his machine. If he'd been content to stick to facts, to saying that it was a good machine and worth the price asked, all might have gone well. But he enthused as per the schedule of the selling talk artist and, in the language of the poet, here's where he spilled the beans.

His whole outfit was almost a Chinese copy of a machine of well-known make. Even that might have been forgiven because Johnson knows from experience that the only way some manufacturers live is by copying other designs. The Johnson motor has been flattered many times in this way. But when the salesman called the machine No. 23, which was the exact designation of the original of this size, he blew up.

"Son" he said "that's a little too much. I can stand your copying my old friend Taylor's machine from stem to stern, for you couldn't copy a better one. But when you calmly appropriate his machine number so as to fool some people into thinking it's the original machine, it's going a bit too far. That number means something to Taylor—it's the third design of his number two machine.

"It doesn't mean a darn thing to your people except to try to fool somebody with. It's mighty near to securing money under false pretenses and I wish there was some way of jailing a few of the fellows who do it. Even if you can't originate a machine, you can at least keep off the real designer's grass plot when it comes to names and numbers. Better get a job with some real people my boy and don't try to sail under false colors."

Some Common Sense Advice on Picking a Salesman

It so happened that Johnson also had another caller that morning, a manufacturer in a somewhat similar line to his own, who wanted to get advice on putting salesmen on the road. He was one of the old timers who thought all the brains were in the office and that salesmen, like office boys, could follow a set schedule day after day and be tied down by a set of rules. He wanted to know what sort of rules Johnson made for his salesmen and how he kept tabs on 'em in general. And he was a bit surprised when Johnson told him about as follows:

"Jones, any salesman who has to have a set of rules isn't worth two hoots in Halifax to you or anyone else. Just remember he isn't a clerk or an errand boy, but that he goes in *your* place because *you* can't spare the time or haven't the nerve or the 'know how.' Your representative wants to be big enough to handle any question that comes up, and no rules can be made to cover all cases.

"You want someone to depend on, not someone who depends on you for orders and rules. If you don't get a man you can trust to do the right thing, don't get any—you can't afford to be represented by anyone who *needs* a set of rules to work by. But don't expect to get anyone who will never make a mistake. Don't forget those you've made yourself. And remember that it's a lot easier to tell a man what he ought to have done after the fracas is all over, than it is to guess right on the spot, with the whole question up to you to decide in a minute or less."

Seems to me we can sort of say Amen to both Johnson's interviews and that they prove him to be a fairly level-headed sort of a man for one of the old school.



The Triple Gear for Ford Transmissions

THE triple gear is one of the main gears in the Ford planetary transmission, three of them being required for each car. The gears were formerly made in three pieces, a central gear with hubs on each side on which the smaller sized gears were pinned. By the new method the gears are all forged in one piece, either on Ajax or National forging machines.

The first machining operation is done on a Bullard Mult-Au-Matic having six working spindles. The operation includes drilling the center hole 0.995 in. in diameter, rough turning the outside diameter, roughing one side, cutting recess for side and hub and finish drilling the 0.995-in. hole. The same machine takes a second cut over the outside diameter, finishes the face and hub, chamfers the corners, finishes one side, finish-bores the hole, finish-turns the outside diameter of the smaller gear which is uppermost, finishes the outside diameter of the larger or center gear to 3.5 in. and chamfers the end of the central hole. These operations are all performed at the rate of 60 pieces per hour. The total requirements being between 11,000 and 12,000 per day, a battery of fifteen machines is required for this work.

The second operation, shown in Fig. 1, is also done on the same type of machine which rough turns the outside diameter of the gear on the other end, cuts the recess on that end, finishes that side and the outside diameter of the other gear. These operations are performed at the rate of 80 pieces per hour.

Next comes the broaching of the hole, after which the teeth are cut in the large or slow gear, as shown in Fig. 2. These machines are Barber-Colman gear hobbers which handle five gears on a single mandrel and finish them at the rate of 13 per hour, requiring 67 machines for the job. The gears are then tested and marked for location and go to a battery of Fellows gear shaping machines as shown in Fig. 3, for roughing and finishing the teeth on the reverse gear which is on one side of the center. This is done in two separate cuts at the rate of 15 gears per hour, requiring quite a battery of machines to secure the necessary production. The primary or low speed gear is cut in the same way, the two cuts requiring five minutes, the production being 12 gears per hour.

After this the gears go to the heat-treating room for hardening and then have all burrs removed from the teeth on Potter & Johnston shaving machines at the rate of 250 per hour.

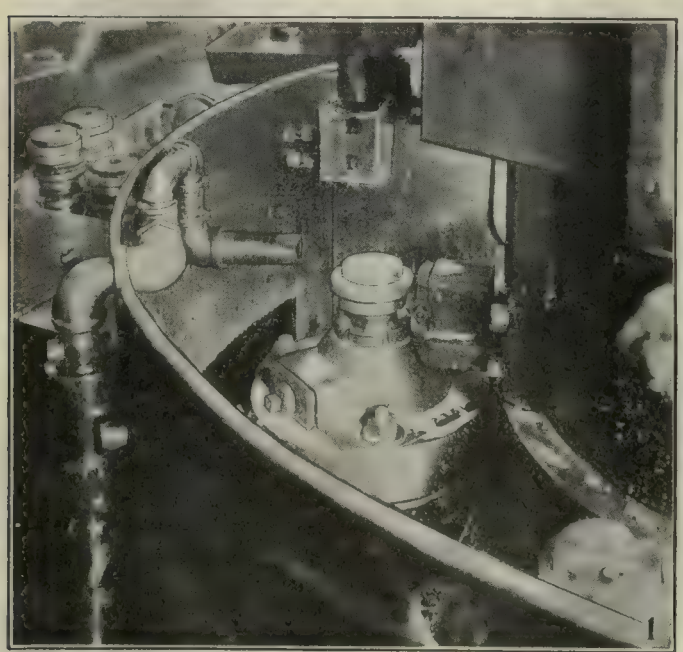


FIG. 1. THE SECOND OPERATION ON MULT-AU-MATICS

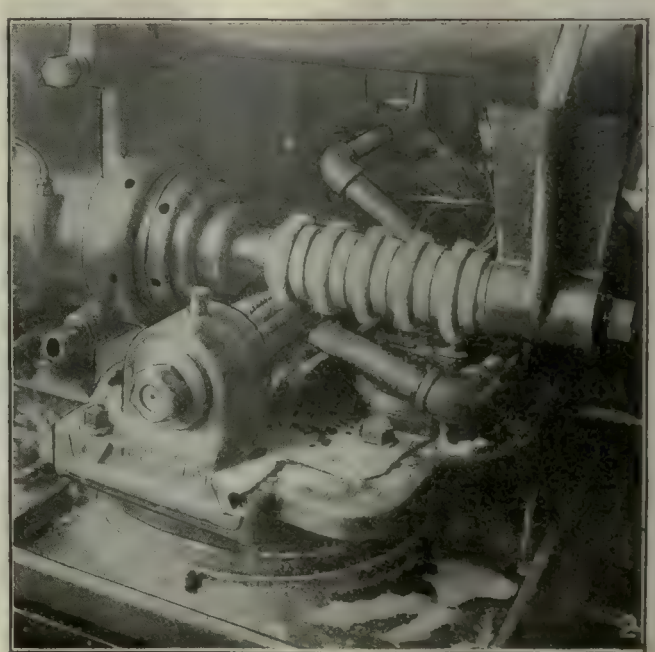


FIG. 2. HOBBING THE LARGE GEARS

AUTOMOTIVE CONSTRUCTION



FIG. 3. CUTTING THE SIDE GEARS ON THE GEAR SHAPER

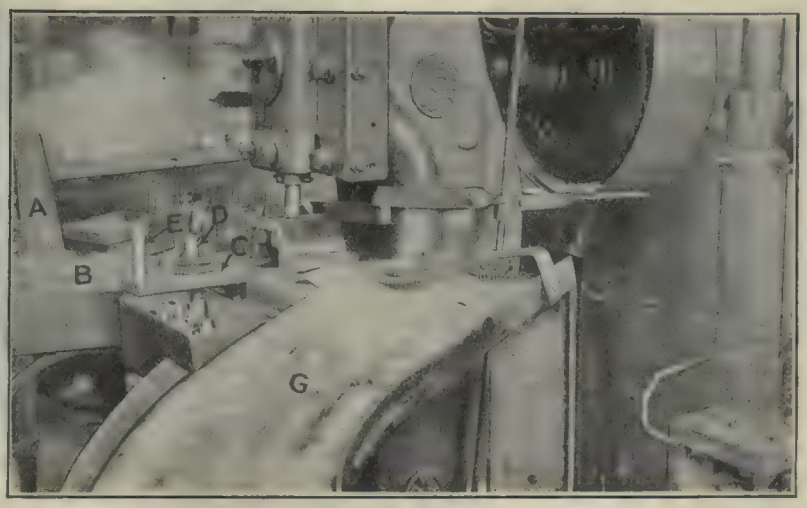


FIG. 4. FORCING THE BRONZE BUSHINGS IN PLACE

The bushings are put in place with a Ferrocute press, as shown in Fig. 4. The chute *A* shows how the gears come to the table *B*, from which the operator picks them and places them in the slide *C*. The bronze bushing is then entered as at *D*, and the slide pushed under the punch by the handle *E*. A single stroke of the ram forces the bushing into place, after which the gears are removed from the slide and placed on the chute *G*, sliding by gravity to the next operation. The spindle of one reaming machine is shown at the right of the chute. This makes very quick handling possible, as can be seen by the production of 750 pieces per hour.

The bushing is then reamed in the Cincinnati drilling machine shown in Fig. 5. Here the gear is placed and centered on plate *A*, which has a vertical movement by means of the handle *B*. When it is forced up into place, guided by the pins *C* and *D*, the reamer finishes the hole, being guided both by the long pilot and the bushing shown at the upper end of the reamer. The guard shown at the left has been removed from the machine to show the operation more clearly. The gears are handled at the rate of 350 per hour. Spot facing the bushing finishes the operations on this gear.

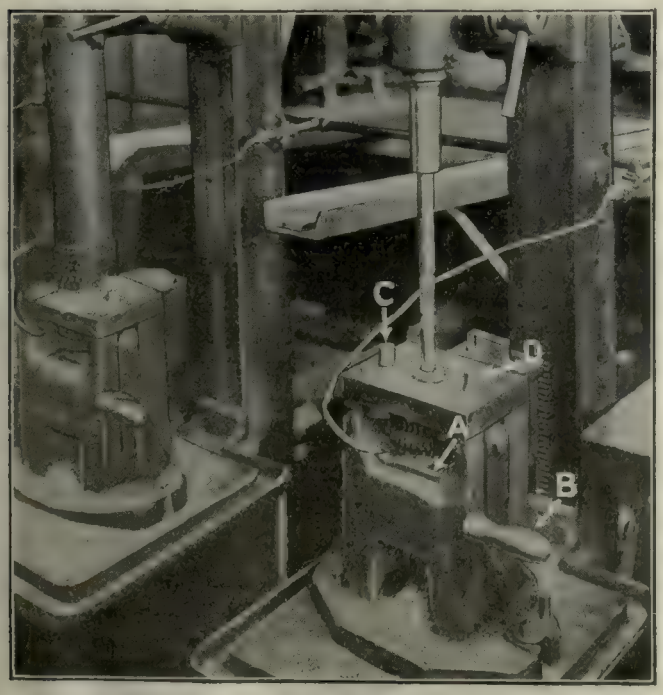


FIG. 5. REAMING THE BRONZE BUSHINGS

Machining Change Gears

BY DOUGLAS T. HAMILTON

A simple part, such as a change gear, would seem hardly worth looking at from the production standpoint; but when several thousand of such parts must be turned out every month, a few minutes saving on each one, makes a study of the problem worth while. On the Fellows gear shaper, the change gears range from $1\frac{3}{8}$ to $9\frac{1}{8}$ in. in diameter. Up to 3 in. in diameter they are made from bar stock; whereas from this size up they are made from iron castings, the smaller sizes being solid blanks, and the larger sizes cast with arms.

The former method of machining was to turn the

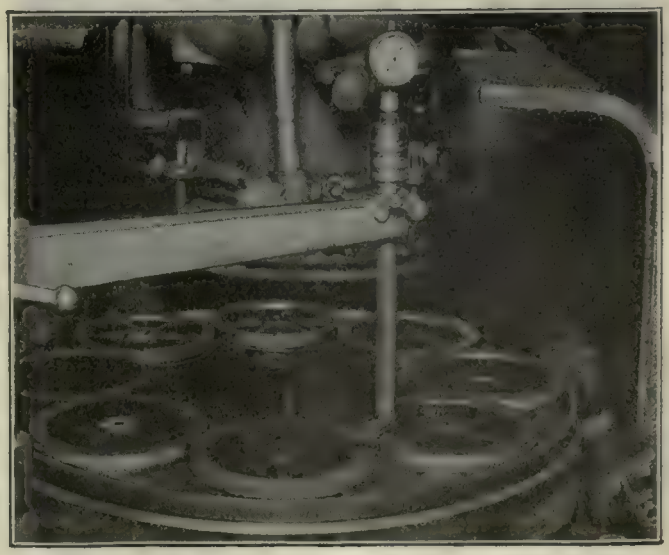


FIG. 1. SURFACING GEAR BLANKS TO THICKNESS

outside diameter, drill, bore and face one side in a turret lathe. Then the blank was reversed and the other side and hub faced in another turret lathe. The keyway was then cut with a hand-operated key-seating tool, after which the blanks were ready for having the teeth cut. By these methods, one blank was machined at a time, making production rather low.

The present method of maching these change gear blanks differs considerably from the former method, both as regards methods of handling and from a production standpoint.

The first operation, which is illustrated in Fig. 1, consists in facing the rough castings on a Blanchard surface grinding machine. The castings are made with $\frac{1}{32}$ in. excess stock on each side, and this amount is removed by grinding. The production time is governed by the diameter of the blanks being ground, as it is evident that the smaller the blanks the greater the number which can be held on the magnetic chuck at one time. The second operation is handled on a two-spindle drilling machine, as shown in Fig. 2. This machine has a special indexing fixture clamped to the table and arranged to carry three universal three-jaw chucks. The first spindle drills the hole, and the second one finishes it with a reamer. It will be noted in the illustration that two arms are attached to the column of the drilling machine that carry guiding bushings for the drill and reamer, respectively.

The drilling machine is provided with power feed, so that the operator's hands are free to load and unload the chucks, and index the fixture. The third chuck is provided, so that while one blank is being drilled and the other reamed, the third chuck can be unloaded and loaded, making the machining practically continuous.

Following this the keyway is cut in a key-seating machine, after which the blanks are taken to the Fay lathe, shown in Fig. 3, where the outside diameters are turned to size and the corners rounded. Four blanks, as shown in Fig. 3, are held on an arbor, and are completed at one setting. The large range of sizes is

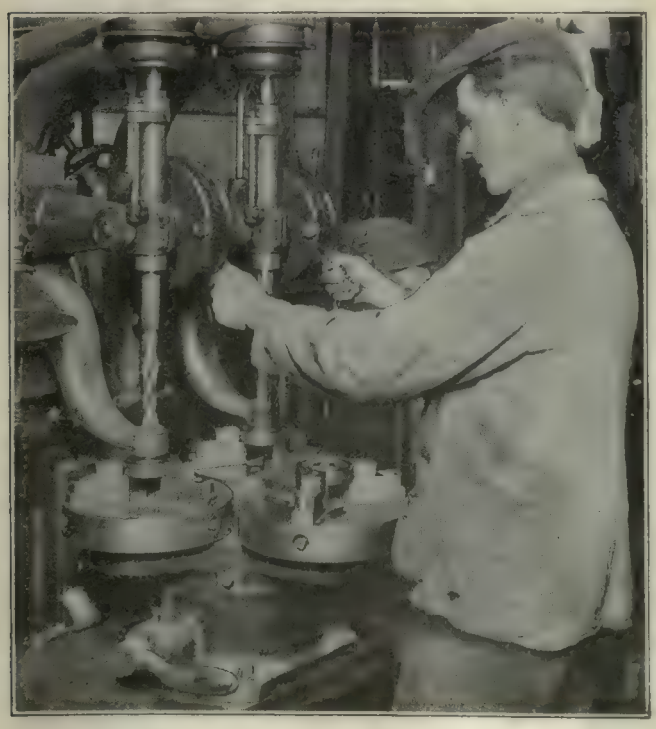


FIG. 2. DRILLING AND REAMING HOLES IN GEAR BLANKS

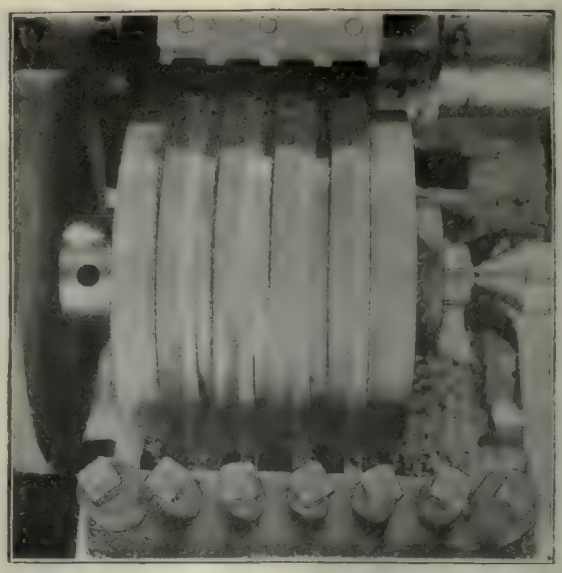


FIG. 3. TURNING AND CHAMFERING GEAR BLANKS ON A FAY LATHE

easily handled in this lathe by using interchangeable arbors. The only change for each size being the resetting of the tools. Four tools are used for turning the outside diameter so that the length of travel is equal to the face width of one gear blank. Four gang tools that are fed straight into chamfer the corners on the four blanks.

The next operation, not illustrated, is cutting the teeth, which are of 16 pitch. This operation is handled on a Fellows spur gear shaper. The average time per change gear, complete, is five minutes.

Built Up Adjustable Angle Plate for Light Drilling

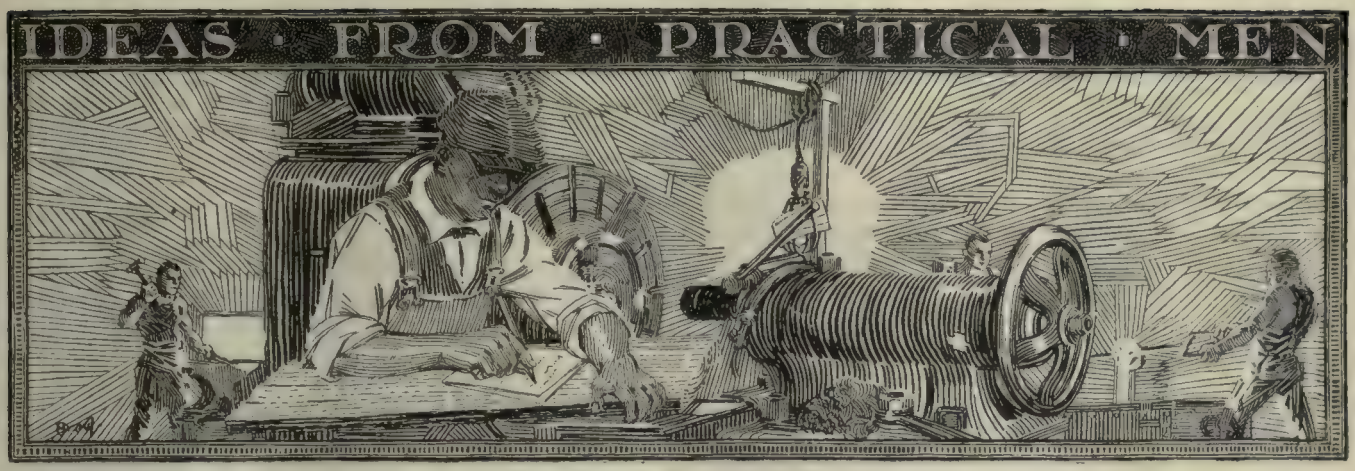
By W. Burr Bennett

On page 279 of *American Machinist*, H. H. Parker describes a device with the above title. In a purely constructive spirit of criticism the writer would like to make some suggestions.

First of all, apart from the design, does it pay to build this kind of a tool from small pieces; assuming of course that any such fixture is built to use and not for amusement? We long ago found out in our toolroom that this type of construction costs approximately twice as much as to make a pattern, get a good casting and then machine up the necessary surfaces.

Secondly, this built up construction is never free from coming apart and losing its alignment. Take the pivot plate in this design for example; even with dowels, which are not shown, it will loosen under the wear and tear of use and spoil the alignment. Ears cast solid with the angle plate would be far cheaper to build and would be permanent.

This same criticism would hold good for the top plate, the angles that hold the rocking column, and the bearings for the rocking shaft. Finally, how is the locknut on the adjusting screw manipulated when assembled and what is to insure the taper pin always being with the angle plate when needed? We have found in reference to this point that all loose pieces must be attached with a chain. Admittedly the functional design of this tool is good. It can be used through 90 deg. and would prove to be a handy device but the writer has learned that the above points of criticism are quite relevant.



Figuring Diameter of Three-Surface Tangent Plug

By Francis W. Shaw

The tangent-plug problem seems to have occasioned considerable trouble, even in its more simple form. The case where two of the three surfaces to be gaged were at right angles was treated on page 1098 of Vol. 50, page 914 of Vol. 51 and on page 148, Vol. 52, of the *American Machinist*. The toolmaker is just as likely to meet a problem where the angle at *A* in the sketch is greater or less than 90 deg., hence a consideration of the problem from the broader aspect will, it is thought, be worth the space it will occupy.

The original problem is a particular case of the escribed circle of a triangle *ABC*, referring to the accompanying figure. Let *r* be the radius of the escribed circle to be determined, and *abc* the sides of the triangle opposite respectively to the angles *ABC*.

Bisect the exterior angles at *B* and *C* by *BO* and *CO*. These lines will intersect at *O*, which can be readily shown, as follows, to be the center of the required circle. Draw *OD*, *OE* and *OF* perpendicular to the sides of the triangle *ABC*, extended if necessary. Now the angles *ABC* and *DBC* are together equal to two right angles. Therefore, the angle *DBC* is equal to two right angles minus the angle *ABC*, or *B*. Half the angle *DBC*, therefore, is equal to one right angle minus half the angle *B*. That is:

$$\text{angle } OBF = 90^\circ - \frac{B}{2}$$

Similarly, it can be shown that

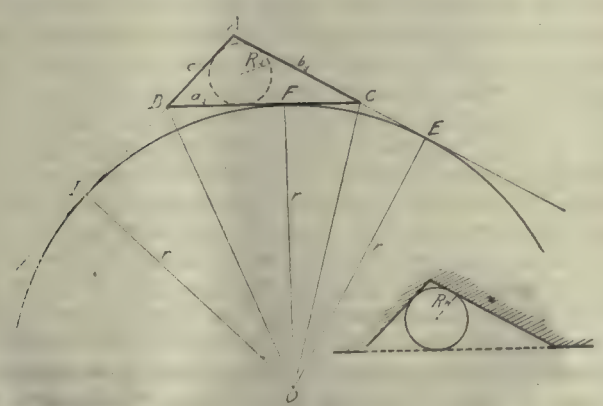


DIAGRAM SHOWING GENERAL CASE OF THE THREE-SURFACE TANGENT PLUG PROBLEM

$$\text{angle } OCF = 90^\circ - \frac{C}{2},$$

from which it follows that

$$BF = r \cot\left(90^\circ - \frac{B}{2}\right) = r \tan \frac{B}{2},$$

and that

$$CF = r \cot\left(90^\circ - \frac{C}{2}\right) = r \tan \frac{C}{2}$$

But, $BF + CF = a$. Therefore,

$$r \tan \frac{B}{2} + r \tan \frac{C}{2} = r\left(\tan \frac{B}{2} + \tan \frac{C}{2}\right) = a$$

This formula rearranged, becomes

$$r = \frac{a}{\tan \frac{B}{2} + \tan \frac{C}{2}} \qquad (1)$$

Where *A* is a right-angle the above can be rewritten:

$$r = \frac{a}{\tan \frac{90 - C}{2} + \tan \frac{C}{2}}$$

or,

$$r = \frac{a}{\tan \frac{B}{2} + \tan \frac{90 - B}{2}}$$

It can also be shown that

$$r = \frac{a \cos \frac{B}{2} \cos \frac{C}{2}}{\cos \frac{A}{2}}$$

For the inscribed circle shown dotted it can be demonstrated that:

$$R = \frac{a}{\cot \frac{B}{2} + \cot \frac{C}{2}} \qquad (2)$$

The relation between the inscribed and escribed circles can therefore be expressed by:

$$\frac{r}{R} = \frac{\cot \frac{B}{2} + \cot \frac{C}{2}}{\tan \frac{B}{2} + \tan \frac{C}{2}} = \cot \frac{B}{2} \cot \frac{C}{2}$$

For those who do not follow the above identity a numerical example will be given, it being remembered that the cotangent is the reciprocal of the tangent. Let $\cot \frac{B}{2} = 2$ and $\cot \frac{C}{2} = 3$; then

$$\frac{\cot\frac{B}{2}+\cot\frac{C}{2}}{\tan\frac{B}{2}+\tan\frac{C}{2}}=\frac{2+3}{1/2+1/3}=\frac{5}{5/6}=\frac{5\times6}{5}=6=2\times3$$

$$=\cot\frac{B}{2}\cot\frac{C}{2}=\frac{r}{R}.$$

The small sketch on the right illustrates the use of the formula for the inscribed circle. The angles would be checked with angle gages and the depth with a wire of the size calculated by formula (2).

Making Spherical-Ended Length Rods

By William Older

Quite a number of spherical-ended measuring rods were recently required in a certain shop. They varied in length from a little over 1 in. up to about 25 inches. There was nothing very accurate about them, a tolerance of a couple of thousandths being allowed.

The first lot of six was made by a young mechanic on the engine lathe, and they were a nice job; but after they came from the hardening practically as much time had to be spent on bringing them to length as had already been put on making them. When the next lot was required it was suggested to make the bodies of the rods of cold rolled, have their over-all lengths shorter than called for, turn the ends square, and force a steel ball into a hole in each end for a contact point.

To fit the steel balls, the rod was held in a collet in a bench lathe and holes drilled in the ends one or two thousandths smaller than the diameter of the ball which was to be forced in. The first hole was drilled, with an ordinary twist drill, sharpened in the usual way, to a depth equal to about five-eighth or two-thirds the diameter of the ball. The ball was then driven in with a brass hammer until it struck the bottom of the hole. The distance from the ball end to the flat end of the bar was then measured and thus it was easy to figure how deep the hole should be drilled in the other end for the second ball. The rod was again held in the collet of the bench lathe, and the hole was drilled first with an ordinary drill, and then brought to depth with a drill ground so that it would leave the bottom of the hole flat. The second ball was forced in with the aid of the brass hammer.

Some of the rods were too short and some too long. The short ones were peened to length while those which were too long were bent slightly to bring them to size. This type of rod is shown at *A* in the accompanying illustration. If the hole is drilled very slightly smaller than the ball, the balls will be held much more firmly than if the hole is made so small that the rod is badly stressed when the ball is driven in.

Removable Balls

Since making these rods we have used the same method to apply ball contact points in multiplying levers for some experimental measuring devices.

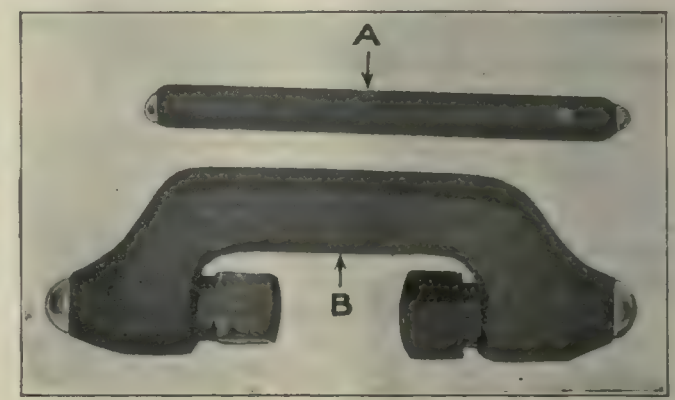
Where it seems desirable to secure the balls so that they may be removed, the holes can be drilled large enough for the ball to enter and seat. They can then be soft soldered in place, the melting point of soft solder being so low that the temper of the balls is not drawn during the soldering process.

Another method of securing ease of removal is to slit the end of the rods after the holes for the balls have been drilled. This permits a narrow wedge to be entered under the ball so as to drift it out. When this method of fastening is used one must not saw the slot beyond the bottom of the drilled hole as the ball will sink slightly into the slot, which results in a shorter distance between the balls than where the flat bottom of the hole is used as a seat.

A peculiar illusion was noted with these ball-ended rods. If the tip of the finger is rubbed over a ball which is tight in the end of a rod one experiences the sensation that the ball is loose enough to roll in the hole.

Adjustable Ball Seats

The making of these measuring rods is not quite as easy as it seems to be from a mere description, and the difficulties encountered resulted in the development of



TWO TYPES OF BALL-ENDED MEASURING RODS

the gage shown at *B*. The rods we use are forgings, but there is no reason why castings should not be used if there are enough of a size required. Malleable castings would, of course, be preferable to gray-iron castings where it is desired to secure the ball by soldering it in place.

The holes for the balls are drilled "between centers" in a lathe. The ends are then turned to the desired size and taper, after which the hole is widened on the inside with a special counterbore, so that when it is tapped the ball seat will be smaller than the threaded part of the hole.

The tap used should have a fine thread; and we used 20 threads per inch as it facilitates setting the ball, one turn advancing it fifty-thousandths.

The tap is also special, although we have used commercial fine-thread taps by grinding them so that they cut with the "heel" of the land. The shanks of the taps must be small enough and long enough to pass through the small part of the hole which is to act as a seat for the ball. The shank of the tap is passed from the inside through the hole and acts as a pilot while the hole is being tapped. The tapped hole should not go beyond say five-eighths of the diameter of the ball from the end of the body. In other words, the length of the hole which is to act as a seat for the ball must be at least five-eighths of the diameter of the ball, and if it is less in length than one-half the diameter of the ball there is a chance of forcing the ball entirely out of the hole by means of the screw.

When one is rigged up for making this type of measuring rod and has made a few of them the operations are very simple and can be carried through very quickly.

WHAT to READ —for the man in a hurry



Suggested by the Managing Editor

WE HAVE run several very instructive articles on deep hole boring in this magazine from time to time but never anything to compare with the story that has the position of honor this week. Why? Because the holes discussed this time are anywhere between a quarter and one-half mile long. In cast iron? No, in sand, mud and hard rock through which the outdoor mechanics of the oil fields have to drill before they reach the oil pool below. And the discouraging part of it is that quite often there is no oil there when they get down to where it ought to be. But read Fred Colvin's story of the oil field mechanics; it gives an interesting picture of ingenuity in the face of obstacles. On page 657 we have the second article in J. V. L. Morris' series on "Programs of Apprenticeship." The system described this time is the one in vogue at the plant of R. Hoe & Co., manufacturers of printing presses. The Hoe plan is no innovation as it has been in successful operation since 1872 and represents an adaptation of the old-fashioned apprentice system modified to meet modern conditions. It should be particularly valuable to managers considering apprenticeship problems because of its proved worth.

What to read was not a difficult matter to decide two hundred years ago when books were few and magazines unheard of. It is far different now when so much reading matter is offered to pass the time pleasantly or profitably as the reader chooses. We are doing our utmost to make the "American Machinist" not only profitable but indispensable as a clearing house of ideas and news of the machinery world. This page is the editors' advertisement of their section of the paper. It gives the high spots

The next article, page 660, gives the machine designers something to think about. It concerns the design of a merchant mill flywheel and is by Captain J. B. Varela of the Coast Artillery. Flywheels have an unfortunate habit of flying into small pieces when wrongly designed or handled and consequently any contributions to the subject of their design should be welcome.

This week's welding article appears on page 665 and takes up the details of arc welding procedure. The illustrations show the best methods of welding all kinds of joints and the text follows them with clear and concise instructions and warnings against unnecessary or harmful steps which are sometimes taken through ignorance. In addition Mr. Viall gives figures on welding costs and suggestions on the design of welded joints. Taking it altogether we think that this is one of the most valuable parts of the whole series.

Something more on the lowly apprentice appears on page 671. Here Mr. Colvin has a few words to say about the way Brown & Sharpe treats its boys outside of the shop. This matter of keeping track of a student outside of school hours is most important, it seems to us, and there is no apparent reason why a little judicious supervision of his loafing and recreation time should not be as good for an apprentice as it is for a college boy.

The second and concluding installment of the Bureau of Standards article on the calibration of precision gage blocks by Peters and Boyd starts on page 674. We have studied this article with a good deal of care and we have learned a lot from it. While the methods and apparatus employed undoubtedly have little value in a machine shop, there is a good deal of satisfaction in knowing just how and why this exceedingly accurate calibrating is done. The authors conclude with some very sensible recommendations which show that their sense of the fitness of things has been well developed.

A little philosophy on salesmen by our old friend Godfrey follows the gage article, page 679. Read it and see if he isn't about right, as usual.

Our automotive article this time has to do with gears, in particular some of those used by Mr. Ford in his famous "noiseless" transmission. Following this article by Colvin is another on gears by Douglas Hamilton of the Fellows Gear Shaper Co. It tells of a high production gear job where several short cuts saved time in the preparation of the blanks for the actual cutting of the teeth.

Again this week we are forced to devote considerable space to the description of new tools. Some of course should have gone in last week but we simply didn't have room for them and they had to wait over. If the rush keeps up at the present rate we will have to put on more pages, and with paper where it is now—well, we'd just as soon not do it.

Before we close, one word more about apprentices, even at the risk of overdoing it. Entropy has some comments on trade school education on page 691 that are well up to his usual standard.

EDITORIALS

Cincinnati Strike Won By Employers

ACCORDING to information which we have received the machinists' strike in Cincinnati, which involved over 100 plants and about 7,000 men, has been called off, the men voting to return to work.

This strike has been in progress about five months and has resulted in the loss of millions of dollars in wages and business.

The men are now returning under the identical open-shop and other conditions prevailing at the time the strike was called. Employers are also requiring that the men who return and are accepted must work at least three weeks in the plant from which they struck before they will be considered for acceptance as an employee by any other company.

Every plant originally affected by the strike is in operation, some at full capacity, and figures compiled by the employers show there are only about 300 machinists remaining out, and they are mostly men for whom there are no vacancies.

The International Association of Machinists assessed its 350,000 members each $1 per month for the first six months of this year. This fund was intended for use in unionizing the entire industry and Cincinnati was chosen as the ground on which to begin the battle. The National Metal Trades Association stepped in and protected the Cincinnati manufacturers by assuming entire charge of handling the strike. Thus it became squarely an issue between the N. M. T. A. and the I. A. of M. as to whether Cincinnati was to remain open-shop in the metal trades, or be forced to unionize.

A phase of the situation not ordinarily encountered was the fact that several members of the committee which signed the original demands on the employers were known members of the Communist party, so in certain respects the employers' victory is not merely one for the open-shop, but for Americanism against Bolshevism. E. V.

For the Good of the Industry

IN THESE days, when changes are in the air, whether they appear on the surface in our immediate neighborhood or not, it is wise to look beyond the details of our individual businesses to the broader problems of the industry as a whole. The machine-building industry stands at the forefront of civilization as we know it. Its importance gives it not only advantages and privileges, but duties and responsibilities as well. And these should be considered by all in determining the policies of their business.

The old idea of absolute individuality and independence no longer holds. Associations of business men, such as the National Machine Tool Builders' Association, have long proved the necessity and the advantage of collective action. In the same way we are coming to realize that the consumer or the public has an interest in the proper and progressive conduct of all business. All management which considers the future, and this should include all but fly-by-night concerns which are a serious detriment to any industry, must look beyond its immediate business and consider the industry as a whole. Individual advantages and practices which reflect on the good name of the industry as a whole tend to invite disaster, as they invoke the wrath of a not too discriminating public and lead to legislation which is not always wise.

Whenever annoying problems arise, and this is all too frequent, there is a tendency to act hastily and give decisions which, instead of settling the difficulty, only fan the flame. While we are none of us angelic, and the wisdom of Solomon is not a common commodity in these trying days, it may help a little if we try to consider the effect on the industry as a whole, instead of confining our attention to our own plant. If we stop to think how a decision or a policy would affect us if adopted by others, of how it may affect other manufacturers in our lines either directly or through adverse legislation which may come from public resentment, it may help in deciding wisely for all. F. H. C.

The Awakening of the Engineer

SIGNS are multiplying that the engineers of the country are beginning to wake up to a new sense of their importance and responsibility as a profession. The vast majority of them have always been awake to their individual responsibilities and their devotion to duty has been exemplary.

The Federated American Engineering Societies represents a movement in the right direction in which we firmly believe, and concerning which we have had a good deal to say. Such a federation has been talked of many times in the past but in no case was it possible to interest more than a very few members of the profession. The time was not ripe, for the average engineer was so engrossed in his own affairs that he did not realize the importance of co-operation with other engineers, to the profession and to the community.

The federation plan looms large among the big progressive movements of the day. Not only will the engineer come into his own, but the country as a whole will benefit by his wisdom, skill and trained initiative when he is drawn from his seclusion to an active part in our national life.

But this is not the only significant occurrence. Another plan is afoot. Briefly, it contemplates the introduction of courses in industrial management in a majority of our colleges, the placing of students and teachers in summer jobs in various industries and the reaching of men already engaged in management work through extension courses. The scheme is backed by corporations capitalized at more than twenty-five billion dollars and the control is vested in a council composed of representatives of the corporations and of the colleges and universities interested.

Most of the educators back of the movement served in the Council of National Defense and were aroused to the value of continuing the co-ordination secured by that organization. The approval of the idea by engineer-

ing teachers indicates an awakening on their part to the necessity of providing better contact with practical matters for engineering students before graduation.

On the other side, the cordial reception of the scheme by industrial concerns shows their appreciation of the need for properly trained engineers to fill executive positions, and their belief in the efficacy of making a start along this line before the man leaves college. We heartily favor the plan as outlined in a news item on another page and we look forward with a good deal of optimism to its effect on the future welfare of the engineer and the community.

Either of these movements would probably have failed dismally if they had been attempted ten years ago. That they have been received with so much favor now indicates clearly that engineers are at last awake and are going ahead to new service and power.

K. H. C.

The Federated American Engineering Societies Will Help

UNDER the caption "Have We a Representative Government?" the *Canadian Chemical Journal* prints the following:

Imagine some of our chemical friends or engineering colleagues entrusted with the framing of a bill to present to the Imperial Parliament having in view the establishment of a court of last resort in the Dominions to replace the Privy Council, or an act to revise the proceedings in chancery.

Our representative (?) system of government has resulted in a situation wherein lawyers, country doctors and farmers are called upon to legislate upon the details of forest protection, water pollution, railroad operation, food conservation, the development of mines and technical education.

Is it not time that our agrario-medico-legal friends had some technical colleagues at Ottawa and the Provincial Capitals? No group of men is better prepared to discuss these subjects in a disinterested way, or better equipped for the discussion, than chemists or engineers.

The question may well be asked whether a representation that is geographical and based on population only, is really representative.

Would not a chemist from Winnipeg or Halifax be more representative of the chemists of any part of Canada than a farmer, lawyer or labor leader from their home town?

Let us have chemists in Parliament and let our engineering friends have engineers in Parliament. "Even though they be voices in the wilderness," let's have a voice!

It seems that our northern neighbors have much the same trouble that we have—their government is representative in a sense, but not in the fullest and best sense. Wild lands, such as theirs and ours were, have been conquered, put to work and made to support great numbers of people, by the explorer, the settler and the engineer. Then the running of them has been turned over to the "lawyer, the country doctor and the farmer."

We need lawyers and we need farmers in the legislative branch of our government and it doesn't hurt to have an occasional country doctor. But so much of our legislation is directly concerned with things technical and there is required so much legislation to bring about conservation of our national resources, that we also need engineers—in the legislative branch and in the executive branch as well.

There are many engineers in the United States and they all realize the truth of these assertions. They have been working toward the goal suggested for many years, but in a small way only, because they had no strength—no organization. If all the engineers in the country could get together, agree on what ought to be done concerning things technical which affect the welfare of the country and then use their united efforts to get those things done, they could accomplish wonders.

The first several steps toward getting all engineers together have been taken, resulting in the formation of the Federated American Engineering Societies, an organization with membership made up of existing engineering and allied technical societies. The Federation is to be managed by a body known as the American Engineering Council, consisting of representatives of member-societies. Member-societies may be national, local, state or regional, thus insuring an organization truly representative which will then have the voice of a large number of the engineers of the country as regards matters of public welfare where technical knowledge and engineering experience are involved.

The F. A. E. S. was organized in Washington, D. C., on June 3 and 4. The American Engineering Council, its managing body, will hold its first meeting Nov. 18, 19 and 20 in Washington. We urge that such of the 171 societies represented at the organization meeting, as have not done so, make application for membership to the society, so that they may have their representatives on American Engineering Council when it meets Nov. 18 at the New Willard Hotel, in Washington. Engineers are to be awakened in regard to their own capabilities and the public is to be awakened as to the value of the engineer. These awakenings had better be begun in November, 1920, than in November, 1921, when the next annual meeting of the Council will be held. The time between now and Nov. 18 is short but it should be sufficient for member-society action.

L. C. M.

We Agree With Gompers!

IT IS not often that we can whole-heartedly agree with what Mr. Gompers says or does, but this time he has shown himself a real level-headed American, and we are with him.

In a statement in the last issue of the *American Federation*, which is signed by Samuel Gompers, president, and Mathew Wohl, vice president, of the American Federation of Labor, the American body repudiates the labor movement of Great Britain, declares utter lack of sympathy with policies announced by the International Federation of Trades' Unions, which met last month in Amsterdam, and declares against the Soviet movement of Russia.

Of course Mr. Gompers' statement was authorized by a vote of the labor body of which he is president, but to him is largely due the credit.

Repudiation of British labor and of the international organization is based on the refusal of American labor to join in a socialistic movement which aims to support the Soviet system of Russia and is urging support of revolutionary activities. Sovietism and all that the Russian movement means is utterly condemned.

Mr. Gompers recognizes the fact that the ballot in America offers the opportunity for any desirable changes of government. He says:

"But it (America) is a republic based upon the principle of freedom, justice and universal suffrage. Our men and our women are not likely to throw these rights and principles into the scrap heap for the dictatorship of Moscow's Lenine and Trotzky."

Industrial America owes much to Mr. Gompers for his sane and AMERICAN stand on this issue. E. V.

What Other Editors Think

The Gospel of Work

By H. H. Southgate
Advertising Manager, the United States Motor Truck Co.

IS AMERICA to become a nation of shirkers and slackers? Shall we continue to "let George do it"? Or are we now ready to emerge from the mental slump which followed the World War and jump aggressively into the world-wide battle of commerce?

Our place is among the leaders of the earth in commerce, finance and industry. But unless we come out of our trance, that place will be forever lost to us. America today plays the part of the dissolute Nero, jazzing away the precious hours while the Rome of our opportunity is destroyed by the fires of indifference.

"George"—meaning both our friends and enemies among the nations—is doing it, alright. He is going full speed ahead. Instead of leading, we are trailing. And lack of production is wholly responsible.

Work pays the bills. Work earns promotion. Work—honest, hard work—will help bring down the high cost of everything. Nothing else will.

We idle. We talk. We play. Others work. They toil night and day to repair the ravages of war, and to build up production in all lines.

What is the answer to be? Will America work, or will she want? Is the high cost to decrease, or will idle plants and empty shelves force it still higher?

The man who works fewer hours or does less work hurts his own cause. He cuts down production. He is an industrial SLACKER. There is no more excuse for his conduct than there was in war times for the man who evaded his war obligations. Not alone does he injure himself. He hurts his family—his friends—his country.

Our safety as a nation depends upon PRODUCTION—hard, driving effort to forge ahead. Before the war, and during it, we made wonderful progress through production. Then we stopped to rest. Our minds and bodies are now rested and refreshed. Once more we must work—work to LIVE.

PRODUCTION means work—WORK—and still more work!—until each of us has reached the height of his efficiency and earning power. Not alone do we need production in the factory, but in the office, on the road, on the farm, in the home—in every phase of our lives.

Work for the joy of the work itself—for the sake of successful accomplishment—for the betterment of all—to bring down the high cost of living through increased production and decreased overhead—for the future peace and comfort of our sons and daughters—for the salvation of America—WORK!

Talk will not right conditions. Act! Work more and talk less. And as production creeps higher, day by day, the difference in prices and conditions will become apparent. PRODUCTION alone will make that difference. Work brings production. Preach the Gospel of Work.—*An editorial from the U. S. Floating Power Plant News.*

A Discredited Government Report

From the *New York Sun*

AN INSTANCE of the superficial and unreliable character of economic investigation under the present Administration is to be found in the critical study of the United States Public Health Service's Bulletin No. 106 that has been made by the National Industrial Conference Board, an organization representing twenty-nine large industrial organizations.

The Public Health Service bulletin purported to be an authoritative study of the comparative results obtained in an industrial plant with an eight-hour day and in one where the ten-hour day was the standard, the conclusion reached in the Government report being that "a comparison of the eight-hour and ten-hour systems leads to the conclusion that the eight-hour system is the more efficient." Specifically the report states:

(1) The outstanding feature of the eight-hour system is steady maintenance of output; (2) under the eight-hour system work with almost full power begins and ends approximately on schedule and lost time is reduced to a minimum; (3) under the ten-hour system artificial limitation of output is widely prevalent. Under the eight-hour system output varies more nearly according to individual capacity.

When submitted to the acid test of fact by the National Industrial Conference Board it was shown that "the two plants from which the data were obtained are not fairly comparable and the basis of experience is too small to justify comprehensive conclusions."

The Government bulletin compared a thoroughly established and highly efficient manufactory of automobiles, running on an eight-hour schedule, with a rapidly expanding munition plant operating with a hastily recruited labor force. The eight-hour plant was slightly reducing its labor force during the year under investigation, while the ten-hour plant had more than doubled its force. The number of women in the eight-hour plant was only about one per cent of the entire force, while in the ten-hour plant it was twenty-five per cent of the whole; and the operations studied at the eight-hour plant were the characteristic processes of an automobile factory, to which the personnel were thoroughly accustomed, while the operations studied at the ten-hour plant were the novel ones of making brass fuses for shells.

The report of the National Conference Board points out that "the official sanction behind the publication of these conclusions gives them a special prestige in the minds of many people," and adds:

It is always against public interest for unwarranted and unscientific statements relating to any important problem to be given publicity, whatever the source may be. In these days of industrial unrest it is especially unfortunate if that source is an agency of the Government. Such is the condemnation that can justly be leveled against Public Health Bulletin No. 106.

This indictment is all the more effective from the fact that the Conference Board some months ago issued a study of its own on this subject with the statement

that the facts reported were not conclusive as to industry. The number of working hours which economy, efficiency and the welfare of the worker meet to mutual advantage cannot be arrived at from the experience of a single factory or a single industry. Each plant usually must discover for itself. The employees of a Western factory recently proved to their employers, in a test lasting six months, that they could do as much in nine hours as in ten. The employers gladly lowered the hours. This is the practical and safe way.

Calculation of Loads on Bearings

By John S. Watts

There seems to be a certain degree of carelessness among designers in fixing the size of bearings, not so much in the standard machines made in quantities, as in the special machines for mining and constructional work, where only one machine is made from each design.

A common practice seems to be to make the shaft large enough to carry the torsional and bending stresses and then use the standard size of bearing for that size shaft. While it generally happens that this gives a sufficiently large bearing surface, it is apt to be disastrous when it does not, and a few minutes spent in making sure that the bearing pressure is not too great is time well spent.

On the other hand, some designers forget or neglect to take into account the action of the lever arm of the shaft in reducing the load on a bearing. This, with a shaft in a pair of bearings, makes one bearing of the pair larger than needed, while the other bearing will be too small. For the sake of uniformity it may be desir-

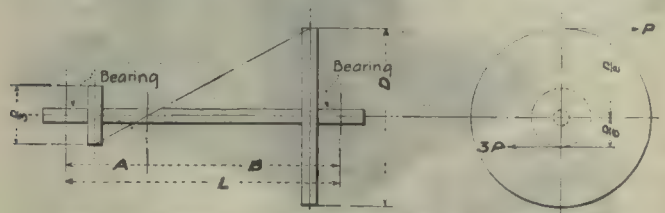


FIG. 1. TYPICAL ARRANGEMENT OF BEARINGS

able to make both bearings of the same size but it must not be assumed that each bearing will carry half of the load. Take the case of a shaft with a gear and pinion, used as a part of the reduction gearing. An average example of this type is shown in Fig. 1.

Taking the gear diameter as being three times that of the pinion, the load on the pinion teeth will be three times the load on the gear teeth. The total load on the two bearings, will be equal to

$$\frac{P \times \left(\frac{D}{6} + \frac{D}{2}\right)}{\frac{D}{6}} = \frac{P \times \frac{4D}{6}}{\frac{D}{6}} = 4 \times P$$

or, is equal to the load on the gear teeth plus the load on the pinion teeth. This total load will be divided between the two bearings in inverse proportion to the lengths A and B, which are the lever arms of the load on each bearing. The load on the bearing nearest the pinion will be $\frac{4P \times B}{L}$, and on the other bearing $\frac{4P \times A}{L}$.

In the arrangement shown in Fig. 2, the total load P + P, is taken by the one bearing, but as the load point will not usually come central with the bearing center line, the bearing will tend to wear more on one side than the other, and the second bearing should be fitted to keep the shaft from getting out of alignment.

When the gear is transmitting motion to a long shaft, we have an arrangement like that shown in Fig. 3, the load on each bearing is then $\frac{P \times A}{L}$ and $\frac{P \times B}{L}$, the latter being the load on the bearing nearest the gear.

For belt drives, the calculation of the load on the

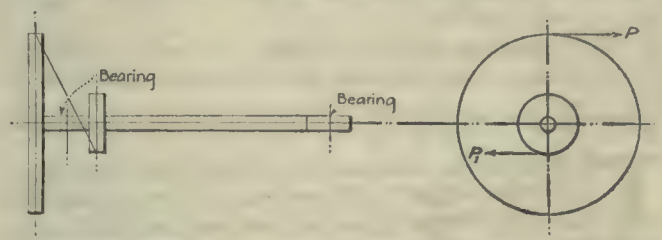


FIG. 2. ONE BEARING TAKES MOST OF THE LOAD

bearings cannot be made so exactly, as it involves estimating the tension that will exist in the slack side of the belt. But for the average case we can safely assume that the total pull on the bearings will not exceed twice the pull required to transmit the power. This load will be divided between the two bearings in the same proportion as shown in Fig. 3.

The pressure per sq. in. of bearing surface that can be safely allowed is the pressure which will not squeeze out the lubricant from between the surfaces. When the pressure is applied intermittently, and especially if the pressure reverses in direction, it will take a much greater pressure to break down the film of oil than if the pressure is continuous. The method by which the oil is applied has also considerable effect on the pressure that can be carried. The lubricant should always be introduced into the bearing at a point where there is no pressure, the capillary attraction will then draw the oil in between the surfaces and so maintain the film under a higher pressure than could be used if the oil were introduced at a point of the bearing which was under pressure.

Assuming that the oil supply is well looked after and the oil channels so arranged that the lubricant will

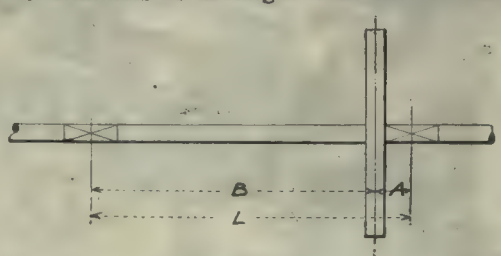


FIG. 3. BEARINGS WHERE POWER IS TRANSMITTED THROUGH A LONG SHAFT

have an easy passage to the point of greatest pressure, the following bearing pressures in lb. per sq. in. may be used as a maximum, under the respective conditions specified. The area of the bearing surface being taken as the diameter of the bearing multiplied by its length.

Bearing with intermittent reversing loads at very slow speeds 3000.

Bearing with intermittent reversing loads at moderate speeds 1200.

Bearing with intermittent reversing loads at ordinary speeds 900.

Bearing with intermittent reversing loads at high speeds 500.

Bearing with intermittent loads 400.

Bearing with continuous loads 300.

American Milling Machine Co. No. 1½ Plain and Universal Milling Machines

By J. V. HUNTER
Western Editor, *American Machinist*

The development of a machine differing in design from the several models that preceded it is seen in this new milling machine brought out by one of the more recent builders of this line of machine tools.

THE excessive demand for milling machines of all sizes and types has been one of the outstanding features of the machine-tool market during the past few years. Many existing models have been discarded for something newer, so that our pages are continually showing something that the maker considers better than that which he has built in the past. In this category are the models of No. 1½ plain and universal back-geared milling machines built by the American Milling Machine Co., Cincinnati, Ohio.

The plain back-geared milling machine is shown in Fig. 1. A heavy flanged base has been provided, with a box-form section of column, tapering from the base to the top. The knee is fitted to the column with adjustable gibs. Power feed is provided for both the cross and longitudinal feeds. All operating levers are on the front of the machine, with the exception of those for the feed gears. The feed-gear box is located on the left-hand side of the column at the rear, and the feeds are concontrolled by means of three levers. There are sixteen feeds ranging from 0.005 to 0.212 in. per revolution of the spindle. All of the steel gears are heat-treated and all shafts are ground and run in bronze bushings. The cut-

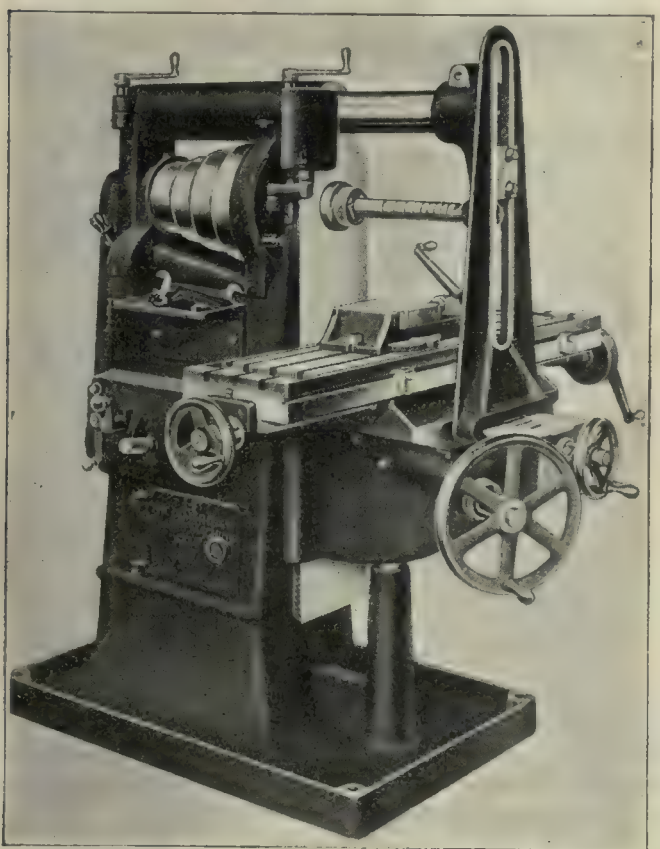


FIG. 1. AMERICAN NO. 1½ PLAIN BACK-GEARED MILLING MACHINE

Specifications: Working surface of table, 46 x 10¼ in. Power longitudinal feed, 25 in. Power cross feed, 9 in. Hand vertical feed, 19 in. Face of column to over-arm brace, 21⅝ in. Size of taper hole in spindle, No. 10 B. & S. Spindle speeds, 16, ranging from 12 to 382 r.p.m. Distance from over-arm to center of arbor, 6¼ in. Four-step cone pulley with largest diameter 11 in. and smallest diameter 7⅝ in. Width of belt, 3 in. Sixteen feeds ranging from 0.005 to 0.212 in. Two-speed countershaft, 107 and 265 r.p.m. Countershaft friction pulleys, 12 x 4 in. Floor space, 85 by 64 in. Net weight, 3,000 lb. Weight crated, 3,250 lb. Weight boxed for export, 3,700 lb. Export case, 118 cu.ft.

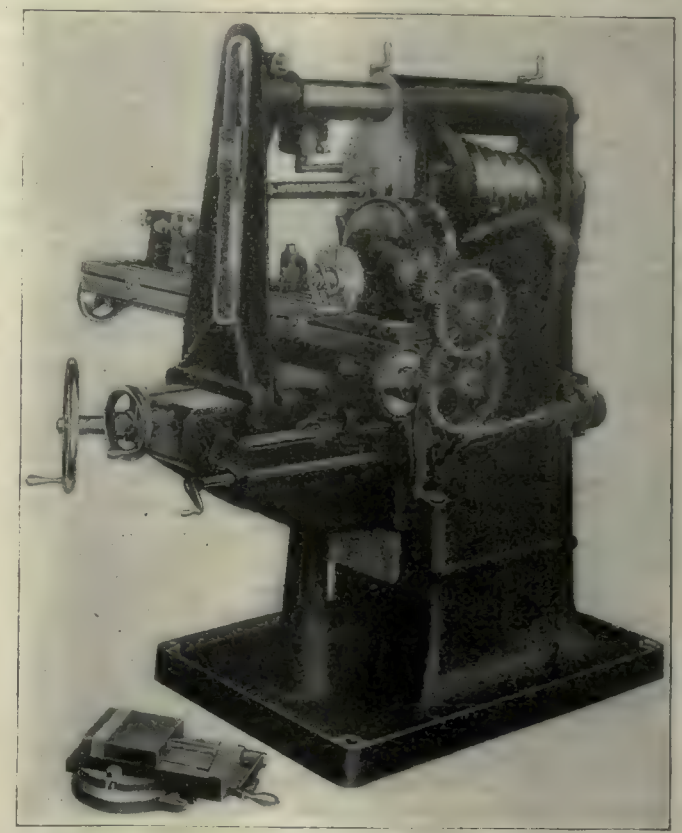


FIG. 2. AMERICAN NO. 1½ UNIVERSAL BACK-GEARED MILLING MACHINE

Specifications: Same general dimensions as for the plain milling machine. Universal table swivels 54 deg. on each side of center; 11-in. universal dividing head. Net weight, 3,400 lb. Weight crated, 3,650 lb. Weight boxed for export, 4,100 lb. Export case, 118 cu.ft.

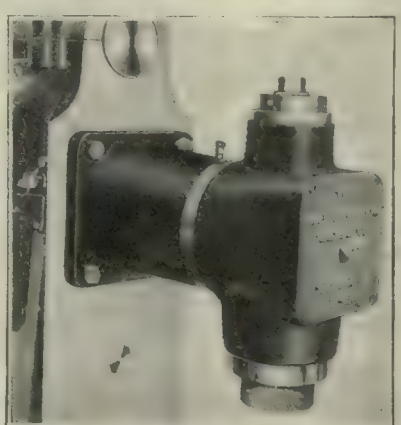


FIG. 3. AMERICAN VERTICAL MILLING ATTACHMENT

ter spindle runs in bronze bearings; the front one is 5 in. in length, and has a No. 10 B. & S. taper hole. Sixteen spindle speeds are obtained, using the four-step cone pulley together with a two-speed countershaft and the back gears, which are of a 6 to 1 ratio. The speeds range from 12 to 382 r.p.m. An overarm of 3¾ in. diameter and brace are provided.

The universal type of machine is illustrated in Fig. 2. The table swivels through 54 deg. on each side of the center. It is also provided with a swivel vise and with an 11-in. universal dividing head.

When desired, the swiveling vertical milling attachment shown in Fig. 3 can be furnished. This attachment is secured to the face of the column by four screws and located by the front spindle bearing. The body of the attachment swivels through a complete circle and has a graduated dial so that it can be set in any desired position. The columns of all machines are drilled and tapped so that this attachment can be applied at any time. The distance from the face of the column to the center of the spindle is 10½ in.

Harmful Tendency in Trade Education

By Entropy

B. A. Tibbab, whose name sounds much more euphonious spelled the other way around, takes a fling at trade school graduates under the above title on page 74 of the *American Machinist*. There is no doubt but that the instances he cites in which boys have been exploited under the name of trade education can be duplicated many times over, and yet it is not fair to judge trade education in terms of individual instances like these selected by a prejudiced observer. Any one interested in making out a good case can find many more cases in which the boys have profited immensely by their training and have come out so trained that they have very promptly taken their places alongside of men of long years of experience in the shops.

The criticism made by Mr. Tibbab sounds almost as though he did not believe it right for boys to be trained as machinists on machine work done as it is done in the shops into which they must go to earn their living. It sounds like a plea for manual training methods instead of practical methods. He would apparently take an order for 250 spindles and distribute them among the 250 boys in the school and have each make one all the way through. In the shop (commercial shop) one man would take all of the blanks and straighten and center the lot, another man would square the ends of all before he started to rough turn any. Why not do it the same way in a trade school? To be sure professional educators will tell us that the boy who has once straightened and centered a shaft without the aid of luck has derived all the educational value of the "Exercise," but that is not what we are after. We are trying to train a boy so that he can straighten shafts with certainty, celerity and confidence, and no man ever learned that on one shaft. To be sure if he has straightened 250 one-inch shafts he will not need to straighten so many two-inch shafts in order to get the hang of it, but at some time or other before graduating or after he must straighten enough shafts so that it is perfectly natural for him to do it, and he can do it without having to reason out every move as he goes along. Suppose Mr. Tibbab were to learn to ride a bicycle. It would not be enough for him to know the principles of balance, but he would have to apply those principles long enough so that balancing would be just as natural as walking before he ought to venture into traffic.

This does not mean that every boy who comes into the trade school should have to straighten and center 250 of those particular shafts for Blank & Co. He might only straighten 225 for the Roe Manufacturing Co. Or he might have a lot for one concern this week and another lot next fall, but it does mean that sometime in his course he would perform these operations for a considerable number of shafts, and that the school would look out that every boy had a reasonably large number of these shafts to do before he went ahead on work which was much advanced beyond that point. It would not mean that every boy would straighten 250 shafts. One boy might straighten 100 and another 500, provided the first boy caught the trick promptly and the second boy was slow to pick it up. It would not necessarily mean that the second boy was to have a lower mark either, for he might be slower to learn.

The principle of teaching a boy to make things in quantities rests on giving them to him in quantities for practice. If it appears to some manual training teacher that he is being exploited he should investigate pretty carefully before he is too certain of his statements. It may be, as has often happened, that the boy only partially completed his course and then claimed, without any foundation, that he was kept so long on one job that the school was making a profit. If the other side of the story was told it might be found that the boy was unteachable and that the apparent exploitation was an attempt on the part of the instructor to get him to do some thoroughly good job at something before he pushed him ahead. I do not doubt that Mr. Tibbab will grant that it is wise to be thorough. We used to have as the slogan of the Worcester Trade School, "Do your work habitually well," which proved a very good motto for consumption by the students and their parents.

We have seen a great deal of emergency training in so-called vestibule schools during the war which was amply justified by the emergency, and which proved wise and profitable because of the great amount of repetition work done. Men and women were taught to become necessary cogs in a great war mechanism, but rather unintelligent cogs. What is needed for constant growth of our industries is that the workers shall be intelligent forces knowing the reason why they do their work, knowing the processes through which it has passed before it reaches them, and the processes which are to follow, so that they can say of the finished product, "That is better for the care with which I heat-treated this part, or for the care with which I fitted that." These things cannot be taught by the vestibule system alone, nor on the other hand can they be impressed on a boy's mind thoroughly without driving the facts home by constant and thorough training on the actual job. A technical graduate could undoubtedly go into any of our machine shops and in a very few days, if he were so inclined, learn to perform any one operation as well and perhaps better than the men who ordinarily do it, but that would be like taking a sixteen-inch gun to hunt quail. The boy who goes to a trade school thereby rates himself as of a lesser caliber than if he aspired to an engineering education, but in many instances he is simply mistaken and he may become an engineer in spite of his training, but the teaching methods of a trade school must be adapted to the needs of the average boy.

SHOP EQUIPMENT NEWS

-Edited By-
S. A. HAND

SHOP EQUIPMENT • NEWS •
A weekly review of modern designs and • equipment •

Descriptions of shop equipment in this section constitute editorial service for which there is no charge. To be eligible for presentation, the article must not have been on the market more than six months and must not have been advertised in this or any previous issue. Owing to the news character of these descriptions it will be impossible to submit them to the manufacturer for approval.

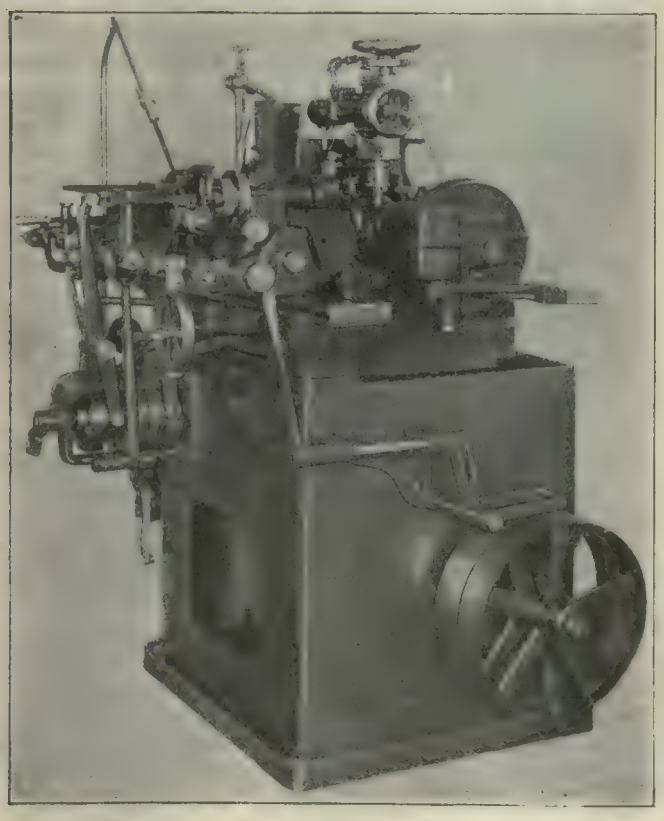
• CONDENSED • CLIPPING INDEX
A continuous record of modern designs • and equipment •

Fraser Full-Automatic Grinding Machine

The grinding machine herewith illustrated is the product of the Warren G. Fraser Co., Westboro, Mass.

The machine is intended for grinding rolls and other small work where the length of the surface to be ground does not exceed the width of the grinding wheel.

The work is placed in a magazine and fed by gravity to the machine. The automatic control unit consists of a cam-set rotated by worm gearing and in its cycle accomplishes the following: Swings the feed arm from the magazine to the chuck, holding the work until the chuck grips one end and the tailstock center enters the other end; brings the grinding wheel quickly to a predetermined position, then traverses it across the work for a predetermined distance, holds it stationary for a predetermined number of revolutions of the work, moves it quickly back to the starting position, stops rotation of the work, opens the chuck jaws and moves the tail center back, allowing the work to drop out. Both the wheelhead and headstock rest on three-point bearings. The wheel-spindle is hardened and ground and runs in bronze boxes which are adjustable for wear. The wheel-slide is adjusted by a screw having a graduated handwheel to obtain the proper size for work being ground and to correct for wheel wear.

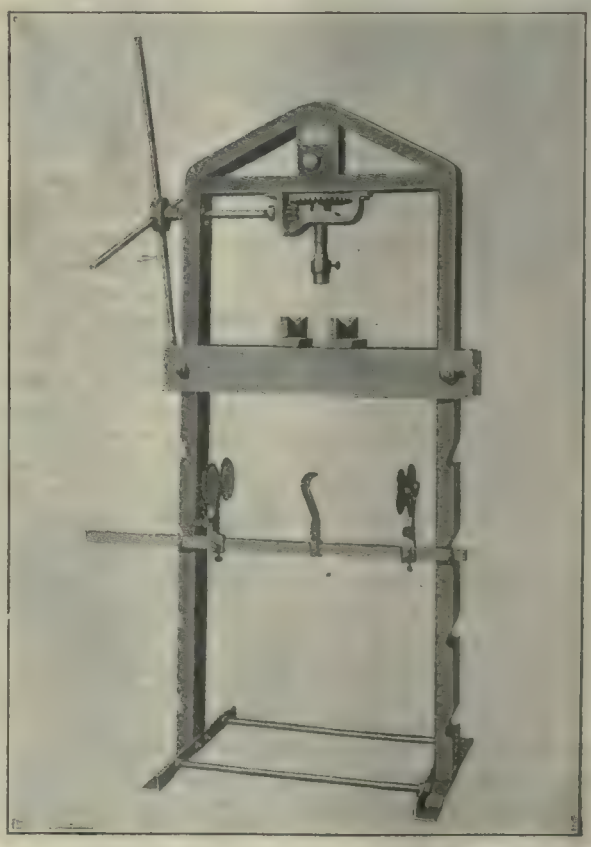


FRASER FULL-AUTOMATIC GRINDING MACHINE

Detroit Combination Arbor Press

The Detroit Garage Equipment Co., Detroit, Mich., has placed on the market the combination straightening press, arbor press and truing machine shown in the illustration. It is intended primarily for automobile repair work.

The frame of the machine is formed from one piece of 6-in. channel steel, the cross member and vertical strut at the top being welded in place. The screw is hand operated through bevel reduction gears, is 2 in. in diameter and has a travel of 9 inches. The work is supported on two ¾ x 6-in. plates. A truing device is provided for use when straightening shafts. This



DETROIT COMBINATION ARBOR PRESS

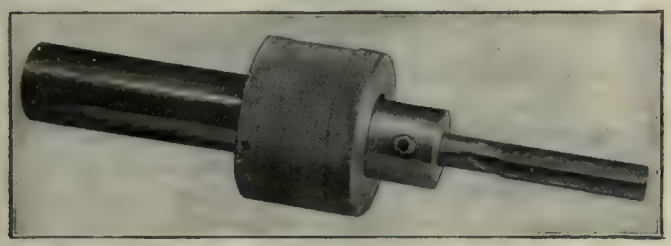
device consists of a movable indicator holder, centers, and disks mounted on a rail 5 ft. long and removable, if necessary.

The guaranteed capacity of the press is 50 tons, but it is stated that as much as 200 tons pressure can be obtained. The height of the machine is 85 in., the width 35 in., and the weight 615 pounds.

Scully-Jones Floating Reamer Holder

The floating holder shown in the figure is made by Scully-Jones & Co., Railway Exchange Building, Chicago, Ill., for holding reamers in turret lathe and similar work where it is important that the reamer be permitted to float freely in its axis of rotation and find its own center so as to insure straight round holes. Short shank reamers can be used in this holder, thus reducing the cost of high-speed finishing reamers.

It can be furnished with various types of collets for driving all types of reamer shanks and all styles of finishing tools where a floating holder is required. The



SCULLY-JONES FLOATING REAMER HOLDER

holder can be furnished with a shank to fit any size of turret lathe or with any size of taper shank to fit drilling-machine spindles or lathe tailstocks.

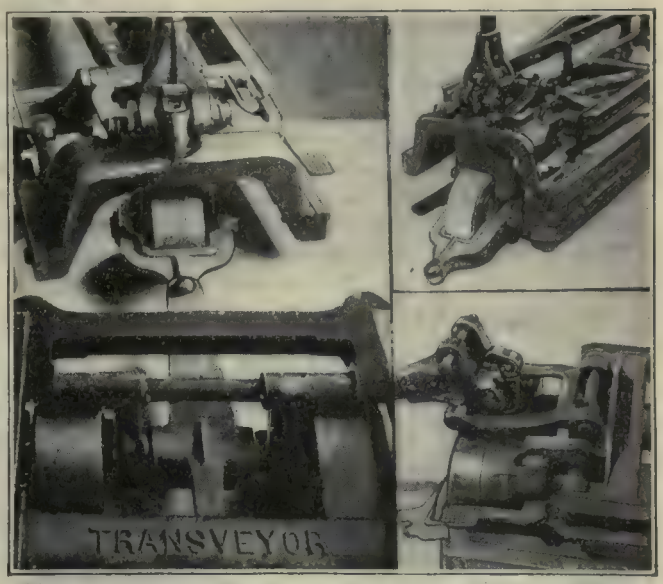
All parts with the exception of the shank are hardened throughout. The latter is left soft so that at any later time it can be changed by the customer to fit the spindle of a machine differing from the one for which it was originally intended. The holder is made in four sizes.

Improvements in Cowan Transveyors

The Cowan Truck Co., Holyoke, Mass., has added some improvements to its Transveyor truck. On the left of the illustration is shown an attachment that enables the Type G Transveyors to be used as trailers behind electric storage battery trucks, either singly or in trains.

The attachment requires no change in the construction of the truck, except a longer axle for the front wheel so that the coupling yoke can be mounted. The draw bar can be applied to the truck without taking off the wheels, as it merely slips over the rear axle. Both the attachment and the draw bar are steel castings.

It is stated that the two parts of the hitch are so proportioned that the shortest possible connection is provided for; that the tracking is almost perfect and that the turning radius is so short that a train of ten trucks has been turned in a circle on a 20-ft. roadway. Up and down play is allowed, so that there will be no binding as the machines go over door sills or the tops of steep inclines. The two views at the right show a latch for holding up the handle of the type G truck when it is not in use. It is made of two leaves of tempered spring steel attached to the top of the king pin. As the handle is thrown back into a vertical position, it slips over the

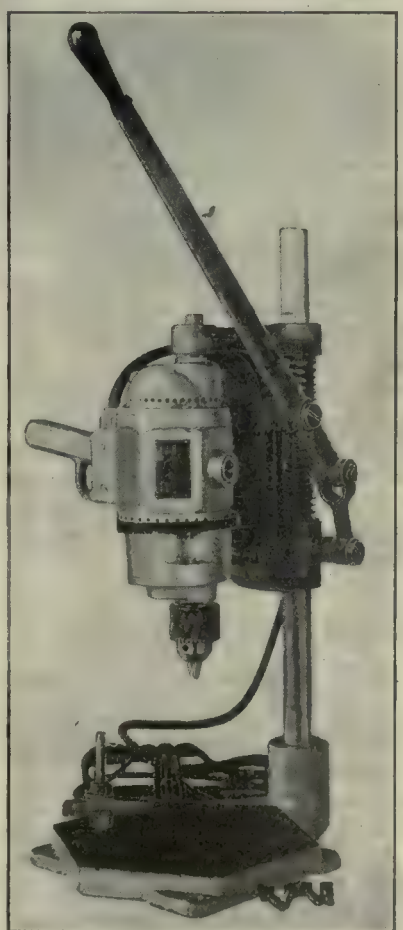


TRAILER ATTACHMENT AND SAFETY HANDLE-LATCH FOR TRANSVEYOR

spring, and jarring will not cause it to fall forward. The latch, however, does not interfere with the free movement of the handle, when it is necessary to bring it down to manipulate the truck.

Black & Decker Bench Drilling Stand

A bench drilling stand which nas just been put on the market by the Black & Decker Manufacturing Co., Baltimore, Md., takes $\frac{3}{8}$, $\frac{1}{2}$, $\frac{9}{16}$, $\frac{5}{8}$, and $\frac{7}{8}$-in. Black & Decker portable drills. The bracket carrying the drill can be raised or lowered on the vertical column and is secured in any position by means of a split collar and clamping screw. The drill may be swung clear of the base, making it possible to use this stand for such work as applying ring gears to automobile axles, drilling in the ends of shafts, and other work too high to be drilled on the bench. The feed lever gives a feed ratio of 6 to



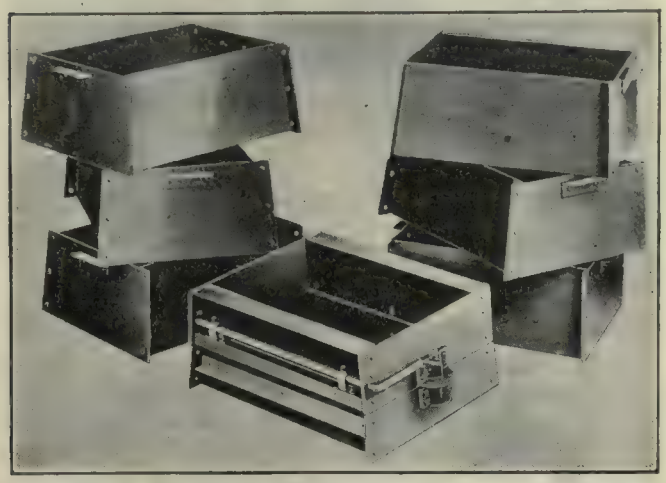
BLACK & DECKER BENCH DRILLING STAND

Specifications: Height (bottom of base to top of vertical column), 30 in. Vertical adjustment of drill, 12 in. Drilling radius (distance from center of drill bit to circumference of vertical column), 7 in. Horizontal adjustment of drill, 360 deg. Feed (vertical travel of drill when operated by feed lever), 4 in. Net weight, 70 lb. Shipping weight, 110 lb. Shipping dimensions, 19 x 14 x 33 in.

1. In the base are six tapped holes to accommodate ½-in. studs, used to clamp work in place. One stud with nut and clamp is supplied with stand. Stand is shipped complete with adapter block to take Black & Decker ½, ⅜, or ⅝-in. drills, types C-D-DG-E-EG-EF-EGF-F-FG. If stand is desired for use with ⅜-in. Black & Decker portable electric drills or ⅞-in., or for ½-in., ⅜-in. and ⅝-in. Black & Decker portable electric drills other than the types named, the size and type as shown on the name plate of the drill should be specified.

Oliver All-Steel Self-Releasing Snap Flask

The illustration shows the all-steel self-releasing snap flask and jackets being manufactured by the Oliver Machinery Co., Grand Rapids, Mich. The flask and



OLIVER ALL-STEEL SELF-RELEASING SNAP FLASK WITH JACKETS

jackets are of simple construction, being tapered 5 deg. so that it is easy to lift them perpendicularly from the mold. They are made of 8 to 10 gage steel and all parts are riveted together. It is said that their all-steel construction is economical, as they last longer, take up less room, have less repair costs, and are less liable to be burned than the wooden types; also that more and better castings can be made from them.

The flask is constructed with angle irons to make it rigid and has sand supports at its parting line. These supports are connected to levers which, when depressed by the operator, withdraw them to the edge of the cope, thus enabling him to lift both cope and drag with a minimum of care. The jackets are claimed to fit exactly the molds that the flask makes.

Smith Standard-Radius Lathe and Planer Tools

The R. G. Smith Tool and Manufacturing Co., 315-17 Market St., Newark, N. J., has added to its line the radius tools illustrated herewith.

A set of tools comprises a spring toolholder, and cutters from ⅛ to 1 in. both convex and concave varying by 16ths of an inch. Also a 60-deg. cutter for cutting threads and a cutting-off tool. All cutters are of the formed type and need be ground on the face only. If the faces are ground radially the original shape will



SMITH STANDARD-RADIUS LATHE AND PLANER TOOLS

be preserved until the cutters have been used up by grinding. Special cutters and holders can be furnished to order.

Keller Dial Indicator

The Atcheson Tool and Die Co., 609-613 North Fourth St., Columbus, Ohio, has recently placed on the market the Keller indicator shown in the illustration. The device is intended especially for gaging the diameter of cylindrical work while being rotated, as on a grinding machine.

The indicator dial is mounted on the end of a shaft, through which a pin, connected with the indicator and provided with a hardened tip for touching the work, extends. The shaft is held in a split bushing, so that it can be slid either toward or away from the work. The bushing is so mounted on a link that its height can



KELLER DIAL INDICATOR

be adjusted. The base of the device can be bolted to the table of the machine on which it is used, and the indicator may then be adjusted in two planes. It is claimed that the device can be quickly adjusted, that it is very accurate and that it facilitates rapid production.

Tec Industrial Platform Truck

The platform truck illustrated is manufactured by the Terminal Engineering Co., Inc., 17 W. 44th St., New York City. The rated capacity is 5,000 lb. and



TEC INDUSTRIAL PLATFORM TRUCK

Specifications: Drive and elevating motors, G.E., 60 volt, series wound. Frame 4-in. steel channel. Tires, 20 x 5 in. solid rubber. Springs semi-elliptic, 2 x 26 in. leaf. Controller, drum type. Coupler for trailers, automatic, uncoupled from dash. Accessories: Red and white electric running lights with Conaphore lens, electric horn, license plate brackets, Sangamo ampere hour meter, Veeder odometer, combination latch lock on controller.

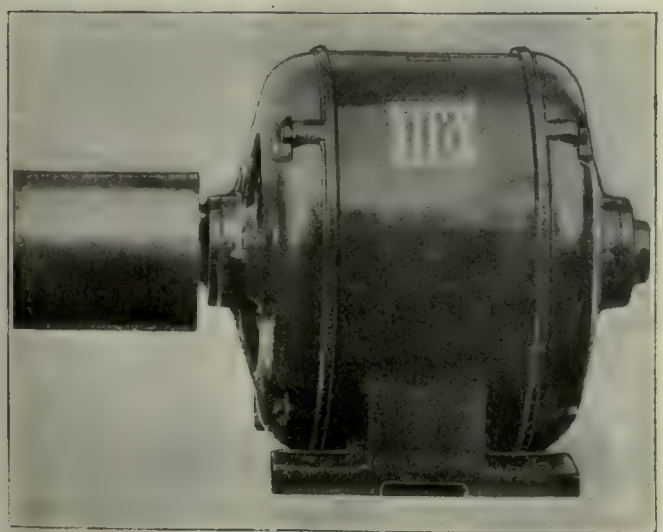
the rated speed is ½ to 10 miles per hour light and ½ to 7 miles per hour full load. The elevating mechanism consists of four steel screw jacks driven by roller chain direct from an electric motor. The batteries are ironclad Exide 34 cell M.V. 9 or 34 cell M.V. 11, or Edison 59 cell A-4 or G-6. They have three-point support.

The drive is the four-wheel type, with a motor on each wheel. Steering also is done through the four wheels. The platforms have pressed steel legs and 2-in. spruce planking.

Hobart Brothers HB Motors

The Hobart Brothers Co., Troy, Ohio, has brought out a line of electric motors from 1 to 10 hp., one of which is illustrated herewith.

The d.c. motors are equipped with starting boxes,



HOBART ELECTRIC MOTOR

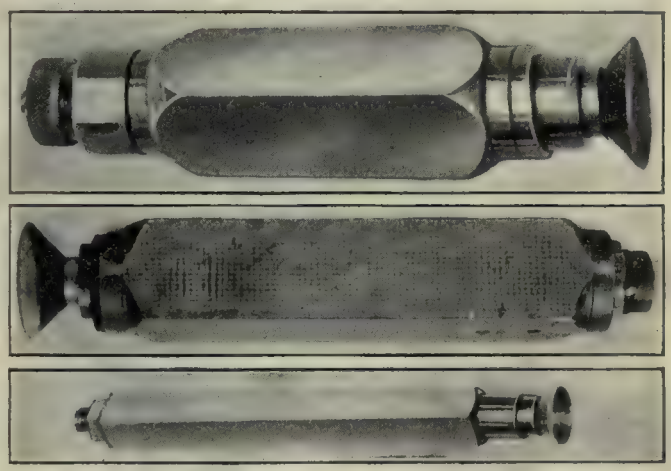
the 7½- and 10-hp. units having compensators also. All the motors have ball bearings and are furnished with base tracks and pulleys. On motors below 5 hp. the pulleys are 4 x 4 in.; on 5 hp. and above they are 6 x 4 in. The speed of all the motors is 1,800 r.p.m. The a.c. motors can be furnished in either 2 or 3 phase and practically any cycle and voltage and the d.c. motors in any voltage. The weights of the different sizes are as follows: 1 hp., a.c. 140 lb.; d.c. 180 lb. 2 hp., a.c. 160 lb.; d.c. 200 lb. 3 hp., a.c. 210 lb.; d.c. 250 lb. 5 hp., a.c. 315 lb.; d.c. 340 lb. 7½ hp., a.c. 590 lb.; d.c. 600 lb. 10 hp., a.c. 650 lb.; d.c. 675 lb.

"Commercial" Grinding Wheel Dressers

The Commercial Welding and Machine Co., Worcester, Mass., has recently placed on the market three styles of grinding wheel dressers. The dressers all use conical cutters and are provided with tool-steel spindles.

The dresser at the top of the illustration is equipped with a double ball bearing in the front end and a ball radial and thrust bearing in the rear. Different sizes of cutters can be used. The tool is made in 2- and 2½-in. sizes, the standard length being 6 inches.

The dresser shown in center is equipped with straight roller bearings and a ball thrust bearing. It is made in two sizes, the casing being either 2 or 2½ in. square.



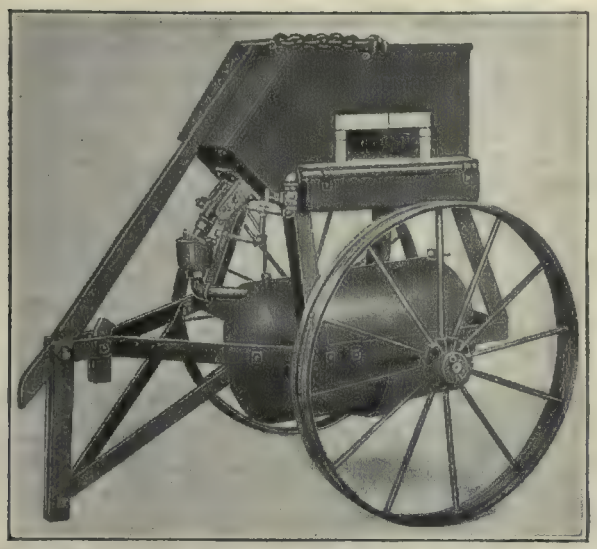
COMMERCIAL GRINDING WHEEL DRESSERS

The bottom dresser is small enough to permit its use on small cup and cylinder wheels. The spindle runs in a soft bushing, has a ball end adjustment and ordinarily carries a ⅜-in. conical cutter. The casing is ⅝ in. square.

Mahr Portable Oil-Fuel Rivet Forges

The Mahr Manufacturing Co., Minneapolis, Minn., has placed on the market the portable oil-fuel rivet forge shown in the illustration. The device is intended especially for car repair work or for work performed in yards where the forge must be trucked over uneven ground. It is mounted on two large, wide-tread wheels fitted with roller bearings, the third point of support being provided by the leg of the steel frame to which the handle is attached. It is designated as the No. 18 forge.

The burner and the forge proper are the same as the stationary type of rivet forge described in the *American Machinist* on page 432. Either fuel oil or kerosene may be burned, and compressed air is employed



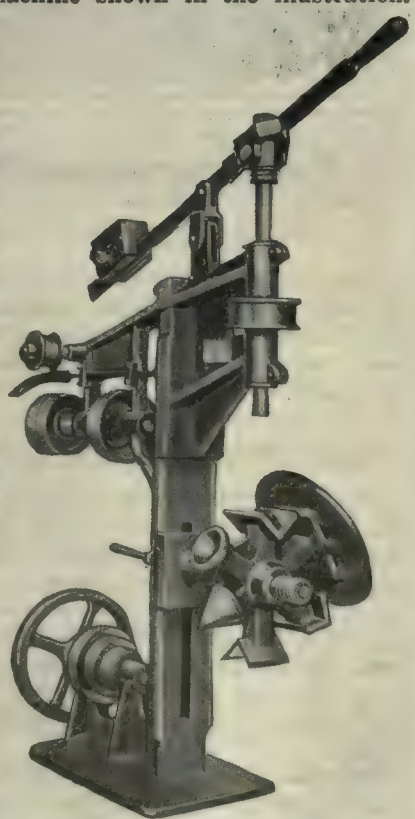
MAHR PORTABLE OIL-FUEL RIVET FORGE NO. 18

at a pressure of from 30 to 120 lb. per square inch, the air consumption being 8 cu.ft. of free air per minute. The burner operates on the vacuum principle, drawing oil from an 18-gal. fuel tank. The forge has a capacity of four hundred ¾ x 3-in. rivets per hour.

For boiler shops and for use on level floors, this same type of forge is mounted upon a different style of truck and known as the No. 15 forge. Three small-diameter, wide-tread wheels are provided, one wheel being swivel-mounted. All joints of the truck are welded, and the fuel tank serves as the principal member of the frame.

Mellon Bench Drilling Machine

G. R. Mellon, 380 Wayne St., Jersey St., N. J., builds the bench drilling machine shown in the illustration. The machine, which was originally described in the *American Machinist*, May 15, 1913, has been redesigned, so as to give greater strength and stability. Lever feed is provided, the thrust being taken by a bronze and fiber bearing. The spindle runs in long bronze bearings, being belt driven. The chief feature of the machine is the monitor table carrying different forms for holding the work. The flat table can be easily detached. The fixture makes it possible to readily drill holes centrally in balls and shafts. To bring the proper form under the spindle, the monitor table is pulled out, thus disengaging it. It can then be rotated, and when released it locks itself in position automatically.

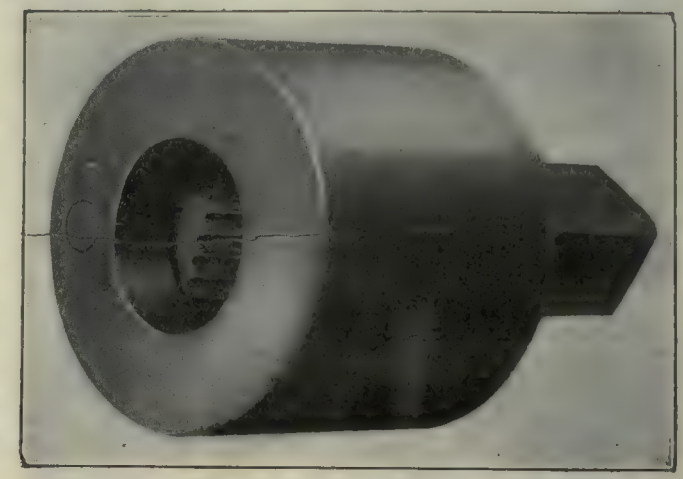


MELLON BENCH DRILLING MACHINE WITH MONITOR TABLE

Specifications: Capacity up to ⅝-in. drills. Spindle to table, maximum, 11 in. Spindle: travel, 3¾ in.; diameter, ⅞ in.; hole, No. 1 Morse taper. Diameter of table, 8 in. Number of speeds, 3. Extreme height, 40 in. Net weight, 125 lb.

"Perfection" Reversible Stay-Bolt Chuck

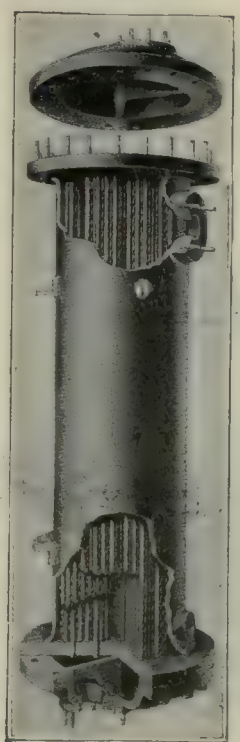
The stay-bolt chuck shown in the illustration is being manufactured by the Lovejoy Tool Works and sold through Tom Brown & Co., 800 Great Northern Building, Chicago, Ill. The chuck grips round staybolts, either threaded or blank, and saves squaring the ends.



PERFECTION REVERSIBLE STAY-BOLT CHUCK

Specifications: Built in three sizes: No. 1 for bolts from ⅞ to ⅞ in.; No. 2 from 1⅛ to 1⅛ in.; No. 3 from 1⅛ to 1¼ in. Either square shank or Morse No. 3 taper furnished as ordered.

It will drive in either direction, so that when necessary it can be used for backing out the bolts. The chuck can be furnished with either a square or Morse taper shank. It is made in three sizes, each size fitting three different sizes of bolts.



GRISCOM-RUSSELL "G-R" OIL HEATER

Griscom-Russell "G-R" Oil Heater

The Griscom-Russell Co., 51 West St., New York, N. Y., has recently placed on the market an oil heater unit of the straight-tube type. This device, shown in the accompanying illustration, is known as the G-R oil heater and is intended for the pre-heating of fuel oil before it goes to the burners, so as to insure complete atomization and perfect combustion of the fuel. The oil is pumped through the tubes, making 3 passes between the inlet and the outlet, and high-pressure steam in the shell serves as the heating medium.

The shell of the heater is constructed of wrought steel welded to the steel tube sheets, and the heads are cast iron. The tubes are of seamless drawn steel expanded into the sheets at both ends. Perforated steel baffles are placed in the steam space. If

desired, the tubes can be fitted with agitators for increasing the oil velocity and the rate of heat transfer. No fittings are required. The heater is made in a wide range of sizes, the weights varying from 150 to 3,100 lb.

Some Jigs for Drilling Harvesting Machine Parts

By H. W. Johnson

Harvesting machinery presents some odd problems to the tool designer. Fig. 1 shows a casting in which hole *B* is cored to size and is not to be bored. The balance of the work is to be jigged from this hole and from the flat side of the casting. It is necessary that provision be made for supporting the casting against the thrust of the boring tools, and this support must be so arranged as to need no adjusting, even though some variation be met in the shape of the casting. A set of jigs which meets these requirements very closely is shown in the illustrations. They were made at the Harvester Plant of the Moline Plow Co.

The first operation is to bore a 1⅜-in. hole as at *A*, Fig. 1. This hole is cored 1⅞ in. in diameter, and is bored with a 3-lip high-speed drill at 183 r.p.m., feeding 0.040 in. per revolution. The casting is laid on the flat bottom member of the jig, shown at the left, and is located by a conical top piece which enters an annular recess around the hole.

This jig is typical of a line of such tools used in the Moline plant, the upper members of which are raised by a lever and held down by two powerful springs when the lever is released.

The second operation is done in another spring jig, shown at the right-hand side of Fig. 1. Inspection of this illustration will show a flattened stud in the jig base. The cored hole *B*, which is not to be bored at all, but used as a locating point for the other holes, is slipped over this stud. The upper member of the jig is a steel bushing, countersunk to slip over the boss on the upper end of the casting. One side of the countersink is entirely cut away and allows the work to be forced back against the four bearing spots *C* on the flat support at the rear, thus establishing the distance from the flat side of the casting to the hole being bored. The thrust of the boring tool is taken by the strut *D*. A flattened stud *E* is pushed into the hole which was bored by the first operation. This stud does not locate the castings. It simply resists torque. It is flattened horizontally in order that the casting may surely rest on the strut *D*, even though there be some small variation in the castings. The hole bored by this operation is 1⅞ in. in diameter.

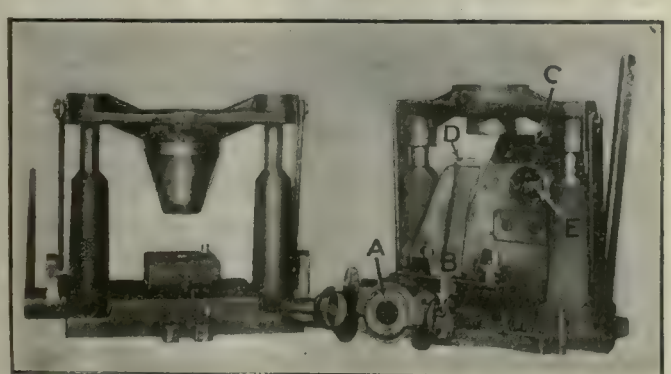


FIG. 1. JIGS FOR OPERATIONS 1 AND 2

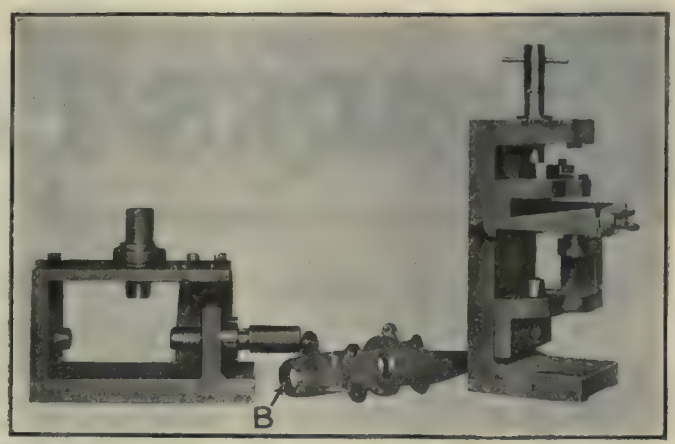


FIG. 2. JIGS FOR OPERATIONS 3 AND 4

The third operation is done in the tall jig shown at the right in Fig. 2. The lower stud enters the cored hole *B*, a sliding plug is dropped into the hole bored by operation 2, and the casting is fastened against a hardened locating stop by a quick-acting clamp operated by a wingnut. In this operation the hole is drilled from the solid, using a ⅞-in. high-speed drill. Speed, 458 r.p.m.; feed, 0.0012 in. per revolution.

In the final operation five ⅝-in. holes are drilled from the solid in the jig at the left. Locating is from the cored hole *B* and the two large bored holes by means of one solid and two sliding plugs. Speed, 610 r.p.m.; feed, 0.010 in. per revolution.

A Spring Block for Use in a Milling-Machine Vise

By H. M. Fay

The illustration, Fig. 1, shows a pin with two slots milled across it. This pin, being but ⅜ in. diameter by 1¼ in. long, was rather difficult to hold and as a solution of this difficulty the split block shown below the pin was used. The block has four holes *A* in it, and into each of these holes one pin is placed, the shoulder *B* on the pin serving to locate it lengthwise. The block with the four pins is gripped in the milling machine vise as shown in Fig. 2 and by tightening the vise in the usual manner the block is made to grip the pins securely.

The principle involved is similar to that used in some expanding mandrels. By using two of these blocks, loading one while the machine is at work on the pins held by the other, continuous operation is obtained.



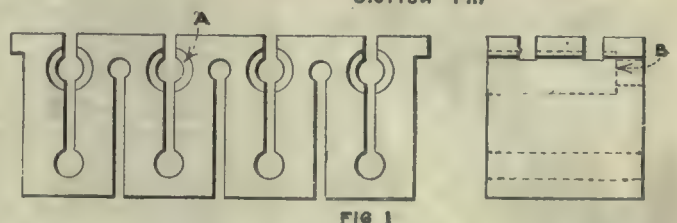


FIG 1



FIG 2

FIG. 1. FLEXIBLE BLOCK FOR HOLDING SMALL PINS
FIG. 2. THE BLOCK IN THE MILLING-MACHINE VISE



Forty-Two Cities To Celebrate Fortieth Anniversary of A. S. M. E.

Engineers will gather simultaneously in forty-two cities on Nov. 5, to celebrate the fortieth anniversary of the founding of the American Society of Mechanical Engineers. Plans being made at the national headquarters of the society, 29 West 39th St., New York, it was announced, include the transmission by radio-telephone of speeches reflecting engineering ideals to be delivered here by the heads of the leading engineering organizations, including Herbert Hoover.

Speakers prominent in the affairs of the society will make addresses in each of the forty-two cities represented by local sections. In New York it is planned to have these meetings addressed through the radio-phone and at a central celebration by Fred J. Miller, president of the American Society of Mechanical Engineers; Herbert Hoover, president of the American Institute of Mining and Metallurgical Engineers; Arthur P. Davis, Washington, D. C., chief engineer of the United States Reclamation Service and head of the American Society of Civil Engineers, and Arthur W. Berresford, of Milwaukee, head of the American Institute of Electrical Engineers.

Speakers at the celebrations will dwell upon the engineer as a constructive force in civic progress as evidenced by the movement to reorganize the Federal Departments at Washington, now indorsed by both the Democratic and Republican parties. The plan to coördinate the immense public works functions of the Government, it was pointed out recently by making over the Department of the Interior into a department of public works, was originated in Engineering Council, of which J. Parke Channing, of New York, is chairman.

This Is Hardly Slavery

Kansas' new industrial court has been denounced by Mr. Gompers and other labor leaders as a devilish contrivance designed to enslave wage earners and reduce them to a state of abject servitude. If such is the purpose of the court its methods are Machiavellian. Listen to this extract from an opinion it handed down in a recent case involving members of the International Brotherhood of Stationary Firemen and Oilers employed by the Union Pacific railroad:

> These men are required to work seven days in the week in order to earn a sufficient wage to support their families even scantily. The evidence shows a state of facts which would unquestionably warrant this court in taking jurisdiction in order to preserve the public peace, protect the public health and promote the public welfare.

The court announced a new wage scale based on an eight-hour day with time and a half for overtime, Sundays and legal holidays, and then remarked on the seven-day week:

> The members of the court feel that the seven-day week ought to be discouraged. The occupation in which these workers are engaged must necessarily operate seven days in the week, but where ever it is reasonably possible to do so a revolving system should be used so that individual workers will be allowed one day's rest and recreation in seven.

No order compelling the adoption of such a plan was issued, the court desiring to give the employer time and opportunity to work out the details of such a scheme, but there is an unmistakable intimation that if action is not forthcoming the court will step in.

If this is the path to slavery, where, Mr. Gompers, is the road to justice and freedom?—*The Employer.*

"Management Education" Course To Be Established Throughout Country's Colleges

Plan an Outgrowth of Convention of Industry and Colleges, Held To Bring the Two to Working Agreement — Industry To Appropriate $100,000 Annually

A course in "management education" to provide a sufficient number of properly trained executives for the industries of the United States is to be established in a majority of the 620 American colleges, according to an exclusive announcement made to the Associated Press by Dr. Hollis Godfrey, president of the Drexel Institute, Philadelphia, formerly commissioner of the advisory commission of the Council of National Defense.

$26,000,000,000 Backing

The plan, an outgrowth of a convention attended by representatives of industry and colleges in Philadelphia last March, is backed by corporations representing a capitalization of $26,000,000,000. It is the result, Doctor Godfrey said, of these two factors coming to a definite working agreement for the first time through the establishment of the Council of Management Education, an organization formed "to study mutual problems in order that the colleges may render the greatest possible service to industry."

Doctor Godfrey, chairman of the new body, assisted by Dr. Samuel P. Chapen, general director of the American Council on Education, representing the 620 colleges, and Dr. Frederick C. Ferry, president of Hamilton College, are perfecting the plan, which contemplates establishing practical courses in the schools, assisting undergraduates and others to choose their life's work, by placing several thousand students and teachers in industry during the summer months and by introducing extension courses for men now in industry. By the summer work, students will be enabled to defray their expenses at college, obtain an insight into American industry and enable the executives to select men for future management.

The Council of Mangagement Education, which has been formed, it was said, to become "a clearing house for all industrial and educational matters in the country, to promote the mutual understanding of the mutual problems of industry and the college, and to keep perpetual inventory of the educational needs of industry and of the ability of the colleges to meet these needs," has opened temporary offices in the Drexel Building, Philadelphia, until headquarters are furnished in Washington.

An annual appropriation of $100,000, entirely borne by American industry, has been made to carry on its work, which has been divided into two classes: First, to determine the field of service which each college can cover, and, second, to provide the college with all industrial data which may be utilized in forming undergraduate courses for men contemplating entering industry and in reaching the management men already in industry through extension courses.

All of the courses and scholastic recommendations, it was said, will be passed upon jointly by the Council of Management Education and the American Council on Education before being forwarded to the institutions of learning. Within one year, it is estimated, 100 colleges will have included the extension industrial courses and all will be provided with the industrial material upon which to base undergraduate work.

Only Surviving War Organization

The council, acording to Dr. Godfrey, is the only war organization which has carried operations into time of peace Nearly all of the educators back of the movement served in the Council of National Defense. When the armistice was signed these men de-

LD'S INDUSTRIAL FORGE
News Editor

cided that the educational knowledge gained during the war at an expenditure of millions of dollars should not be lost. Accordingly, plans were set in motion to turn this information over to industry. A survey of the needs of industry was made under the auspices of the Technology Clubs Associated of the Massachusetts Institute of Technology.

In the most extensive industrial survey ever made, executives of 250 of the largest corporations in America agreed that increased production, decreased cost, increased stability and increased incentive were the most important needs. The convention in Philadelphia last spring met to discuss these needs. It was agreed by both college presidents and executives of America's industries that the needs of industry can be met only through proper education, and plans were made for the formation of the permanent Council of Management Education.

While the majority of American industries are represented on the council, those having members on the executive committee are the railroads, public utilities, oil, textiles, mining, rubber, leather and shoes, paper, machinery and cotton finishing.

The executive members of the council appointed to represent their industrial group are as follows: Railroads, A. W. Gibbs, chief mechanical engineer, Pennsylvania Railroad; paper, Colonel B. A. Franklin, vice president Strathmore Paper Co.; public utilities, H. B. Shaw, educational director, H. L. Doherty Co.; shoes and leather, Frederick B. Rice, president, Rice & Hutchins; mining, J. Park Channing, mining engineer; machinery and metals, Frederick H. Payne, Greenfield Tap and Die Co.; rubber, Dr. R. S. Quinby, service manager, Hood Rubber Co.; cotton finishing, J. K. Milliken, president, Mt. Hope Finishing Co.; textiles, Albert Bigelow, Ludlow Manufacturing Co.

The educational group includes, besides Doctor Godfrey and Doctor Capen, Dr. Frank Graves, dean of the school of education, University of Pennsylvania; Dr. Charles Tilden, professor of engineering mechanics, Yale University; Dr. David Tennant, professor of biology, Bryn Mawr College; Dr. Leigh Reid, professor of mathematics, Haverford College; C. L. Evanson, professor of engineering administration, Drexel Institute, and J. S. Pearson, professor of production engineering, Drexel Institute.

The American Council on Education has appointed the following committee as a permanent body to co-operate with the Council of Management Education:

Doctor Capen, chairman; Dr. Charles R. Mann, chairman of the advisory board educational training of the general staff, War Department; Frederick L. Bishop, dean engineering school, University of Pittsburgh; Park R. Kilbe, president Municipal University of Akron; Raymond Hughes, president Miami University.

Buffalo Builders' Exchange Votes "Open Shop" by 108 to 1

"Resolved: That this Exchange hereby endorses the policy of open shop for the following reasons:

Because we believe that absolute independence of the individual to work or not to work, to employ or not to employ, is a fundamental principle which should never be questioned or assailed. That on it depends our whole social fabric and business prosperity and that employers and workmen should be equally interested in its defense and preservation.

We believe in the right of individuals or of corporations to deal directly with their employees on the question of wages and conditions of employment without dictation or interference from any person or organization not directly concerned.

We believe that no individual firm or corporation should be discriminated against because of membership or non-membership in any organization.

We believe in organization along the proper lines but are opposed to strikes, boycotts or any and all forms of intimidation or interference with the personal liberty granted by our form of government.

We believe that no two men are created alike and that no standard can be set as a day's work. That there should be no limitation as to the amount of work a man shall perform other than the ability of the man himself and no limitation should be placed on the use of machinery, tools or material and no restriction as to the employment of foremen or apprentices.

We believe the principle of absolute closed shop is contrary to the principles of free government and conflicts with the rights and traditions of American citizenship. We are convinced it deprives the individual workman of all incentive to excel in his chosen calling and is productive of serious loss in time and output.

For these reasons and many more which might be enumerated, we are unalterably opposed to a closed shop policy and pledge ourselves herewith to support the principle of open shop and to maintain in so far as it is possible open-shop conditions in the building industry."

The following list of concerns, and groups are now operating 'open shop" in Buffalo: The entire clothing industry, the entire building trades, the eleven principal hotels of the city, all the principal restaurants and cafes, the entire street railway system, all the mammonth grain elevators, every machine shop of any consequence.

In addition to the above, the following organizations composed of business men and women have endorsed and promised support to the open-shop movement: Chamber of Commerce, Employers' Association, Rotary Club, Kiwanis Club, Conopus Club, Buffalo Federation of Women's Clubs.

Trade Market Letters

New York

During the summer sales were at a low ebb, with a minimum of inquiries for new equipment. Recently, there has been an improvement, but good business can hardly be expected until after election. Machine-tool manufacturers and dealers are receiving more inquiries, but many are for future requirements. Plants contemplating additional equipment are asking for estimates, but are not closing orders as yet. However, despite the small business transacted in heavy equipment, there is a large demand for taps and dies, milling cutters, small drills and all tool attachments.

The period of little buying activity has enabled the manufacturers to catch up with past orders on file and consequently deliveries have improved greatly.

The railroads in the Chicago territory have been asking for a number of machine tools of all types, but the Eastern roads are still absent from the New York market. Recently, however, several tools were purchased by the Pennsylvania and the New York, New Haven & Hartford Railroads. The New York Central is reported to have a large list in preparation which will be released shortly.

The only feature of interest in the export market is the requirements of the South American railroads. The railroads of northern Brazil will buy through their agents, Costa, Campos & Malta, of Sao Paulo, Brazil, about $1,000,000 worth of rolling stock, including much machine tool equipment. Nelson Malta is now in New York arranging for the placing of this business.

Cleveland

The action of the Ford Motor Co. in reducing its prices 30 per cent for cars and trucks has become the chief subject of discussion in the machinery and machine-tool trade here. With business virtually at a standstill for the last three months, still greater uncertainty as to the immediate future confronts the industry, leading machine-tool interests admit. The most significant development of the last few days is the difference in opinion as to what the price trend for equipment will be.

Some manufacturers and distributors here admit that the trade is in for a

reaction in price. Still others assert, and these are mostly manufacturers, that there is no reduction in price in sight.

The latter point to the fact that machinery equipment has advanced no better than 100 per cent above pre-war prices. They consider these increases modest, as compared to many other lines, and also because raw material that formerly was bought for 3 cents a pound now commands a price of 10 cents, while wages alone have doubled in cost to the producer. Moreover, these manufacturers point out that the large equipment manufacturer cannot go into quantity production as does the automobile manufacturer for instance, which also cuts down the chance for lowering overhead.

Whether price reduction would have any effect upon the industry, in stimulating demand, is doubtful at this time. The fact of the matter is there is hardly a house in the Cleveland district that reports doing any business.

Small tools alone seem to be wanted —arbor presses, broaching machines, twist drills, attachments, auxiliary parts. Punching and shearing equipment demand is below normal. Fewer automatic-machine orders are being taken than at any time in the last four years. Drilling-machine demand is only fair. With general manufacturing slowed down, most firms here are turning their attention to the railroads.

Against this uncertainty comes the announcement that at least five large firms here have started to expand their operations.

Chicago

Prevailing quiet in general business conditions has extended to the machinery industry, to the extent that new business is probably about 60 per cent of the average established for the first half of the year. The delivery of long expected machines on back order continues and is of sufficient volume to keep sales accounts of good volume. Some cancellations of moment have occurred, principally in orders to the automobile trade, and while such cancellations have, in the case of dealers depending largely on this line of industry, amounted to a large figure, in no case has it seriously inconvenienced any one.

One other feature which right now tends to discourage buying is a feeling of uncertainty in regard to the immediate future of his own business on the part of the prospective buyer. Here in Chicago the feeling is that the present price-cutting wave will not spread to disastrous proportions and that its effect may be such as to stimulate buying and put all manufacturing on a thoroughly sound basis.

The railroads present an encouraging feature for the machine-tool industry. Several large lists on which no buying has been done are still out and it is known that requirements yet unlisted amount to very considerable figures. Rehabilitation of the railroad shops must proceed, almost regardless of general business conditions, and this should be a prolific source of business in the near future. Current booking of new business has been too small in the past week to note demand for various definite lines.

Collections are fair. Effort is required to keep money coming in when due, but an encouraging feature is that a reasonable amount of effort is almost always productive of results.

The Future Course of Business

Curtailment of manufacturing and merchandising activities was inevitable while price changes were radical in character. On the other hand, slowly declining prices require that business be carried on cautiously with careful thought to the long future, but do not preclude sane and conservative operations. Unwillingness to face the facts in the hope of a return to another period of rapidly rising prices, and failure to admit that a new working basis must be found, not only react on the individual interests involved, but on the entire business community. Fortunately, the facts have been recognized by many interests, but in some lines failure to do so is handicapping business.

The United States is in a more favorable position than any other country in the world. If a mutual basis for transactions is found in the immediate future, labor will be kept reasonably well employed, and manufacturing, commercial and financial operations will be maintained at a healthy level. Delay in finding such a mutual basis is not only unwise but it might well result in entirely unnecessary industrial, financial and social disorganization.

International Conditions

The condition now prevailing in the United States of declining prices and of consequent hesitation on the part of the buyer, whether he be manufacturer or ultimate consumer, prevails in every important country of the world. The British textile industries have felt not only a slackened domestic demand, but the effects of curtailed buying in distant markets, especially India. The boot, shoe and leather industries of the United Kingdom are now in a state of stagnation. Extreme dullness in the main commodity markets is reported from Constantinople. Business in South Africa is likewise reported as dull. The Japanese situation is a matter of common knowledge. Ports as widely scattered as the Piraeus and Barranquilla are congested with goods bought in large quantities at the flood-tide of postwar prosperity. These goods must now be handled on over-burdened railways, in markets disposed to be critical of prices.

If the business hesitation now prevalent in the United States were peculiarly an American condition, a quick return to a condition of activity could be anticipated. An adjustment of international trade, however, will require a long period for its completion. American business must depend primarily on domestic demand, with the expectation of a fluctuating and uncertain foreign demand.

Manufactures

Pig-iron production in August reached the highest point since February, 1920, being 3,147,402 gross tons. Steel ingot output as reported by companies producing a little less than 85 per cent of the total was 3,000,432 tons, the largest amount since March, 1920. The wool manufacture continues to operate on a restricted basis. On Aug. 2, about 50 per cent of wide looms and woolen spindles, 37 per cent of the worsted spindles, and about one-third of the combs and cards were idle.

Curtailment of operations by automobile manufacturers has resulted in a corresponding reduction in the activity of tire manufacturers. The lessened demand for tire fabrics is an important factor in the lessened activity of the cotton mills. Cotton consumption for August was 483,193 running bales, as compared with 525,405 bales for July.—*Commerce Monthly.*

Norton Co. Holds Sale Conference

The Norton Co., Worcester, Mass., held its 1920 sales conference from Sept. 13 to 18. While the conference was held mainly for the promotion of sales, there was much time spent for entertainment. All of Wednesday was devoted to golf, baseball and a sheep bake. On the other days there were dinners, boat races, dancing, etc.

Round-table discussions, practical demonstrations of new machines and talks, kept the conference busy. "Past Accomplishments and Future Possibilities," by Charles H. Norton, contained a clear and interesting analysis of cylindrical grinding problems. The rest of the conference was devoted to company business.

S. A. E. Winter Meetings

The Society of Automotive Engineers will hold three important meetings during the coming winter. The first of these will be a motorboat meeting on Dec. 4, and the second, the annual meeting from Jan. 11 to 13; both of these will be held at New York. The third, the Chicago truck and tractor meeting, will be held on Feb. 2 at the Morrison Hotel.

Catalogs Wanted

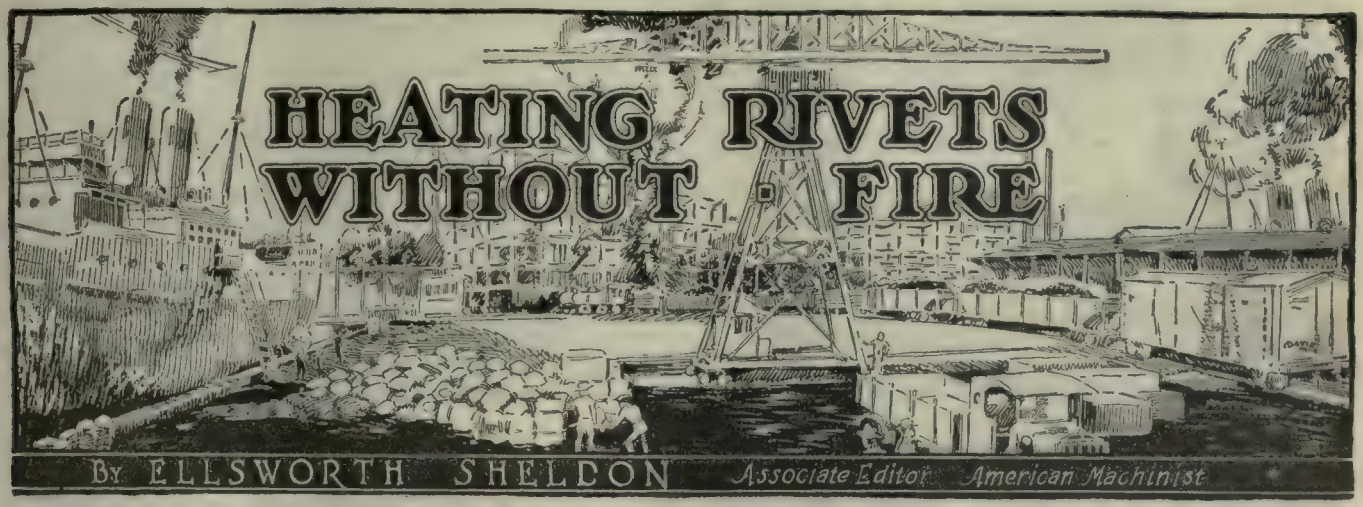
The Bedford Steel and Construction Co., Bedford, Ind., would be pleased to receive catalogs on canning machinery, conveying systems, conveyors, tanks, motors, etc., for installation in a large factory.

C. J. Cazole & Sons., 532 Royal St., New Orleans, La., would be pleased to receive catalogs on woodworking machinery.

Frank Cino, 707 Bourbon St., New Orleans, La., would be pleased to receive catalogs on edging machines for galvanized iron.

The Shaw Manufacturing Co., Lynn, Mass., would like to receive catalogs on automatic machinery, turret lathes, drill presses, and machinery suitable for manufacturing small metal products.

October 14, 1920 American Machinist Vol. 53, No. 16



HEATING RIVETS WITHOUT FIRE

By ELLSWORTH SHELDON Associate Editor American Machinist

During the war we heard a great deal about riveting and the wonderful records made by "teams" of riveters. A full "team" comprised four individuals; the "driver," who handled the pneumatic hammer; the "holder on," whose job it was merely to hold the "dolly bar" against the head of the rivet while his superior did all the hard work; the "sticker," who saw to it that there was always a red-hot rivet in the hole next to the one upon which the others were working; and lastly, the "heater-boy," who had only to build the fire and keep it burning, rustle up the rivets necessary to keep the others busy, keep a sufficient number of rivets white hot, and deliver them at exactly the right time and with unerring aim to the sticker, often many feet away. A machine which relieves the heater boy, and incidentally the others, from much of the discomfort of the job, is here described.

MILLIONS upon millions of iron rivets are needed each year to built the stately ships that carry our commerce; to erect the huge steel structures that house our industries and offices; to span our waterways with bridges for railroad and vehicular traffic. Construction of innumerable boilers, cranes, tanks, and a hundred other devices of iron and steel help to swell the enormous total. Rivets big and little are in demand wherever two pieces of structural material are to be permanently joined together, and it is difficult indeed in these days of humming industry to get beyond the sound of the pneumatic hammer or sight of the glow of forge fires. As important as the rivet itself is the means of heating it; for all rivets on structural work are driven red-hot in order to obtain the advantage of the shrinking metal as it cools to draw the riveted members closer together. Whether deep in the hold of the growing ocean-liner or upon the dizzy heights of the latest skyscraper; suspended in mid-air over the rushing torrent or buried in the bowels of the earth at the deepest level of a mine; wherever rivets are driven—there, close at hand, must be the glowing forge to supply the incessant demand for red-hot rivets.

Far from the least, but rather, indeed, close to the head of the list of industries in its appetite for rivets, is the building and repairing of the countless thousands of steel railroad cars that carry the bulk of our land traffic. Cars of all sorts, sizes and conditions, from the pretentious Pullman, which conveys our luxury-loving people from the place where they are to the place where they think they want to be, to the humble coal-carrier or the lowly dump car that helps to build the roadbed or transports the fuel wherewith to move the trains; whether palace on wheels or peripatetic receptacle for refuse; they are all alike to the car builder who bestows upon the construction of either the same careful consideration.

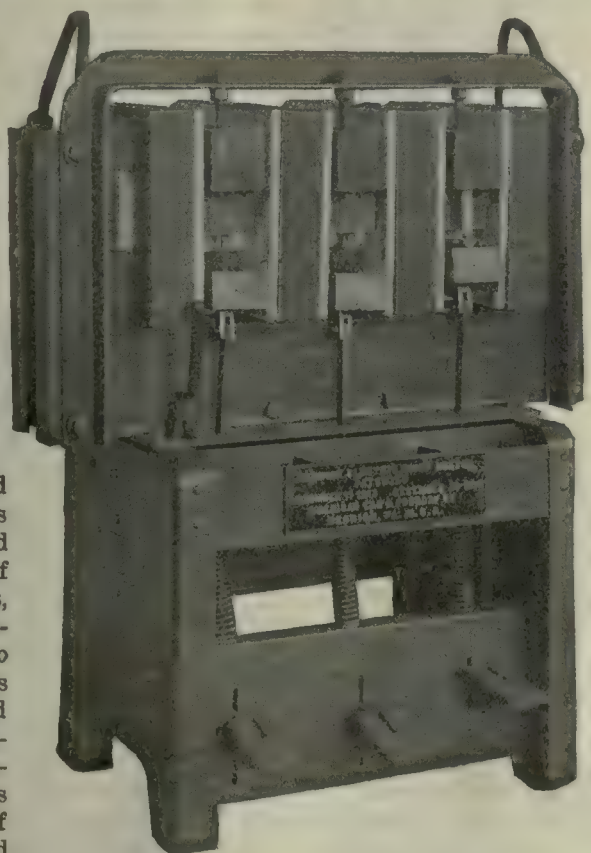


FIG. 1. BERWICK ELECTRIC RIVET HEATER

At the huge plant of the American Car & Foundry Co., located at Berwick, Pa., where there are 85 acres of ground within one enclosure devoted exclusively to the building and repairing of railroad cars; where there are eleven acres of ground under the one roof of the car-finishing shop;

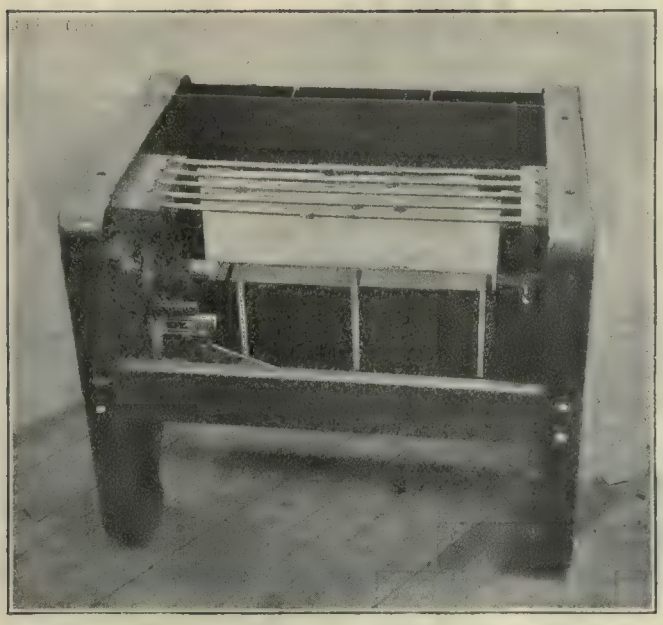


FIG. 2. THE UNDER FRAME

where are turned out in normal times forty passenger cars per month complete from truck to ventilator, ready to be pulled up to the station platform and receive their load of passengers; besides about one hundred per day freight, coal and tank cars.

A Spectacular Scene

Standing at one of the many entrances to the immense car-shop, gazing down what seems to be miles of tracks containing cars and parts of cars in all stages of construction; tangled ruins of cars, fished piecemeal from the latest wreck and sent in for repairs; the eyes confused by the whirling maze of machinery and the ears deafened by the clangor of pneumatic hammers upon iron structures; one of the sights that would have impressed the visitor in the days, or rather nights, of not so long ago was the rows upon rows of winking fires beside the tracks where were heated the tons of rivets that every hour took up their humble though responsible duties of welding the seemingly inconglomerate masses of metal into the completed product.

Spectacular though these fires may have been, presenting through the reek and murk of the vast building a picture of incipient inferno, their presence was the cause of much discomfort and not a little danger to the workers by reason of the smoke and gas thrown off by them. Wherever riveting was being done, and that was everywhere, there would be one of these little fires, at times sending up billows of yellow smoke and continually the source of a stream of white-hot rivets flying through the air as they were thrown from "heater-boy" to "sticker."

Aside from the dirt and discomfort of open fires they were expensive to operate. It required some time to start up a new coal fire or to heat a cold oil-furnace; rivets were continually being lost in the fire or burned beyond reclamation because of being hidden from the heater-boy's sight, and a large percentage of the heat generated was dissipated in the surrounding air instead of being converted into useful work.

Because of certain lack of portability, especially of the oil furnaces, the fires were sometimes an inconvenient distance from the riveters that were using their product, and the heater-boy would have to throw the rivets a long way or even to relay them to the sticker, while the latter would fumble them (they catch them in tongs or basket, not in bare hands) in a way that in another field would lose him his place on the home team.

Obliged to Make a Change

In sheer self-defense the company was obliged to start something with a view to eliminating the waste and discomfort caused by these fires. Their engineers got busy on the job and as a result the long rows of ruddy fires have vanished; smoke and fumes no longer obscure the vision or choke the respiration of the over-head men; and the grimy, sweating mob of heater-boys are transformed into cool and calculating young gentlemen whose only care in life seems to be to see how many white-hot rivets each can keep in the air between himself and the particular stickers he is serving.

Instead of confronting a roaring, smoking fire, each boy stands before an apparently inert machine that does not look as if it could generate heat enough to boil a potato. But let us watch what happens: Taking up in his tongs a rivet perhaps ¾ in. in diameter and 4 or 5 in. long, the boy depresses a treadle in the base of the machine, thereby opening an innocent appearing pair of jaws in the upper facade, so-to-speak, inserts the rivet between them and releases the treadle.

Nothing happens! There is no fire, no roar, no smoke. But wait! The black rivet is slowly (and not so *very* slowly, either) turning blue. From blue it begins to turn red, gradually lightening in color until within a few seconds the once cold rivet has assumed the dazzling brilliance of a new Mazda lamp, while sparks fly and scale drops from its surface exactly as if it were in a white-hot fire. No fire could more quickly have brought the rivet to a welding heat than has this unsympathetic-looking machine, yet there is nothing in its appearance to indicate a capacity for generating heat; nothing about it is hot but the rivet.

The Berwick Electric Rivet Heater

The solution of the problem of the engineers, the explanation of our seeming mystery, is the Berwick Electric Rivet Heater; designed by its builders as a means of relief from their own troubles; now on the



FIG. 3. THE CORE OF THE TRANSFORMER

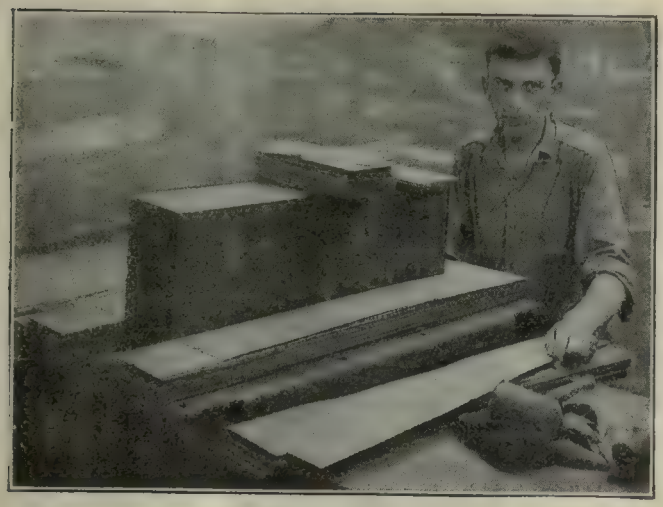


FIG. 4. LAYING UP THE CORE

market to relieve the troubles of others. It is built with two, three, or five heating units, a picture of the three-unit machine being shown in Fig. 1.

The Berwick heater is in effect a "step-down" transformer. Its high-tension coils may be wound to receive whatever voltage of current is commercially available. Its low-tension coil is a single (interrupted) turn of laminated copper with terminals of copper forgings. Castings were found to be unsuitable for this purpose because of lack of homogeneity and consequent heating and pitting.

The construction of the machine is extremely simple. The under frame is built up as shown in Fig. 2, from two end pieces of flanged plate joined by suitable angles or channels. Attached to the inner side of one of the end pieces is the panel carrying the cutouts and control switches. Extending from end to end near the top of the underframe are five copper bars that distribute the current to the high-tension coils in accordance with the heat requirements. Current distribution is under control of the operator (the heater-boy) through the medium of a lever extending through the ledge in front and to the left of the heating units.

The transformer comprises almost the whole of the upper part of the machine; there being in addition but a few pieces of angle iron to bind it together and support the weight of the copper coils. The core is built

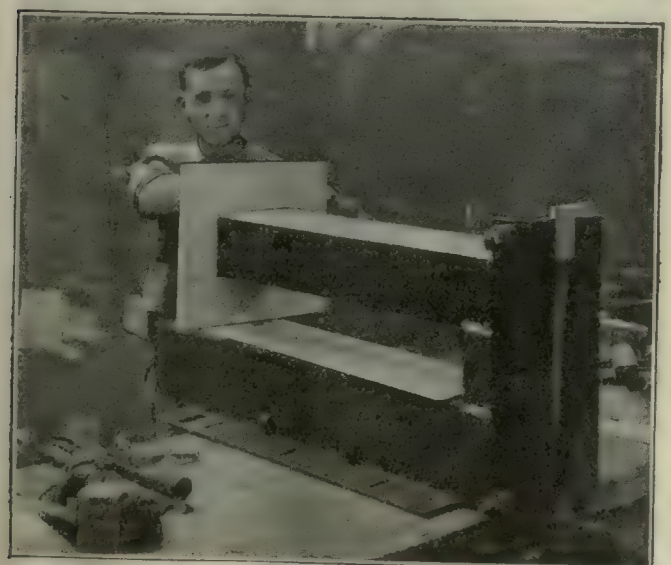


FIG. 5. PUTTING ON THE INSULATING SEPARATORS



FIG. 6. FURTHER OPERATIONS ON THE CORE

up from rectangular pieces of sheet iron with the corners interlocked but not fastened together by any means other than clamping. The scale is not removed from the surface of the sheets before cutting them up, thus leaving a thin film of oxide between adjacent laminations, serving to break up the flow of eddy currents that would generate heat in the core and decrease the efficiency of the machine.

A partly finished core is shown in Fig. 3, and the method of laying it up about a wooden form in Fig. 4. When completed it forms a rectangular frame, but it obviously would not do to close it up at this stage of the process for the coils and insulating partitions are yet to be put on.

The strips forming the top and bottom are not cut full length but are shorter than the core by the width of one end piece, so that in interlocking the corners of the closed end the long strips are laid alternately flush first with one end and then the other, leaving a comb-like effect at the open end into which the end pieces, with spacers between, may be fitted after the coils are placed. This construction is evident at *AA* in Fig. 4.

In Figs. 5 and 6 are shown further steps in the construction of the transformer. In Fig. 5 the closed end has been clamped together by the bolts and corner pieces, and the workman is just putting on the first separator, which is of an asbestos compound made into boards or sheets about $\frac{3}{8}$ in. thick. This asbestos board is sawed to required shape on band saws; cutting as readily and being handled in much the same manner as

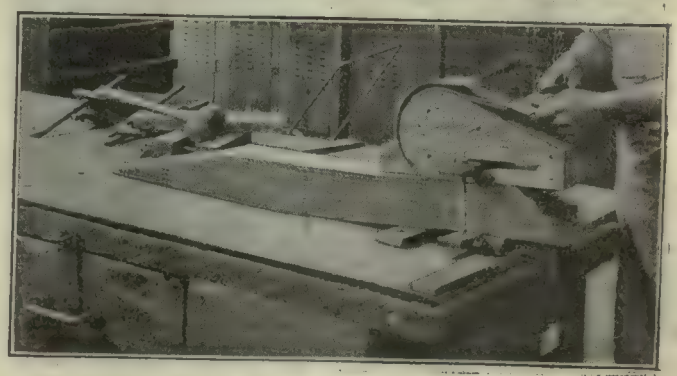


FIG. 7. BUILDING THE LAMINATED COPPER COIL

wood. In Fig. 6 the workman is placing the long strips of the same material which serve to keep the coils from electrical contact with the iron of the core.

Low-Voltage Coil of Laminated Copper

The low-voltage coil is built up from strips of sheet copper formed about a wooden block, shaped somewhat like a horseshoe. The strips are cut successively



FIG. 8. LOW-TENSION COILS READY FOR WELDING

shorter from the outer one toward the center and piled as shown in Fig. 7. The forming block is placed on the pile near one end and the whole is clamped to the bench. The workman bends each strip over the former, fastening the loose ends with copper rivets until the coil is completed ready for welding as shown in Fig. 8. The copper rivets are but temporary fastenings, serving to hold the strips in place until the welding operation makes them one piece with the terminal blocks.

The terminals are solid blocks of forged copper, the upper one weighing over 100 lb., arc-welded to the copper strips that form the body of the coil. In Figs. 9 and 10 may be seen the apparatus with which the welding is accomplished. The effect of cutting the copper strips successively shorter is plainly shown in Fig. 9 in the shape of the wide V between the ends of the laminations and the terminal, which is the piece under the right-hand strap.

Welding on the Terminals

The horseshoe of laminated copper and a terminal block are placed together in a cast-iron fixture and firmly bolted down. Both rest directly upon the iron to make the necessary electric contact, but are otherwise surrounded by firebrick to prevent work and fixture from being fused together. The fixture rests upon an iron table to which is permanently attached one lead from the generator that furnishes the welding current.

A more comprehensive view of the welding outfit is shown in Fig. 10. The clamping fixture is not attached to the iron table but can be moved about to suit the welder's convenience. Its broad surfaces insure ample contact with the table wherever it may happen to be.

The hood to the right is connected to an exhaust fan to carry away the fumes and some of the surplus

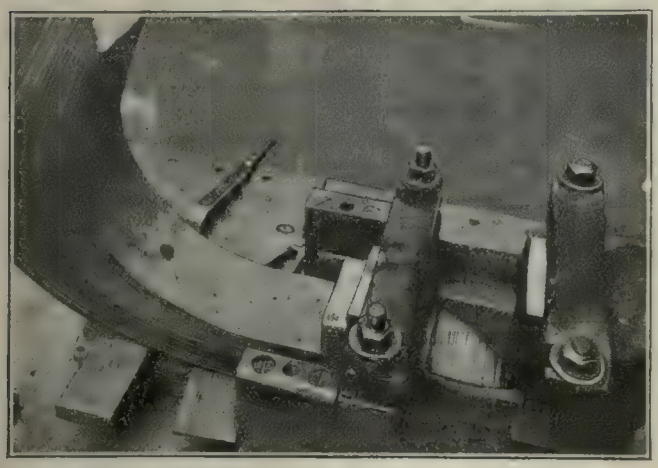


FIG. 9. SHOWING THE SHAPE OF THE WELD



FIG. 10. THE WELDING OUTFIT



FIG. 11. HIGH TENSION COILS

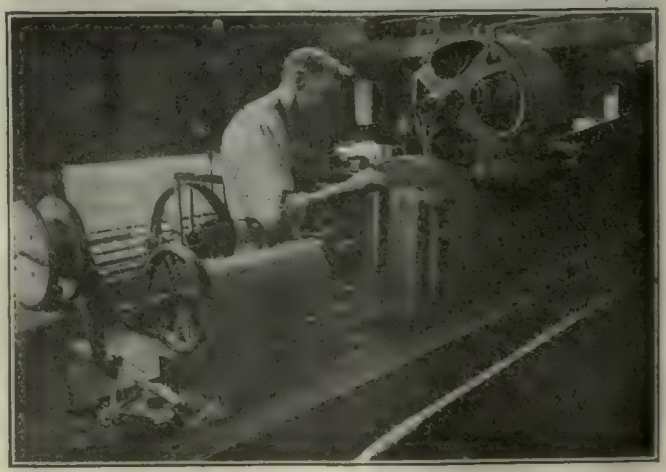


FIG. 12. WINDING THE COILS



FIG. 13. ASSEMBLING THE TRANSFORMER



FIG. 14. PARTLY ASSEMBLED TRANSFORMER

heat generated by the arc. Two men are employed to do the welding; one to manipulate the arc and the other to sift in small scraps of sheet copper with which the V, seen in Fig. 9, is eventually filled up. The shape of the weld may be seen in Fig. 10, where the upper block is shown welded in place.

The welding is, of course, carried on in a separate well ventilated room where no one is allowed to enter unless protected by suitable masks.

Winding the High-Tension Coils

Some of the high-tension coils may be seen in Fig. 11, and the winding device in Fig. 12. A separable wooden bobbin is attached to the faceplate of the machine and the wire is guided by hand during the winding. The movement of the machine is at all times under instant control of the operator by means of a treadle connected to the starting switch and brake.

The winding is an apparently simple operation; yet it requires a considerable degree of skill and experience to lay on the wire smoothly and compactly so that each turn will occupy the least possible space and the finished coils contain the required number of turns without exceeding the limitations in dimensions.

At several points during the winding branches are taken off by soldering in short pieces of wire leading to the outside of the coils. These branches are for the purpose of regulating the flow of current and consequently the degree of heat delivered by the machine. They must be attached at just the right place and must lead to the outside without interfering with the symmetry of the coils.

Further steps in the building of the transformer are shown in Figs. 13 and 14. The high-tension coils and the insulating partitions are all put in place, and then the open end of the core is closed by inserting the sheet-iron strips cut for that purpose.

Four of the five low-tension coils have been placed in Fig. 14. They are not attached in any way to the core, but are suspended by stud bolts from a yoke of angle plate that passes over the top of the machine, and steadied by a similar yoke at the back. A three-unit machine is shown in Fig. 15, suspended from the crane in position for the workmen to solder the leads of the high-tension coils to the control bars in the under frame.

Machine Ready for Testing

Figure 16 is a five-unit machine practically completed and ready for test. Sheet-iron covers completely enclose the high-tension coils so that there may be no damage by abrasion or burning of the insulation upon the wire. The machine is provided with a sheet-iron cover to enclose the entire transformer if desired; but this is not a necessary adjunct, as there are practically no working parts to get out of order and little material other than iron, copper, and asbestos used in its construction.

In the shops of its builders, for whose use it was primarily designed, conduits are laid beside each car track and connecting terminals provided at short intervals so that a heater may be installed almost anywhere without loss of time.

Though the machines, so solidly constructed, are

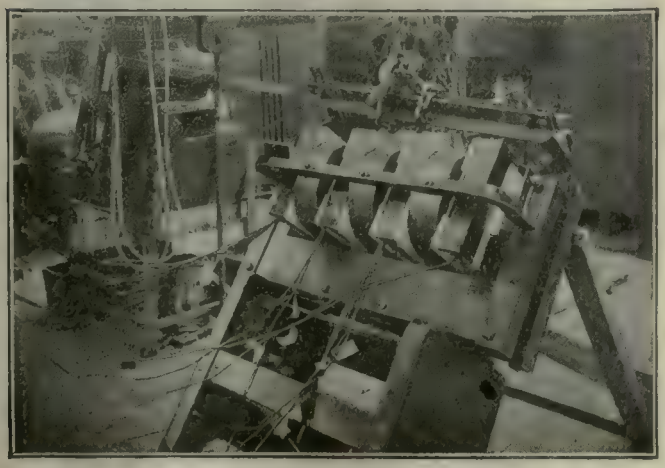


FIG. 15. READY TO SOLDER THE LEADS ON THE CONTROL BARS



FIG. 16. A FINISHED 5-SECTION HEATER ON THE TESTING FLOOR

very heavy, they are still considered "portable," as it is the work of but a moment for a crane to hook onto the supporting ring and transport the machine to any desired location. Pushing the attachment plug into a terminal box, less work than turning an ordinary incandescent lamp into its socket, completes the operation of moving, and the machine is ready for business.

Though heat derived from the electric current does not always compare favorably in cost with that generated directly from fuel, the elimination of waste heat made possible by delivering *all* of the energy to the place where it is most needed more than offsets the difference. Besides this, the freedom from gas and smoke, the saving in the matter of burned or lost rivets and the reduction of difficulty in the matter of keeping efficient heater-boys on the job far more than warrants the trouble and expense of the change.

Applying Magnetic Chucks to Best Advantage

By C. A. Macready

The caption of the article by I. A. Hunt on page 267 of *American Machinist* is such an inclusive one that it may mislead prospective buyers of magnetic chucks who wish to use the chuck for holding work as accurately as possible. Work is often of such shape that it must be held on top plates that conform to the seat that is being worked from, and the finished surface must be as accurate as is possible to obtain for the reason that it is of such shape as to make hard lapping if there is much left to lap.

The particular part of the article to which I object in his very good explanation of the magnetic lines of force is the statement that "A solid auxiliary top plate defeats it's purpose," illustrated by Fig. 6 on page 268. On the same page a companion top plate is shown in Fig. 5, that will make prospective buyers think that top plates are expensive to make, whereas if they would take into consideration the operations that they were going to use the chuck for they would buy a different combination of coils than that Mr. Hunt advocates.

The transferring of a magnetic chuck from the surface grinding machine to a milling or planing machine is not very good practice although for economy's sake it may have to be considered by the buyer. This is the real point for prospective buyers to consider: "Do I need a powerful holding chuck that requires expensive top plates for all classes of work or one that will be powerful enough to be used for surface grinding operations without expensive top plates?" He looks over the catalogs of the different makers and as they all guarantee strength enough to hold work to be milled or planed he probably would buy from the one who makes a big point of non-magnetized cutters and machines, when really the principal use that he would have for a chuck would be grinding of refined work, not the taking of extremely heavy cuts on other machines.

I have never made top plates in which the poles were insulated, as shown in Fig. 5, although I have seen them. As a general rule those I have used came from the machine that roughed them out and were finished in the position they were to occupy upon the face of the chuck. On long thin work I sometimes separate the bed pieces, if they are in parts, with tin foil or paper; using the tin foil where water is to be used on the work. The finishing of the auxiliary plate in position assures one of a true seat to place the work upon. If one happens to be using a chuck that is not true, a flat piece of cast iron placed upon the face of the chuck and trued off will be the quickest way of obtaining a true seat if one is able to make use of a pole opposite to the ones that are in the center of the chuck.

Twenty years ago the magnetic chuck was very little known outside of high-class shops. Since the war it has, along with the sine bar, the knife-edge square, and the straightedge, become a familiar tool, but I believe that a mistake is made when a chuck is selected for its holding-down strength alone. There should be the same distinction made as to their qualifications as there is with micrometers. For grinding, one pole should be so that it can be extended to the best point of contact, and also to have a side pull.

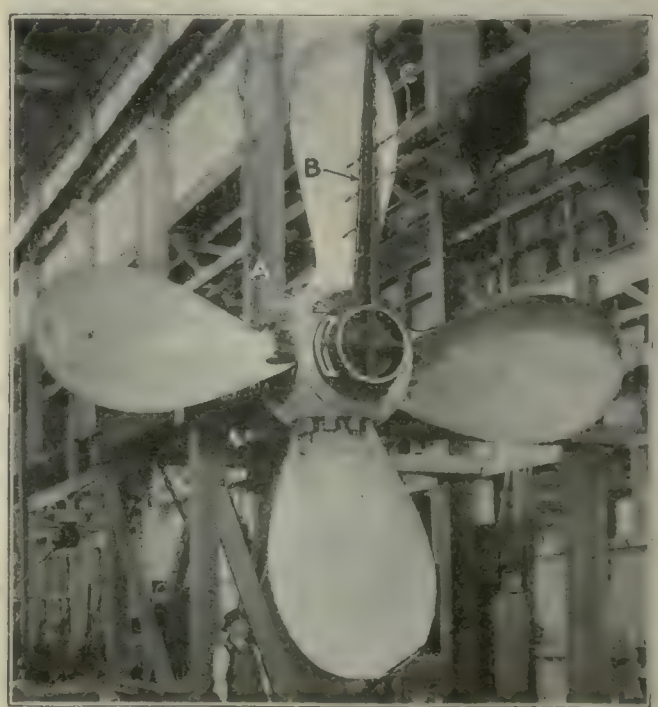
I hope that my article is in order as I would like to have a discussion and get the ideas of other chuck users. The chuck is one of the finest things that have been devised for holding work and I wish that tool and gage makers understood it better than they do.

Measuring Propeller Blades

By I. B. Rich

The illustration shows the method used in one of the large shipbuilding plants on the Pacific Coast for measuring the pitch of the blades of a propeller, so as to insure duplication or at least to know the amount of variation between the blades. The hub carrying the four blades is mounted on a stub shaft, the end of which carries the plate *A* with the arm *B*. This arm has holes suitably spaced for receiving the rods *C*.

With the arm *B* swung parallel with the blade to be measured, the various rods are pushed through the holes until the ends touch the blade. The distance each rod projects is then noted and the arm *B* swung to the next blade. In this way the pitch of the various blades can be compared at any point of their width.



MEASURING THE PITCH OF PROPELLER BLADES

Interference of Involute Spur-Gear Teeth

By A. B. COX

The relation between gear ratio, the number of teeth in the pinion and interference is shown in this article, the derivation of the formula having been worked out by the author. The accompanying curves should prove useful to machine designers when laying out gears.

IT IS well known that in order to avoid interference in involute gears the teeth must make contact with each other only on the curve of the involute and not on the straight flank. This means, since contact cannot be made below the base circle without interference, that the limiting point at which the teeth may begin to make contact without interfering is the the point of tangency A of the line of contact to the base circle. Fig. 1 shows the construction and gives the meaning of the terms used. A radius of the base circle drawn to this point is perpendicular to the line of action, which makes the angle between the radius and the line of centers equal to the angle of the line of action. This enables us to calculate the minimum number of teeth required in a pinion for any given ratio as shown in equation (1). The form given in (2) is more convenient for plotting the curves shown in Fig. 2.

Referring to the curves, it is seen that when a pinion meshes with a rack, K becoming infinity, the value of n is found to be 31.8, or 32 teeth, for the 14½-deg. standard tooth. The curve for 22½-deg. involute teeth has been drawn in to show the effect on tooth interference of increasing the angle of action.

Derivation of Interference Formulas for Involute Gears

$$a = r \cos \phi$$

$$y = a \cos \phi = r \cos^2 \phi$$

$$k = \frac{n}{N} = \frac{r}{R}; N = \frac{n}{k}$$

$$x = a \sin \phi = r \sin \phi \cos \phi$$

$$P = \frac{N}{D} = \frac{N}{2R}$$

$$\text{Addendum} = \frac{1}{P} = \frac{2R}{N}$$

$$R_o = R + \frac{1}{P} = R + \frac{2R}{N} = R\left(\frac{N+2}{N}\right)$$

$$R + r = C; C^2 = (R + r)^2 = R^2 + 2Rr + r^2$$

$$Z = \sqrt{R_o^2 - x^2} = \sqrt{R^2\left(\frac{N+2}{N}\right)^2 - r^2 \sin^2 \phi \cos^2 \phi}$$

$$Z = C - y = C - r\cos^2 \phi =$$

$$\sqrt{R^2\left(\frac{N-2}{N}\right)^2 - r^2 \sin^2 \phi \cos^2 \phi}$$

Squaring:

$$C^2 - 2Cr \cos^2 \phi + r^2 \cos 4\phi = R^2\left(\frac{N+2}{N}\right)^2 - r^2 \sin^2 \phi \cos^2 \phi$$

$$R^2 + 2Rr + r^2 - 2Rr \cos^2 \phi - 2r^2 \cos^2 \phi +$$

$$r^2 \cos^2 \phi + r^2 \sin^2 \phi \cos^2 \phi = R^2\left(\frac{N+2}{N}\right)^2$$

$$R^2 + r^2 + 2Rr\ (1 - \cos^2 \phi) - 2r^2 \cos^2 \phi +$$

$$r^2 \cos^2 \phi\ (\cos^2 \phi + \sin^2 \phi) = R^2\left(\frac{N+2}{N}\right)^2$$

$$R^2 + r^2 + 2Rr \sin^2 \phi - r^2 \cos^2 \phi = R^2\left(\frac{N+2}{N}\right)^2$$

$$R^2 + r^2 + 2Rr \sin^2 \phi + 2Rr \cos^2 \phi - r^2 \cos^2 \phi - 2Rr \cos^2 \phi = R^2\left(\frac{N+2}{N}\right)^2$$

$$R^2 + r^2\ (1 - \cos^2 \phi) + 2Rr \sin^2 \phi = R^2\left(\frac{N+2}{N}\right)^2$$

$$R^2 + r^2 \sin^2 \phi + 2Rr \sin^2 \phi = R^2\left(\frac{N+2}{N}\right)^2$$

$$1 + \left(\frac{r^2}{R^2} + 2\frac{r}{R}\right) \sin^2 \phi = \left(\frac{N+2}{N}\right)^2 = 1 + \left(\frac{r}{R} + 2\right)\frac{r}{R} \sin^2 \phi$$

$$1 + (K + 2)\ K \sin^2 \phi = \left(\frac{N+2}{2}\right)^2 = \frac{N^2 + 4N + 4}{N^2}$$

$$N^2 + N^2\ (K + 2)\ K \sin^2 \phi = N^2 + 4N + 4$$

$$n^2\ (k - 2)\ \frac{k}{k^2} \sin^2 \phi - 4\frac{n}{k} - 4 = 0$$

$$N^2\ (k + 2) \sin^2 \phi - 4n - 4k = 0$$

$$n = 2 \pm 2\frac{\sqrt{1 + k\ (k+2) \sin^2 \phi}}{(K+2) \sin^2 \phi} \qquad (1)$$

This formula enables us to calculate the minimum number of teeth allowable in a pinion with any given gear ratio. However, for convenience in plotting the curves of Fig. 2, it is desirable to solve for k instead of n, the resulting formula being:

$$K = \frac{4n - 2n^2 \sin^2 \phi}{n^2 \sin^2 \phi - 4} \qquad (2)$$

The method of finding the interference formula for internal gears is similar in every respect to that used for finding the formula for external gears and a similar

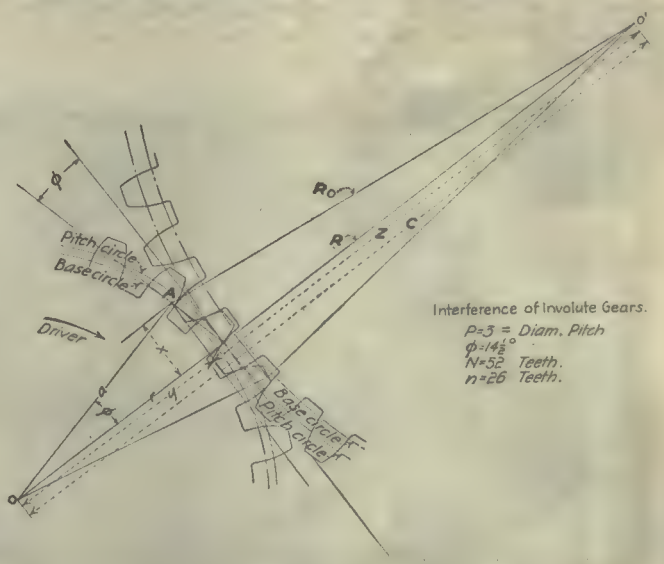


FIG. 1. LAYOUT TO DETERMINE CONDITIONS FOR INTERFERENCE OF INVOLUTE SPUR GEARS

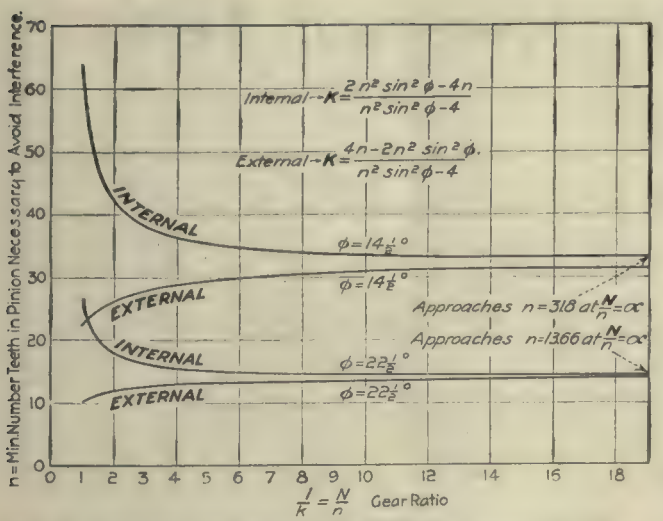


FIG. 2. CURVES SHOWING THE EFFECT OF GEAR RATIO AND NUMBER OF TEETH IN PINION ON THE INTERFERENCE OF INVOLUTE SPUR GEARS

formula is obtained, there being only a change of sign. The formula for plotting the curves then becomes:

$$K = \frac{2n^2 \sin^2 \phi - 4n}{n^2 \sin^2 \phi - 4}.$$

Formula for Gears of Equal Size

In the 1 to 1 ratio the involute extends over the entire face of the tooth. A simpler formula for this condition can be obtained, since the radius of the base circle is then equal to the radius of the dedendum circle. Using the same symbols as before:

$$r \cos \phi = r - 1/p = r - \frac{2r}{n}$$

$$\cos \phi = 1 - \frac{2}{n}$$

$$n - n \cos \phi = 2$$

$$n = \frac{2}{1 - \cos \phi} \text{ or } \frac{2}{\text{versin } \phi}.$$

Since circular pitch can be expressed as diametral pitch, all of the foregoing formulas hold for circular as well for diametral pitch. The differences between the curves found for the internal and for the external gears is easily seen, the internal gears requiring more teeth to prevent interference as the meshing gears approach the same size, while the external gears require fewer teeth under the same condition.

Machine Shop for Light Electrical Work

By C. W. Geiger

The Department of Electricity of the city of San Francisco owns and operates a machine shop, where all fire-alarm boxes are manufactured and repairs are made to boxes and electrical equipment of the fire-alarm and police-signal systems of the city. The manufacture and repair of this equipment by the city has proved highly economical and convenient.

The machine shop is housed in a substantial brick building designed for it, and it is immediately under the supervision of the chief of the Department of Electricity, who has given special attention to the layout of the building. Fig. 1 is a general view of the shop. In the left background there are a number of speed lathes, each placed at the end of a 6-ft. table, so that each man has a bench and a lathe. When a panel or fire alarm box is to be constructed, the work is entrusted to one man, who makes each part and assembles the mechanism complete. An idea of the type of work done can be obtained by referring to Fig. 2, which shows the mechanism of an alarm box. The shop has special equipment for testing these boxes after they have been repaired.

Most parts are stamped, and for this purpose fifty-five dies have been made. Through considerable experimenting, the metal that will best answer the purpose for each particular part has been determined. The equipment of the machine shop is quite varied, there being, among other machines, a punch press, 2 milling machines, 3 drill presses, 2 engine lathes, 10 speed lathes, a shaper, shears and a power coil-winder. There is an air compressor supplying chiefly a furnace for tempering and annealing dies and tools. All equipment is electrically operated, there being two overhead motors and line shafts. A 3-hp. and a 2-hp. motor are used.

The shop is unusually well lighted, and it receives indirect light by special skylights. Window blinds are attached to the lower sill of the windows. Artificial light is provided by four rows of lights, there being six 100-cp. lamps with reflectors to each row.

In addition to the manufacture of alarm boxes, almost the entire equipment of the central fire-alarm station was made here. The department of electricity operates a fleet of ten automobiles, and all repairs, with the exception of reboring the cylinders, are made in this shop.

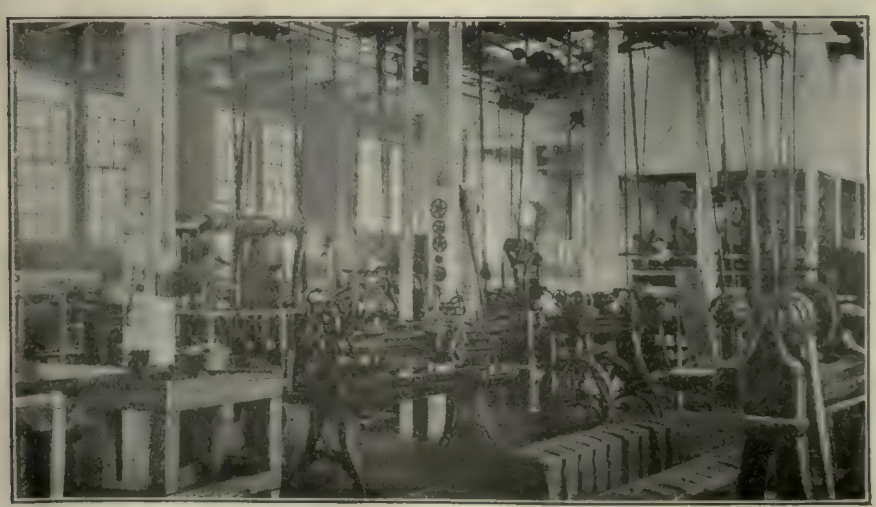


FIG. 1. GENERAL VIEW OF SHOP

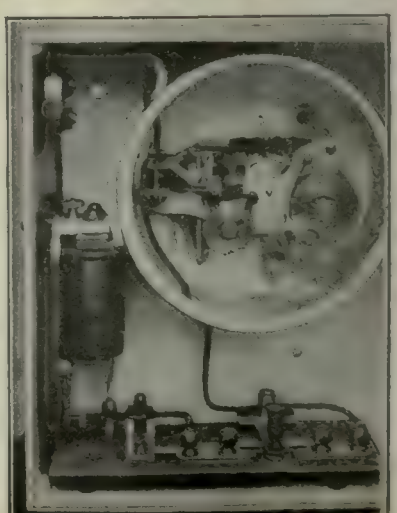
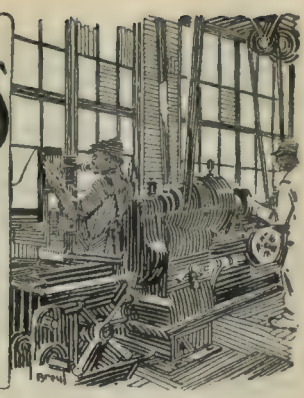


FIG. 2. FIRE-ALARM BOX MECHANISM



MODERN PRODUCTION METHODS

By
W R. Basset
of
Miller, Franklin, Basset & Co



MOST all progressive manufacturing executives are constantly on the lookout for methods by which they can reduce the cost of their products. However, they commonly do it by the observational method: that is, they stroll through the plant and when they see a condition or a method that does not look just right, they set some one to examining it to find out if that method cannot be bettered. Often considerable savings are effected in this way; often, too, conditions or methods which to the eye appear inefficient, are necessary and cannot be bettered; but more often the extravagant and inefficient methods are not apparent to the casual observer.

The effort to reduce the cost of the product is at the bottom of all betterments in manufacturing methods. But betterments made through the observational method are apt to be spotty, and many which might be made are more than apt to be overlooked. The certain way to catch expensive methods is through the medium of a correctly designed and accurate cost system which presents to the executive at frequent intervals, monthly at least, all elements of his costs in comparison with those same costs for previous months and period.

I know the general manager of one machine shop who on the first of each month, takes home with him cost reports which visualize for him the activity of the different departments of his plant for the preceding month. The next day when he arrives at his office, certain erring department heads and foremen are pretty apt to receive a call from the "old man" and have some unpleasant figures put before them. The cost figures which this executive receives do not show exactly what is wrong in the plant, but they do show in what department things are going amiss and who is responsible. At these first-of-the-month lectures he is able to pin the responsibility on the right men and effectively set them going to search out the troubles for which they are responsible.

Cost figures can be made to serve as an index of the methods being used in any phase of manufacturing.

In one plant, the cost figures showed an increase in the expenditure for lubricating oil for one month over the preceding one. An investigation showed that the purchasing agent was attempting to make a showing by buying cheaper oil, which was resulting in a greater total expenditure for all of the productive departments.

In another machine shop, an increased use of oil in the automatic machine department led to an investigation, which by its promptness probably saved a loss of $50,000 worth of machinery that would have been ruined in another month or two. In this instance, oil was forced through the bearings of the machines under pressure. Too light a grade of oil was being purchased which, under pressure, went through the machines too rapidly, at the same time improperly lubricating them. The monthly comparison of oil expense in this department showed that something was wrong before the improper oil had been used long enough to seriously damage the machines.

The use of supplies, of which the foregoing instances are samples, is seldom checked as closely as its importance warrants, because the total expenditure for shop supplies is seldom more than a very small percentage of the expenditures for raw materials. It is customary to pay a great deal more attention to the waste of raw materials than to the waste of supplies. In fact, unless cost figures are so developed that they show the actual use of supplies by departments, very little line can be had by the executive on the amount being used compared with what should be used.

It may seem as though there were very little connection between the cost figures and the skill of individual workmen, yet I know of an instance where a cost report showed that, of two workmen performing the same operation, one turned out nearly twice as much as the other. When the foreman's attention was called to this by the general manager he discovered that the less productive workman was performing five operations on his part—the better workman had by his ingenuity contrived to combine two of his operations into a single one. As the two operations were the longest and most difficult on the part, his ingenuity had enabled him to increase his production. The new method was naturally taught to the other workman, and in a very short time his production reached that of his fellow. This is not uncommon; in fact next to time studies of each workmen and operation, the cost system is the best way to gage the relative ability of the various men.

When we come to consider machines, the cost system is invaluable. The present tendency is to substitute a machine for a hand operation wherever possible. This

X. What a Cost System Can Do For You

Probably the first manufacturer who gathered figures in an attempt to find out how much his product cost him, did so for the purpose of setting a selling price which would assure him of a profit. That in itself is valuable information, but after all, it is one of the least of the benefits which a properly designed cost system gives. Here are some of the others.

(Part IX appeared in the September 30 issue.)

is proper enough if the machine can do the work better or less expensively than a man. To the manufacturer, a machine of itself is nothing. It is valuable only if by it the cost of production can be reduced. I have seen, for instance, most ingenious systems of conveyors which more than offset the savings in men's wages by the increased cost of depreciation, maintenance and operation. If such a conveyor does not increase production enough to cut the final cost of the product, it is not admirable, nor is it good judgment to install it. On the other hand it is frequently good economy to invest $25,000 or $30,000 in a single machine. Instances of this sort will occur to every machine shop executive. But whether or not such an investment is a money making one, cannot safely be determined by impressions —cost figures must be the test.

Even in the use of machines, cost figures can be made to indicate possible economies and betterments. In one plant the most important operation for the three different sizes of the product was performed on three large machines of different sizes. Each of these machines was best adapted to perform the operation on the product of the size for which it was designed.

Quicker Deliveries Sometimes Prove Costly

But the customers of this concern were pounding the sales department for quicker and yet quicker deliveries. As the smallest size of the product was the most popular seller, it had become the custom for the superintendent to route the smaller sizes to the larger machines in order to fulfill the unduly early deliveries dates promised by the salesmen. This is a condition which many plant managers face where the sales department dominates the plant. On the face of it, it might seem all right to route the stuff that had been sold to machines which had idle time. In no way but through the medium of a cost system could the fact have been determined that this was resulting in a considerable loss. In fact, the loss amounted to about $32,000 a year.

In a general way, the management knew that the situation was not the most desirable one, but they did not realize in figures how much the less suitable machines were used, the extent to which output was curtailed, and the extent to which the normal operating conditions were upset. When cost figures were developed it became apparent immediately that when the smaller product was made on its proper machine it was made at a profit of six cents each. But when it was made on the larger machine, there was a loss of one cent each. These machines turned out 7,000 units a day, which meant a loss of $70 a day when the large machines worked on the small goods, while a profit of $420 a day per machine was made when the goods were turned out on the machine best adapted to them.

Fundamental Changes in Management

These figures resulted in fundamental changes in the management. Now, instead of forcing the plant to make what the sales department chooses to sell, or rather chooses to take orders for, schedules of the possible economical production of the various types of product are presented monthly to the sales department, showing the possible production of each type, of orders on hand, and the additional orders which the plant can handle. It is now up to the sales department to sell what the plant can make at a profit. This led to the installation of a production planning department in the plant which has resulted in even greater increases in production and reduction in costs.

Even in plants that have engineering departments it is not uncommon for the executive to find that more money than is necessary is being spent on materials. For instance, in one shop a certain part had been machined out of a plate of cast iron, about $\frac{1}{4}$ in. thick. Its finished dimension was $\frac{1}{8}$ in. thick. Later it seemed desirable to make this plate out of copper. The specifications were changed, but the thickness was kept at $\frac{1}{8}$ in. When cost figures were developed the executive immediately put his finger on the excessive cost of this comparatively unimportant part. When the chief draftsman was asked why a $\frac{1}{8}$-in. thick copper sheet was necessary, he didn't know. As a matter of fact, it wasn't necessary. A copper sheet of very much thinner gage was all that was needed. Thousands of dollars had been literally thrown away because the loss, which was not apparent to the eye, was quickly apparent in the cost report.

Other Savings

In another case, a sleeve which for years had been machined from bar stock is now machined from a casting at a saving of about $350 a month. In another plant it had been customary for the engineering department to specify bolts and screws of the best theoretical size. Cost figures showed an excessive expense for this material and finally a conference of the superintendent and chief engineer and the head of the cost department reduced the number of screws and bolts used to about one-tenth the former number. It was perfectly possible to use these standardized parts in many places where previously special screws had been made. This made it possible to buy many of the screws and bolts from outside at much less than it was possible to make them inside the plant.

Every good cost system reports monthly the amount of waste made in each department. For if it appears that an excessive amount of material is being used investigation will usually show some better method of manufacturing. Then too, the fluctuations of the amount of waste made from month to month comes to view quickly and shows up any bad tendencies which usually can be traced to poor supervision. In one machine shop, the chief executive was able to reduce the waste in one department by 47 per cent. This later resulted in saving thousands of dollars a year.

The Many Uses of the Cost System

It would be easy for me to string out incidents like the foregoing indefinitely, to prove the multiplicity of uses to which cost accounting can be put. Those I have cited should, however, be sufficient to show the machine-shop executive that cost figures are of value in innumerable ways other than as a basis for setting selling prices.

I know, however, that many executives will admit this and yet will object to a cost system which will show all of these conditions in his plant on the grounds that it would be too complex and too expensive to operate and would involve too much red tape. Admittedly that is a fault of many cost installations which often spring from the fact that when an executive finally accepts costs as valuable, he is apt to become enamored of the cost system itself. I know of one concern of only medium size which currently developed such elaborate

reports and tabulations that more than 40 clerks were kept busy compiling them. The figures they developed were undoubtedly interesting and ingenious, but most of them were of very little value as an aid to the management. In fact the company had been making but slight profits. A careful investigation showed that what profits the manufacturing departments had been making had been largely absorbed in maintaining the cost department. That, of course, was not good sense.

The elaboration and intricacy of the cost system and the figures developed by it is not a criterion of the value of the system; on the other hand I believe firmly that cost accounting methods which give figures of most value to the management are invariably simple. Not infrequently I find that it is possible to develop cost figures which will throw a bright light on all phases of manufacturing with no more clerks than are already employed in the factory offices. Certainly it would be a plant of immense size or one turning out an exceedingly intricate product which would require more than a half dozen or so clerks engaged solely on cost work.

Every Cost System Must Be Adapted to Methods of Manufacture

It seems necessary for brevity's sake to refer to cost systems. I dislike the word "system," for it smacks not only of red tape, but of uniformity. There is no one, nor several, cost systems which are adaptable to all plants. There are no two machine shops making identical products and using identically the same methods of manufacturing. The fundamental principles, however, for gathering the cost of labor, the cost of material, and for spreading the overhead expense may, and usually should be uniform within an industry; but the actual routine will differ with every plant. In fact often the method of spreading the overhead expense will have to differ in the different departments of a single plant. I will grant that it is conceivably possible to devise a system which can be forced into several machine shops, but if that is done, the shop itself, the personnel of the management and the methods of manufacturing will have to be radically changed to fit the system. That is not my idea of the proper way to install costing methods. The most important thing for the machine shop is production and profits. Costing is valuable only as it aids these two. Therefore, my experience has been that the cost accounting methods should be adapted to the conditions as they exist in the plant, rather than vice versa.

It may seem that if the costing methods needed by every plant are different, the problem of choosing the right one is exceedingly difficult and touchy. This is not necessarily true. However, it is much better for the executive to go slowly in choosing new methods and finally to adopt the one which appeals to his common sense. It is easily possible, in a passion for exact costs, to carry costing to a ridiculous extreme, tracing down every fraction of a cent to its lair. I do not want to give the impression that I approve of inaccurate costing, but it is not good sense to carry it to such a fine point that as the scientists say—"The error of observation is greater than the error of computation." What I mean by that is this—why spend money to calculate costs to a fraction of a cent when the original data on which they are based, such for instance as the amount of time put in by a workman, is known to be incorrect to the extent of two or three cents? I believe that if final costs are accurate to within one-tenth of one per cent, sufficient accuracy has been obtained. Usually a half of one per cent is close enough.

I have given a great deal of attention in this article to showing the values of a cost system other than as a guide to setting selling prices, and yet this latter use must not be considered unimportant. Some executives object to installing cost methods because, as they say, competition sets their selling prices. On the strength of this, they feel that it will do them no good to know what their product costs them.

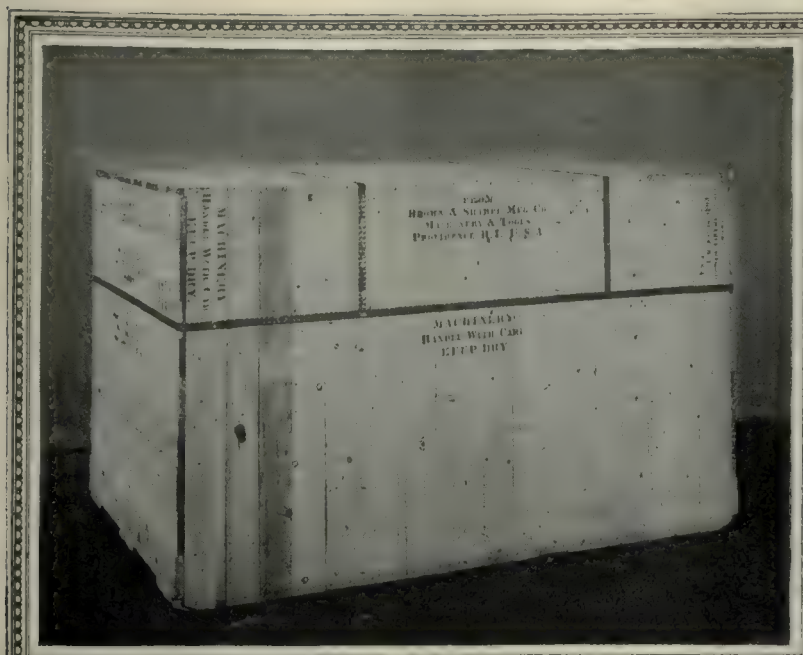
In the first place, I want to point out that because in some businesses the price is set by one's competitors, it is necessary in that business to get the costs as low as possible. This can be done only by bettering methods of manufacture. And these betterments can only be surely discovered by means of a cost system. Then again, if competition is setting the prices at a point too low to allow a manufacturer profit, he should know it. It is usually better to refuse business than to take it at a loss, especially if the extent of the loss is not known.

A case in point, is that of a concern with a plant consisting mostly of a machine shop, and which made seventeen different products, the price of which was set by competition. When accurate cost accounting methods were installed in this concern, it was discovered that thirteen of these items were being manufactured at a dead loss. The other four were being made at a price high enough to allow the business as a whole a profit. The profit on these four lines was in fact so high that competition was rapidly taking business away and before long the concern would probably have been bankrupt. With the definite figures before him, the president of this concern decided to eliminate entirely nine of the thirteen losing lines. Methods were found by which two of these unprofitable lines could be put on a profit making basis through betterments of production. It was decided to continue manufacturing the other two at a slight loss, but orders would be taken only in conjunction with orders for other lines. The second year's operation under this new policy showed that on only one-half as much gross sales, four times as much profit had been made as was customary, and this all occurred in pre-war years, when rising markets had nothing to do with it.

In future articles of this series, I shall outline the methods of cost accounting which have been found best adapted to the machine-shop industry, showing how different conditions call for different methods. The methods which will be described are those in actual use in machine shops.

Two Points on Cost Accounting

Lest any of the readers of this series become over enthusiastic on cost accounting, I want to lay stress on two points which my experience shows are warnings sometimes needed. First, cost accounting is not an end in itself. The aim of business is profits. Cost accounting is of value only as it aids the manufacturer to make profits. The second warning is that no cost accounting system will of itself make these profits. The reports are inanimate things which can't of themselves make industrial betterments. They must be intelligently studied by an executive who has the intelligence to translate their figures into needed changes and the authority to see that these changes are made.



INSURING THE SAFE SHIPMENT OF MACHINERY

By FRED H. COLVIN
Editor-American Machinist

There is nothing more discouraging, both to the manufacturer and the consumer, than to have valuable machinery damaged in transit. This is particularly annoying as well as being costly in every sense, when a machine goes to a far-away customer where it is often a matter of months before the damaged parts can be replaced. This article shows how the problem of safe shipment has been met by a large manufacturing company that has won an enviable reputation for crating and boxing so as to insure safe delivery of its machinery.

WHEN we see the way in which machinery is frequently handled from the time it leaves the factory until it reaches the consumer, it seems little short of a miracle that any of it arrives whole. This is particularly true where shipments of this kind are handled by inexperienced men, which has been too often the case during the past year, owing to the disputes with freight handlers at shipping ports. When in spite of this, machines shipped by a machine-building firm secure the reputation of always arriving safely, it becomes well worth while to study the methods used in crating and boxing.

The methods shown herewith have been developed through long years of experience by the Brown & Sharpe Manufacturing Co. of Providence, R. I., who gladly furnished all the details given, in the desire to aid all builders of machine tools and similar products, and for the benefit of the industry as a whole. The design of the crates and boxes has been a matter of considerable study extending over a long period, and they have been standardized to such an extent that the various parts, such as the base or platform, the sides, ends and top, as well as the bracing, can be made up in advance for practically all of the standard machines. This method not only makes for economy in lumber and construction, but also enables machines to be prepared for shipment much more rapidly and with a minimum crew. The way in which this is accomplished will be shown both by the illustrations and the description which follows.

Beginning with the knowledge that a suitable base or platform is necessary in order to have a substantial crate or box, the method of construction used is shown in Fig. 1. First come substantial skids with the ends beveled to allow for getting pinch bars underneath and spaced according to the size and weight of the machine. A solid flooring of 1⅛-in. matched boards is nailed crosswise of the skids as can be seen. The 10d. nails used are long enough to reach nearly through the skid, but it has been found unnecessary to have them clinched on the bottom. On top of the cross-flooring of matched boards, square-edged boards ⅞ in. thick are nailed lengthwise with 6d. nails, making a double flooring with the boards running at right angles to each other; 10d. nails are used at the ends. At each of the four corners, however, 20d. nails, sufficiently long to reach nearly through the skids, are used to insure extra strength at these points. These large nails are driven in at an angle to prevent prying off the boards in using pinch bars or when lifting with hooks between skids.

The size of skids varies with the machine, the standard sizes being 2 x 4, 2 x 6, 2 x 8, 3 x 4, 3 x 8 and 4 x 6 in. Some of these sizes are also used for the side rails and for bracing the sides of the machine against the crate, as well as for tying the sides together. Besides the 1⅛-in. matched boards, square-edged boards 1⅛ x 4, 1⅛ x 5, ⅞ x 4 and ⅞ x 5 in. are also used, these being standard dimensions which are kept in stock.

A very simple method is used to determine the correct dimensions of the crate or box. When a new machine is to be crated, the man in charge of the work takes a stick about 1 or 1¼ in. square and longer than the greatest dimension of the machine, and goes to the erecting floor where the machine is completed. On this stick he marks the extreme height, width and length of the machine, making such allowance as has been found desirable for clearance, usually about ½ in. at the extreme points. In large crates, where the sides are apt to give more under the pressure of the rope or chain slings used in handling, this clearance may be

increased to 1 inch. The stick is then properly marked to allow for the thickness of the lumber, the length of the skids, sides, etc., and is then kept for future use in cutting lumber for machines of that type and

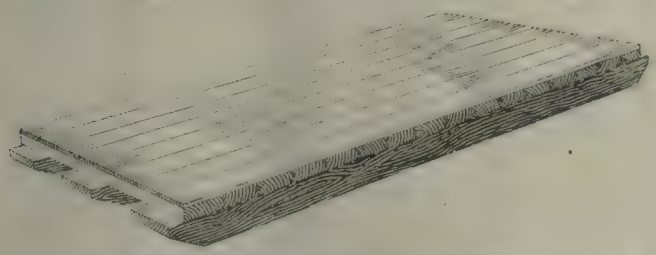


FIG. 1. A TYPICAL PLATFORM

size. On this stick is also marked the position of the side rails when their proper location has been determined, so as to make it possible to make up platforms, sides and ends in advance of the actual crating of the machines, Fig. 2. The "stick" is shown at *A*.

Having determined on the exact size of the crate, orders are given for a sufficient number of platforms, sides and braces to crate the machines delivered from the assembling department. The platforms and sides are made up on a bench, *B*, of convenient size and height. All cutting is done by one man, so far as possible, and in this way a considerable saving has been effected in the use of lumber. One saving is in the utilization of odds and ends for bracing as at *A*, Fig. 3. These pieces are waste ends sawed to the proper length to form a substantial brace between the end of the machine base and the crate itself. Using the wood endwise for bracing gives best results as it does not shrink much in length. This view shows a holding-down brace at *B*, the table of the machine at *C* and the use of old papers to protect the paint.

When a machine arrives from the assembling department, a platform which has been previously constructed is laid on the floor and two lines drawn according to schedule, to mark the location of the base in order to insure even clearance all around the machine, Fig. 4. The machine is then lowered on the platform in the correct position and the building of the crate begins.

The guards and the smaller parts are removed for proper packing and all the bright parts carefully wiped dry before applying the anti-rust or slushing compound. Great care is taken to be sure that the polished parts are perfectly clean before applying the compound, as it has been found that the presence of ordinary machine oil or a little grease of any kind is apt to prevent the heavy slushing oil from sticking to the metal. Unless the slushing oil makes actual contact with the metal, it is apt to slide or run off the greasy surface and so fail to protect it against rusting. In the same way it is necessary to remove all signs of rust or discoloration which may have accumulated owing to special atmospheric conditions before applying the compound.

In this connection it is interesting to note that a dark compound has been found most satisfactory for bright parts, principally from the fact that it enables the packer to see whether or not the bright parts have been properly slushed. The contrast in color between the dark compound and the bright metal surfaces makes it evident at a glance.

Gear boxes and similar parts are slushed with an oil somewhat resembling heavy cylinder oil, so that, while protecting them from rust, it is not necessary to remove the oil before running the machine. Both the compound and the oil are supplied by the Harris Oil Co. of Providence.

In order to safeguard racks and gears, tables of grinding and similar machines are raised from their beds and held in position by interposing strips of soft wood between the V's of the table and the machine. This raises the rack out of mesh and prevents damage to the teeth, should any sudden jar give even a slight movement to the table.



FIG. 2. PLATFORM AND SIDES READY FOR USE

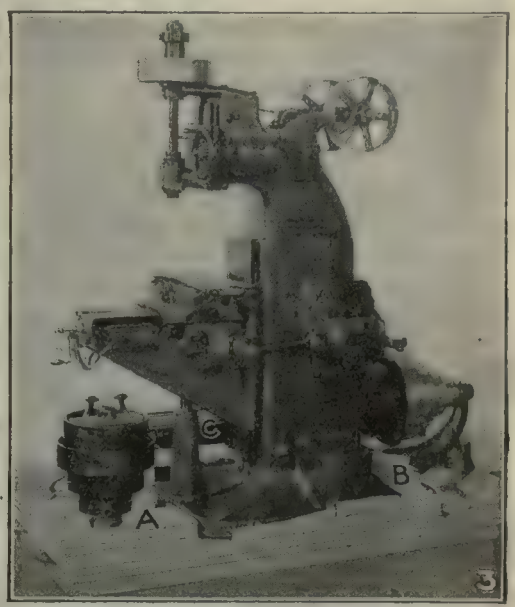


FIG. 3. MACHINE MOUNTED ON PLATFORM

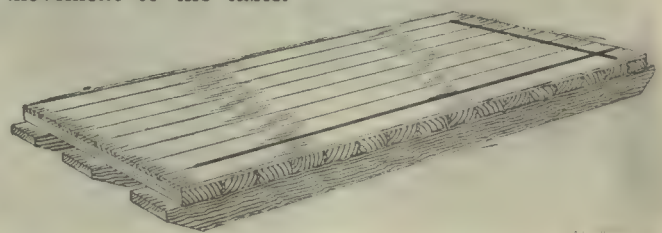


FIG. 4. A PLATFORM MARKED FOR LOCATING MACHINE

The Brown & Sharpe Co. does not fasten machine bases to the platforms with lag screws on account of the localizing of the stresses which sometimes cause breakage. Instead they use substantial holding-down strips across the more solid parts of the machines, as

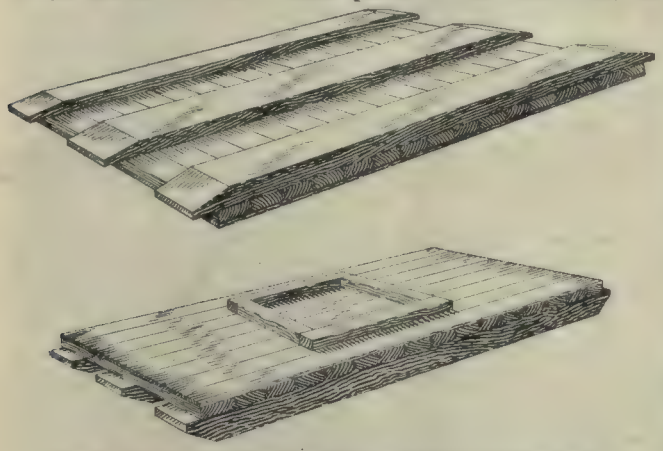


FIG. 5. PLATFORM WITH RAISED BLOCKING

at *A* and *B*, Fig. 8, instead of at the ends. The same principle holds good in selecting the parts of the machine to brace against in crating. The braces should be as near the central part of the frame as the design will permit, preferably above the center.

Where a machine has a large flanged base in which the metal in the flange is necessarily thin, the base is not allowed to rest on the platform of the crate, as it has been found that such flanges crack readily when subjected to rough handling which imposes undue stresses on the outer edge such as comes from slings in hoisting. To avoid this difficulty, the platform is made with a small hollow square built in the proper place as in Fig. 5, to receive the weight of the machine and allow about $\frac{1}{2}$ in. space all around the flanged base of the machine itself. Great care is also exercised to build the crate so that no deflection of the boards under the stress of hoisting or handling shall force

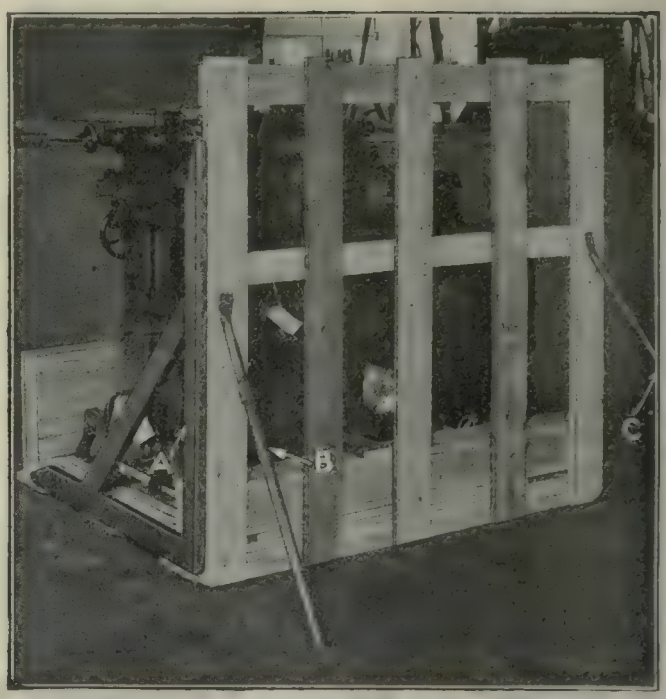


FIG. 6. SQUARING THE SIDES OF THE CRATE

them in contact with handwheels or other portions of the machine, and thus avoid breaking wheels and levers, also bending screws and shaft.

The next step is shown in Fig. 6, where the side has been put on, using the large wooden square shown at *A* to set the side at right angles to the base. The braces shown at *B* and *C* are then put in place to hold the sides square while the crate is being built. These braces are made of 1¼-in. pipe with the ends flattened and slotted as shown. The braces are in two pieces, connected with a right- and left-hand coupling, so as to secure whatever adjustment may be necessary in order to hold the side at right angles to the base.

After such parts as are to be removed have been taken off they are arranged around the machine so as to take up as little room as possible and avoid increasing the bulk of the case or crate. Fig. 7 shows a No. 10 Grinding Machine with the overhead works packed at one end and side and the grinding head and tailstock at the other. The overhead pulleys *A* and *B* are at the end, held in position on the platform by the curved cleats *C* and *D*. The hangers are fastened to the platform by the lag screws shown and also cleated to separate them and prevent rubbing.

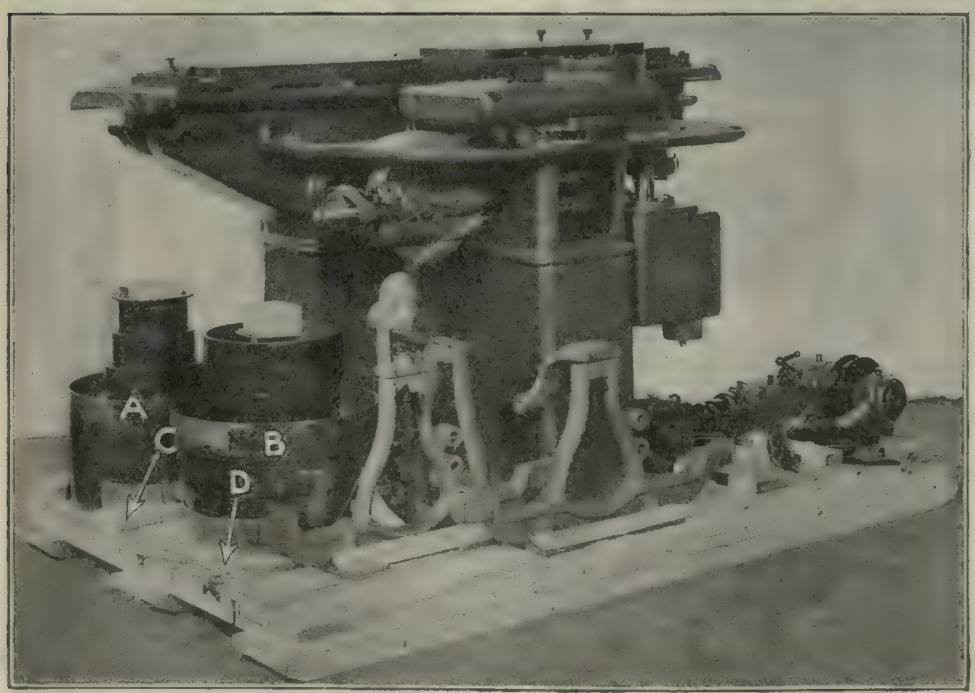


FIG. 7. PLACING THE PARTS AROUND MACHINE

The general construction of the crate is shown in Fig. 8. The pieces *A* and *B* hold the machine down, the heavy crossrails at *C* in this case being considerably above the center. The method of cross bracing is shown at *D*, where the lower 2 x 4 extends from

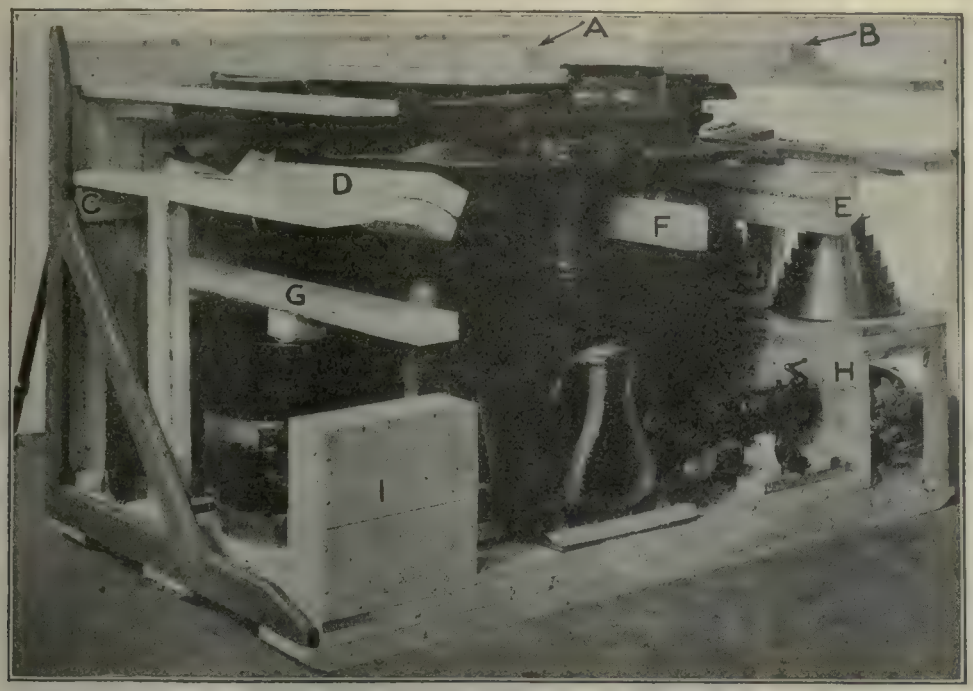


FIG. 8. MACHINE WITH BOX PARTIALLY BUILT

side to side of the crate. Nailed to this cross brace in the proper positions are two shorter pieces of the same size, forming a pocket which encloses an extension of the bed of the machine, holding it against side movement. This cross brace is also duplicated at *E*, at the other end of the machine. A short brace which fits between the bed and the heavy side rail is shown at *F*. Paper is packed plentifully around the parts to prevent marring the paint.

This view also shows how the large, overhead pulleys are held down by the cross brace *G*, a short block being used over each pulley to avoid having the pressure come on the rim. The head of the machine has been built into a sort of case at *H* and the top of this affords a place for the feed cones which are held in place in the same manner as the pulleys at the other end. Small parts are boxed and the box fastened in the crate as shown at *I*. This view shows the location of the heavy side-rails and the cross-bearing, which adds materially to the ability of the crate to resist the crushing tendency of the slings used in hoisting. This springing or crushing is in fact one of the main points to be considered in crating or boxing. The platform, the ends, the corners and the strength of the material necessary to prevent their being forced against the machine in hoisting must be carefully considered. For this reason, 1⅛-in. stock is always used on the corners and for the top rail of the sides. Spruce has been found the best wood, all things considered.

In building up the sides and ends it is planned to

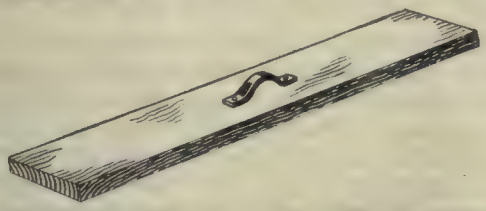


FIG. 9. GAGE FOR SPACING SIDE STRIPS

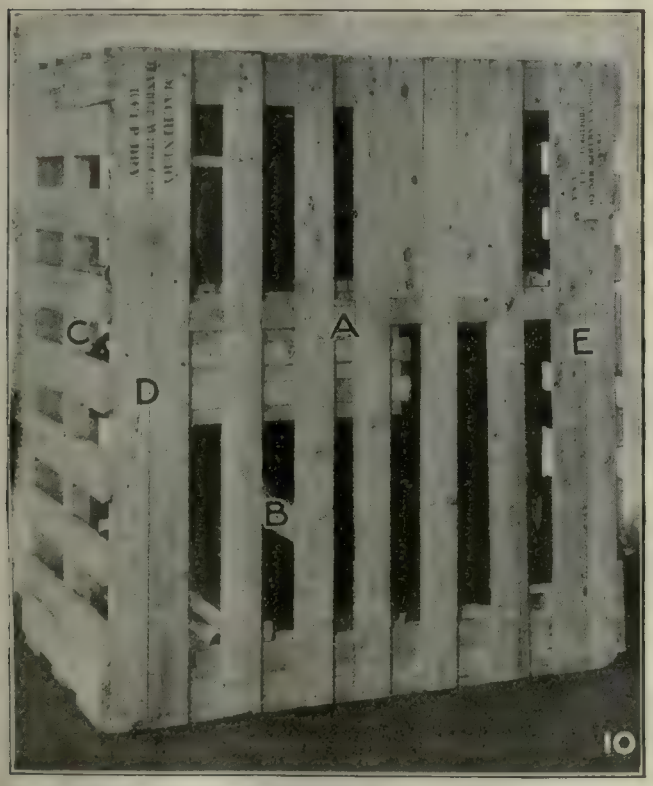


FIG. 10. MILLING MACHINE COMPLETELY CRATED

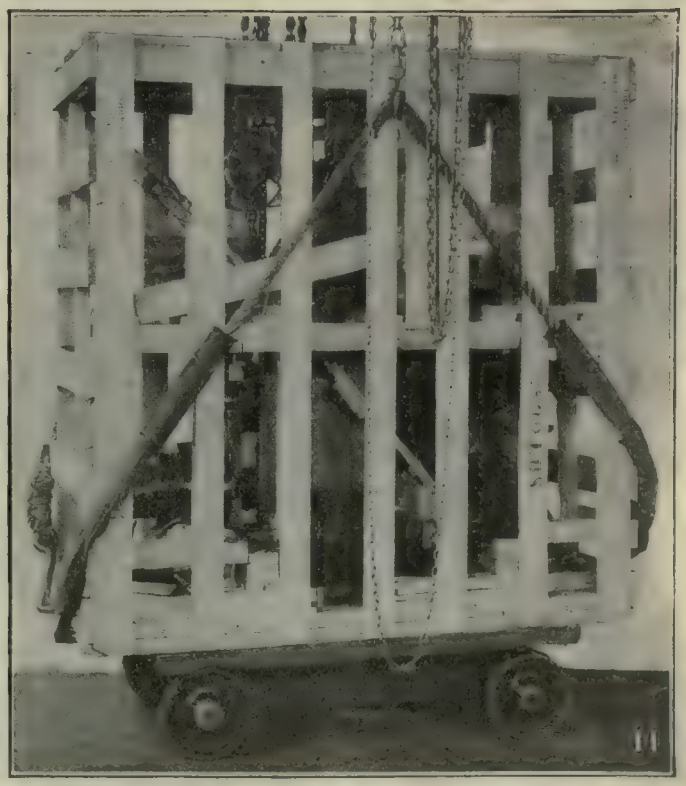


FIG. 11. WHERE THE STRESSES COME

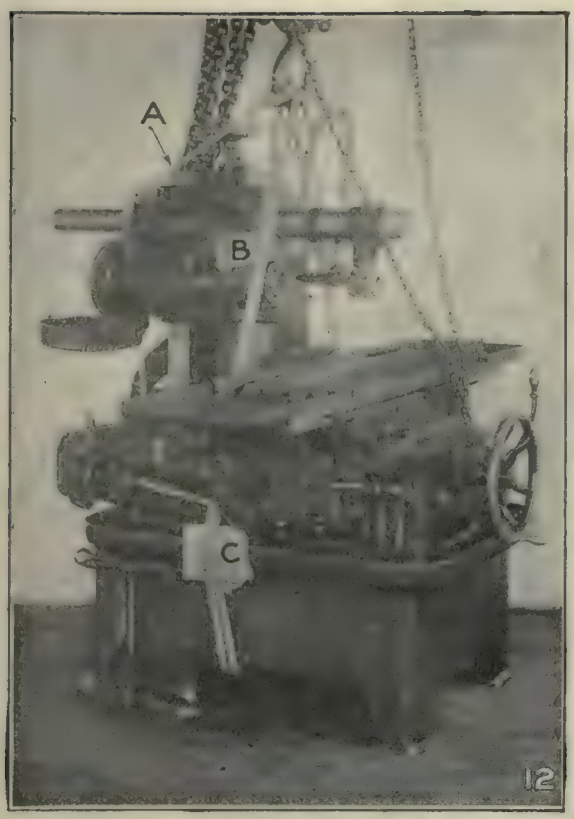


FIG. 12. PLACING SLINGS ON MILLING MACHINES

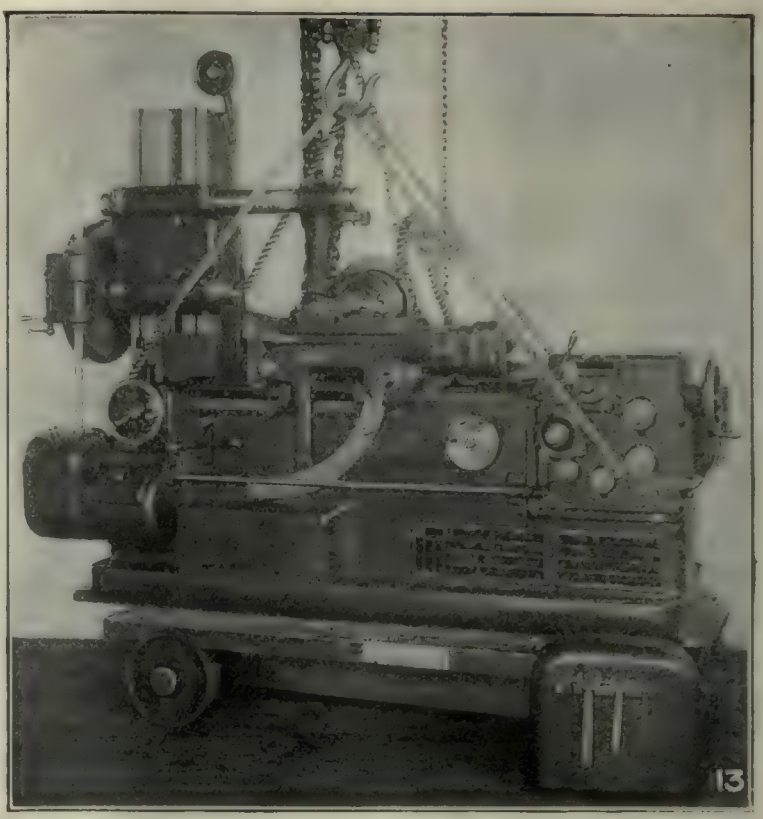


FIG. 13. HOISTING A GEAR CUTTER

have the 4-in. strips spaced 4 or 8 in. apart. This is so that in case a machine already crated is desired for foreign shipment, it is only necessary to fill in the open spaces between the strips, using one or two of the standard 4-in. pieces for this purpose, and in this way make a tight box which is the only difference in the crating for domestic or the boxing for foreign shipment. In other words, using the same platform, sides and top, the machine for foreign shipment is simply closed in by filling in the open spaces so as to make a box instead of a crate. The crating boards are spaced by using the gage shown in Fig. 9 when nailing the 4-in. boards in place.

After the sides are located in position and the braces put between the sides and the machine, clamps are put over the top so as to hold the sides firmly against the cross or bracing strips during the nailing process. This holds everything firmly in place while being nailed and makes a substantial job as well as saving time. The top of the machine is covered with a waterproof burlap before the top crating is put on and in some cases various kinds of papers are used to keep moisture away from small parts where it is not deemed advisable to cover them with the usual slushing compound. A light oil or grease, however, is used under the anti-rust paper.

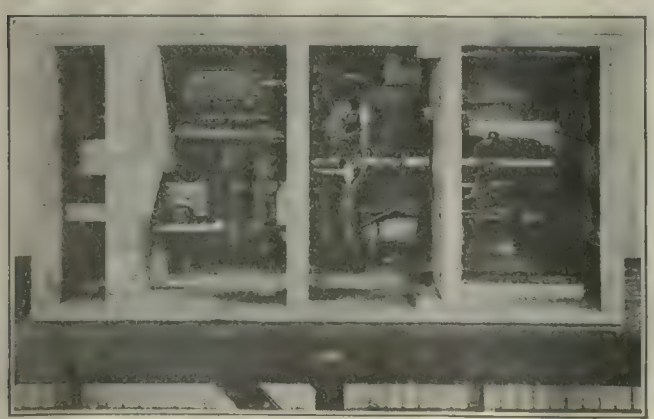


FIG. 14. PACKING AN AUTOMATIC SCREW MACHINE

The disposition of the small parts depends, of course, on the design of the machine and the ingenuity of the man in charge of the packing. In some cases it is advisable to use separate boxes for some of the overhead work or smaller parts in order to avoid increasing the bulk of the main box and particularly to keep down the clearance around the machine itself for the reasons before stated.

As an example of crating of a fairly heavy machine, the milling machine shown in Fig. 10 answers admirably. This shows the single-spaced sides, the heavy side rail, shown at *A*, located well above the center, the cross brace *B*, the vertical rail *C* and the doubling up of boards at *D* and *E*. Another example of careful crating is shown in Fig. 11, which also shows how slings are hooked on and the tendency to crush the corners if they are not sufficiently strong and also well braced against the pressure.

Although perhaps not directly connected with the crating, the handling of machine tools by cranes is somewhat closely related, as they must be hoisted for placing on the crating platform. Figs. 12 and 13 show the methods of slinging a manufacturing milling machine and a gear cutter. The placing of the sling and the use of a steadying rope as at *A*, Fig. 12, is worth careful consideration. Fig. 13 also shows the use of a wooden block *B* as a bearing point for the rope, and the pad of newspapers at *C* to prevent marring the paint.

The men who actually crate the machines are divided into gangs of four, one of whom is the gang leader or foreman. Every machine crated is credited to the

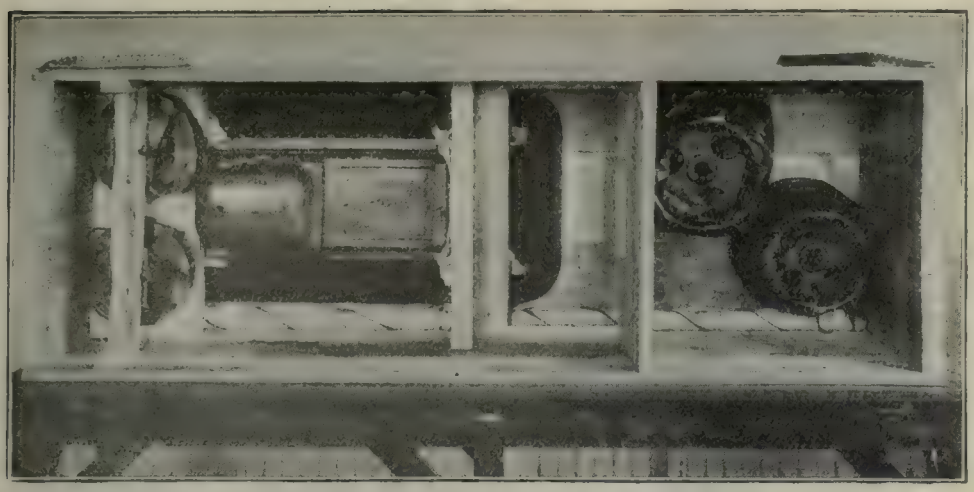


FIG. 15. BED, FRICTIONS AND SHAFT IN PLACE

gang doing the work so that in case of damage there can be no question as to divided responsibility.

It was formerly the custom to have certain men crate certain types of machines, but this has been done away with and the results are entirely satisfactory. By having each gang take any machine as it comes along for shipment, it provides variety and also makes a more flexible working force, as any gang can successfully crate any type of machine which comes in for shipment.

When it comes to the boxing of comparatively small and highly specialized machinery such as the automatic screw machine, the complete machine, with the exception of the pan and legs, are boxed solidly as a unit, using 1½-in. matched boards with reinforced ends. The extra thickness at the ends is of the plain square-edge boards. Great care must be taken in blocking the machine firmly and at the same time to avoid bracing against parts which will be sprung or damaged in any way. Such machines, however, usually have the advantage of being so compact as to allow short blocking between the machine and the case, as seen in Fig. 14.

The pan and legs are packed in another box and in a very careful manner, as can be seen in Figs. 15 and 16. While the case itself need not be so substantial, owing to the comparatively light weight of the pan and the legs, the way in which the pieces are separated and the blocks used in preventing movement are of particular interest. The pan is packed in the bottom of the box, but it is so blocked up that its edges do not bear. In fact the edges have about 1½ in. clearance in all directions in order to prevent breaking or cracking by an unexpected shock. Cross pieces over the pan, which is turned bottom side up, hold it in place. The partition prevents movement of the legs and the blocks shown hold them in place against side movement. A second strip keeps the two legs from coming in contact with the second block and performs a similar function in saving the legs from sudden shock and undue stresses. The friction pulleys for the countershaft are packed in a partition beneath the legs. The countershaft itself may be seen wrapped in paper in the bottom of the box next to the pan.

Small tools such as milling cutters, reamers, micrometers and other machinists' tools are packed in an entirely different manner, the tools being first covered with a thin coating of special cosmoline and then wrapped in a wax or waterproof paper. One of the difficulties sometimes encountered is in the chemical properties of the paper which have been known to attack the tool it was supposed to protect and cause rust and discoloration. The paper-wrapped tools are carefully packed in wooden boxes of suitable size, these boxes being usually lined with a heavy waterproof paper and packed tight.

In some cases where the tools are likely to be subjected to unusual delays in overseas shipment, the wooden boxes are lined with sheet zinc and soldered so as to make an airtight case inside the wooden box. There is a difference of opinion as to the desirability of waterproof covering under all conditions. Some claim that it is a detriment rather than a help in preventing rust because, when the dampness once penetrates the covering or boxing, the waterproof covering holds it so that it can do more damage than if left open to the circulation of air, which would probably dry it out, though this, of course, depends largely upon the care with which the tools are originally protected.

A method of locking small cases against petty thieving is particularly interesting. The thin clamp shown at *A*, Fig. 17, is driven in the same way as a staple into both the body of the box and the edge of the cover as shown at *B*. The spear-shaped nail is then driven in flush as at *C*, the two barbs forcing their way through the holes in the end of the clamp and being held by them so that it is practically impossible to open a box without actually destroying it.

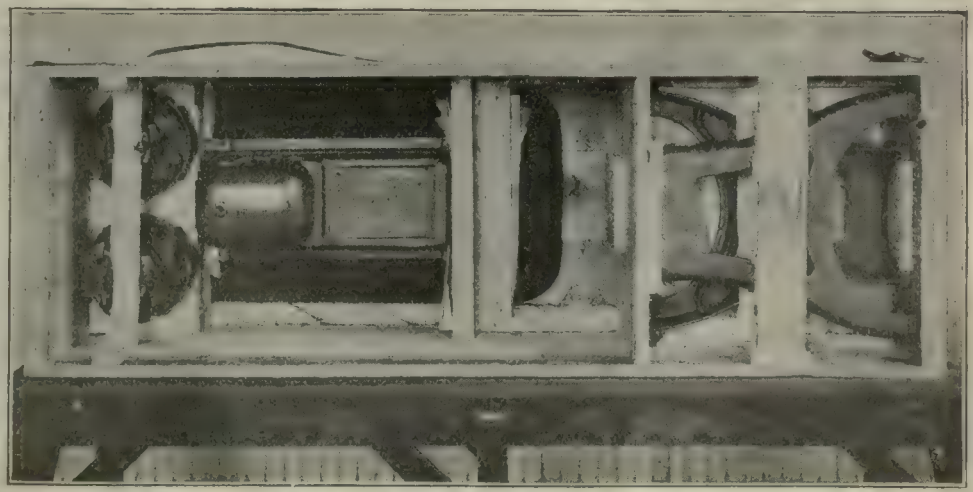


FIG. 16. LEGS PACKED AT THE END

Another important feature in shipping is the use of a correct packing list to accompany the box or crate. This list is made in triplicate, one copy being retained, one going with the invoice and the third being packed with the machine or tools. The consumer, on receiving the package, should be very careful to check the items and should not overlook the fact that the more thoroughly a machine is packed, the more care is needed in unpacking to see that none of the parts are lost. There are cases of considerable correspondence and delay over parts said to be missing, when these parts were afterward found in the fireroom of the boiler house, sometimes after having been through the fire. If the parts unpacked were carefully compared with the packing list, it would save delays and misunderstandings.

While it is impossible to give detailed information concerning the crating of all kinds of machines, enough has been shown to give a good general idea of the principles involved and the main points to be taken care of. While economy is always desirable, and it is this which makes it permissible to use crates instead of solid boxes for most domestic shipping, any skimping as to either the quantity or quality of material used for making a substantial platform or for properly bracing the sides, is an entirely mistaken notion of economy. The loss caused by one machine damaged from improper

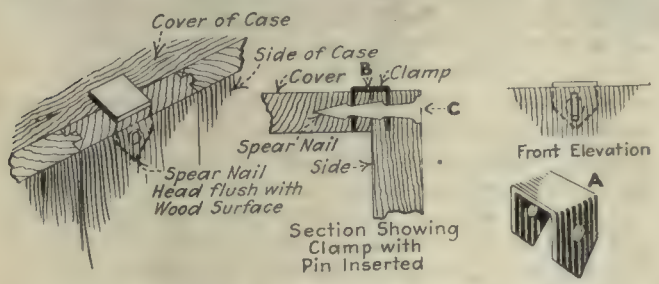


FIG. 17. DEVICE FOR LOCKING SMALL BOXES

crating will buy many thousand feet of good lumber without mentioning the loss in time and prestige which can only make itself felt in future orders.

The Brown & Sharpe Manufacturing Co. have a simple system of keeping track of this work and enabling the costs to be carefully figured. A card file in the office of the Boxing Department contains a complete list of the materials required for boxing or crating any machine. Taking as an example the No. 10 grinding machine which we have been considering, the necessary materials for boxing are:

47 ft. of 2 x 4-in. rough spruce
24 ft. of 2 x 8-in. rough spruce
43 ft. 1⅛-in. matched spruce
13 ft. ⅞-in. matched spruce
42 ft. of 1⅛-in. crating spruce
178 ft. of ⅞-in. crating spruce
1 lb. 30 d. common wire nails
2 lb. 20 d. common wire nails
3½ lb. 10 d. common wire nails
12 lb. 8 d. common wire nails
2 lb. 5 d. common wire nails
6 ft. of lined waterproof burlap for top
12 1¾-in. No. 8 flat-head bright wood screws
4 ½ x 3-in. coach or lag screws
4 ⅝ No. 12 wood screws
10 sheets 18 x 48-in. anti-rust paper
10 lb. newspaper

The slushing requires:

1 lb. No. 1 Cosmoline
2 lb. Harris oil—light
2 lb. Harris oil—dark

This is the material for a complete domestic box. For foreign shipment add 27 ft. of 1-in. box band, which is used as shown in the headpiece, and ½ lb. 4d. common wire nails. If this is for a crated domestic shipment, deduct 71 ft. of ⅞-in. crating material and about 5 lb. of 8d. nails, as it has been found that a well-made crate uses about one pound of nails to every 15 ft. of lumber.

The platform of the No. 10 grinding machine consists of three 2 x 8-in. skids, 1⅛-in. matched boards and ⅞-in. covering boards laid as shown in Fig. 1. The sides require 2 x 4-in. and 1⅛ x 4-in. as rails, while the uprights are of ⅞-in. with 1⅛-in. at the corners. The small box shown is 15 x 13¼ x 4-in. and is all made of ⅞-in. stock. The outside dimensions of the crate are 51 x 54 x 59 in. The net weight is 3,850 and the gross weight 4,450 pounds.

The main point of the problem of shipping machinery safely may, perhaps, be summed up as follows:

1. Protection against rusting.
2. Designing substantial boxing which consists of a heavy platform, with sides, end, and top so fastened and braced as to prevent movement of the machine in the case. Minimum clearance should be allowed between machine and box, both to reduce cubic contents on account of shipping costs, and because the smaller the case the more rigidly it can be built. Particular attention should be paid to the corners and top edges which must resist the stress of hoisting ropes or slings.
3. The prevention of loss of parts either by theft or by coming loose in the case.
4. Careful marking and invoicing, which must meet all the various requirements of countries to which machines are being shipped.

Toolholder With Key for Holding the Bit

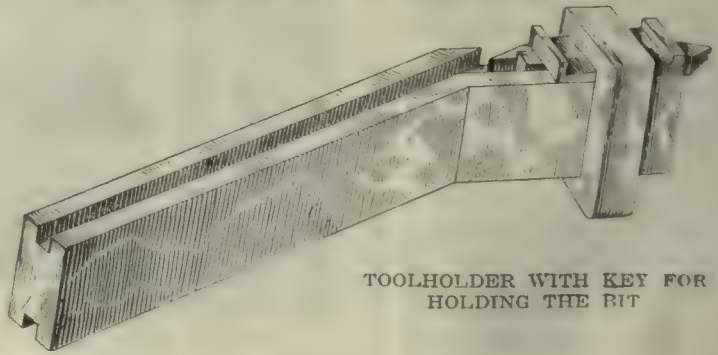
By S. B. Dressler

The toolholder shown in the accompanying sketch overcomes many of the disadvantages of holders of the conventional types. The bit-breaking setscrew is replaced by a taper-key and bridge. The tool body is offset and has three grooves for holding standard bits of stellite, blue chip or other high-speed steels. The shorter grooves serve for right- or left-hand side tools, round nose, hog nose, etc., while the long one, with the tool reversed, holds small boring bars.

The same bridge and taper key can be used on either end or in either position of offset.

As the key distributes the pressure evenly over the bit it will eliminate breakage absolutely and cut down chattering to a minimum as compared to a setscrew bearing at a single point.

A light tap on the key serves either to tighten or to release the bit while the pressure of the work only serves to make the key hold more tightly.



TOOLHOLDER WITH KEY FOR HOLDING THE BIT



PROBABLY no mechanical job ever attracted more general attention than the repair of the German ships seized by us when we entered the World War. Even the mechanically minded Germans repeatedly declared that repairing was an impossibility, but the American engineers and mechanics showed the Hun that he had, as usual, vastly over-rated his own knowledge. One big factor in making the Hun so positive in this case, was his utter ignorance regarding the possibilities of arc welding—but he learned and in the teaching many others were also enlightened. The work necessary on these German ships, of course, included much besides welding of the broken castings, but the welding work was of primary importance.

XXIX.
Examples of Arc-Welding Jobs*

Examples of welding jobs can necessarily only be of a scattered nature, and are principally of suggestive value. Aside from the examples shown in this article, numerous others will be found in the arc-welding articles of this series.

(Part XXVIII appeared in last week's issue.)

The principal ships on which this welding work was done were the:

U. S. Name	German Name	I.H.P.	Gross Tonnage	Class of Vessel
Aeolus	Grosser Kurfurst	8,400	13,102	Transport
Agamemnon	Kaiser Wilhelm II	45,000	19,361	Transport
America	Amerika	15,800	22,621	Transport
Antigne	Neckar	5,500	9,835	Transport
Covington	Cincinnati	10,900	16,339	Transport
George Washington	George Washington	21,000	25,570	Transport
Huron	Fredrich der Grosse	6,800	10,771	Transport
Leviathan	Vaterland	90,000	54,282	Transport
Madawaska	Koenig Wilhelm II	7,400	9,410	Transport
Martha Washington	Martha Washington	6,940	8,312	Transport
Mercury	Barbarossa	7,200	10,984	Transport
Mt. Vernon	Kronprinzessin Cecelie	45,000	19,503	Transport
Pocahontas	Prinzess Irene	9,000	10,983	Transport
Powhatan	Hamburg	9,000	10,893	Transport
President Grant	President Grant	8,500	18,072	Transport
President Lincoln	President Lincoln	8,500	18,168	Transport
Savannah	Saxonia	2,500	4,424	Repair Ship
Susquehanna	Rhein	9,520	10,058	Transport
Philippines	Bulgaria	4,200	10,924	Shipping Bd.

The total gross tonnage of the ships named, was 288,780 tons, and the welding work was done by the Wilson Welder and Metals Co. of New York, using their "plastic-arc" process.

In all, there were thirty-one ships interned in the port of New York. Of these thirty-one ships, twenty-seven were German and four Austrian. Of the German ships, two were sailing vessels and four were small steamers which the Germans had not taken pains to damage materially. This left twenty-one German ships whose engines and auxiliaries were damaged seriously, ranging in size from the "Vaterland," the pride of the Hamburg-American Line, of 54,000 tons, to the "Nassovia," of 3,900 tons.

On the cylinders of the twenty vessels of German origin, not counting for the moment the turbine-driven "Vaterland," there were no less than 118 major breaks which would have entailed the renewal of some seventy cylinders if ordinary practice had been followed. In fact, such was the recommendation of the surveying engineers in their original report.

To any engineer familiar with the conditions at that time in the machine shops and foundries in the vicinity of New York, also in the drafting rooms, the problem of producing seventy cylinders of the sizes required by these vessels would seem almost impossible, and it is pretty well established that some vessels would have had to wait nearly two years for this equipment.

It must be remembered that few drawings of these engines were available, and those in many cases were

*For the author's forthcoming book, "Welding and Cutting."

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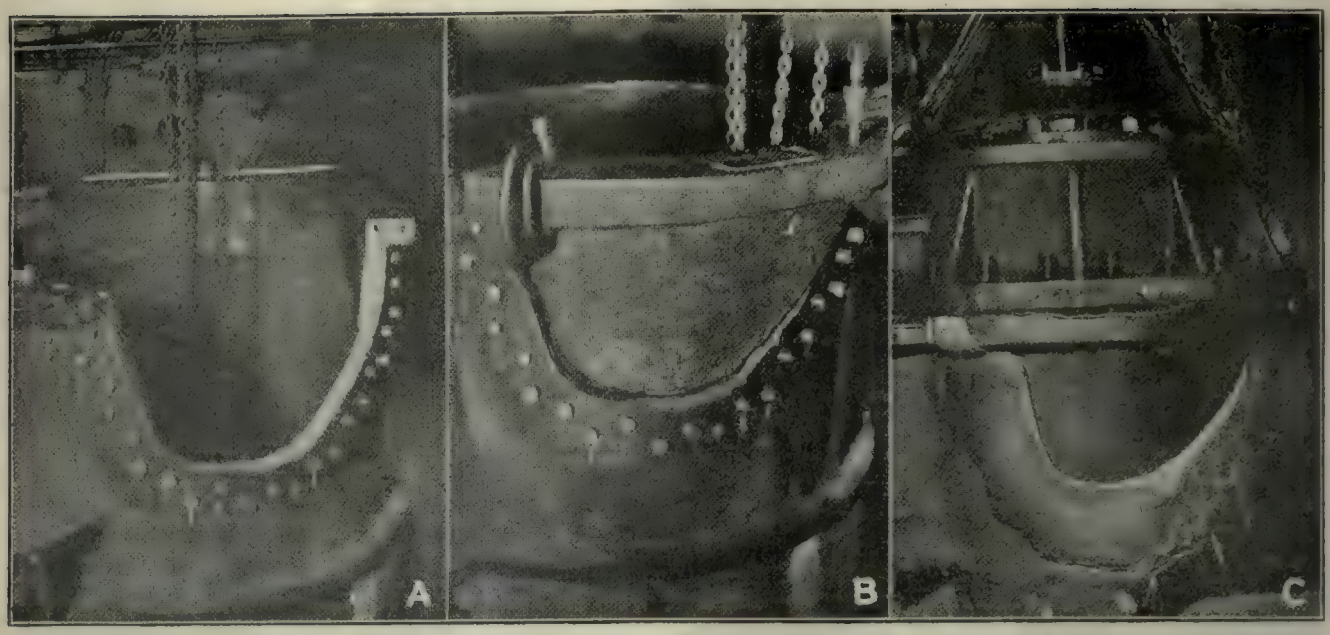


FIG. 345. BROKEN HIGH-PRESSURE CYLINDER OF U. S. S. "GEORGE WASHINGTON" AND METHOD OF REPAIRING

not discovered until months after the repairs had started. Therefore, it would have been necessary to make drawings from the actual cylinders, and competent marine engine draftsmen not already flooded with work did not exist.

The cylinders of fifteen vessels were successfully welded, while those of six were repaired by fitting mechanical patches, or, in other words, eighty-two of the major breaks were repaired by welding and thirty-six by mechanical patches.

It was not until July 12 that the final decision was made placing the transport service in the hands of the Navy and designating what ships were to be transferred from the control of the Shipping Board to that of the Navy Department. However, the first two large ships, the "Friedrich der Grosse," now the "Huron," and the "Prinzess Irene," now the "Pocahontas," were ready for sea on Aug. 20, in spite of the fact that the engines on these vessels were among the worst damaged of them all, the "Irene" having the whole side of the first intermediate valve chest broken out on each engine, the side of the high-pressure cylinder on each engine destroyed, and other smaller breaks, which, under ordinary methods, would have necessitated the renewal of four cylinders. The "Friedrich der Grosse" had the following breaks: Broken valve chest of high-pressure cylinder of each engine (valve chest cast in one with the cylinder), flanges knocked off both valve chest and cylinder covers, steam inlet nozzles knocked off both first intermediate valve chests and walls between the two valves in each check broken out, also steam inlet nozzles on both second intermediate valve chests broken off.

These two vessels were the first in which straight electric welding was used, that is, where patches were not bolted to the cylinder walls.

The nature of some of the breaks in castings is shown by the accompanying photographs, which were taken at various stages of the work.

A, Fig. 345, shows the break in the star-board high-pressure cylinder of the North German Lloyd steamer "George Washington." This break was effected by boring a row of holes about an inch apart and knocking the piece out with a ram.

To prepare this for welding it was necessary to chisel off the surface only roughly, build a pattern of the

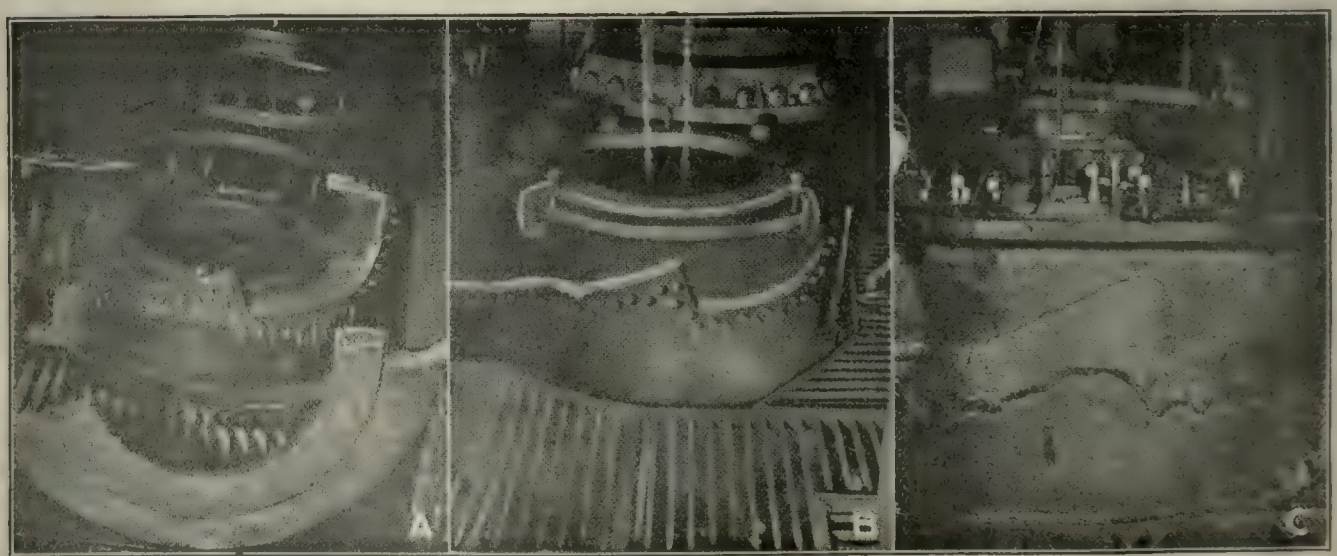


FIG. 346. BREAK AND REPAIR OF FIRST INTERMEDIATE CYLINDER OF THE U. S. S. "POCAHONTAS"

break, cast a steel piece from the pattern, stud up the surface of the cast iron of the cylinder with a staggered row of steel studs ⅝ in. in diameter, projecting ½ in. from the cylinder, bevel the edge of the cast piece, place the piece in position as shown in *B*, and make the weld. When completed, the appearance of the work is as it appears in *C*. The broad belt of welded metal is due to the laying of a pad of metal over the rows of studs previously noted.

It cannot be too strongly insisted that tests have shown conclusively that the weld can be properly made without this pad; that is, if the approximate strength of the original metal is all that is desired—in which case the studding of the metal is unnecessary. But the work in these particular cases was of vital importance, due to the uses to which the vessels were to be put when in service, and also it was appreciated that this exhibition of a new application of the art in the marine engineering world required that the demonstration be satisfying, not only to the mind of the engineer, but to the eye, and ear, and when any engineer looked at that band of metal and sounded it with a hammer, he could not be but satisfied that the strength was definitely there and that the method of padding could be used in most of the situations which would arise. This at least was the effect upon all the engineers who saw the actual work.

The metal was laid on in layers in such a manner as to take care of the contraction in cooling. Each successive layer was cleaned with a wire brush before the next layer was put on. It is in the keeping of the successive layers clean and in the laying on of the metal so as to take care of the contraction that the operator's ability comes in fully as much as it does in the handling of the apparatus. The cylinders were not removed, but were repaired in place. Thus the work of fitting was reduced to a negligible quantity, and the refitting of lagging was not interfered with by projections, other than the ⅝-in. pad, which is laid over the studs for extra strength. It will also be noted that these repairs can be undertaken at any place where the vessel may be lying, either at her loading dock or in the stream, since such apparatus may be carried on barges, which can be placed alongside and wires run to the work.

In this work a part consisted of the caulking of the surface of the welds which prevents porosity and also locates any brittle spots or places where poor fusion of metal has been obtained. This permits the cutting out of the bad places and replacing with good metal. The tool used was an air caulking hammer operated at 110 lb. air pressure.

Strength of Cast-Iron Welds

Capt. E. P. Jessop, U. S. N., personally tested many welds for tensile strength in which cast iron was welded to cast steel, and in but one case was there a failure to obtain practically the original strength. This case was due to an inexperienced operator burning the metal, and was easily detected as an inferior weld without the strength test being applied.

Much has been said about the effect of the heat of welding, upon the structure or strength of cast iron, and in this particular instance the Navy engineer who had direct charge of this work, made experiments to note if there were any deleterious effects on the iron resulting from the action of the weld and reported as follows:

"Scleroscopic investigation of the structure of the welds shows only a very slight vein of hard cast iron at the line of the weld, shot through with fingers of gray cast iron, while behind this area there was no heat effect whatever. The metal thus deposited was easily workable with hammer and chisel, file or cutting tool. Another very important feature is that with the use of the low voltage and absolute automatic current control of the Wilson system, there is a minimum of heat transmitted to the parts to be welded, this being practically limited to a heat value absolutely necessary to bring the electrode and the face of the metal to be welded into a semi-plastic state, thus insuring a perfect physical union, and in accomplishing this result neither of the metals suffers from excessive heat, and there is absolutely no necessity for pre-heating. Neither are there any adverse results from shrinkage, following the completed work owing to a minimum amount of heat being transmitted to the repair parts, thus avoiding the possibility of distortion of parts through uneven or excessive shrinkage strains that are very common where pre-heating is necessary or excessive heat is used for fusing metals."

A, Fig. 346, shows the damage done to the first intermediate cylinder of the U. S. S. "Pocahontas," formerly the "Princess Irene." The damage to this cylinder, it will be noted, was more destructive than to that of the "George Washington," rendering the repairs much more difficult.

B shows the steel section in place ready for welding, with the surfaces properly V-d out and with a staggering row of steel studs adjacent to the welding edge of the cylinder section.

C shows the complete job with the extra band or pad of metal completely covering the studs on the cast-iron section. These bands or pads of metal are peaned or worked over with a pneumatic hammer to insure protection against porosity of metal.

Had either or both of these cylinders been fractured on the lines shown of the cast-iron sections, and none of the parts removed, then the surfaces or edges of all lines of fracture would have been V-d out, and the weld made of the two cast-iron surfaces in the same manner that the cast steel was welded to the cast-iron cylinder proper.

In connection with the repair work just described, the Wilson people claim that their success, and the uniformity of their welds, was made possible because their apparatus enables the welder to control his heat at the point of application. In welding there is a critical temperature at which steel can be worked to give the greatest tensile strength, and also ductility of metal. By raising the heat 15 or 20 amp. above this critical amperage a fracture of the weld will show segregation of carbon and slag pockets, which, of course, weakens the weld. If the amperage is decreased from the critical temperature, a fracture of the weld will show that the metal has been deposited in globules, with many voids, which proves that the weld has been made with insufficient heat. This shows, they claim, that with a fluctuating amperage or voltage, it is impossible to obtain uniformly high-grade welds.

In addition to their apparatus they use special electrodes for various jobs. One electrode is composed of a homogeneous alloy combined with such excess of manganese as will compensate for losses while passing through the electric arc, thus insuring a substantial amount of manganese in the welded joint which is essential to its toughness. They also claim to have a manganese copper alloy welding metal electrode which is composed of iron homogeneously combined with such an excess of manganese and copper over the amount

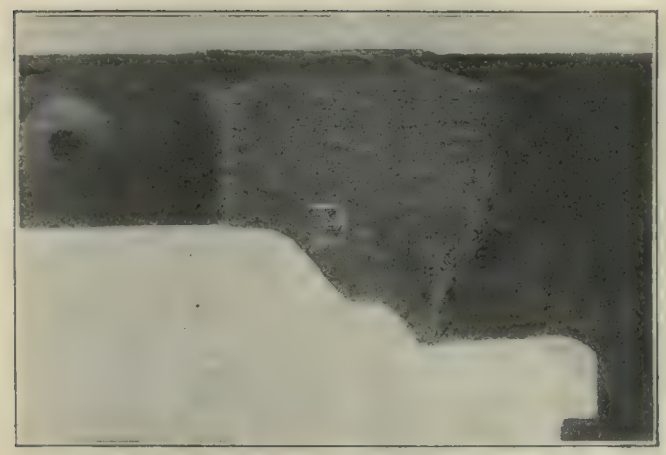


FIG. 347. WELDED LOCOMOTIVE FRAME

lost in the arc as will insure to the welded joint a substantial additional degree of toughness and ductility.

Their special electrodes run in grades, corresponding in sizes to the gage numbers of the American Steel and Wire Co.'s table. Grade 6 is for boiler work; grade 8 can be machined; grade 9, is for engine frames, etc.; grade 17, is for filling castings and grade 20 is for bronze alloys, bells, etc. The tensile strength of welds made with these electrodes is given as from 40,000 to 60,000 lb. The wire furnished is usually gage 9, approximately $\frac{5}{32}$ in. in diameter. This is shipped in coils of about 160 lb. No fluxes are used with any of these electrodes.

Locomotive Work

The railroad shops of the United States were among the first to use arc welding to any extent. In fact, without the great amount of experimental work done in railroad shops, the use of the arc in the repair of the damaged ships by welding would have been practically impossible.

In some cases of locomotive repair there is a big question in the minds of engineers as to whether replacement is to be insisted upon or welding allowed. Rules have been drafted by a number of railroad associations, but at present no uniform rules covering all cases are in existence. However, on certain classes of work there is no real question that welding is the quicker and better way.



FIG. 348. BUILT UP PEDESTAL JAW



FIG. 349. AT WORK ON A LOCOMOTIVE FRAME

In Fig. 347 is shown a repair on a steel locomotive frame, the size of the smaller section being 5 x 6 in. The broken ends were beveled off on each side and a piece of steel bar was welded in between the ends, thus saving considerable time and electrode material.

Fig. 348 shows how the worn face of a pedestal jaw was built up by means of the "plastic-arc" process.

Another frame-welding job is shown in Fig. 349. The weld was 3 in. high, $4\frac{1}{2}$ in. wide and 4 in. deep. One man finished the job with a Westinghouse outfit in about 5 hours.



FIG. 350. WELDING CRACKED DRIVING WHEEL SPOKES



FIG. 351. WELDING LOCOMOTIVE'S BOILER TUBES TO BACK SHEET

Fig. 350 shows the welding of a locomotive cast-steel drive wheel. Four spokes were cracked.

Fig. 351 shows the welding of locomotive boiler tubes to the back flue sheet. All of these jobs were done by the "plastic-arc" process, and represent a very small portion of the kinds of jobs that may be done in a railroad shop.

The method of welding flue ends to the sheets as suggested by Westinghouse is shown in Fig. 352.

H. A. Currie, assistant electrical engineer, New York Central R.R., writing in *Railway Age*, says:

"The saving in our locomotive shop since electric welding was installed can hardly be calculated and the additional mileage that is obtained from locomotives is remarkable. This is mainly due to the following:

"A. Greater permanency of repairs.

"B. Shorter periods in the shop, giving additional use of equipment.

"C. Existing shop facilities permit taking care of a larger number of locomotives than originally expected. Shop congestion relieved.

"D. The use of worn and broken parts which without electric welding would be thrown in the scrap pile.

"E. The time required to make repairs is much less and requires fewer men.

"F. A smaller quantity of spare parts carried in stock.

"The following is a brief description of some of the work done on steam locomotives:

Flue and Firebox Welding

"The most important results are obtained by welding the boiler tubes to the back flue sheet. The average mileage between shopping on account of leaky flues on passenger locomotives was 100,000 miles. This has been raised to 200,000 miles with individual records of 275,000 miles. For freight this average has been raised from 45,000 to 100,000 miles. At the time of locomotive shortage this effect was of inestimable value.

"Good results have been obtained without the use of sandblast to prepare the tubes and sheets. The engine is either fired or an acetylene torch used to burn off the oil, after which the metal is cleaned off with a scraping tool. The ferrules are of course well seated and the tubes rolled back. The boiler is filled with water in order to cool the tubes, which having a much thinner cross-section than the sheets, would overheat sufficiently to spoil the weld or burn the tube. The metal is then laid on, beginning at the bottom of the bead and working to the top. Records show that the time to weld a Pacific type locomotive boiler complete is 12 hours.

"A variety of repair work is readily accomplished in locomotive fireboxes such as the welding of crown-sheet patches, side-sheet cracks and the reinforcing and patching of mud rings. Smokebox studs are also welded on.

Side Frames, Couplers and Wheels

"Cracked main members of side frames are restored and wearing parts built up and reinforced. Because of accessibility no special difficulties are encountered in this work. Formerly this work was chiefly done with oil welding and some acetylene and thermit work, but it was very much more expensive as the preparation required considerable effort and took a good deal of time.

"Fifty per cent of the engines passing through the shops have worn and broken coupler parts and pockets. By welding an average saving of about $15 per coupler is made. It costs about $30 in material and labor to replace a coupler and only $4 to repair the average broken coupler. The scrap value is about $5.

"Great success has resulted from various repairs to steel wheels and tires. Flat spots have been built up without removing the wheels from the locomotives, thus effecting a great saving in time and money. Building up sharp flanges saves about ⅝-in. cut off the tread, which when followed through means about $30 for a pair of wheels, a great increase in tire life and reduction in shop costs.

Cylinders

"The most interesting feature developed by arc welding was the accomplishment of cast-iron welding. The difficulty in welding cast iron was that while the hot metal would weld into the casting, on cooling the strain would tear the welded portion away from the rest of the casting. Small studding was tried out with no success. Not until wrought-iron studs, proportioned to the sectional strength of the casting, were used did any satisfactory welds turn out. Studding of this large size was looked upon with distrust, as it was thought that the weld was only to the studding. This naturally meant that the original structure was considerably weakened due to the drilling. This, however, was not the case. The large studding was rigid enough to hold against the cooling strains and prevented the welds in the casting from pulling loose, thus adding

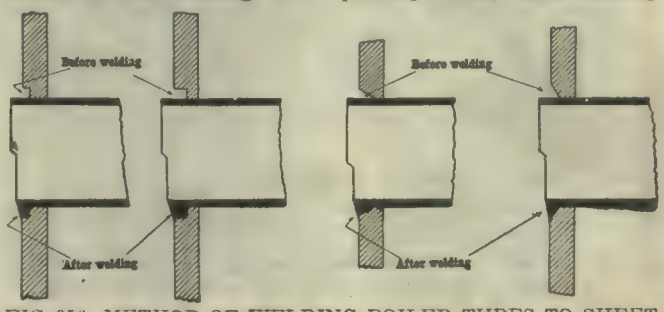


FIG. 352. METHOD OF WELDING BOILER TUBES TO SHEET

the strength of all the welded portion to that of the studs. In most cases where external clearance will permit, sufficient reinforcing can be added to more than compensate for the metal removed in drilling for the studs.

"Perhaps more skill is required for this class of welding, but with a properly prepared casting success is certain. A concrete case of the economy effected in welding a badly damaged cylinder on a Pacific type engine is as follows:

WELDED JOB

Cost of welding broken cylinder, labor and material	$125.00
Length of time out of service, 5 days at $20 a day	100.00
Scrap value of old cylinder (8,440 lb. at 2.09 lb.)	177.00
Total	$402.00

REPLACED CYLINDER

Cost of new cylinder ready for locomotive	$1,000.00
Labor charge to replace it	150.00
Locomotive out of service 18 days at $20 a day	360.00
	$1,510.00
Less cost of welding	402.00
Total saving	$1,108.00

"Some twenty-five locomotives have been repaired in this way at one shop alone.

"Many axles are being reclaimed by building up the worn parts. These are tender and truck axles which are worn on the journals, wheel fits and collars. The saving is about $25 per tender axle and $20 for truck axles.

"The range of parts that may be repaired or brought back to standard size by welding is continually expanding. Wearing surfaces on all motion links and other motion work, crosshead guides, piston-rod crosshead fits, valves and valve seats, air, steam, sand and other pipes, keys, pins and journal boxes have all been successfully welded.

"A large saving is effected in welding broken parts of shop tools and machinery. During the war this was of untold value, as is some cases it was out of the question to get the broken part replaced.

Training of Operators

"The training of arc welders is most important. Success depends solely on the men doing the work. They must be instructed in the use of the arc, the type, size and composition of the electrode for various classes of work and the characteristics of the various machines they will be called upon to use. A properly equipped school for teaching these matters would be a valuable adjunct for every railroad. Manufacturers of equipment have recognized the importance of proper instruction and have equipped schools where men are taught free of charge.

Supervision

"Co-ordinate with the actual welding is intelligent supervision. The scope of the supervisors should include preparation of the job for the welder and general oversight of the equipment in the shop.

"Thus the duties of the inspector might be summarized in the following points:

"1. To see that the work is properly prepared for the operator.
"2. The machines and wiring are kept in good condition.
"3. Proper electrodes are used.
"4. To inspect the welds in process of application, and when finished.
"5. To act as advisor and medium of interchange of welding practices from one shop to another.

"In work such as flue welding and industrial processes which repeat the same operation, piece-work rates may be fixed. For varying repair jobs this method cannot be used with justice either to the operator or the job.

"Bare electrodes are used almost exclusively, even for A. C. welds. Whenever a new lot of electrodes is received it is good practice to make up test-piece samples and subject them to careful tests and analysis.

"The sizes of electrodes and uses to which they are put are shown in the following table:

Size	Type of Work
$\frac{1}{8}$ in.	Flue welding.
$\frac{3}{32}$ in.	For all repair work, broken frames, cylinders, etc.
$\frac{1}{16}$ in.	For building up wearing surfaces.

General Rules

"In closing it will be well to point out a few general rules required to obtain satisfactory welds:

"1. The work must be arranged or chipped so that the electrode may be held approximately perpendicular to the plane of welding. When this cannot be accomplished the electrode must be bent so that the arc will be drawn from the point and not the side of the electrode. For cast iron the studding must be properly arranged and proportioned. The surfaces to be welded must be thoroughly clean and free from grease and grit.
"2. The proper electrode and current value must be selected for the work to be done.
"3. The arc should be maintained as constant as possible.
"4. For nearly all work the prepared surface should be evenly welded over and then the new surfaces welded together.
"5. Suitable shields or helmets must be used with proper color values for the lenses.

"For locomotive work a good operator will deposit an average of 1 to 1½ lb. of electrode per hour. The limits are from 1 to 2 lb. High current values give more ductile welds, in proportion to deposited metal. For locomotive welding the great advantage of the arc over thermit, oil or acetylene welding is that preparation at the weld is all that is necessary. No secondary preparation for expansion of the members is necessary. This is the great advantage in welding side frames."

Considerable welding work is done in building up worn track parts. Fig. 353 shows the building up of cupped rail ends and Fig. 354 shows manganese-steel cross-over points built up by arc welding. Such repairs have stood long and hard service.

Other Welding Work

In the steel mills a great deal of welding is required to build up worn roll or pinion pods. Fig. 355 shows a welder at work building up worn pods with a carbon arc and filler. Fig. 356 shows a finished job with the worn part outlined in white. The cost of repairing four ends (two pinions) was $170. The pinions cost $1,000 each.

The way a five-ton roll housing was repaired is shown in Fig. 357. In this case a heavy steel plate was bolted over the crack and welded as indicated. It might have been all right to weld direct, but in this case, owing to the heavy duty required, it was thought best to play safe and use the steel plate.

Welded blowholes in the rim of a large pulley are

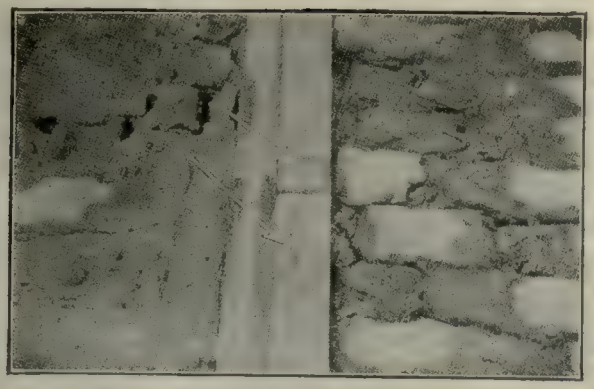


FIG. 353. BUILT UP CUPPED RAIL ENDS

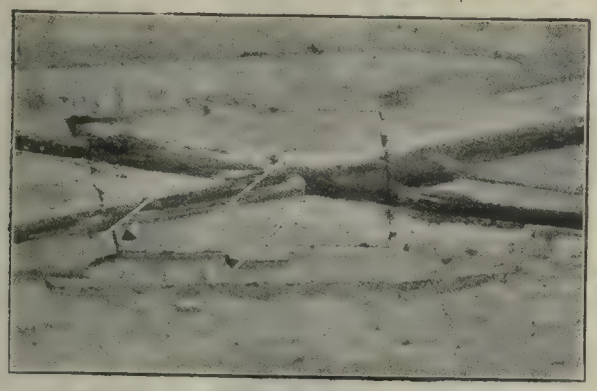


FIG. 354. BUILT UP MANGANESE STEEL CROSS-OVER POINTS

shown at the left in Fig. 358. At the right the pulley is shown after machining.

Broken taps may be removed if a nut is welded on as shown in Fig. 359. In doing work of this kind, the arc is struck on top of the tap and kept there until the metal is built up above the top of the hole. An ordinary nut is then laid over it and welded fast. If the arc is kept on the tap the metal may run against the sides of the hole but will not adhere, but care must be exercised so as to not let the arc strike the sides of the hole.

Electrically Welded Mill Building

A small all-welded mill building was erected in Brooklyn in 1920 for the Electric Welding Co., of America, by T. Leonard MacBean, engineer and contractor. The structure is about 60 x 40 ft., and has four roof trusses of 40-ft. span supported on 8-in. H-beam columns fitted with brackets for a five-ton



FIG. 356. FINISH-WELDED PINION PODS

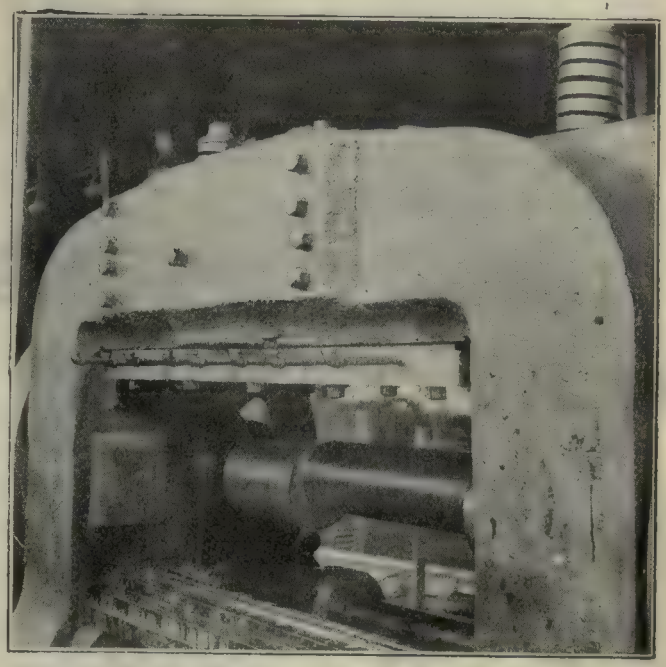


FIG. 357. REPAIRED 5-TON ROLL HOUSING



FIG. 355. BUILDING UP WORN ROLL PODS

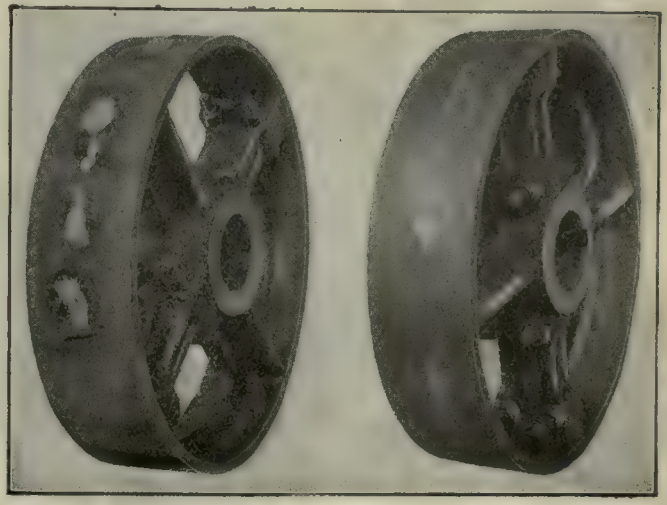


FIG. 358. WELDED BLOWHOLES AND MACHINED PULLEY

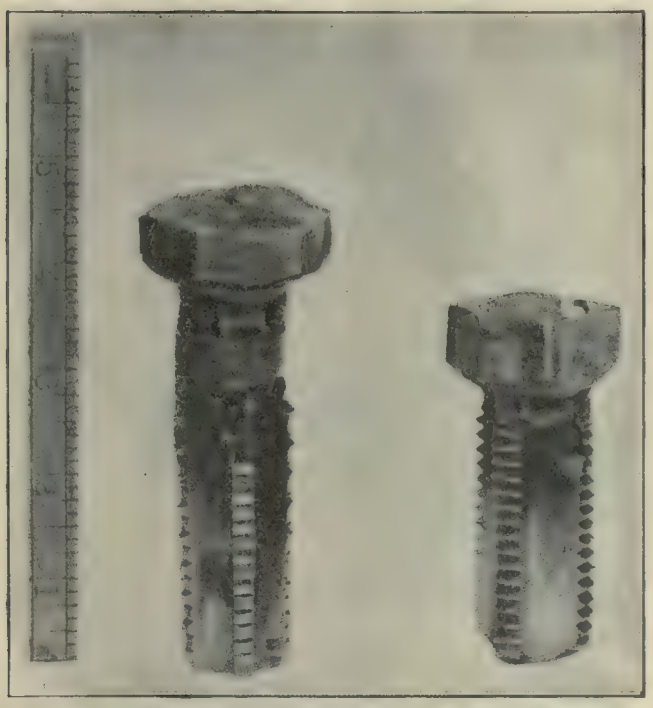


FIG. 359. METHOD OF WELDING TAPS BROKEN OFF IN THE HOLE

traveling crane. In its general arrangement the structure follows regular practice, but the detailing is such as to suit the use of welding, and all connections throughout are made by this process. A considerable advantage in cost and time is claimed for the welded connections, but in the present instance the determinative feature was not cost economy so much as the fact that the fabricated work could be obtained more quickly by buying the plain steel members and cutting and welding them at the site instead of waiting for bridge shop deliveries.

The roof was designed for a total load of 45 lb. per sq.ft., of which about 30 lb. represents live load. Each truss weighs 1,400 lb. The chords are 4 x 5 x $\frac{3}{8}$-in. tees, while the web members are single 3 x 2 x $\frac{3}{8}$-in. angles. On the trusses rest 10-in. 15-lb. channel purlins spanning the 20-ft. width of bay. The columns are 8 x 8-in. H-beams, 19 ft. high, and the crane bracket on the inner face of the column is built up of a pair of rear connection angles, a pair of girder seat angles, and a triangular web plate, as one of the views herewith shows. Base and cap of the columns are made by simple plates.

All material was received on the job cut to length. A wooden platform large enough to take a whole truss was built as a working floor and the chord members were laid down on it in proper relative position to form a truss when connected. The top chord was made of a single length of tee, bent at the peak point after a triangular pieces was cut out of the stem. At the heel points of the truss the stem of the top-chord tee was lapped past the stem of the bottom chord tee, and when the two members were clamped together the contact seams were welded; the seam of the stem at the peak was also welded shut. Then the web members were placed in position and clamped, and their connections to the chord welded. The metallic-electrode arc process was used.

Loading Tests

When the plans for the building were submitted to the Department of Buildings, Borough of Brooklyn, the proposal to weld the connections was approved only with the stipulation of a successful load test before erection. This test was carried out March 20. Two trusses were set up at 20-ft. spacing and braced together, purlins were bolted in place, and by means of bags of gravel a load of 48 tons was applied. This was sufficient to load the trusses approximately to their elastic limit. No straining or other change was observable at the joints, and the test was considered in every respect successful. The deflection of the peak, 0.0425 ft., did not change during 48 hours, and upon removal of the load at the end of that period a set of less than 0.01 ft. was measured.

Speed of Arc Welding

In a paper read before the American Institute of Electrical Engineers, New York, Feb. 20, 1919, H. M. Hobart says:

All sorts of values are given for the speed, in feet per hour, with which various types of joints can be welded. Operators making equally good welds have widely varying degrees of proficiency as regards speed. Any quantitative statement must consequently be of so guarded a character as to be of relatively small use. In general, and within reasonable limits, the speed of welding will increase considerably when larger currents are employed. It appears reasonable to estimate that this increase in speed will probably be about 25 to 35 per cent for high values of current. This increase is not directly proportional to the current employed because a greater proportion of time is taken to insert new electrodes and the operator is working under more strenuous conditions. Incidentally, the operator who employs the larger current will not only weld

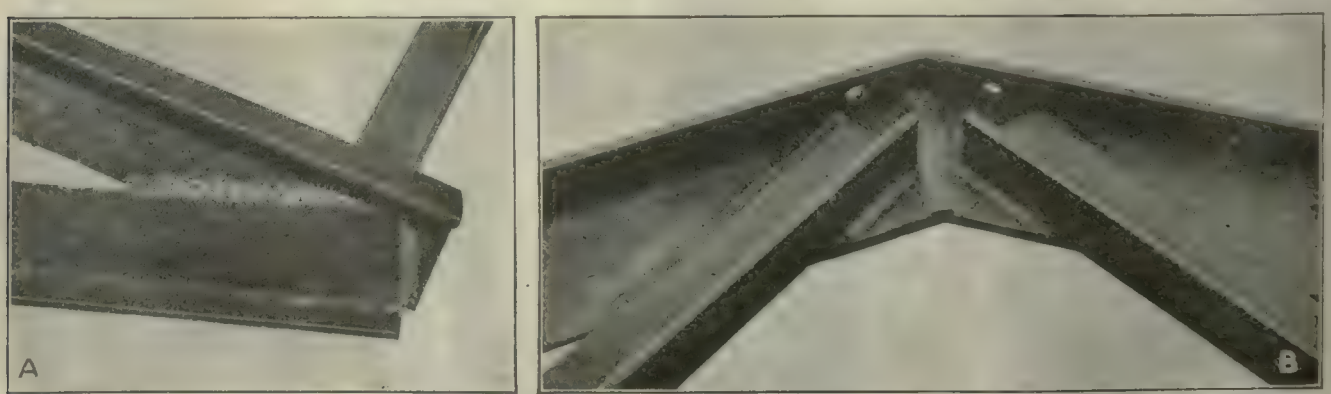


FIG. 360. SOME DETAILS OF ALL-WELDED MILL BUILDING. A HEEL JOINT OF 40-FT. TRUSS. *B* AND *C* FRONT AND BACK SIDES OF PEAK JOINT TRUSS. *D* COLUMN BASE. *E* CRANE BRACKET. PARTS OF BRACKET WERE FIRST WELDED TOGETHER AND THEN UNIT WAS WELDED TO THE COLUMN

quicker but the weld will have also better strength and ductility.

On this point Mr. Wagner writes as follows:

I would not say that speed in arc welding was proportional to the current used. Up to a certain point ductility and strength improve with increased current, but when these conditions are met, we do not obtain the best speed due to increased heating zone and size of weld puddle. Speed may fall off when current is carried beyond certain points.

In a research made by William Spraragen for the Welding Research Sub-Committee on several tons of half-inch-thick ship plate, the average rate of welding was only two feet per hour. Highly skilled welders were employed, but they were required to do the best possible work, and the kinds of joints and the particular matters under comparison were very varied and often novel.

However, in the researches carried on by Mr. Spraragen it was found that about 1.9 lb. of metal was deposited per hour using a $\frac{5}{32}$-in. bare electrode and with the plates in a flat position. The amount of electrodes used up was about 2.7 lb. per hour, of which approximately 16.5 per cent was wasted as short ends and 13 per cent burnt or vaporized, the remainder being deposited at the speed of 1.9 lb. per hour mentioned above.

For a 12-ft.-cube tank of $\frac{1}{2}$-in.thick steel welded at Pittsfield, the speed of welding was 3 ft. per hour. The weight of the steel in this tank was 16,000 lb. and the weight of electrode used up was 334 lb. of which 299 lb. was deposited in the welds. The total welding time was 165 hours corresponding to using up electrodes at the rate of just 2 lb. per hour. The total length of weld was 501 ft., the weight of electrode used up per foot of weld thus being 0.60 lb. The design of this tank comprised eighteen different types of welded joint. Several different operators worked on this job and the average current per operator was 150 amp.

For the British 125-ft.-long Cross-Channel Barge for which the shell plating was composed of $\frac{1}{4}$-in. and $\frac{5}{16}$-in. thick plates, described in H. Jasper Cox's paper read before the Society of Naval Architects on Nov. 15, 1918, and entitled "The Application of Electric Welding to Ship Construction," it is stated that: "After a few initial difficulties had been overcome, an average speed of welding of 7 ft. per hour was maintained including overhead work which averaged from 3 to 6 ft. per hour."

In a report appearing on page 67 of the minutes and records of the Welding Research Sub-Committee for June 28, 1918, O. A. Payne, of the British Admiralty, states: "A good welder could weld on about one pound of metal in one hour with the No. 10 Quasi-Arc electrode, using direct current at 100 volts. An electrode containing about $1\frac{1}{2}$ oz. of metal is used up in about 3 minutes, but this rate cannot be kept up continuously."

The makers of the Quasi-Arc electrode publish the following data for the speed of arc welding in flat position with butt joints, a 60-deg. angle and a free distance of $\frac{1}{8}$-in.

Thickness of Plates	Speed in Feet per Hour
$\frac{1}{8}$ in.	30
$\frac{1}{4}$ in.	18
$\frac{1}{2}$ in.	6
1 in.	1 3

I cannot, however, reconcile the high speed of welding $\frac{1}{2}$-in. plate published in this report as 6 ft. per hour, with the report given above by the British Admiralty that a good welder deposits 1 lb. of metal per hour with the Quasi-Arc electrode. If the rate given by the manufacturer is correct, it would mean that about four pounds of metal were deposited per hour. On this basis the rate must have been computed on the time taken to melt a single electrode and not the rate at which a welder could operate continuously, allowing for his endurance and for the time taken to insert fresh electrodes in the electrode holder and the time taken for cleaning the surface of each layer before commencing the next layer. From his observations I am of the opinion that a representative rate for a good welder lies about midway between these values given respectively by Mr. Payne, and by the makers of the Quasi-Arc electrode, say for $\frac{1}{2}$-in. plates some 2 lb. per hour. This, it will be observed, agrees with Mr. Spraragen's experience in welding up some 6 tons of $\frac{1}{2}$-in. ship plate with a dozen or more varieties of butt joint and Mr. Wagner's results with an 8-ton tank. Even this rate of 2 lb. per hour is only the actual time of the welding operator after his plates are clamped in position. This preliminary work and the preparation of the edges which is quite an undertaking, and requires other kinds of artisans, accounts for a large amount of time and should not be under-estimated.

The practise heretofore customary of stating the speed of welding in feet per hour has led to endless confusion as it depends on type of joint, height of weld and various details. A much better basis is to express the speed of welding in pounds of metal deposited per hour. Data for the pounds of metal deposited per hour are gradually becoming quite definite. The pounds of metal per foot of weld required to be deposited can be readily calculated from the drawings or specifications. With the further available knowledge of the average waste in electrode ends and from other causes, the required amount of electrode material for a given job can be estimated.

Suitable Current for Given Cases

For a given type of weld, for example, a double V-weld in a $\frac{1}{2}$-in. thick ship plate, it was found that in the summer of 1918, while some operators employed as low as 100 amp., others worked with over 150 amp. Some, in making such a weld, employed electrodes of only $\frac{1}{8}$-in. diameter and others preferred electrodes of twice as great cross-section. For the particular size and design of weld above mentioned, the Welding Research Sub-Committee had welds made with 200 to 300 amp. The conclusion appears justified that the preferable current for such a weld is at least 200 amp. If the weld of the $\frac{1}{2}$-in.-thick plate is of the double-bevel type, some 50 amp. less current should be used for the bottom layer than is used for the second layer if two layers are used. For $\frac{3}{4}$-in.-thick plates, the most suitable welding current is some 300 amp. This is of the order of twice the current heretofore usually employed for such a weld.

Mr. Wagner writes:

We have made a number of tests to determine the effect of varying current on the strength of the weld. Tests were made on a $\frac{1}{2}$-in. plate with current values as follows: 80, 125, 150, 180, 220, 275 and 300 amp. These tests show improvement in the tensile strength and bending qualities of welds as the current increases. The speed of welding increases up to a certain point and then decreases.

Effect on Arc Welding of Voltage Employed

We have made a number of tests to determine the influence of variable voltages on the strength and character of electric welds. The experiments were made welding $\frac{1}{2}$-in. plate with 150 amp. held constant and voltage varying as follows: 40, 75, 100, 125, 150, 200 and 225 volts. This test demonstrates that there is no material difference in the tensile strength, bending qualities or the appearance of the welded-in material. There is this advantage, however, in the higher voltage, that variations in the strength of the arc do not materially affect the value of the current. A curve-drawing ammeter was installed on the welding circuit which showed variations in current at 75 volts, but at 150 volts the current curve was practically a straight

Preferable Size of Electrode

On certain railways, a single diameter of electrode is employed independently of the size or shape of the plates or parts being welded. The experience of other people leads them to make use of several different sizes of electrodes according to the size of the job and the type of joint. Present British practise appears to be to use such a size of electrode as to have a current density of some 4,000 to 6,000 amp. per square inch. The investigations of the Welding Research Sub-Committee indicate that at least 10,000 to 12,000 amp. per square inch is suitable for electrodes of $\frac{1}{4}$-in. and $\frac{5}{32}$-in. diameter and well up toward 10,000 amp. per square inch for electrodes of $\frac{3}{16}$-in. and $\frac{3}{4}$-in. diameter.

Alternating Current and the Planer

By TELL BERNA*

The necessity for an alternating-current motor which will give a satisfactory direct drive is increasing. The author considers the motor generator set, the squirrel cage, slip ring, and four-speed squirrel cage motors and a special motor now being developed.

THE gradual expansion of high-tension transmission systems and the development of public utility power plants at the expense of small private power plants is constantly increasing the use of alternating current in industrial plants. Many a machine-shop owner would like to change over to alternating current and do away with the cost and the complication of having his own power plant if he could feel sure that he would get the same results with the alternating-current motor that he can with the direct-current motor which he is now using. Unfortunately there are certain limitations which seem to be inherent in alternating-current motors which must be carefully taken into consideration before making so serious a change.

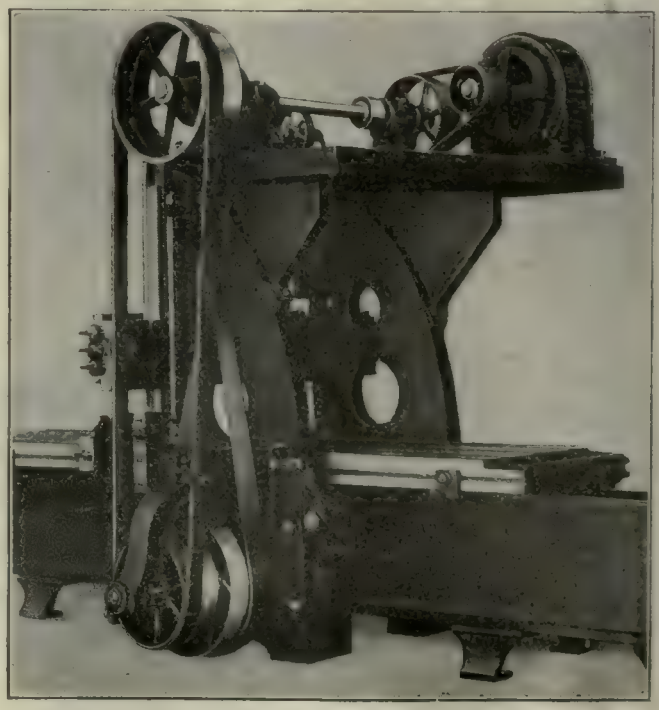
This question is particularly difficult in its application to the planer department. Of course the motor-generator set will solve this problem, but its use is objected to in a great many plants on the ground that the very idea of installing the alternating-current equipment is to do away with the engine room and to obviate the necessity of having a skilled engineer on hand. The motor-generator set is a piece of machinery not understood by the ordinary shop man, and it adds materially to the cost of the electrical equipment required. It must also be remembered that when a motor-generator set is purchased with sufficient capacity to take care of prospective increases in shop equipment over the next few years, it is larger than is required at the present time and is therefore not operating at anything like maximum efficiency. If, on the other hand, a motor-generator set of just the right size is purchased, there is the danger of overload and the addition of new machines will run the load up beyond this capacity with resultant troubles, such as burning out and the continual opening of the circuit breaker. It takes a good deal of time under present commercial conditions to get the additional motor-generator set which must then be purchased to handle the increased load.

If we consider the application of the alternating-current motor itself to the planer instead of the use of the direct-current motor and the motor-generator set, we find that there are several interesting possibilities and that we have before us a field which offers splendid opportunities for further development by electrical engineers.

The Self-Contained Motor Drive

The simplest form of motor drive is, of course, the self-contained motor drive as illustrated herewith, in which a motor is mounted on a shelf which in turn is supported by the housings of the planer. This motor is connected either by gearing or by a short endless belt to a self-contained countershaft which in turn drives the planer through the usual shifting belt arrangement. This motor, if it is a constant-speed motor, gives one cutting speed and one return speed, these being decided by the sizes of the pulleys used and the speed of the motor. There are, of course, mechanical devices, such as the speed variator, on which, by shifting belts, four cutting speeds are obtained. It is, however, desirable to get four speeds directly from the motor so as to avoid the expense of the additional mechanical arrangement. This form of drive has long been available for alternating current by the use of the squirrel-cage motor. The motor is started by the use of a compensator, which not only cuts down the inrush demanded by the motor on starting, but also protects the motor against failure of voltage and sustained overload. With the assistance of the countershaft, which has a considerable inertia, and of its own rotor, the motor has sufficient flywheel action to tide over the peak loads which occur when the planer table is reversed. The motor is started only in the morning and at noon, and does not need to have a heavy starting torque, a feature which is notoriously lacking in squirrel-cage motors.

This type of drive is open to the criticism that only a few plants are large enough so that the single speed available can be prescribed with certainty for the work which is to be done. Most of us have to put a wide range of work on our planers, and for this purpose a selection of speeds must be available. On direct current, this requirement is met by the use of the so-called variable speed non-reversing motor drive which makes use of a non-reversing, direct-current motor that runs continuously but that varies in speed, depending on whether the table of the planer is cutting or returning. Strictly speaking, this is an adjustable speed motor. The distinction between the variable speed motor and



SIMPLEST FORM OF DIRECT MOTOR DRIVE

*Sales Engineer, The G. A. Gray Co.

the adjustable speed motor is simply that when the speed of the variable speed motor is set for a certain point, its speed is not constant at that point, but varies with the load, while with the adjustable speed motor, if connections are made for a certain speed, the motor will have decided constant speed characteristics at that point and the speed will vary only slightly with varying load. The latter is, of course, a very desirable feature on planer drives. If after the tool enters the work, the sudden increase in the load results in slowing down the motor, the surface which comes off of the planer will not be flat by any means.

The Slipring Motor

The simplest form of motor which may be suggested to meet these requirements is the slipring motor, which can be regulated by the introduction of resistance. The speed range available is from normal to about 50 per cent below normal. We discover immediately, however, that this is a variable speed motor, which means that it is not suited for the type of load we encounter on a planer. We cannot relieve this difficulty by supplying a flywheel in any form since this would retard the acceleration of the motor on the beginning of the return stroke, when it is supposed to speed up. We also find that on changing the speed, as in reversing the planer table from cut to return, that the current inrush taken by the motor is excessive. This would not only tend to overheat the motor, but these current inrushes cost a good deal of money.

New Squirrel-Cage Motor

There is another type of motor which is newer and not so well known as the slipring motor and that is the four-speed squirrel-cage motor. This motor can be arranged for speeds of 300, 600, 900 and 1,200 r.p.m. which is really a wider range than would be required for ordinary planer service. The stator, or stationary part of the motor, has four distinct windings, any one of which may be connected to the power lines. In this way we have practically four squirrel-cage motors in one. To change the speed of the motor it is only necessary to open the circuit and connect the proper winding to the line to get the desired speed. No intermediate speeds are available, so that we can get only 300, 600, 900 and 1,200 r.p.m. Suppose we employ the last three, that is 600, 900 and 1,200 r.p.m.—we could then connect this motor up to the countershaft so as to get cutting speeds of 30, 45 and 60 ft. per minute. The pulleys would be so designed as to give us a return speed of 100 ft. per minute when the motor runs at 900 r.p.m. We can then mount a master switch on the bed of the planer as we do on the direct-current installation. This would automatically connect the motor to the line in the proper manner so as to get a cutting speed of 30, 45 and 60 ft. per minute, as desired, but we should always get the same return speed of 100 ft. per minute, as the master switch would connect the 900 r.p.m. windings of the motor to the line at the end of the cut stroke. At most, the change from the return to the cut speed would only involve a 33⅓ per cent increase or decrease in motor speed. The change from the cut to the return speed would necessitate a 5 per cent increase in the motor speed when cutting at 40 ft. per minute and returning at 100 ft. per minute. At first analysis, this motor seems to present attractive possibilities.

There are difficulties, however, which should not be overlooked. There would be a heavy inrush current in speeding up the motor varying from 175 to 250 per cent of the normal current. To cut down this inrush externally will weaken the torque just as it is most needed. It may, however, be decreased with an increase in the torque available by a special design of the motor rotor. The torque must be sufficient not only to reverse the planer but to accelerate it promptly to the higher speed. The most serious difficulty would be met in reducing the speed of these motors. In shifting the windings of the motor from the 900 r.p.m. connection to the 600 r.p.m. connection, there is a sudden breaking effect which is excessive in its severity and which would undoubtedly result in a great deal of belt slippage and burning and might even injure the mechanism of the planer itself. So far, no successful method of damping this change in speed has been devised.

There remains another possibility which has, however, not been developed very far as yet, in the form of a very special alternating-current motor used in the higher ratings in paper mills. This is now being developed by one of the largest electrical concerns for use in small sizes for machine tools and similar service. This motor has a speed range of about 500 to 1,500 r.p.m. It has constant-speed characteristics at any speed. Whether the current inrushes resulting from sudden changes in the speed of the motor will be excessive or not, remains to be seen. It is claimed for this motor that slowing down suddenly gives a smooth retardation similar to that obtainable on direct-current motors.

For the reversing-motor drive our electrical friends have as yet nothing to offer as there is no alternating-current motor which can be produced at a commercial price which could compare in any way with the advantages of this form of drive on direct current. Whether this is a practical possibility or not remains to be seen, but we can be sure that the fortunate man who develops such a motor will find a tremendous field awaiting him.

Drafting-Room Kink

By L. A. Wirick

The drafting-room kink published on page 564e of the *American Machinist* appears to me to be a step in the wrong direction in the matter of showing screw threads.

A good draftsman will endeavor to reduce the number of tools he uses rather than to increase the size of his kit. Of course it is inconvenient to cock a 30- or 45-deg. triangle around to draw these thread lines at a right or left inclination, and difficult to always get the same inclination; but the remedy is to make the lines without any inclination, in all cases—that is, perpendicular to the axis of the screw. Then the T-square and triangle are sufficient and the result is even better.

In any case the method of showing screw threads is conventional. We do not make drawings of standard threads, and if we did the machinist would not use them, for he has taps and dies and does not lay out the threads from the drawing. Neither does he depend upon the lines of the drawing to know whether to make the thread right or left hand. The notation on the drawing that specifies the pitch of the thread should also state whether right or left thread is to be made.

A busy draftsman has no time to be "fussy" with such details, which add nothing to the value or usefulness of the product.



Sliver Gouge Made from Part of Broken Light Bulb

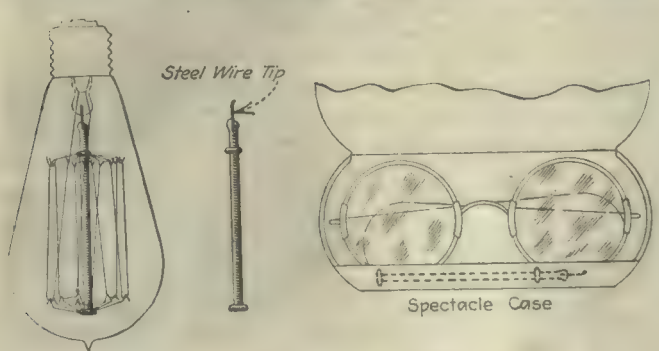
By B. W. Franklin

There are two classes of slivers that add to the petty annoyances of the routine of shop work. The first comprises those small bits of sharp iron or steel that can be pulled out of the skin with a knife-blade or even a moderately small pair of pliers. To the other class belong those infinitesimally fine bits of sharper steel that push their way through the outer skin sometimes unnoticed and then in the sensitive layer below torture one at every movement of the hand. Slivers of this kind every mechanic knows cannot be pulled or lifted out, they have to be dug out, sometimes with the aid of a glass. It takes a very fine flat pointed tool to get them, and trying to remove them with a knife-blade or tweezers is like trying to pick strawberries with a steam shovel.

The sketch shows how a very convenient gouge can be procured from the filament stand of an old Mazda mill-type electric bulb, such type being furnished invariably for drop cord and extension lights about any shop where the nature of the work renders them liable to breakage from jar or vibration. You will notice that the two glass column-like portions are separated by a bit of fine steel wire, and by breaking out the end of the wire from the upper portion you have a good gouge, the longer glass part making a perfectly good handle.

The wire is firmly fastened in the glass and will not come out, even with rough digging. It can be drawn into a sharp, fine flat point, making a tool that could hardly be better if designed for the purpose.

Without crowding your glasses the tool can be carried in the lower or shelf-like bottom of your spectacle case.



A SURGICAL TOOL FROM AN ELECTRIC LIGHT BULB

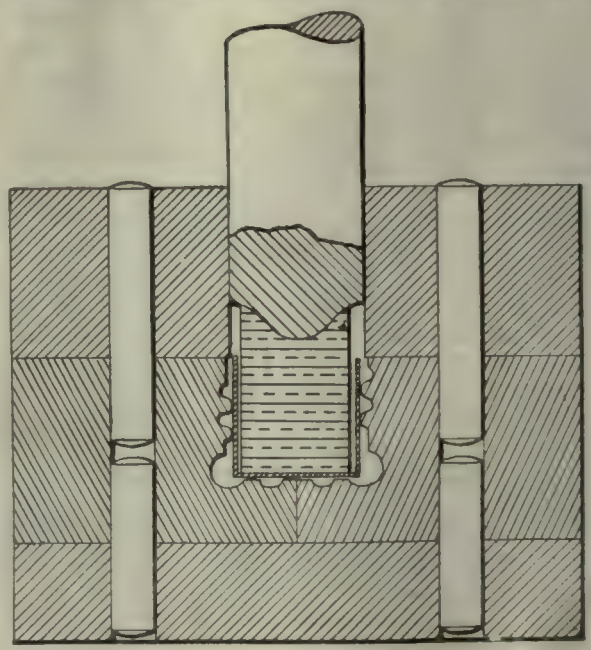
Bulging With a Rubber Punch

By Frank Richards

I read with much interest the article under the above title by L. J. Voorhees appearing on page 423 of the *American Machinist*. The bulging out of the thin brass cap to fill the die is one of those things that are self-evidently possible and require no experiment to prove; but when we come to consider the entire operation as presented, questions arise and the matter should not pass without discussion and explanation.

The die, the cut of which is reproduced herewith, was made in halves so that the pressed and distended cup could be removed. Now, looking at the shape of the lower portion of the die, it is evident that the cup could not be removed, and even the halves of the die could not be separated without the application of considerable force and the consequent mutilation or distortion of the finished article, so that until this matter is made clear any discussion of the curious phenomenon of the "shredding" of the brass after it had been distended to fill the die must start under a handicap.

Nevertheless, I feel impelled to do a little theorizing about it; and first I would call attention to the unique peculiarity of rubber which we find convenient to call



BULGING DIE AND RUBBER PUNCH

its elasticity. If this be indeed elasticity, then we greatly need two words instead of one for two properties which are very different from each other. The elasticity of rubber permits great changes of shape when any force is applied, whether of tension or of compression, and causes immediate resumption of normal shape when the force is removed, while the actual material composing the rubber is very slightly changeable, if at all, as to volume, or is practically incompressible.

On the other hand, air and the gases may not be said to have any normal bodily shape to be maintained, but wherever they are they respond immediately by change of volume without limit when subjected to change of pressure. This may not appear to have much to do with the present case, but it may be well to remember that the word elasticity so applied to the chief physical characteristic of rubber and of air is necessarily uncertain or unsatisfactory for either or for both. Indeed it would seem that any careful definition which could be applied to the one would be entirely inapplicable when tried upon the other. There is an additional complication in the difference between the elasticity of rubber and that of a steel spring, but I have probably suggested trouble enough. Let some expert mechanical pacemaker try to reconcile things.

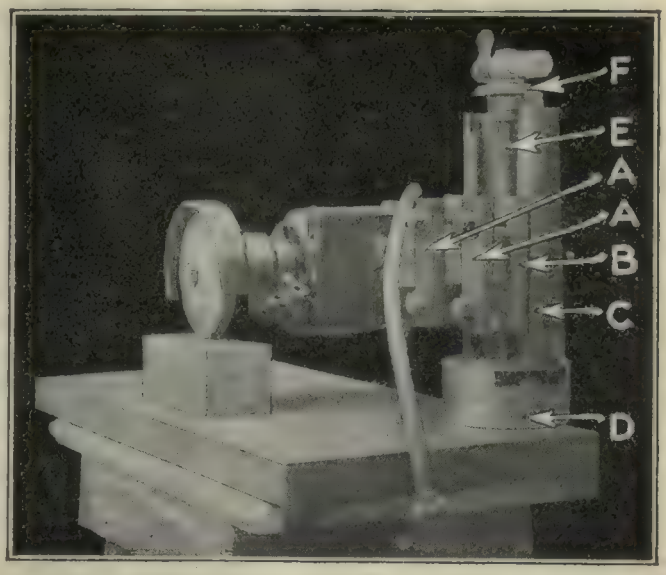
Although we are not told the thickness of the brass before or after nor the diameter of the bulged cup, we are warranted in assuming that the metal was quite thin, and we know that thin brass is actually more or less porous, even when not visibly so, and that water will percolate through it even under slight pressure. We assume now that the thin brass cup, bulged to fit and fill the die, and the rubber plunger which has done the bulging are both in position in the die at the conclusion of the bulging stroke. The thin brass has been made considerably thinner by the bulging operation, since the area of it is much extended. This thin brass is also under tensile stress circumferentially, as it has been distended to a larger diameter. It is backed internally by the mass of rubber under a pressure presumably much above 1,000 lb. to the square inch and with every individual particle of it alert and active to escape the pressure as it may find the opportunity. We knew that there must exist minute interstices in the brass which water would readily find, and we may assume that the rubber would be equally penetrating. The minute wedges of rubber thus entering the crevices and each relatively to itself exerting a lateral pressure would convert the tensile stress of the brass into a compressive stress, and so enlarge the opening or collectively produce the "shredded" effect spoken of.

A Home-Made Surface Grinding Machine

By E. F. Tuttle, Jr.

The grinding rig shown in the illustration was made to sharpen small dies, etc., and did the work as well as one of the more expensive machines and took up less space than a regular grinding machine.

The grinder (a Dumore AG in this case) is held by its shank on the sliding block *B* by two straps *AA* and may be swiveled up or down to increase the range by tilting it under these straps. The block *B* slides in the dovetail of the upright *C* and is moved by the ½-in. 20-pitch screw *E*. The micrometer collar *F* has 50



THE HOME-MADE SURFACE GRINDING MACHINE

graduations. A straight gib on the farther side of the dovetail takes care of the play and a ball handle is fitted to the top of the screw. The upright *C* turns on the base *D*, being held by two bolts, one of which is shown. Base *D* is in turn fastened to the surface plate by two capscrews put in from the bottom.

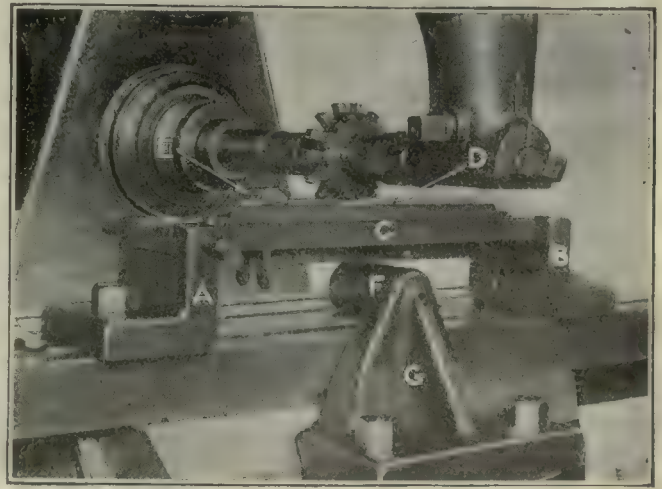
An Unusual Form Milling Fixture

By E. A. Suverkrop

The illustration shows a simple and original form milling fixture of a somewhat unusual type.

The brackets *A* and *B* are bolted to the table of the milling machine. The member *C*, to which the work *D* is attached by the hook bolt *E*, is pivoted on *A* but capable of upward and downward movement between the jaws at the top of *B*. Beneath *C* and attached to it by suitable screws is the form or cam which rides on the roller *F* carried by the bracket *G*.

With form milling fixtures of this type the contour of the work is *not* a reproduction of the form used to produce it. For this reason it would be well for those who wish to adopt this method of form milling to make sure before proceeding that their formers are the shape required to produce the work they desire. This can easily be ascertained by means of a cardboard model, a proper layout, or by mathematics.



UNUSUAL FORM MILLING FIXTURE

Profile-Curvature Gage

By Wilmer Souder

With permission of the Director, U. S. Bureau of Standards.

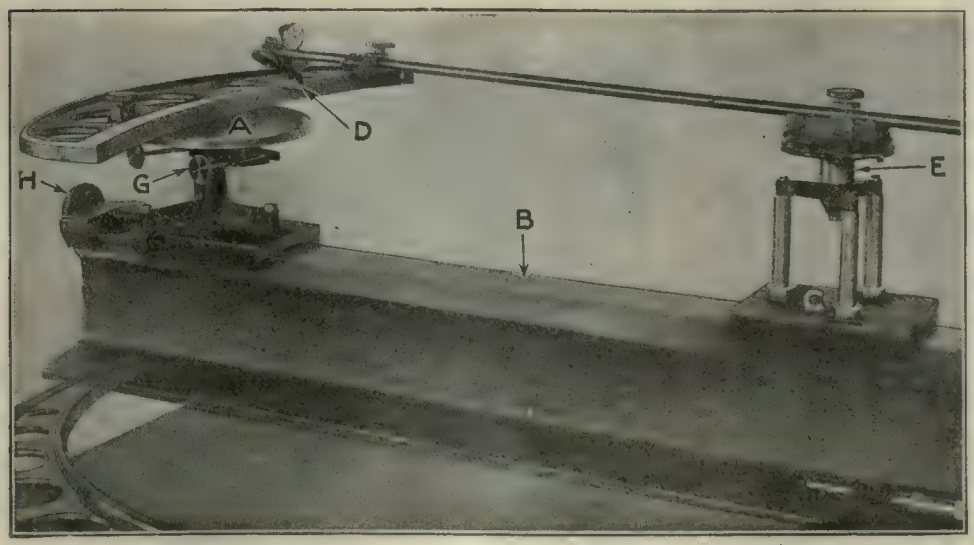
The accompanying illustration shows a device for measuring the curvature of an arc. This apparatus involves no new principles; it is merely a convenient arrangement of instruments which may in many instances replace the more elaborate set-ups. The design may be abbreviated if desired; however, the entire outfit as shown is not difficult to construct.

The profiles to be tested are fastened to the table *A* so that the arc passes through a center mark on the table. Making measurements consists of two distinctly separate acts: first, rotating the table *A* until the center of the arc falls at some point over the way *B*, and second, moving the indicator support *C* along the way until its axis of rotation coincides with the center of curvature of the article being tested.

Briefly these are accomplished as follows: To secure the first adjustment lengthen the indicator arm until the indicator point *D* comes in contact with the profile at one side of the table *A*; then swing the indicator along the profile to the opposite side of the table. Rotate the table until these readings, at opposite sides of the table, agree. The center of curvature is now along the way B, and table *A* should be clamped to prevent rotation.

To secure the second adjustment; move the table and the indicator support *C* toward or from each other, always making the adjustment of indicator point such that it will touch the article being tested. When the separation is such that the indicator reading is constant throughout its entire travel over the arc being measured, the desired radius has been set up and is the distance from the profile to the axis of the support *C*. The radius is measured by calipering from the collar *E* to the indicator point, closing up the micrometer until the previous constant indicator reading is secured. This measurement, minus half the diameter of the collar gives the desired value. Final adjustments of the table are made by a tangent screw *G* and a slow motion screw *H*. The point of the indicator must be kept at a height above the way *B* equal to that of the collar E. For arcs of convex pattern, it is only necessary to reverse the indicator (by slipping it off the rod and replacing after turning 180 deg.) and take measurements with an inside micrometer from indicator to collar adding half the diameter of the collar. Irregularities of contour and location of exact end of curvature are possible without additional adjusting. The indicator support *C*, as illustrated, is made from a theodolite table, and readings of degrees and minutes are possible, thus enabling one to secure additional data bearing on length of arc, distance of center of curvature from reference surface, etc.

The accuracy of this device is, or course, a function of its construction, and while not an instrument of final decision, still a well adjusted instrument will be found sufficiently accurate for all practical tests.

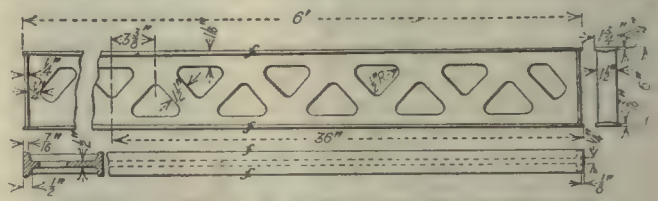


PROFILE-CURVATURE GAGE

The Accuracy of Long Straightedges of Cast Iron

By M. H. Ball

I read with much interest the article by E. A. Dixie on "Care of Cast Iron Straightedges," on page 1341, Vol. 52, of *American Machinist* and am submitting a drawing of one 72 in. long which in a general way



DESIGN FOR LONG CAST-IRON STRAIGHTEDGE

closely approaches the design of the one shown by Mr. Dixie.

In making this one, an attempt was made to make it as light as possible and to distribute the metal in a way that would show the least distortion when supported at widely separated places as it frequently is when testing an uneven surface. Its weight is 57 lb.

While I do not question the accuracy of the standard cast-iron straightedge with arched back suspended in the usual way at two points, each point being about one quarter the length of the straightedge from the ends, if it is used in a suspended position, counterbalanced and used with extreme care, I do question its accuracy when used in any other than a suspended and well counterbalanced position, and this latter condition, I am sure, frequently prevails in many places where extreme accuracy is not necessary—yet a straightedge is needed and one that is convenient to handle is preferred if accurate within a reasonable limit.

The one shown when resting on its extreme ends has a sag of 0.002 in. at its center and when resting on a point at its center each end has a sag of 0.0025 in. When suspended in the usual way or supported at these points about one quarter of its total length from each end its inaccuracy does not exceed

0.0005 in., therefore it is obvious that with careful and proper handling very good tests can be made with it, and we think for the average run of work it is a very practicable tool. Our line of work is general repairing and building steel mill machinery.

Notes on the Federated American Engineering Societies

The representatives of the American Society of Mechanical Engineers on the American Engineering Council have been appointed. They are:

L. P. ALFORD, formerly editor of *Industrial Management.*

E. S. CARMAN, secretary and chief engineer, The Osborn Manufacturing Co., Cleveland, Ohio.

R. H. FERNALD, professor mechanical engineering, University of Pennsylvania, Philadelphia, Pa.

A. M. GREENE, JR., professor mechanical engineering, Rensselaer Polytechnic Institute, Troy, N. Y.

W. B. GREGORY, professor experimental engineering, Tulane University, and irrigation engineer, U. S. Department Agriculture, New Orleans, La.

W. A. HANLEY, master mechanic and chief engineer, Eli Lilly & Co., Philadelphia, Pa.

D. S. KIMBALL, professor industrial engineering, Cornell University, Ithaca, N. Y.

CHARLES T. MAIN, consulting engineer, Boston, Mass.

FRED J. MILLER, president of A. S. M. E., 1920.

L. C. NORDMEYER, secretary and treasurer, Tait & Nordmeyer Engineering Co., St. Louis, Mo.

V. M. PALMER, engineer of industrial economy, Eastman Kodak Co., Rochester, N. Y.

H. P. PORTER, superintendent gas department, Gypsy Oil Co., Tulsa, Okla.

ARTHUR L. RICE, managing editor, *Power Plant Engineering*, Chicago, Ill.

PAUL WRIGHT, engineer and contractor, Paul Wright & Co., Birmingham, Ala.

The delegates appointed will hold office for two years beginning January 1, 1921, and will also represent the society at the organization meeting of the American Engineering Council to be held at Washington, D. C., November 18 and 19 at the New Willard Hotel.

PROGRAM OF NOVEMBER MEETING

The first session of the November meeting will be devoted to the election of temporary officers and the appointment of temporary committees, and the second to an address by J. Parke Channing, chairman, Engineering Council, to be followed by a discussion concerning the field of activity for the Federated American Engineering Societies. The morning and afternoon sessions of the second day will be given over to the reports of committees, the election of permanent officers and the formal ratification of constitution and by-laws. The evening session is to include an address by Herbert C. Hoover, president of the American Institute of Mining and Metallurgical Engineers, and an informal reception and smoker. The organization meeting of the Executive Board, American Engineering Council will be held November 20 in the morning.

A WORD OF CAUTION

Under the caption "A Word of Caution Regarding the Federation," *Mechanical Engineering* prints the following letter from Howard E. Coffin:

To those of us who went through the harrowing days at the beginning of our participation in the war of 1917, there can be no doubt of the value of an organization harnessing together, for the national security, development and welfare, all those engineering activities which lie at the very foundation of our industrial strength in every line.

I believe I can give no clearer indication of the national need in emergency than to say that within one year after our entry into the war there had been co-ordinated under the direction of the Council of National Defense, with whose Advisory Commission I had the honor to serve as a member, more than 144,000 distinct organizations of various kinds throughout the United States.

One strong word of caution I should, however, like to voice. We should endeavor at every point to make The Federated American Engineering Societies a truly practical and workable agency for definite accomplishment. We should avoid the pyramiding of new engineering activities, committees, boards, etc., which are so apt to come into being for the furtherance of localized and sometimes selfish interests of individuals or societies and which tend to still further confuse a sufficiently complicated situation. The activities of many of our society members of The Federated American Engineering Societies already overlap, and as these societies endeavor to develop and extend their prerogatives we may naturally expect further complications in authority and in duplication of work.

We have in The Federated American Engineering Societies a co-ordinating influence which can be made of inestimable practical value, both to its member organizations and to the departments in Washington.

Let us see to it, therefore, that this new co-ordinating body is made to efficiently fulfill these objects for which it has been created.

Cleaning a Grinding Wheel With Gasolene

BY S. E. FREW

We discovered by accident a good way to clean an oil-soaked and glazed emery wheel. Some gasolene was accidentally spilled on the wheel and later, after the wheel had been run, we noted that the oil and dirt had been thrown off, apparently by centrifugal force.

We then soaked the entire wheel in gasolene, rigged a paper guard around it to prevent it from spattering all over the place, and after allowing it to stand a few moments turned on the power.

The oil and dirt loosened by the gasolene were thrown out by the rapidly revolving wheel, leaving it clean and in good condition for grinding.

Removing Paint from Steel Structures

BY F. A. MCLEAN

A simple way of removing old paint from steel structures is to dissolve one pound of concentrated powdered lye in three quarts of hot water, adding lime to make the solution thick enough to spread evenly. The solution should be applied as soon as it is mixed, by means of a brush and allowed to remain on the surfaces to be cleaned until it is almost dry. If it is then removed it will take the paint with it unless the paint is very old and thick, in which case a second coat of the solution should be applied. Before applying a new coat of paint, the metal should be thoroughly washed with a solution composed of one-half pound of sal soda dissolved in two gallons of warm water. After the soda solution has been applied, the surface of the metal should be wiped or warmed until thoroughly dried. It is stated that a method similar to this is in use by the United States Coast Artillery, for cleaning the exterior portions of big guns and their carriages.

EDITORIALS

Boxing Machinery to Insure Safe Shipment

THE boxing or crating of machinery for shipment is a problem that has vexed many builders and customers. It is one thing to build and ship a perfect machine but quite another to have it reach the customer with castings cracked, parts sprung, shafts or handles bent and parts rusted or missing. The greater the distance, when counted by time in transit, the more the delay, loss and annoyance.

Reports from foreign countries tell us that we have in this country some manufacturers of machine tools who know how to box machinery so that it almost invariably reaches its destination in good order. So, in order to assist those who may not have had wide experience, we give, in another part of the paper, an outline of the way in which one company handles the packing of machinery both for domestic and foreign shipments.

It is not assumed that no other method will secure equally good results, for there are other firms which enjoy a similar distinction. The main thing is to realize that the crating or boxing of machinery is a real engineering problem which must be solved by a careful study of the weight, of the stresses likely to be encountered, and the way in which these should be taken care of.

The good of the industry demands that every precaution be taken to insure the safe delivery of machinery to its destination, particularly in the case of foreign shipments in competition with the rest of the world. It is for this reason that the Brown & Sharpe Manufacturing Co. was perfectly willing to give us all details of its method, instead of reserving the benefit of long years of experience for its own use. For whatever benefits the industry as a whole benefits every member of that industry.

We shall be very glad to show other methods, especially those used by builders of different classes of machinery. In fact we expect to show another builder's method in the near future. F. H. C.

Protecting Our Dye Industry

ALL of us can easily recall our difficulties when the World War shut off our importations of dyes from Germany. Prices rose so high on dye-stuffs that desperate efforts were made to bring them in. A large part of the cargo of the submarine freighter, Deutschland, consisted of dye-stuffs.

The reason for this state of affairs was that, owing to our trade policy, we had no dye factories worth the name.

Germany had a monopoly of the dye trade of the world, and came near choking all her enemies to death with gas, made largely in her dye factories

By almost superhuman efforts we solved the great problems connected with the production of satisfactory, fast-color dyes, on a commercial scale. It is not only a necessity for us to protect these factories for industrial purposes, but also with an eye to future chemical warfare, for he who thinks we have seen our last war does not know human nature.

But now the Germans are sending over large quantities of dye-stuffs, and increasing these shipments weekly. They are selling them at a price and in such quantities as to seriously cripple our own dye factories.

Prompt aid is needed to save our dye industry.

We must protect and encourage our dye-makers, because their future is linked with the destiny of the country as a whole. E. V.

Training for Economical Production

THIS is a good time to do some constructive thinking along a number of lines. And one of them is the question of training men and women for the work to be done.

Under the spur of war necessity we established training schools and accomplished marvels in the way of securing production from men and women who had never before seen the inside of a shop. It was not all smooth sailing to be sure, and it took much time and trouble to secure results, but they were secured. Mistakes were made as a matter of course, but on the whole we succeeded very well.

Are we going to let the supply of trained workers again become a matter of chance and trust to luck or to stealing them from someone who does train them?

A number of the more progressive shops are maintaining their training departments as a part of the regular, peace-time routine. Methods are modified to be sure, in order to meet varying conditions, but the idea of training is still being fostered and the future supply of trained men and women is not left to chance. Nor is this training confined to new workers. Those who for any reason are not as proficient as they should be, are trained to do more or better work or both. For it is much better to spend a little money in adding to the foundation already laid than to start at the beginning with a new worker.

Foremen are also being given training in different ways. They are shown how to handle different situations; how to win the confidence of their workers. They are shown the policy of the company; shown how they can assist in making it more prosperous; taught to utilize the result of the training received in the schools.

The future of America and of the world lies in securing economical production and plenty of it. This cannot be done without trained workers, trained not only in the knowledge of how to perform the different operations but also in the knowledge that they will be treated fairly in all things.

This is not the time for drifting with the tide. It is rather the time for getting busy on some progressive program that shall recognize conditions as they exist, and prepare to mold them in the way that is best for the industry. One of the needs is that of training both workers and executives so as to secure more economical production. It should not be left to chance—a definite program is necessary. F. H. C.

The International Chamber of Commerce Did *Not* Indorse the Metric System

In relation to our editorial on page 957, in which we called attention to the unauthorized use of Professor Roorbach's name, by Albert Herbert of the World Trade Club, we wish to call special attention to the following misleading letter being sent out by the secretary of the club:

Chamber of Commerce, Inc.,
Clinton, Mass.

Gentlemen:

When the International Chamber of Commerce met in Paris last month, one of the important questions to claim its attention was world standardization of weights and measures.

Realizing the inefficiency of the cumbersome jumble of measurements with which a few people still handicap themselves and appreciating the obstacle that this lack of standardization has proved in world trade, *the International Chamber of Commerce strongly urged that the United States of America and the British Empire "forthwith standardize on the Metric System solely."* A copy of this epoch-making resolution is attached.

It is urgently requested that your organization, if it has not already done so, appoint a committee to consider this question thoroughly and take the necessary action to secure for the United States the benefits of the simple decimal system of weights and measures—"the universal language of quantity."

The Metric advance is one of the vital trade topics of the day. Even the anti-metric propagandists recently sent out a broadside in which they declared it "a live question." Will you not urge the Chamber of Commerce of the United States to hold a referendum among its members on this very important question?

Sincerely yours,
(Signed) AUBREY DRURY,
Executive Secretary.

This letter of Mr. Drury's is being sent to various Chambers of Commerce, and elsewhere, in an endeavor to mislead the members into thinking that resolutions favoring the use of the metric system were adopted by the International Chamber of Commerce, but they were NOT. *The resolutions he refers to were introduced, discussed and definitely turned down.*

Ethan Viall
Editor

WHAT to READ —for the man in a hurry



Suggested by the Managing Editor

THE use of electricity to replace the old hand-blown rivet forge which has its place in the field rather than in the shop, is the subject of the first article this week. Sheldon has written a story of the manufacture of an electric rivet heater built in a plant where one of the biggest factors in the work is the driving of rivets. The heater was designed by the user to meet a definite problem in his own shop, a fact which adds interest to the description.

As announced on this page a fortnight ago this issue contains the introductory chapter to the second section of Mr. Basset's series "Modern Production Methods," under the title "What a Cost System Can Do for You." Page 709. There is small doubt that many manufacturers are not convinced of the value or necessity of cost accounting as applied to their particular plants. It is for these men that this article is written —to show what has been done by proper cost systems in shops of various types. The articles to follow take up the details.

That Mr. Basset has a keen sense of values and looks upon cost accounting and production planning as useful tools rather than as independent activities that are sufficient unto themselves, is indicated by his concluding paragraph.

"Lest any of the readers of this series become overenthusiastic on cost accounting, I want to lay stress on two points which my experience shows are warnings sometimes needed. First, cost accounting is not an end in itself. The aim of business is profits. Cost accounting is of value only as it aids the manufacturer to make profits. The second warning is that no cost accounting system will of itself make these profits. The reports are inanimate things which can't of themselves make industrial betterments. They must be intelligently studied by an executive who has the intelligence to translate their figures into needed changes and the authority to see that these changes are made."

Probably the greatest contributing cause to the failure of the American merchant or manufacturer to secure foreign trade or to hold what little he gets after he gets it, is the matter of proper packing. This fault exists in every field of industry but for our purpose its effects on our overseas machine-tool sales is of the greatest moment. Our brainy business manager, Mason Britton, on his return from a recent European trip gave us instance after instance where expensive automatic machines had arrived in a totally useless condition due to poor packing and inadequate protection against rust. Convinced as we are of the vital importance of proper packing for shipment, both foreign and domestic, we have delegated to Fred Colvin the job of describing the packing of several machine-tool builders who have developed this rather prosaic process to a fine art. On page 712 is the beginning of his article on the crating and boxing system in use by Brown & Sharpe.

What to read was not a difficult matter to decide two hundred years ago when books were few and magazines unheard of. It is far different now when so much reading matter is offered to pass the time pleasantly or profitably as the reader chooses. We are doing our utmost to make the "American Machinist" not only profitable but indispensable as a clearing house of ideas and news of the machinery world. This page is the editors' advertisement of their section of the paper. It gives the high spots

That arc-welding played a prominent part in transporting the A. E. F. to France is clearly shown in Ethan Viall's welding article on page 719. Among the examples of arc-welding jobs are the many cylinder repairs made on the partially wrecked engines of the commandeered German passenger ships lying in American harbors when we entered the war. If the German crews had realized the possibilities of making cylinder repairs by welding they would certainly have made their work of destruction more complete. The Navy department conducted tests on these cylinder repairs to ascertain the relative strength of welded and original material and a brief statement from the report is included in the article. Other tests are also described and information is given on the speed of arc-welding.

In the Shop Equipment News Section, beginning on page 737, appears the first new German machine tool that has come to us in some time. There is nothing startling about its design and we show it principally to keep American machine-tool builders informed of the doings of German firms that will be strong competitors in foreign trade in a very few years. The present stagnation in the German market should act as an additional incentive to her merchants to reach for foreign markets.

SHOP EQUIPMENT NEWS

-Edited By-
S. A. HAND

SHOP EQUIPMENT • NEWS •
A weekly review of modern designs and equipment

Descriptions of shop equipment in this section constitute editorial service for which there is no charge. To be eligible for presentation, the article must not have been on the market more than six months and must not have been advertised in this or any previous issue. Owing to the news character of these descriptions it will be impossible to submit them to the manufacturer for approval.

• CONDENSED • CLIPPING INDEX
A continuous record of modern designs and equipment

Heidenreich & Harbeck Cone and Geared-Head Lathes

The firm of Heidenreich & Harbeck, Hamburg, Germany, has introduced the lathe shown in Fig. 1. The illustration gives the general details of the cone-head model. The lathe is also fitted with the geared head shown uncovered in Fig. 2.

The cone has been designed with but three steps to keep each step as broad as possible. The smallest step is of ample size to keep the belt speed high. Double back gears are employed in the cone-head model, thus giving nine forward spindle speeds. The countershaft usually supplied is fitted with two friction clutch pulleys for forward and reverse drive, although it is possible to secure one with tight and loose pulleys.

The lead screw is used only for thread cutting, the feed rod governing ordinary longitudinal and transverse motion of the carriage. In addition a reversing shaft permits either the lead screw or feed rod to be operated in the reverse direction. Built-in change gears provide fifty feed steps without the removal of a gear. These gears are designed to permit standard English threads to be cut. For odd pitches and for metric threads extra gears are supplied at an additional cost. All gears are of steel.

The reversing shaft does away with the necessity for backing the lathe except when cutting threads of quick lead and consequently it may be advisable in certain cases to substitute a countershaft with two forward speeds for the reversing one.

Feeds are operated through friction clutches in the rear apron and cannot be engaged simultaneously. The compound rest is graduated and the saddle is extra long to cover the slides and keep out chips.

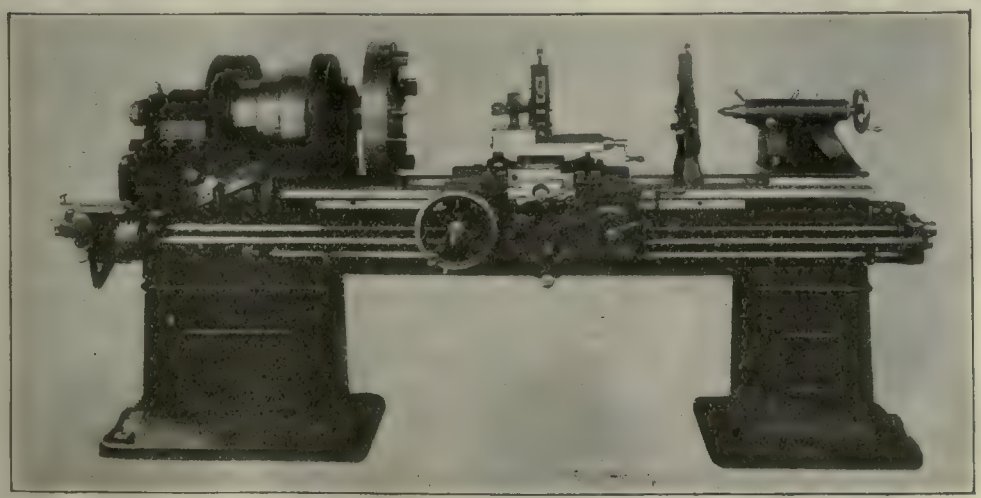


FIG. 1. HEIDENREICH & HARBECK ENGINE LATHE

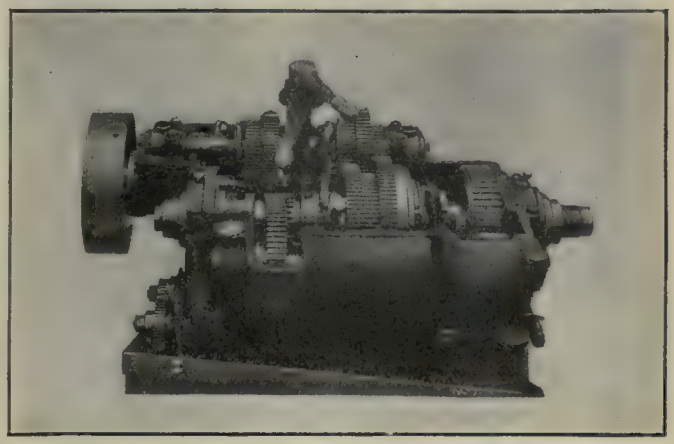


FIG. 2. GEARED HEAD UNCOVERED

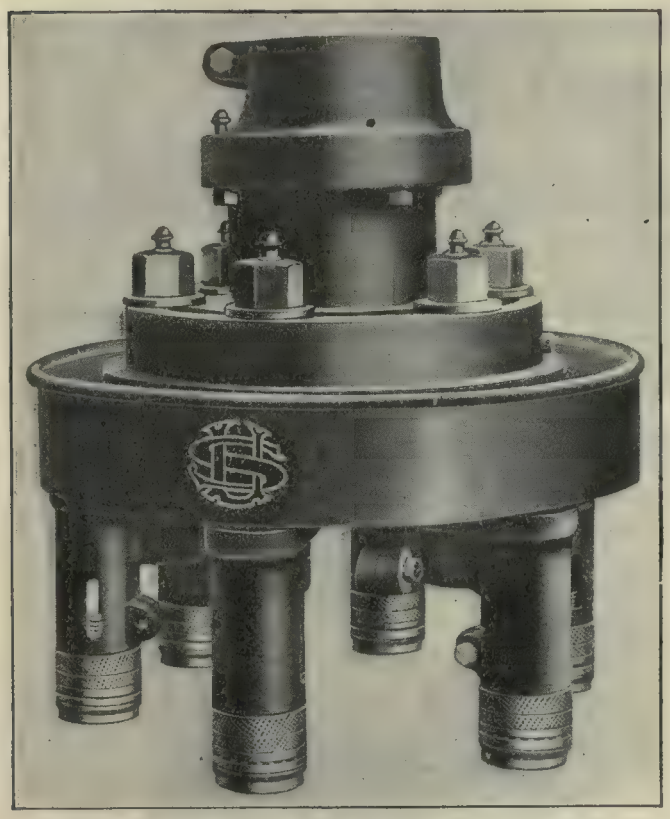
The box bed has ample strength and can be supplied with a gap and bridge at extra cost.

The plain bearings are supplied with ring oilers and gear guards are incorporated in the design.

Adjustable-Center Multiple-Spindle Drill Heads

The United States Drill Head Co., Cincinnati, Ohio, is building the type of adjustable-center multiple-spindle drill head shown in the illustration. The maximum number of spindles that can be used and still obtain full adjustability is six. With this number or less the spindles can be arranged to drill holes having any grouping within the limits of the device. There is, of course, a minimum center distance permissible between the spindles. More spindles than six may be used, but it reduces the amount of adjustment that is possible with each spindle.

Each drill spindle is carried on an auxiliary arm, which permits it to be swung in a circle whose center is that of an intermediate pinion that meshes with the main gear in the center of the head. Each intermediate pinion has



"U. S." ADJUSTABLE-CENTER MULTIPLE-SPINDLE DRILL HEAD

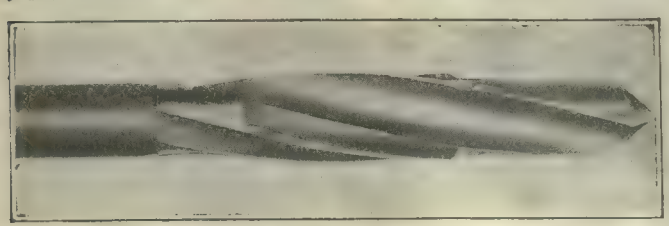
Specifications: Built in five sizes: No. 1 drills on circles from 2 to 5 in. in diameter; No. 2 from 2⅜ to 7 in.; No. 3 from 4⅛ to 11⅛ in.; No. 3-A from 8 to 18 in.; No. 4, special, for drilling pipe fittings and flanges.

a wide face and the gear on the drill spindle may be slid along it. This is necessary because there is a vertical adjustment provided for each drill spindle, to permit the use of different lengths of drills at the same time.

The head is clamped to the quill of the drilling machine upon which it is used. It may be driven by either a taper shank or a key in the drift slot in the spindle of the drilling machine. The drill spindles can be readily attached or removed, only one locking nut being used to hold each one. The spindles are provided with ball-thrust bearings and have adjustment for end wear. They are geared with a speed ratio, when compared to the driving spindle, of about 3½ to 1. The drill heads are built in five standard sizes, and special sizes can be furnished upon order.

"Fastfeed" Combination Drill and Reamer

The Fastfeed Drill and Tool Corp., Toledo, Ohio, and 21 Murray St., New York City, has recently placed on the market the combination drill and reamer shown in the illustration. The tool is intended for use with drill jigs, so as to drill and ream at one operation. The use of slip bushings, necessary in a jig when drilling and reaming are separate operations, is thus eliminated.



"FASTFEED" COMBINATION DRILL AND REAMER

The tool is made of high-speed steel and the point is the same as that of any two-fluted drill. The reamer section is 0.010 to 0.015 in. larger in diameter than the drill. It has four blades, two being placed on the continuation of each land of the drill. The reamer blades can be sharpened from the front edge, the same as with any solid reamer. In order that the drill may start the hole properly, the reamer should enter the bushing in the drill jig at least ⅜ in. before the point touches the work. It is claimed that a high rate of production can be obtained by this method.

The tool can be furnished in a wide range of sizes, the standard reamer diameters varying from ½ to 1½ in. Either straight or taper shanks of any size can be furnished, the Morse taper being standard.

Purves Drilling Attachment for Milling Machines

The Purves Manufacturing Co., 408 S. Franklin St., Syracuse, N. Y., has perfected the drilling attachment for milling machines that is shown in the accompanying illustration. The maker claims that it is possible to drill holes at an angle as easily and cheaply as vertically.



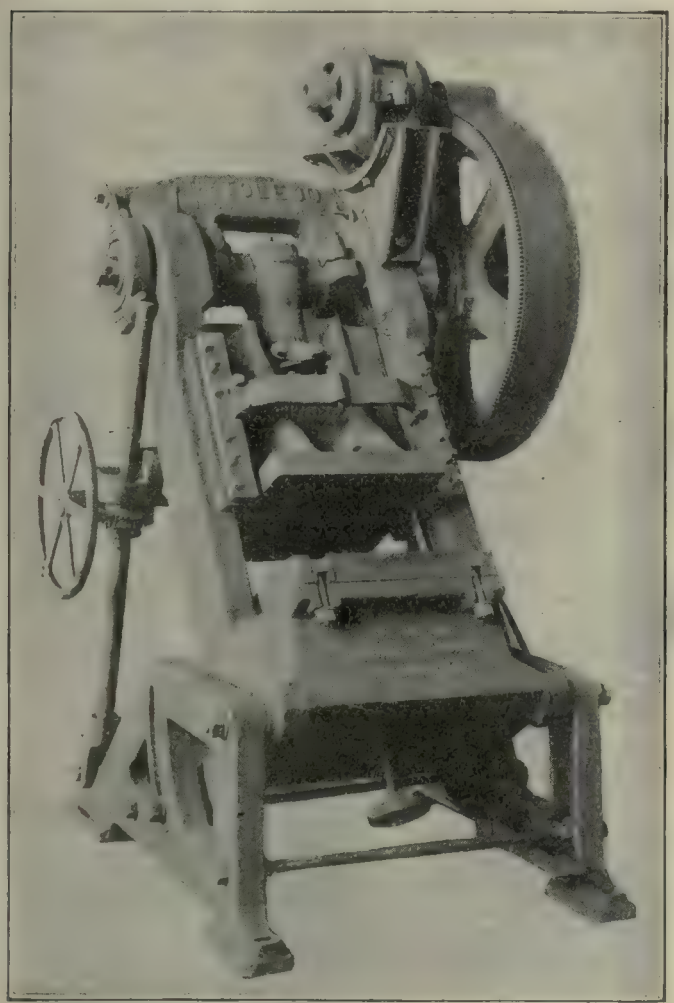
PURVES ANGLE-DRILLING ATTACHMENT ON A MILLING MACHINE

The device is mounted on a universal milling attachment fitted on a horizontal-spindle knee-type milling machine, the attachment being set at the angle desired. The work is placed on the table in the ordinary manner so that no angular fixture is required. The drill is fed directly by the hand lever of the attachment. Since the operator can thus feel the pressure of the feed, breakage of the drill is not apt to occur. The position of the feeding lever can be easily changed, so as to accommodate any shape of work. A stop is provided, so that it is possible to drill a number of holes to the same depth.

Toledo Straight-Column Inclinable Press

The illustration shows a straight-column inclinable press recently brought out by the Toledo Machine and Tool Co., Toledo, Ohio, and known as No. 54 Special. The press has direct motor drive, with the motor so mounted that it is always in a vertical position and the pinion is always in mesh, no matter what the inclination of the press. The arrangement by which the machine is inclined is shown in the illustration.

The makers state that the machine may be furnished



TOLEDO NO. 54 SPECIAL STRAIGHT-COLUMN INCLINABLE PRESS

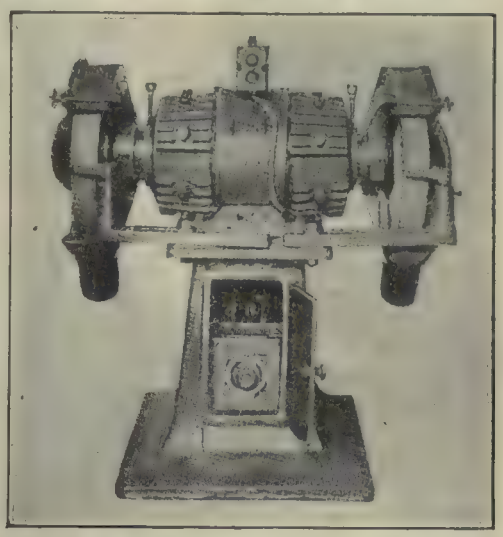
Specifications: Weight as shown, 6,500 lb. Bed, 24 x 23 in. Bottom of ram, 21 x 19½ in. Opening in bed, 12 x 12 in. Distance between housings, 24 in. Stroke, 2 in. Distance from bed to ram, stroke down and adjustment up, 13 in. Thickness of bolster, 3 in.

with or without gearing, bar knockout in ram, direct connected lower liftout and motor bracket, and that the press is also built with the frame arched from front to rear to allow a 14-in. opening in the housings to permit of feeding stock sidewise.

Self-Contained Motor-Driven Tool Grinding Machine

The U. S. Tool Co., Cincinnati, Ohio, has recently placed on the market the self-contained tool-grinding machine shown in the illustration; ease of starting and total enclosure of the motor and control apparatus being features claimed by the maker.

The machine is equipped with a 5-hp., shunt-wound, adjustable-speed Westinghouse motor running at from 1,120 to 1,600 r.p.m. on 230-volt direct current. The motor is started and stopped by a push button that



U. S. SELF-CONTAINED MOTOR-DRIVEN TOOL GRINDING MACHINE

controls a type C Westinghouse starter equipped with a speed-adjusting rheostat and located in the base of the machine. The push button is mounted on the top of the motor so that the workmen will not start the motor by jabbing the button with the material which they intend to grind, since it is easier to operate it by hand.

Thor Moisture Separator for Air Lines



THOR MOISTURE SEPARATOR FOR AIR LINES

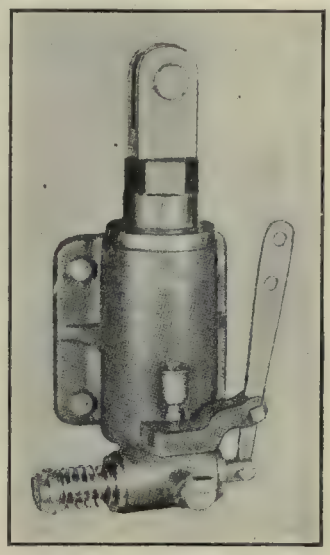
The Independent Pneumatic Tool Co., 600 W. Jackson Blvd., Chicago, Ill., builds the Thor separator, shown in the illustration, for separating moisture and dirt from compressed air. It is especially intended for cleaning the air used by pneumatic tools.

The air enters the separator through two pipes and strikes the inside wall or casing tangentially, which causes it to revolve rapidly. Centrifugal force throws the entrained moisture and dirt to the walls, on which they descend to the bottom of the tank, while the cleaned air passes on to the pipe line. A drain is provided at the base for removing the accumulation of water and dirt. The separator is built in two sizes having capacities of 150 and 400 cu.ft. per minute.

Specifications: Built in two sizes. Respective capacities, 150 and 400 cu.ft. of air per minute. Face of gage, 3 in. in diameter. Height including gage, 31 and 47 in. Diameter of base, 8½ and 12½ in.

"Perfection" Pneumatic Trip for Power Presses

It has often been found that when a single operator attempts to handle large steel plates in a punching machine or other type of power press he experiences trouble due to inability to reach the foot- or hand-trip lever while standing at the front balancing the plate. This difficulty is said to be eliminated by the use of the "Perfection" pneumatic trip, shown in the illustration. The device is built by the Lovejoy Tool Works and sold by Tom Brown & Co., 800 Great Northern Bldg., Chicago, Ill. The device, consisting of a working cylinder and valve, is bolted to the side of the machine in such a position that the coupling on the end of its piston can be attached to the trip lever. The air valve can be operated by a jerk of a cord held in the hand of the operator. This admits air to the cylinder, raises the piston, and operates the trip mechanism of the machine. Two springs quickly return the valve and piston to their idle positions ready for another operation.



PERFECTION PNEUMATIC TRIPPING DEVICE FOR POWER PRESSES

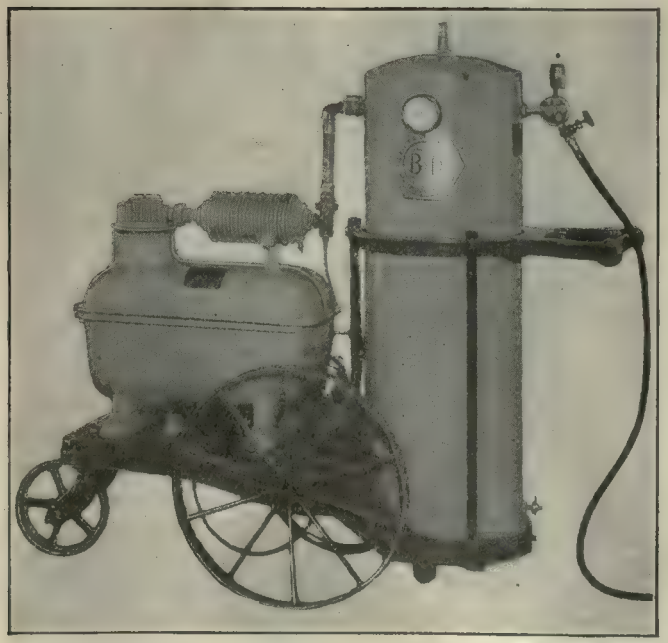
Black & Decker Portable Air Compressor Outfit

The Black & Decker Manufacturing Co., Towson Heights, Baltimore, Md., is now making up its No. 46 Electric Compressor Portable Automatic Tank Outfit equipped with reducing valve, hose and blow-gun. The outfit consists of the No. 46 electric compressor and a 40-gal. air reservoir mounted on a 3-wheel carriage provided with pushing-handle and brake. It is claimed that one man can readily wheel the outfit about. An automatic switch starts the compressor when the tank pressure drops below 160 lb. and stops it when the pressure reaches 200 lb. An automatic unloader is provided with the switch. The compressor is rated to have a volumetric capacity of 6 cu.ft. of free air per minute and a pressure capacity of 200 lb. The pressure in the reducing valve can be adjusted to give a working pressure of 40 to 80 lb. The blow-gun is equipped with trigger and jet tube.

The outfit is supplied for 110 or 220-volt direct current or 110 or 220-volt, 2 phase or 3 phase, 60 cycle alternating current.

The regular equipment includes valves, gages, electric cord, 25 ft. of air hose and blow-gun. Extra valve and air hose with tire connector can be supplied as additional equipment.

The makers advocate the use of this outfit for blowing dust from motors and machinery; cleaning grease from machinery when used with air engine cleaner in place of the blow gun; and for inflating tires.



BLACK & DECKER PORTABLE AIR COMPRESSOR OUTFIT

Westinghouse Electric Arc Furnace Regulator

The illustration shows both a front and a back view of an electric arc furnace regulator recently placed on the market by the Westinghouse Electric and Manufacturing Co., East Pittsburgh, Pa.

Among the claims made by the manufacturers for this regulator are: High electrode operating speed and close precision of regulation with absolute freedom from "hunting"; ability to incorporate high speed with a narrow current zone, due to the fact that the electrode speed tapers from full to zero as the regulated current approaches its normal value. With small variations in current the speed is slow enough to prevent continuous breaking of the arc and, at the same time, when the

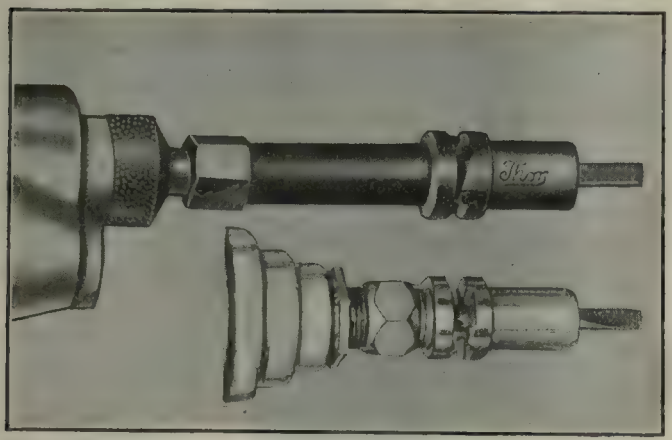


WESTINGHOUSE ELECTRIC ARC FURNACE REGULATOR (FRONT AND BACK)

solid metal begins to cave into the pools of molten metal under the electrodes, sufficient speed is available to permit the regulator to extricate the electrodes before the time relay allows the breaker to trip; it utilizes the arc voltage as well as the current to control the motors and it is impossible for the electrode to get into the molten metal; the voltage coils render the control of each electrode independent of the others so that one electrode may be entirely withdrawn without disturbing any of the others.

Screwdriver Attachments for Thor Portable Drill Motors

The Independent Pneumatic Tool Co., 600 W. Jackson Blvd., Chicago, Ill., manufactures screwdriver attachments for its portable drill motors. The devices are made in three styles, so as to fit the different types of portable motors which the firm builds. The No. 1 screwdriver attachment for the Thor turbine air drill is



SCREWDRIVER ATTACHMENTS FOR THOR PORTABLE DRILL MOTORS

shown at the bottom of the illustration, it being capable of handling up to No. 12 wood screws, 1¾ in. long.

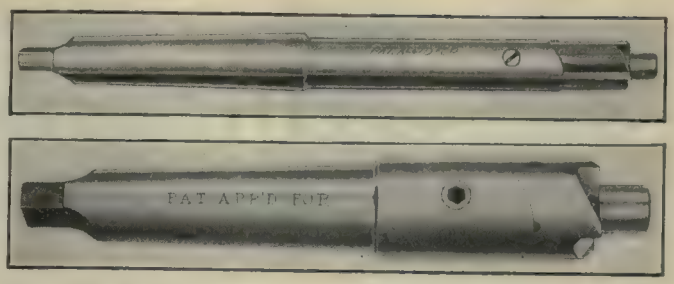
For use on electric drills the attachments are built in two styles, the short type, No. 3, such as previously described and the No. 2 extension type shown at the top. The latter type will handle any size of wood screw, ¾ in. or longer up to No. 14, 2 in. long. The No. 3 attachment can be used on the No. 00 Thor electric drill only when the latter has been equipped with a special spindle and gear case.

"Duplex" Interchangeable Counterbores and Spot-Facers

The type of counterbore shown in the accompanying illustration is manufactured by the Dayton Machine Products Co., Dayton, Ohio. The tool consists of four parts, the holder, the cutter, the pilot and the locking screw.

The holder is made of low-carbon steel case-hardened, as is also the pilot. The cutter is of high-speed steel and it has two cutting faces, both permitting of resharpening. It is claimed that the cutter is self-centering in the holder, that even without the pilot in position there is no side play of the cutter, and that because of the numerous driving surfaces in contact on the cutter and the holder, the bending or twisting strain on the pilot shank is minimized.

The tool can be furnished with cutters from ⅝ to 3



"DUPLEX" INTERCHANGEABLE COUNTERBORES AND SPOT-FACERS

in. in diameter. Morse taper shanks Nos. 1 to 6 are standard, although straight-shank holders can be furnished. Pilots of the size desired can be furnished. The tool can be disassembled by the removing of one screw, and the interchangeability of the cutters to different holders is claimed as one of the chief points of advantage of the device.

Tapers for Machine Spindles

By T. Fish

President, Ready Tool Co., Bridgeport, Conn.

In general practice it is customary to use Morse tapers for the holes of drilling spindles, but for lathes, grinding machines, etc., there seems to be no standard practice.

Of ten large manufacturers of grinding machines, three use Brown & Sharpe; three use Morse and four use Jarno tapers.

Of thirty lathe manufacturers, twenty use Morse; one uses Brown & Sharpe; two use Reed and five use Jarno tapers; three use a taper of their own and two use a modified Morse taper.

It would seem well to the writer that in designing a machine requiring a taper hole in the spindle, the designer should use one of the three well-known standard tapers.

The Morse tapers are not the same in all sizes, varying from 0.600 to 0.626 in. per foot Nos. 0 and 7 are 0.625 in. and Nos. 2 and 3 are 0.602 in. per foot and each one of the others is different.

The Brown & Sharpe tapers with the exception of three are 0.500 in. per foot, but there are two No. 6, two No. 7 and three No. 10 tapers, all of which is somewhat confusing.

The Jarno tapers are all 0.600 in. per foot and their proportions are readily remembered. Further, the numbers by which they are known have a definite relation to their sizes. That is, the number of the taper is the number of tenths of an inch in the diameter at the small end, the number of eighths of an inch in the diameter at the large end, and the number of halves of an inch in the length. Thus the No. 6 taper is six tenths (⅘ in.) at the small end, six eighths (¾ in.) at the large end and six halves (3 in.) in length.

It would seem to the writer that if anyone was going to make a taper center for any of his work he would use one of the the three standards, Brown & Sharpe, Morse or Jarno. The latter, I think, would be preferable, as the proportions are so easy to remember.

I hardly think it would be possible for all manufacturers to adopt one standard at this time, as the changes would be too expensive. However, if anyone was bringing out a new machine, some well known standard taper should be adopted.

Three Southwark Hydraulic Presses

By C. J. PRIEBE
Associate Editor, *American Machinist*

The design of hydraulic presses may not have undergone as great changes in recent years as that of the cutting type of machine, but the recently developed products of a large concern that are here described show that some changes are taking place. The presses, although suited to general work, are each intended for some particular job.

HYDRAULIC machinery of many types is built by the Southwark Foundry and Machine Co., Philadelphia, Pa. The presses here shown and described have recently been added to the line, being among the smaller machines built by the concern. The broaching press and the bushing press are both unique in that they have but two columns, presses of this type formerly being built by this concern with four columns. Lightness and accessibility to the work-table are claimed for the two-column type of press.

The press illustrated in Fig. 1 is intended for forcing broaches through castings and forgings. The maker claims that many classes of work can be broached very quickly and accurately on this machine.

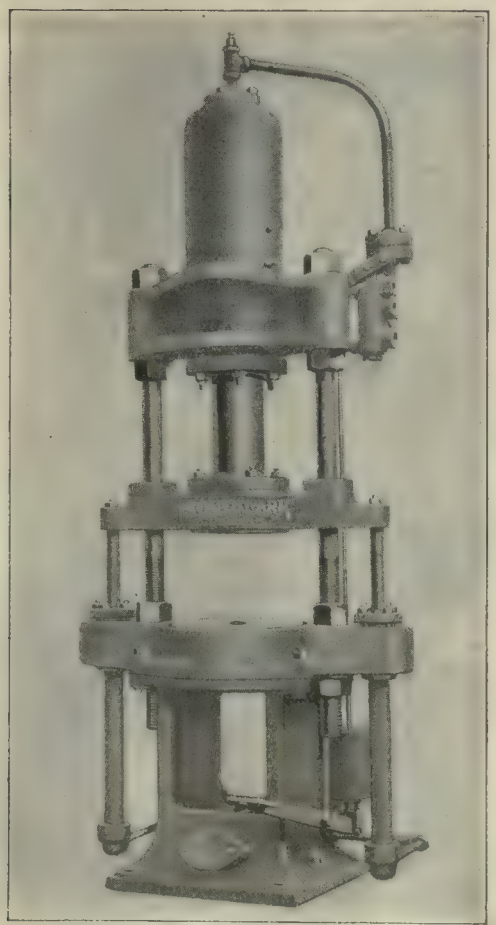


FIG. 1. 20-TON SOUTHWARK HYDRAULIC BROACHING PRESS

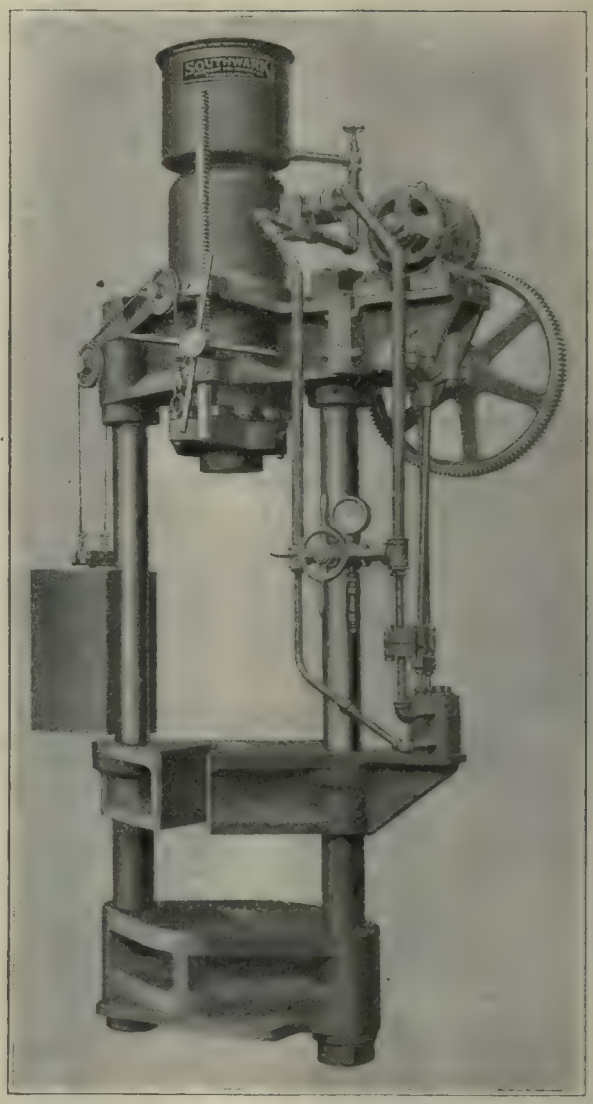


FIG. 2. 200-TON SOUTHWARK HYDRAULIC BUSHING PRESS

The clearance between the columns is 20 in. The distance between the moving and the bottom tables is adjustable by means of long threads on the tension bolts from 24 in. as a maximum to 16 in. as a minimum. The moving table is guided by the tension bolts. The bottom table has a 2-in. hole, so as to allow the broaches to drop through into a bucket designed for the purpose. The pedestal has openings in both the front and back to permit the removal of the broaches. The lower part of the pedestal forms a reservoir for the cutting lubricant.

The press is very quick acting, making from 15 to 20 working strokes per minute. Two auxiliary pressure cylinders, the rams in which are fastened to each end of the movable table, provide for the quick return of the table and ram. A dashpot placed in the top of the main cylinder eliminates shock at the end of the return stroke.

The operating valve is controlled by a treadle, thus leaving both hands of the operator free to handle the work. The press is designed to operate on a pressure of 1,500 lb. per square inch supplied by an accumulator system. It requires a floor space of only 3 x 2 ft. and is approximately 9 ft. in height.

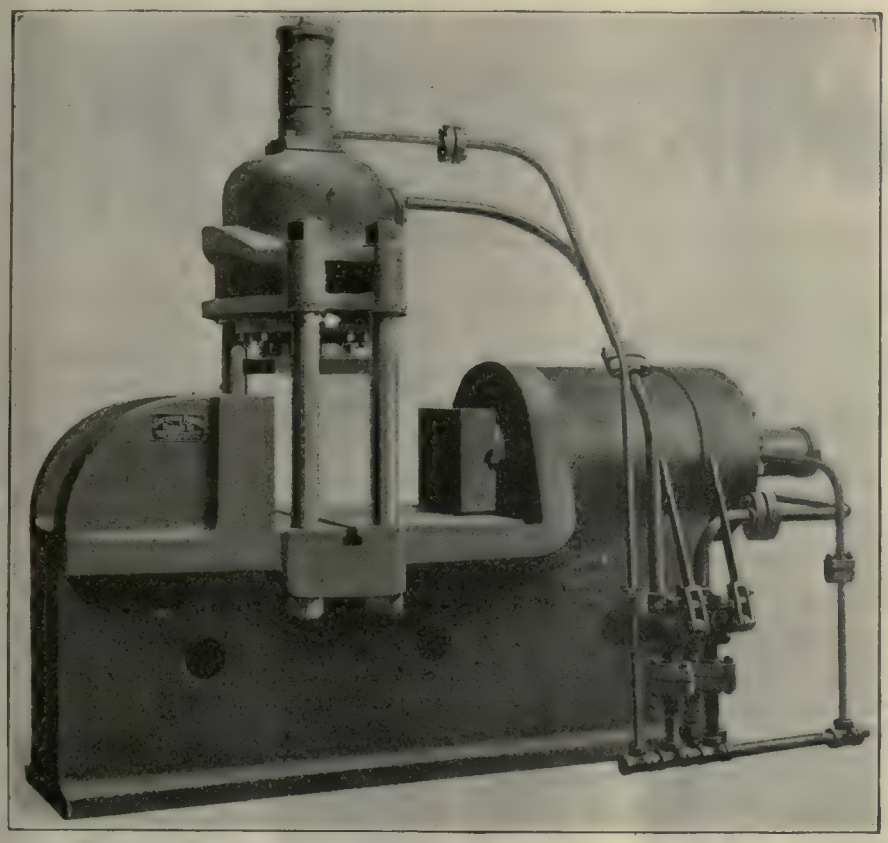


FIG. 3. 200-TON SOUTHWARK HYDRAULIC UPSETTING PRESS

The two-column, quick-acting bushing press shown in Fig. 2 is especially intended for use in railroad shops. The ram is 12 in. in diameter, so that a pressure of approximately 200 tons is obtainable when a hydraulic pressure of 3,500 lb. per square inch is used. The ram is counterbalanced by means of the weight shown at the left.

The machine is equipped with a motor geared to a pump having two ¾-in. plungers operating with a 3-in. stroke in a forged steel body. Operating and relief valves and a pressure gage are supplied. The press is thus self-contained.

The ram is provided with a hand-operated racking device, so that it can be raised and lowered quickly. When the ram is lowered in this way, the pressure cylinder is automatically filled with water from a tank located on top of the cylinder. When the ram touches the work, the pressure is built up by means of the pump. In this way considerable time can be saved, since it is not necessary that the ram be moved by power through the clearance space. The pump valve is controlled by means of the handwheel at the right.

The press is provided with an intermediate platen, the top of which is 27 in. above the top of the bottom platen. The clearance between the face of the ram in its highest position and the top of the intermediate platen is 45 in. The columns are 6 in. in diameter and have a clear distance between them of 32¾ in. The intermediate platen has an 8-in. slot and the bottom platen is provided with a hole 8 in. in diameter, this being especially to accommodate piston rods. The height of the press is approximately 11 ft. above the floor line, the machine being set 2 ft. below the floor, in addition.

Fig. 3 shows a 200-ton hydraulic upsetting press adaptable to general upsetting and forging work, but especially suitable for upsetting the flanges on automobile crankshafts. For such operations, the vertical ram carries a die that can be moved down so as to surround the heated work, which has been previously placed in position on the horn or anvil. The horizontal ram is then run forward, so as to upset the work. In this way the driving disk may be formed on the end of a crankshaft. Both rams are then withdrawn, so that the work may be removed, the action of the rams being controlled by means of the levers at the right. Small auxiliary rams and cylinders, connected to the pressure line, are provided for returning the rams when the pressure is released from the working cylinders.

The horizontal ram is capable of exerting a pressure of 200 tons and it has a stroke of 12 in. The vertical ram has a 9-in. stroke, and can exert a pressure of 110 tons. The maximum distance between the face of the horizontal ram and the horn is 33 in., and the vertical clear opening with the vertical ram raised is 22½ in.

The machine is intended to operate with a hydraulic pressure of 1,500 lb. per square inch, the pressure being supplied from an accumulator system. The floor space required is 12 x 3 ft., and the over-all height is 10 ft. The total weight is 30,000 lb.

Waterproofing Blueprints and Drawings

BY F. A. MCLEAN

Architects, engineers, contractors, linemen, etc., often have occasion to refer to drawings, blueprints, etc., in all kinds of weather, and usually find that before long their prints are in a very dilapidated condition.

A simple way of overcoming this trouble is to render them waterproof by saturating them with melted paraffine wax such as is used for sealing fruit jars, etc., and sold under the name of "parawax."

If the prints are placed directly into a pan filled with this molten wax they will soak up too much of it and will always feel more or less greasy to the touch. The most convenient way, therefore, is to soak a number of pieces of absorbent cotton cloth a foot or more square in the wax. When these pieces of cloth are cool lay as many as are required (depending on the size of the blueprint) on a table or other smooth surface, place the print on top of these and then on top of the print lay more of the cloths until it is entirely covered. After this is done it is only necessary to run a hot iron over them for a few moments. The print will immediately absorb the paraffine until the surface becomes saturated. If the table on which the work is carried out has a highly finished surface a layer or two of heavy wrapping paper should be placed between the cloths and the table. Should one of the family irons be used in the process it would be a good plan to interpose a piece of wrapping paper between the iron and the cloth, as it will prevent the iron from being fouled with the wax.

SPARKS FROM THE WORK

Valentine Francis

Farrell Urges Development of Foreign Trade

James A. Farrell, president of the United States Steel Corporation, was the principal speaker at the annual meeting of the Foreign Trade Council at the Hotel Biltmore recently. The session was executive. In addition to electing officers for next year, Cleveland was chosen as the city for the next convention.

Mr. Farrell spoke on the necessity for developing foreign markets if the present productive capacity of this country is to be maintained. He declared that the last 20 per cent of the total sales of a plant usually determine whether the whole operation has been profitable or otherwise. It is this last 20 per cent, at least, which must find a foreign market.

"The foreign trade of the United States, in common with domestic business, is suffering from the general contraction of credit," he declared. "American exporters in many cases have been unable to finance an extension of their existing trade. In other cases they have been unable to grant to foreign customers the credits necessary to insure continued foreign purchases. Furthermore, the situation has been aggravated by the low purchasing power of many European nations, and by the frequent disturbances in railway transportation facilities throughout the world.

"Under these conditions some of our manufacturers have been forced to diminish or discontinue their activities in foreign fields. But it is inconceivable that such a lessening of our foreign trade interest should be suffered to continue longer than is absolutely necessary, or should be allowed to deter American manufacturers from making foreign trade a permanent and integral part of their business policy.

"In every business there is a part of the production, roughly estimated at the least 20 per cent, which cannot remain unsold if the first 80 per cent of the sales are to prove profitable. Remove this last 20 per cent and the whole operation will cease to show a profit. So it is with the present productive capacity of the United States; a certain volume of foreign sales must be maintained or the industry of the country will suffer throughout.

"If we can obtain from the legislative and executive branches of our Government an understanding of those problems with which we are faced, I am confident that the American business man can meet this foreign competition, if only he appreciates the real need for foreign trade, which this country is now experiencing. To bring home a realization of this situation to our producers and to our Government must continue to be the work and duty of this Council."

Questionnaire Out for Gage Standardization Committee

The sectional committee appointed by the American Society of Mechanical Engineers to standardize plain gages for general engineering work has sent out a questionnaire in an endeavor to collect all possible information on this subject. The questionnaire takes up the extent and kind of gages used, tolerances, fits and range of sizes. The committee also requests that any information or suggestions pertaining to this work be sent to the secretary, H. W. Bearce, Bureau of Standards, Washington, D. C.

H. S. Moos Forms Two Spanish Companies

The American Machinery Corporation, Sociedad Anonima Espanola (Spanish Corporation), Madrid, has been organized by Henry S. Moos with Don Luis Montiel, engineer, congressman and former director of finance and customs of the Spanish Government; Manuel de Ortega, mechanical engineer; Rafael Montiel, civil engineer, and Jose Padros, mechanical engineer, chief engineer of the Sociedad de Construcciones Metalicas, "Jareno," one of the largest steel and construction shops in the Madrid district.

This company with its existing sales organization, warehouses, showrooms and shops, will cover all Spain for the American machine-tool companies it represents, with the exception of the Northern district.

The Northern district includes the provinces of Guipuzcoa, Vizcaya, Alava, Navarra, Valladolid, Leon, Santander, and Asturias, in which territories the "Sindicato de Maquinaria Americana" with headquarters in Bilbao and additional warehouses and showrooms in San Sebastian, Vigo and Valladolid, will operate.

This latter organization has also been formed by Mr. Moos with Messrs. Jose Ormazabal and Antonio Iriondo, owners of the important firm J. Ormazabal y Cia., steel manufacturers, machinery merchants and ship owners, and Don Juan Zaracondegui, former director general of "Altos Hornos" of Bilbao (the largest steel mill in Spain), and until recently director general of the "Hispano-Suiza" Automobile Works.

Practical Course in Boxing and Crating

The economic loss in shipping in the United States due to poor packing, poor containers, unnecessary first cost, etc., is conservatively estimated at not less than $500,000 a day for all classes of domestic and foreign shipments. This loss can be materially reduced by the use of properly designed containers.

Practical training courses have recently been conducted at the Forest Products Laboratory, a government institution, to make available to manufacturers and packers the principles that underlie proper box and crate construction.

The boxing and crating course has proved so satisfactory that as long as there is sufficient demand for shippers and others interested in good container construction, the course will be given monthly. Dates for the two next courses are Nov. 8-13 and Dec. 6-11.

The course consists of one week's instruction in boxing and crating under a staff of competent specialists. To cover the cost of conducting the course, a co-operative fee of $100 is charged.

Firms or individuals interested in enrolling representatives should communicate at once with the Director, Forest Products Laboratory, Madison, Wis.

1920 Foreign Trade Amounts to $14,000,000,000

The foreign trade of the United States for 1920 will approximate $14,000,000,000, according to estimates compiled by the National City Bank.

This total compares, in round numbers, with $11,000,000,000 in 1919, $9,000,000,000 in 1918 and 1917, $8,000,000,000 in 1916, $5,000,000,000 in 1915 and $4,277,000,000 in 1913.

Both imports and exports continue to grow, and the total on both sides of the ledger will be bigger in the calendar year 1920 than in any year since the beginning of the war and several times as much as in any year prior to the war.

The biggest imports in any calendar year prior to the war were a little less than $2,000,000,000, and will total $6,000,000,000 in the calendar year 1919, while exports, which never exceeded $2,500,000,000 prior to the war, will be over $8,000,000,000 in 1920.

Churchill - Morgan - Crittsinger, Inc., Worcester, Mass., has announced a fifteen per cent reduction in the prices of their internal grinding machines.

LD'S INDUSTRIAL FORGE
News Editor

Italy's Metal Trades Difficulties Now Ended

The present trend of events in Italy indicates that the industrial disturbances which have troubled the metal trades in some of the northern cities of that country during the last month have been checked.

Premier Giolitti's plan has been agreed to by both the factory owners and the employees. The advocates of this plan hope that it may result in improved relationships between capital and labor and so react favorably on the economic position of the country.

The following official cablegram was received, from Rome, on September 24, by Francesco Quattrone, Italian High Commissioner for New York:

Following previous communications advise that after lengthy negotiations employees of steel works and laborers have come to understanding regarding economic question and other principles connected with late dispute. Both parties have agreed that laborers be duly represented among employers, and Government will name commission to draw up fundamental principles on which will be based new law to be presented immediately for discussion on part of parliament.

Settlement of dispute proves that action of laborers was merely an economic question, and has brought about amicable relations of much importance between employers and laborers.

Situation of Port of Genoa twentieth instant: Thirty-one steamers unloading with 1,150 cars at their disposal (which means that for about 25,000 tons of merchandise to be discharged there were for immediate use 23,000 tons car capacity).

Condition of all other ports excellent. Metal Workers' strike had no effect on loading and discharging of steamers. Railway service normal with very marked increase in number of trains during national celebration of September twentieth.

ALESSIO, *Minister of Commerce.*

Senator Underwood Predicts Tax Law Revision

"No matter who is elected president, Congress will be called into extra session in March or early in April to revise the revenue laws and place the United States on a peace-time financial basis."

This prediction was made Oct. 4 by Senator Oscar W. Underwood, minority leader of the Senate, and member of Committee on Finance.

"Our finances must be demobilized just as our army was," said Senator Underwood. "When we put our army on a new war basis, we put our finances on a war basis also. Our army has been demobilized.

"It is hardly probable that Congress will attempt this task in December. It may be that the Ways and Means Committee of the House and the Finance Committee of the Senate will gather all the information they can during the winter months, but the real work of preparing a bill will begin in the spring.

"Little doubt exists that the Republicans are bent on repeal of the excess profits tax. The main reasons are its general unpopularity and the fact that it will not produce as much revenue in the future as it has in the past.

"The day of the war profiteer is near an end. A certain number of businesses always earn large profits, but financial experts are of the opinion that within a year or two a large majority of enterprises will be on a pre-war basis. When they get there an excess profits tax will not yield much to the Government."

U. S. Steel Corporation Will Not Reduce Prices

The United States Steel Corporation will not reduce its prices. In fact, it may be necessary to advance rails to meet advanced freight rates. This question, however, has not been decided. These are the conclusions drawn from an informal talk with E. H. Gary, chairman of the United States Steel Corporation, given to news writers in Wall street recently.

Independent Lamp Manufacturers Have Association

The Association of Independent Lamp Manufacturers was organized by the independent lamp manufacturers last July. It has enrolled in its membership nearly all the independent lamp manufacturers in addition to a number of manufacturers of equipment and accessories. It has for its object to improve the conditions of co-operative buying and selling and also the establishment of research, engineering and development laboratory of which members may avail themselves at any time; also to standardize their products and to keep the members informed of improvements in incandescent lamps. In addition to this the association seeks to bring its members together so from time to time that by exchanging ideas and reading reports the members might be benefited thereby. The headquarters of the association is at 8 Bergenline Ave., Union Hill, N. J.

The National Safety Code for the Protection of the Head and Eyes of Industrial Workers has been sent to press by the Bureau of Standards. This is the first edition of this code to be printed, although in the two years during which these rules have been developed, mimeographed copies of several successive drafts have been circulated for criticism. The code specifies appropriate protectors in the form of goggles, helmets, hoods, etc.

New Terminals as Necessary as New Locomotives

In an effort to meet the demand of shippers in improving their service, the railroads have again begun to order locomotives. But the roads are as short of facilities to take care of these new locomotives once they are delivered as they are of locomotives themselves.

Whenever new locomotives are ordered, serious consideration should also be given to locomotive terminals. The lack of terminals in the past has cost the railroads millions.

As a speaker at the A. R. A. Convention last June said:

"Locomotive terminals are not all equipped to handle expensive engines promptly and economically. Has anyone charted or scheduled locomotive terminal movements with a view of short cut delays? Are big engines ever held in yards and sent in herds to the roundhouse for fire cleaning, coaling, sanding and roundhouse jobs, when they could as easily be sent singly to keep the roundhouse load curve more uniform? Because the 'stitch-in-time' at the roundhouse may keep a big engine going strong, the best of mechanics and the best of tool equipment should be at the roundhouses. Is this so today? Unquestionably the roundhouse foreman should be a man of greater authority. It would seem to be a money-making scheme to give him much better standing, also to give him a yard foreman to handle the firing up of engines and all the out-of-door work, to speed up ash pit and other work that delays expensive engines from the road.

"An inspector who has been a locomotive engineer should meet all the incoming engines and discuss with the crews the condition of the engine and the defects found. These men would save their annual pay every month. It would be very profitable to have traveling engineers spend a day or so every month at the roundhouse.

"Adequate locomotive terminals laid out, organized and equipped for quick, thorough work will speed up the entire railroad. Inadequate terminals do more than anything else to slow down the entire railroad."—From the *D. P. R. News*, published by Dwight P. Robinson & Co., Inc.

Paris Auto Market Breaks

The Paris market for automobiles has broken, the big factories being reduced to the merest fractions of their former output.

When the war finished, the thousands

of persons who had waxed fat off war contracts rushed to buy cars. Prices shot skyward. Cars jumped ten times in price, if not value, almost overnight. Several makers adopted the Ford idea and turned out cars at a tremendous rate. They were snapped up almost as quickly as they appeared. Then the French government started auctioning off used American cars. This broke the market for French cars.

The Delauny Belleville factory has practically shut down. Pougueot, Delage, Renault and Paris-Javel are manufacturing only a fraction of their former output. The government itself is finding an increasing difficulty in getting rid of the 18,000 American cars of various makes that it still holds.

DeLamater-Ericsson Memorial Tablets

At the convention of the American Society of Mechanical Engineers last December, held in the Engineers Societies' Bldg., New York, a memorial meeting was held on the evening of Dec. 3 in commemoration of the eightieth anniversary of the arrival in the United States of Captain John Ericsson and his fifty years' association with Cornelius H. DeLamater in engineering work. In advance of the meeting it had been decided to erect memorial tablets to mark the sites of certain buildings which were closely identified with the work of DeLamater and Ericsson. It was proposed to erect four tables: One at the Phoenix Foundry at Laight and West Sts., New York, where the first screw-propelled vessel in this country and the first steam fire engine were constructed and where many other original developments were made; one at Captain Ericsson's residence, 26 Beach St., where he designed the *Monitor* and made all his inventions during his later years; one at the DeLamater Iron Works at the foot of West 13th St., where the engines of the monitors *Puritan* and *Dictator* were built, as well as the first submarine boat, the first torpedo boat, the first torpedo boat destroyer, the first self-propelled torpedo, the first air compressors, the first ice machines, and many other industrial appliances now in general use; and one at the Continental Iron Works, Greenpoint, L. I., where the hulls of the *Monitor* and other warships were built.

It is believed that there are many marine and industrial firms, organizations and individual manufacturers and engineers who, if given an opportunity, would contribute to the tablet fund, especially to commemorate the invention of the screw propeller and the building of the *Monitor*. Those interested are requested to communicate with the DeLamater-Ericsson Tablet Committee, H. F. J. Porter, chairman, Room 1100, Engineering Societies Bldg., 29 West 39th St., New York City.

"Lenine Makes Emma Goldman Work as a Railroad Laborer," says a headline. Conditions in Russia look best at a safe distance.

What Strikes Cost

The Conciliation Bureau of the Department of Labor estimates that the monetary losses throughout the country suffered during the fiscal year ended June 30 because of strikes amounted to $875,000,000. Approximately 3,500,000 workers were affected by industrial disturbances. The basis taken is that of $5 a day, an average continuance of strikes for 10 days and a loss to workers of $135,000,000. The loss to employers in value of production curtailed is estimated at $700,000,000.

The steel strike alone is estimated to have cost the workers $3,000,000 a day in wages and the loss imposed on the country by the outlaw railroad strike cannot be, and has not been, estimated. As a matter of cold fact $875,000,000 does not represent the loss by sustained strikes. The loss to the workers was greater than the figures given. There were cases where the men received aid from their organizations, but if they had money in the bank, or Liberty bonds, they were required to use these. The losses to the manufacturers can not be estimated, and there must also be considered the losses to the country, to the transportation systems, to the consumers, to the retailer, and the moral loss to the whole country. Whether this publication of estimated losses is a new departure which will be maintained remains to be seen. It has not been the habit of the Department of Labor, as at present constituted, to present data which will bring the effect of strikes directly home to the people, or directly home to the workers themselves. If a careful analysis could be made of the effect of every strike, there would be a speedy end to all strikes, and a quick elimination of the agitators who bring them about. By all means let us have detailed data on strikes and give it the widest publicity. —*The Employer.*

Some Interesting "Dope" on Production Conditions of Today

The following is an article which appeared in the *Garvanite*, the shop paper of the Garvan Machine Co., of New York. It was written by George MacLagan, treasurer of that company:

If the entire profits of the industries of the United States were paid to the workers, wages would not be increased more than 25 per cent.

The United States is the wealthiest country in the world, and while it may be true that some men have more than their share, it is a fact that if the wealth were equally distributed, no man would have a very large amount.

Without going into all the causes of the high cost of living, it is quite certain that increased production would be the biggest factor in lowering the same.

There is plenty of wealth in the world, and God provides bountifully in raw material, but it is necessary for man to take those raw materials and put them in such shape that he can use them.

Men have a mistaken notion that by curtailing production more men will be employed. To take an extreme illustration, suppose the machines in this factory were only "cutting air," nothing would be produced and yet men would be employed; but how long could the finances of the company stand it? No money would be forthcoming from sales, and cancellations of orders would be received daily. On the other hand, if production is increased, machines will be turned out sooner and money will be obtained for the pay-roll; hence in the long run more men will be employed.

It may be said that with efficient work, over-production will result, but there is no real over-production until the reasonable requirements of every one is met, and that has never been yet in the history of the world; it is therefore more accurate to say that there is under-consumption.

Wages do not consist in the number of dollars we get, but the amount of necessities which our labor will procure for us.

A man may justly think that he is not getting his share of wealth, but while this matter is being adjusted, if he produces less, his condition will be worse. He cannot get something out of nothing.

If one hundred million loaves of bread are needed daily for the population of the United States, and only fifty million are produced, each one will average only half a loaf. If none is produced, even a million dollars in gold cannot buy a loaf of bread. Money is only a medium of exchange. It has no value in itself. It will neither feed, clothe nor shelter.

When machinery was first invented, hand workers thought it would ruin them, and throw them all out of employment, but the contrary has proved to be true.

We commonly speak of productive and non-productive labor, but in reality, every man who renders a useful service with his hands or his brains is a producer. Every one who fails in this is a drone and a leech. If a man tries to get wages without rendering services, he is only fooling himself in the long run.

It is almost certain that with every man doing his best, the production of the world could be doubled, and the saving in overhead expenses would reduce cost much more than the production itself would indicate.

One of the big items in this business is the payroll coming every Friday. If the Treasurer could pay the men in machinery and work in progress, he would be spared headaches; but since the men require actual money, a good deal of planning is needed.

If everybody were absolutely efficient, there would be much less work in progress, and hence more free money with which to meet the payroll. In dull times, this surplus could be used in manufacturing machines to be stored until better conditions prevail.

Trade Letters from New York and Chicago

NEW YORK

The retrenchment in the automobile industry is beginning to be felt by machine-tool manufacturers, and particularly makers of milling attachments. While the market for the larger tools has been very weak there was a constant demand for small tools until last week. The automobile factories were probably the largest users of milling cutters and other attachments, but the recent cut in production has minimized the need for this equipment. This condition is expected to persist for the next two months. In line with the Western automobile plants that have shut down several of their departments, the factories in this district including the Willys Corporation, International Motors, and Brewster & Co., have reduced their working forces.

The price of motors adapted for machine-tool drive has been increased but no change is noted in the machine-tool price list. There will be no reduction in prices at the present time, according to statements made by several manufacturers. Tool steel and labor costs are not likely to recede from their present high level and will maintain the present cost of production.

Inquiries this week were not numerous and called for a few tools for immediate delivery to complete existing equipment.

CHICAGO

Inactivity is the order of the day on "Machinery Row" in Chicago. The tendency on the part of the buying end of the trade is to sit back and wait for the cut-price fever to hit the machinery trade. It is probable no heavy demand will be felt until the full effect of the present industrial depression is fully measured.

The curtailment of manufacturing activities in this district continues, on the part of both the builder and user of machine tools. In the machinery industry hours are very largely being reduced from ten to eight, and night shifts in certain departments are being eliminated. One large concern is reported as having closed entirely, but no general movement in this direction is indicated, as stocks are a long way from normal yet, and there still remain unfilled orders on the books of many plants.

Deilveries are getting back to normal. With the exception of certain sizes and types of punch presses and some extra heavy types of lathes and radial drills, it is possible to procure fairly prompt shipment on any standard tool. Factories are still taking what seems to be a long time on special stuff. Dealers' floors are gradually accumulating a stock and, for the first time in years, samples of most any machine can be found on display.

This stock accumulation has put dealers in the position of increasing sales efforts, to avoid undue inventories the first of the year. The condition of a buyers' market has been firmly established. Difficulty is being experienced in the matter of collections, considerable pressure being necessary to bring in money.

Machinery production, from a labor standpoint, is in a much better situation than in the recent past. The strike in Cincinnati, so long a brake on output in that city, has been settled and all the Cincinnati makers are rapidly catching up on their delayed schedules. The Chicago foundrymen's strike, while still technically in effect, is ineffectual and supplies are forthcoming as needed. Rockford, Elgin, Milwaukee and other nearby points, as well as Chicago, report that the increase in the supply of labor has enabled them to weed out the ineffectives in their force, replacing them with real mechanics, and that their efficiency is thereby materially increased.

Gary Highly Optimistic Over Future U. S. Trade

In high spirits and optimistic about the industrial future of the United States, but reticent as to the result of his numerous conferences with European steel magnates, Judge Elbert H. Gary, chairman of the board of the United States Steel Corporation, returned recently on the French liner France.

"All I have to say," Judge Gary told newspapermen, "is that the result of my observations abroad will be laid down in an address I expect to make at a meeting this month before the Iron and Steel Institute.

"Let me say this, however, that I am very glad to hear that the tendency in prices of all commodities is downward.

"I advocated a decrease in prices before I went away."

Notes on Paris-to-London Flight

H. M. Norris, secretary of the Cincinnati-Bickford Tool Co., wrote the following account of his Paris-to-London flight on Sept. 20.

Left Grand Hotel 10:10 a.m.; arrived aviation field 10:45. Was met by Monsieur Rene Labouchere, the pilot of the seven-chair Farman (Goliath) in which I am to make the flight. Day clear and very warm. Sorry I bothered with coat and gloves.

Was requested to enter plane at 11:20. Am in foremost seat on right side, which affords a view of at least 220 deg. Engines were started at 11:25. Left ground at 11:28. Am the only passenger. 11:35—the roads begin to look like threads, the trees like bushes, the fields like crazy quilts, horses like ants, men like flyspecks. 11:42—descended to about 150 ft. of ground. 11:50—train rounding curve looks like a worm. 12:00—pilot and mechanic accepted a cigarette and light. 12:08—plane much steadier than a pullman. 12:12—flying much higher. Fields are green, yellow, white, brown and rose color. 12:20—villages look like a handful of colored beads on a carpet. 12:29—passing over a forest which has the appearance of a bear-skin rug. 12:33—ground looks like a huge floor of inlaid wood. 12:39—at edge of channel, very high, view at right obstructed by clouds—glad to have overcoat. Clouds cast curious shadows on ground, giving a blotchy effect.

My flight at Atlantic City and over Lake Geneva was nothing compared to this. Hard to distinguish between clouds and water. Climbing higher. Shadows of clouds on water very fantastic. High above surrounding clouds. Boats visible here and there; those with sails resemble gulls.

Have to rub hands to continue writing.

12:43—very cold. 12:45—cannot see anything but the sky and the shadow of the plane on a cloud with a halo of rainbow colors. Height, 9,900 ft. Speed, 90 miles. 12:48—almost frozen. 12:50—view ahead like Mt. Blanc—nothing else visible. 12:51—can see French Coast at right. Feet feel as if they were in ice water. 12:52—view below like a beautiful snow drift. 12:53—would give more than a trifle for a drink of good old American rye. Pilot is wearing fur gloves and helmet. 12:55—coastline still visible, at right. 12:56—can now see nothing but the sky. 12:57—had to wipe frost from window. 1:00—nothing visible above or below. 1:02—raining. 1:03—can see water but nothing above. Channel looks as smooth as glass. 1:09—approaching apex of equilateral triangle of land—devoid of buildings. 1:13—can now see in all directions; view magnificent. 1:15—turning to left of coast but far out over channel. 1:18—passing over ocean liner and four-mast ship, which look like small toys. 1:20—full view of land ahead. 1:22—sunshine. Can see in all directions except as obstructed by clouds. Sensation glorious. 1:25—passing over snow-white clouds. Nothing more beautiful. Only occasional glimpses of the ground. 1:27—view below beggars description. Wouldn't have missed this for ten times 500 francs. The fields are of all shapes—square, rectangular, round, oblong, conical, angular, horseshoe, etc. 1:32—effect now the same as from the summit of Mt. Blanc, except that the ground may be seen between snow drifts (clouds). More fields of all shapes edged with a deeper shade of green—probably trees. 1:38—an almost unimpaired view of earth. Many clusters of houses with farm land between. Have enjoyed nothing so much in my life. Would feel safe at the end of one of the wings. 1:42—not quite so cold. Noise of engines not objectionable. 1:45—passing over large village, but too high to determine character of buildings. 1:50—free from clouds, except far ahead. Best view of ground yet obtained. Wonderful sight. (If going to Heaven is like this I shall

be glad to start at any time.) 1:57—pilot indicated we are about to descend. 1:59—pointing downward at steep angle. 2:00—craft rather unsteady—difficult to write but beautiful view. 2:01—engines slowing down—spurting ahead. Ribbon effect of some fields most remarkable. 2:03—circling to left over Croydon landing field, about eight miles from Charing Cross, London. 2:05—touched ground. 2:06—some jolt. 2:07—trip ended, but much too soon.

Crossed field to office. Everyone most courteous and obliging. No trouble about passport or baggage. Wired parents at Geneva. Had brandy and soda. Witnessed landing of next 'plane, which ran into some obstruction at other side of field. The shock tossed it back on its side. Red Cross ambulances started to rescue—no one near seemed concerned.

Monsieur Labouchere and I proceeded by automobile to the Waldorf Hotel, where he succeeded in securing a room for me, and shortly thereafter I reached the Olympia Machine Tool Exhibition, one of the objectives of my trip to this side. It is a great show.

Bullard Machine Tool Co. Adds Products Division

Announcement has just been made by the Bullard Machine Tool Co. of the establishment of a products division in connection with the new plant of the company at Bridgeport. The facilities of the plant include pattern shop, foundry, forge shop, heat treating department and an exceptionally well-equipped machine shop. The work of manufacturers with insufficient plant equipment, or with comparatively small jobs calling for the use of special machinery where the size of the job does not warrant this purchase of such equipment, is solicited.

Business Items

The C. J. Root Co., Bristol, Conn., manufacturer of wrought brass goods and metal stampings, has increased its capital from $150,000 to $300,000.

The Spiro & Barrows Machine Tool Co., 168 Centre St., New York, is the name of a new company formed for the purpose of dealing in new and used machine tools. Both members of the new firm were formerly with the Modern Machinery Exchange, 25 Church St., New York. E. Spiro, at one time, was head of the Spiro Electric Co., and H. D. Barrows was sales manager for the American Machinery Exchange.

The Fawcus Machine Co. has consolidated all departments in its new office building, adjoining its Pittsburgh Works at 2828 Smallman St., to facilitate the handling of its enlarged business. A downtown office for meetings by appointment will be maintained in Suite 1501 Peoples Savings Bank Building where its allied company, the Schaffer Engineering and Equipment Co., is located.

The Wade-American Tool Co., Boston, Mass., has just completed and moved into its new plant at 49-59 River St., Waltham, Mass., where it will have double floor space and be able to handle its growing business. The company will continue to manufacture precision bench lathes, gages, dies, tools and fixtures.

The Manufacturers' Steel Exchange Co., Naperville, Ill., is listing the surplus stocks of manufacturers so that one may secure material which may be carried as surplus by another. The company sends out forms on which manufacturers list their surplus stock, and semi-monthly sends out surplus stock lists to all its clients.

The Stewart Manufacturing Corporation, 4500 Fullerton Ave., Chicago, manufacturer of bronze-back bearings and die castings, announces the opening on Oct. 1 of a new branch office at 30 Church St., New York, in charge of Louis Ruprecht.

The Lincoln Steel and Forge Co., St. Louis, has increased its capital stock to $150,000. The company was incorporated under the laws of Missouri in 1910 for $50,000.

The Thompson Type Machine Co., Chicago, Ill., manufacturer of the Thompson type, lead and rule caster machines, has taken an additional step preparatory to locating its entire business in Sheboygan Wis., by an agreement with the Globe Co., whereby they will manufacture its machines.

At a meeting of the stockholders of the Greenfield Tap and Die Corporation, Greenfield, Mass., held Aug. 31, it was voted to increase the authorized capital stock of the company from $6,500,000 to $11,500,000.

The Novelty Steam Boiler Works Co., Baltimore, Md., engineers and machinists, has been reorganized. Its president, Oscar S. Jennings, has been connected with the establishment since it was incorporated in 1905. The company is constructing additional buildings and installing machinery.

The Trimont Manufacturing Co., tool manufacturer, Roxbury, Mass., has recently completed a large addition to its plant, which will give them over 41,000 sq.ft. additional floor space.

The Waldron Tool and Metal Manufacturing Co., 173 Ferry Street, Norwalk, Conn., has recently been organized and incorporated to make tools and metal products, etc.

The Gilbert and Barker Manufacturing Co., Springfield, Mass., last month gave out "Ten-Year Service Pins" to Fred R. S. Whittle, head of the salvage department, and to C. W. Avery, of the assembly department, both having served ten years with the company. Daniel Driscoll, of the sheet metal dept., was given a pin for five-years' service also. The company awards service pins at various times to its employees having rendered specified years of service.

Personals

E. T. Bysshe, formerly a research engineer at the plant of the Greenfield Tap and Die Co., has accepted the position of research engineer of the Automatic Die Division of the Jones & Lamson Co., Springfield, Vt. Mr. Bysshe started his new work in August.

C. E. Neubert, assistant district manager of the Warner & Swasey Co.'s Chicago office, has been appointed district manager of the company's Buffalo office, located in the Iroquois Building, to succeed W. E. Marshall, former manager, who died recently.

S. C. Hope, of the sales department of the Gilbert and Barker Manufacturing Co., Springfield, Mass., has just returned to London, after a trip to Genoa, Italy and to Paris, on business.

E. E. Creed was made assistant sales manager of the Gilbert and Barker Manufacturing Co., Springfield, Mass., on Sept. 1. Mr. Creed will spend most of his time in the field, although his office will be at the main offices in Springfield. Mr. Creed came from the Los Angeles branch office.

Edward Grossman, formerly of the Jasper Bayne Co., New York City, is now connected with the T. P. Walls Tool and Supply Co., New York, in the capacity of sales manager.

Galen Snow has recently been appointed a member of the sales force of the Greenfield Tap and Die Corporation, Greenfield, Mass.

R. W. Thomas, M.A., has become affiliated with the McCrosky Tool Corporation of Meadville, Pa. in the capacity of Publicity Manager. For some time he was professor of English in De Pauw University and until recently was an English master in a prominent eastern preparatory school.

J. J. Siefer, for the last several years mechanical superintendent of the Lux Clock Manufacturing Co., Waterbury, Conn., has resigned.

L. G. Beck, for several years head of the wire cloth and netting sales department of the Wick-Wire-Spencer Steel Corporation, Worcester, Mass., has resigned his position. Mr. Beck has been with the concern for a period of forty-one years, beginning in 1879 as a clerk in the office of the Clinton Wire Cloth Co., Clinton, Mass., which is a branch of the present company.

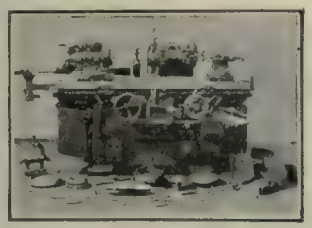
T. D. Scoble, Jr. has resigned as manager of the advertising department of the Yale & Towne Manufacturing Co., Stamford, Conn., to establish an advertising agency.

J. P. Clark has resigned as Phoenix, Ariz., representative of the Gilbert & Barker Manufacturing Co., Springfield, Mass. He now has an 80-acre cotton plantation in Salt River Valley of Arizona.

Condensed-Clipping Index of Equipment

Patented Aug. 20, 1918

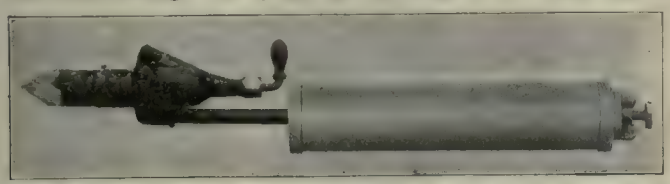
Grinding Machine, "Multipurpose"
Norton Co., Worcester, Mass.
"American Machinist," Sept. 30, 1920



This machine is intended to serve all the purposes of a universal machine in grinding parallel and tapered work, cutters, reamers, etc. The machine will swing work up to 12 in. in diameter and 36 in. long. Both the headstock and wheelhead have swivel bases, graduated in degrees. The work spindle is hollow and will pass a ¾-in. bar. The drive to the headstock is all geared. The rotative speed of the work spindle may be varied from 53 to 320 r.p.m. in six steps. There are eight changes of speed, from 2 ft. to 11½ ft. per minute. An internal grinding fixture attaches to the back end of the wheelhead, which is turned 180 deg. to bring the internal grinding spindle into action, and is driven by belt from a pulley mounted in place of one of the grinding wheels. Weight, 4,950 lb.; floor space, 11 ft. 8 in. x 5 ft. 5 in.

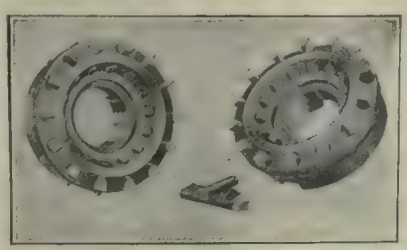
Soldering Iron, Gasoline, "Ever-Hot," "Peterson-Plummer"
Belfrey & Craighead, Tribune Building, Chicago, Ill.
"American Machinist," Sept. 30, 1920

This soldering iron is light in weight and of convenient size to suit the requirements of both light and heavy work. The gasoline reservoir is contained in the handle which is made of seamless brass tubing. The pump unit is placed at the end and is



easily removed for refilling. A rust-proof iron pipe connects the handle with the burner and contains cotton wicking to insure a continuous flow of gasoline. The burner is a one-piece brass casting arranged to preheat the gas and its design permits the use of the iron in any position in both extreme cold and high winds. One large and one small point are furnished with the iron.

Milling Cutter, Face
Lovejoy Tool Co., Inc., Springfield, Vt.
"American Machinist," Sept. 30, 1920



The cutter is recommended for all face milling where the depth of the cut does not exceed ⅛ in. The teeth of this face-milling cutter are positively locked by the arrangement shown in the insert between the two views of the cutter. This is said to insure against the possibility of slipping or loosening under heavy or intermittent cuts. The teeth are easily adjustable when they become worn and it is possible to set the cutters at the best angle for the work in hand. The body is made of hardened steel and is ideal for holding Stellite teeth, which are supplied if so ordered. The cutter is made in sizes ranging from 6½ to 18 in. in diameter.

Dumping Body for Industrial Truck
Karry-Lode Industrial Truck Co., Inc., 98-100 Nott Ave., Long Island City, N. Y.
"American Machinist," Sept. 30, 1920



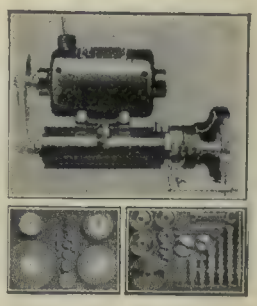
The all-steel dumping body illustrated can be mounted on the electric truck made by its manufacturer. The body has a capacity of 40 cu.ft. and dumps over the end of the truck, being especially adapted for coal handling. The mounting of such a body is possible because of the fact that the truck is so constructed that it is not necessary to raise the platform to gain access to the battery. The steel platform serves as the frame of the truck, and the battery is so suspended that it can be removed without disturbing the platform.

Abrasive Disk, Improved
Gardner Machine Co., Beloit, Wis.
"American Machinist," Sept. 30, 1920



The illustration shows the disk mounted on the steel disk-wheel of a grinding machine. Among the features of the improved disk are its increased thickness, its corrugated surface, and the bond used in its construction. It has more than twice the thickness of the ordinary glue-bond disk. The corrugated surface is said to tilt the abrasive grains into the best position for cutting. The bond is a special cement which powders away during the grinding operation, presenting new cutting points to the work. It is claimed that the improved disk will last longer, cut faster and cooler than the glue-bond disk.

Grinding Machine, Multi-Speed, "Dumore No. 3"
Wisconsin Electric Co., Racine, Wis.
"American Machinist," Sept. 30, 1920



This machine is adapted to both production and toolroom work. The spindle is tool steel and mounted in adjustable, dust-proof ball bearings. Four extension spindles for use on internal work, together with wheel arbors for light and heavy grinding, are furnished. The device can be swiveled to any angle necessary in practice. When used for light tool grinding, the toolrest and shield for the wheel can be attached. Specifications: Motor, ¼-hp. Universal for d.c. and a.c. current. Seven spindle speeds, 3,600 to 50,000 r.p.m. Spindle adjustment, 5½ in. Net weight, without equipment, 25 lb.; with equipment, 35 lb. Shipping weight, 45 lb.

"Rivet-Busting" Tool, "Iron Mule"
Keller Pneumatic Tool Co., Grand Haven, Mich.
"American Machinist," Sept. 30, 1920

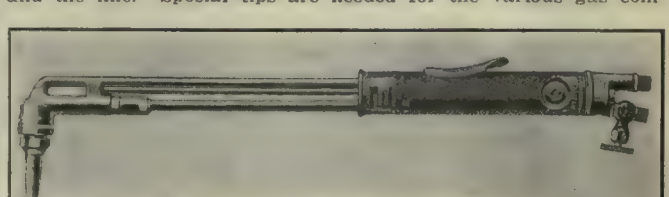
This tool is air-operated and is intended for cutting off and backing out steel rivets in the shop. It is simple in operation, requiring no special skill. Three men are needed to operate the tool to the best advantage. Dimensions of piston, 1¾ x 9 in.



Length of stroke, 41 in. Length of chisel, outside of tool, 7 in. Length of tool, overall, 67 in. Net weight, 75 lb. Weight of chisel, 7 lb. Operating weight, 82 lb. Shipping weight, 135 lb.

Torch, Cutting, Gas, "15 MC"
Torchweld Equipment Co., Fulton and Carpenter Sts., Chicago, Ill.
"American Machinist," Sept. 30, 1920

This gas cutting-torch is designed to use oxy-acetylene, oxy-hydrogen, or oxy-hydrocarbon gases, such as butane, calorene, and the like. Special tips are needed for the various gas com-



binations. An 85-deg. torch-head angle is standard but 70, 50, 35-deg. and straight heads can be furnished when desired. A one-piece cutting tip is used and the mixing chamber is just back of the torch head. All the gas-tight seats in tips, needle valves and connections are of the line-contact type.

Clip, paste on 3 x 5-in. cards and file as desired

V. WELTSCHEFF, of the sales force of the Yale & Towne Manufacturing Co., of Stamford, Conn., has returned to this country, after being thirteen months in Europe, Asia and Africa in the interest of Yale products.

G. R. MELLON, machinist to the trade, has moved his shop from 933 Communipaw avenue to larger quarters on 380 Wayne St., both the addresses being in Jersey City, N. J.

F. R. CROZIER has been appointed district sales superintendent of Los Angeles, Cal., offices of the Gilbert & Barker Manufacturing Co., Springfield, Mass.

Obituary

C. A. SEVERIN, Cleveland district manager of sales, for the interests of Reed-Prentice Co., and Whitcomb-Blaisdell Machine Tool Co., both of Worcester, Mass., and the Becker Milling Machine Co., Boston, Mass., died recently in Cleveland.

Trade Catalogs

Hytempite. Quigley Furnace Specialties Co., 26 Cortlandt St., New York. Catalog. pp. 16, 8½ x 11 in., describing this latest addition to construction work. Hytempite is a high refractory plastic material, scientifically compounded, for bonding firebrick and for kindred use. Its use for repairs in the boiler room, foundry and shop is fully illustrated.

Ready Made Printed Enameled Steel Signs. Ready-Made Sign Co., 16 West 36th St., New York. This circular gives illustrations of steel signs for warning, safety, danger and other wording for factories, offices, mines, hospitals and municipalities. A price list is also given.

Stock List of Shelby Seamless Steel. Peter A. Frasse & Co., 417-421 Canal St., New York. This is a stock list of the company's products.

Pneumatic Scraper. Anderson Bros. Manufacturing Co., Rockford, Ill. Bulletin, pp. 8, 8½ x 11 in. This is a descriptive and illustrated bulletin of the Anderson pneumatic scraper; specifications are included.

Pneumatic Tools. Keller Pneumatic Tool Co., Grand Haven, Mich. Catalog No. 5, pp. 123, 6 x 9 in. This catalog illustrates and describes the quality products of the Keller Pneumatic Tool Co.

Electric Cranes. Pawling & Harnischfeger Co., Milwaukee, Wis. This folder, 8½ x 11 in., gives several illustrations showing the P & H Electric crane in leather tanning industries.

Short Cuts to Power Transmission. Flexible Steel Lacing Co., 4607-31 Lexington St., Chicago, Ill. This is a 64-page handbook of short cuts to, and simplified explanations of, power transmission; it includes two pages of tables on weights and measures. Copies of this book can be obtained by writing the Flexible Steel Lacing Co., 4973 Lexington St., Chicago.

Power Transmission Machinery. The A. & F. Brown Co., Elizabethport, N. J. Catalog, pp. 129, 5 x 8 in. A catalog, printed on coated stock and with a cloth-board cover, has reecntly been issued by the above company, briefly describing and illustrating its products for power transmission machinery.

The revised edition of catalog No. 380 of the Link-Belt Co., 910 South Michigan Ave., Chicago, Ill., is now off the press and available for distribution. This 96-page book covers the Link-Belt line of standardized monorail electric hoists as well as overhead electric traveling cranes in capacities of one-half to three tons inclusive. It completely describes these machines—giving tables of weights, clearance dimensions and speeds—and is copiously illustrated.

Unlike Any Lathe You Have Ever Seen. J. J. McCabe, 149 Broadway, New York. This folder briefly describes and illustrates McCabe's "All-in-1" lathe.

Universal Measuring Machine. Reprinted from *The Engineer* (London), May 7, 1920. The Golden Co., 405 Lexington Ave., New York, U. S. representative of the Societe Genevoise D'Instruments De Physique, Geneva. This catalog illustrates and describes the latter company's universal machine.

Lathe Chucks. The Cushman Chuck Co., Hartford, Conn. Catalog, 3¾ x 6 in. A condensed catalog; it illustrates all of its chucks which have been found to be in most general use.

Plug Drills. Sullivan Machinery Co., 122 South Michigan Ave., Chicago, Ill. Bulletin

General Thread Miller No. 1-C. Smalley General Co., Bay City, Mich. Circular, 8½ x 11 in. This circular describes and illustrates the Smalley general thread milling machine No. 1-C with power traverse.

Automatic Current Regulator. Westinghouse Electric and Manufacturing Co., East Pittsburgh, Pa. Leaflet, No. 3461; describes and illustrates its automatic current regulator for electric arc furnaces with movable electrodes. Schematic wiring diagrams and photographs of detailed parts of this apparatus are produced.

Carbon Electrode. National Carbon Co., 30 East 42nd St., New York. Booklet, pp. 18, 5 x 8 in. This booklet gives information to those interested in electric-furnace operation and certain suggestions relative to the handling, storage and use of carbon electrodes.

Alligator Shears. Canton Foundry and Machine Co., Canton, Ohio. Catalog, pp. 23, 8½ x 11 in. This catalog illustrates and describes "Canton" semi-steel shears, built in various styles and sizes, for cutting from 1- to 3-in. squares.

High Speed Steel. Le Moyne Steel Co., 23-31 West 43rd St., New York. A small service book, giving suggestions for treating Le Moyne high-speed steel.

Clean Clean Thru. Royal Manufacturing Co., Rahway, N. J. Booklet, pp. 24, 6 x 9 in. This booklet gives a "close up" of cotton waste manufacture—from the raw material to the finished article. Copies of this booklet may be had upon application.

Sullivan Rotators. Sullivan Machinery Co., Chicago, Ill. Bulletin 70-F, pp. 28, 6 x 9 in. The Sullivan rotator described in this bulletin is claimed to be an "all round" rock drilling machine. It is used for nearly all kinds of rock drilling work, including block holding and cutting hitches; shaft sinking, and a great variety of down hole drilling, drifting, stoping and light tunneling, etc.

New Publications

Employees Magazine. By Peter F. O'Shea. 122 pp., 5 x 7½ cloth. Published by the H. W. Wilson Co., 960 University Ave., New York.

This gives the results of the author's experience as editor of house organs for employees, such as the "Helix" of the Greenfield Tap and Die Corporation. He shows how such publications can be an aid to management by promoting co-operation, by education, by improving morale and in other ways.

There are many valuable suggestions along various lines which show a keen appreciation of human nature and the fundamentals of securing interest on the part of the men. Those interested in the subject of shop papers will find it well worth reading.

The Modern Electroplater. Kenneth M. Coggeshall. Two hundred fifty-five 4¾ x 7½-in. pages, 142 illustrations. Bound in red cloth boards. Published by the Norman W. Henley Publishing Co., 2 West 45th St., New York City.

This is a practical book on electroplating. The equipment and methods of modern electroplating are explained in simple terms. Elementary outlines of chemistry and electricity as they are related to plating are included. Topics treated are the location and construction of the plating room, current supply, tank equipment, heating and agitating devices, automatic plating machinery, drying apparatus, anodes, brackets, preparation of work for plating, plating of brass, copper, gold, iron, lead, nickel, silver and tin. Formulas and directions for making a number of plating solutions are given.

Personnel Administration, Its Principles and Practice. By Ordway Tead and Henry C. Metcalf, Ph. D., members of the Bureau of Industrial Research, New York City. Five hundred twenty 6 x 9-in. pages. Bound in blue cloth boards. Published by the McGraw-Hill Book Co., Inc., 239 West 39th St., New York City, and 6 and 8 Bouverie St., E. C. 4, London.

The authors have well carried out the purpose of their book, "to set forth the principles and the best prevailing practice in the field of the administration of human relations in industry." Necessarily the conclusions of many students of human relations in industry were examined and made use of and lists at the ends of the chapters afford the reader a knowledge of the references so examined. Personnel administration is considered a permanent problem and a major staff function. The worker is given a position in industry of importance greater than has usually been allotted him, not for sentimental reasons, but because of the bearing upon production of his condition, mental and physical.

The book is addressed to employers, personnel executives and employment managers and to students of personnel administration, but it is hoped by the authors that it will have value, also, for managers, workers and consumers.

Some of the general topics treated are: The field of personnel administration, human values in industry; the reasons for a personnel department; sources of labor supply; methods of selection and placement; hours and working periods; training; health; safety; the problem of foremanship; job analysis and job specification; the measurement of labor turnover; the labor audit check list; the elements in wage determination; the business value of the collective bargain; employers' associations; organizations of workers.

Wings of War. By Theodore Macfarlane Knappen, Chief Aeronautical Instructor, U. S. N. 289 pages, 8 x 5¾ in., 44 illustrations. Published by G. P. Putnam's Sons, New York and London, The Knickerbocker Press.

This book contains an account of the important contribution of the United States to aircraft invention, engineering, development and production during the World War. The author is fair and painstaking, though at times naturally critical of delay and red tape. The book is recommended for the student, the technician and the man in the street.

Rear-Admiral D. W. Taylor writes an introduction, in which he tells how the Navy staked all on the Liberty motor. Some of the chapters of outstanding interest are: The Task Set Before the Builders; Origin of the Liberty Engine; Liberty Engine Production; Development and Production of Other Engines; Centralization and Manufacturing Responsibility; Airplane Production Results; Machine Guns for Airplanes; Military Balloons; Naval Aircraft Production; and others—twenty-seven paragraphs in all.

Forthcoming Meetings

An exposition of U. S. manufacturers at Buenos Aires, Argentine Republic, S. A., has been arranged for the month beginning Nov. 15. Information can be obtained from the American National Exhibition, Inc., Bush Terminal Sales Building, 132 West 42nd St., New York.

The Federated American Engineering Societies will hold its first meeting at the Hotel New Willard, Washington, D. C., on Nov. 18 to 20 inclusive.

The National Machine Tool Builders' Association will hold its 19th annual Fall convention at the Hotel Astor, New York City, on Thursday and Friday, Dec. 2 and 3, 1920. C. Wood Walter, care of the association's offices at Worcester, Mass., is secretary.

The 1920 annual meeting of the American Society of Mechanical Engineers will be held in the Engineering Societies Building, 29 West 39th Street, New York City, from Dec. 7 to Dec. 10.

The Society of Automotive Engineers will hold its annual meeting on Jan. 11 to 13 inclusive at New York.

Condensed-Clipping Index of Equipment

Patented Aug. 20, 1918

Grinding Machine, Tool, "No. 109"

Ransom Manufacturing Co., Oshkosh, Wis.

"American Machinist," Sept. 30, 1920



The motor-driven, ball-bearing, tool-grinding machine illustrated was designed to save floor space. The motor is a General Electric ¾-hp., alternating-current, 60 cycle, 2 or 3 phase, any voltage. A quick make and break oil switch is used. The machine is started by stepping upon either of the two pedals at the base. The bearings are SKF self-aligning and the arbor is of high-carbon steel. Specifications: Abrasive wheels, 12 x 1 in. Wheel flanges, 6 in. Diameter of arbor where wheels go on, 1¼ in. Distance from floor to center of arbor, 38¼ in. Length of arbor, 19¾ in. Size of base on floor, 17½ in. Weight, complete, 489 lb. Speed, 1,800 r.p.m.

Vise, Machine, Quick-Acting

Nelson Tool and Machine Co., Inc., 82-88 Llewellen Ave., Bloomfield, N. J.

"American Machinist," Sept. 30, 1920



The screw operating the sliding jaw of this vise is set at an angle so that when pressure is exerted in holding work the wedge block forces the jaw against the bottom of the vise, making it impossible for the jaw to tilt upward. It is claimed that a hammer is not required to bed work down on either the vise bottom or on parallels. The vise is made in two sizes. No. 1 has jaws 6 in. wide and 2 in. deep; opening 5¾ in. No. 2 has jaws 4 in. wide and 1½ in. deep; opening 4 in.

Drilling Machine, Portable, Universal

Leopold F. Glaude, 930 N. Washtenaw Ave., Chicago, Ill.

"American Machinist," Sept. 30, 1920

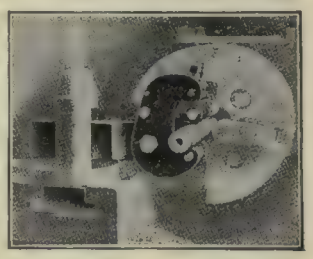


All the working parts of this machine are mounted on a 1½-in. tubular-steel column from which they can be readily removed and clamped to the flat surface of any work that is to be drilled. The machine is operated by hand, has a two-speed change gear, and both screw and lever feed. A centering chuck and a V-block are provided. By clamping a shaft in the outer V-block and having the inner V-block slightly loose, keyways can be cut in the shaft by means of a two-lip tool, the feeding being accomplished by means of a right- and left-hand screw that actuates the V-blocks. Specifications: Column, 1½ x 30 in. Will drill to center of 7-in. circle. Capacity, 0 to ¾ in. drill. Table, 6 in. diameter. Hole in spindle, No. 2 Morse taper. Weight, 45 lb.

Knurling Tool

Newman Manufacturing Co., 717 Sycamore St., Cincinnati, Ohio

"American Machinist," Sept. 30, 1920



The tool carries two knurls, placed on opposite sides of the work. It is claimed that, since there is no side-thrust on the work, it is not necessary to use the tailstock center and that very high speeds are obtainable The tool is furnished with one set of standard knurls, cut either checkered, helical or straight with pitches of either 32, 20 or 14 lines per inch. All parts are of steel. The knurls are easily removable and the distance between them can be varied. The tool is made in two sizes, one for knurling stock up to 1 in., the other for stock between 1 and 2 in. in diameter.

Vise "Handl"

Newman Manufacturing Co., 717 Sycamore St., Cincinnati, Ohio

"American Machinist," Sept. 30, 1920



This vise is applicable to general shop use as well as tool and die work. The jaws are operated by turning the small lever, the two screws being geared together so that they work simultaneously and keep the jaws parallel. One jaw is provided with a V for gripping round work. The overall length of the vise with the handle is 9½ in., the jaws are 1 in. wide and the maximum distance between them is 2¾ in. The jaws can be used as a separate unit and held in a bench vise. The base shown is known as the "Griptite" and is intended for holding the jaws so that they can be adjusted to any position. All parts of the base are made of steel.

Filter, Oil, "9-F"

S. F. Bowser & Co., Inc., Fort Wayne, Ind.

"American Machinist," Sept. 30, 1920



This filter is intended for filtering and sterlizing oil used as a lubricant or coolant in metal cutting. The oil from the machines or chip separators is delivered to the filter, which automatically removes the foreign matter and sterilizes the fluid. After passing through a series of compartments, screens, filtering devices, etc., the oil is delivered to the filter tank which acts as a temporary storage. From this tank the oil can be returned to the machines, the same as new oil, and used again. These filters can be specially designed to fit individual conditions.

Riveter, Ash-Can

Baird Pneumatic Tool Co., Kansas City, Mo.

"American Machinist," Sept. 30, 1920

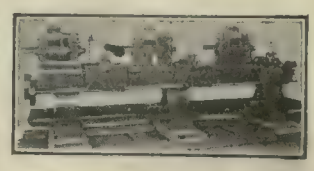


This machine has a four-way valve for operation by workman's foot, so that his hands will be left free in placing and holding the work to be riveted. The dies are wide enough to bridge the reinforcing ribs on the side of an ash-can and will drive two rivets, one on each side of a rib, at a single stroke. It is claimed that a pressure of 35 tons is exerted on the dies with an air pressure of 100 lb. per square inch. The machine can be removed from the stand and mounted on a bench if desired. Weight, with stand, 740 pounds.

Lathe, Multi-Head

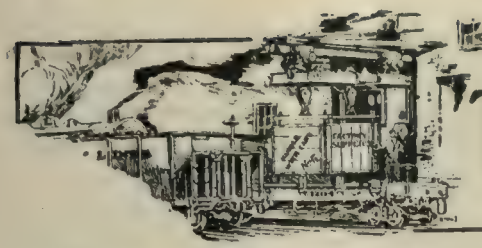
Seneca Falls Manufacturing Co., 387 Fall St., Seneca Falls, N. Y.

"American Machinist," Sept. 30, 1920



This machine is intended for turning short work that can be held on an expansion arbor or in a chuck, and that does not require the use of a tailstock or other form of outboard support. Three heads and carriages are mounted on one bed, the feed of all the carriages being driven from the same feed shaft. The machine can be furnished with heads having plain pulleys and back gears or with two-step cone pulleys without back gears. The feed drive is taken direct from the countershaft to a pulley at the end of the machine and from there to the feed shaft by silent chain. Specifications: Swing: over bed, 18½ in.; over carriages, 11½ in. Spindle: front bearing, 3½ x 5½ in.; back bearing, 2¾ x 4½ in. Drive pulley, 6 in. face; 10½ in. diameter.

Clip, paste on 3 x 5-in. cards and file as desired



THE WEEKLY PRICE GUIDE

IRON AND STEEL

PIG IRON—Quotations compiled by The Matthew Addy Co.:

CINCINNATI	Current	One Year Ago
No. 2 Southern	$46.50	$30.35
Northern Basic	51.30	27.55
Southern Ohio No. 2	48.50	28.55
NEW YORK—TIDEWATER DELIVERY		
2X Virginia (Silicon 2.25 to 2.75)	57.12	32.40
Southern No. 2 (Silicon 2.25 to 2.75)	52.10	35.20
BIRMINGHAM		
No. 2 Foundry	42.00@45.00	29.25
PHILADELPHIA		
Eastern Pa., No. 2x, 2.25-2.75 sil.	51.25	29.00-30.00
Virginia No. 2	50.00*	33.10
Basic	51.00†	26.75
Grey Forge	48.00*	26.75
CHICAGO		
No. 2 Foundry local	47.00	26.75
No. 2 Foundry, Southern	48.67	28.00
PITTSBURGH, INCLUDING FREIGHT CHARGE FROM VALLEY		
No. 2 Foundry	49.56	28.15
Basic	48.96	27.15
Bessemer	51.96	29.35

* F.o.b. furnace. † Delivered.

STEEL SHAPES—The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses at the cities named:

	New York Current	New York One Month Ago	New York One Year Ago	Cleveland Current	Cleveland One Year Ago	Chicago Current	Chicago One Year Ago
Structural shapes	$4.30	$4.47	$3.47	$3.44	$3.37	$4.08	$3.47
Soft steel bars	4.50	4.62	3.37	4.50	3.27	3.98	3.37
Soft steel bar shapes	4.50	4.62	3.37	....	3.27	3.98	3.37
Soft steel bands	6.43	6.32	4.07	6.25	.....	.....	.....
Plates, ¼ to 1 in. thick	4.75	4.67	3.67	3.64*	3.57	4.28	3.67

BAR IRON—Prices per 100 lb. at the places named are as follows:

	Current	One Year Ago
Mill, Pittsburgh	$4.25	$2.77
Warehouse, New York	4.75	3.37
Warehouse, Cleveland	3.52	3.27
Warehouse, Chicago	4.12	3.37

SHEETS—Quotations are in cents per pound in various cities from warehouse; also the base quotations from mill:

Blue Annealed	Large Mill Lots Pittsburgh	New York Current	New York One Year Ago	Cleveland	Chicago
No. 10	3.55-7.00	7.23@8.00	4.57	6.75	7.13
No. 12	3.60-7.05	7.28@8.05	4.62	6.80	7.18
No. 14	3.65-7.10	7.33@8.10	4.67	7.35	7.23
No. 16	3.75-7.20	7.43@8.20	4.77	7.45	7.33
Black					
Nos. 18 and 20	4.20-6.20	8.41@9.80	5.30	8.30	7.90
Nos. 22 and 24	4.25-6.25	8.46@9.85	5.35	8.35	7.95
No. 26	4.30-6.30	8.51@9.90	5.40	8.40	8.00
No. 28	4.35-6.35	8.61@10.00	5.50	8.50	8.10
Galvanized					
No. 10	4.70-8.00	8.91@11.50	5.75	8.50	8.25
No. 12	4.80-8.10	9.01@11.50	5.85	8.60	8.30
No. 14	4.80-8.10	9.01@11.60	5.85	8.60	8.45
Nos. 18 and 20	5.10-8.40	9.26@11.90	6.15	8.90	8.75
Nos. 22 and 24	5.25-8.55	9.41@12.05	6.30	9.05	9.15
No. 26	5.40-8.70	9.56@12.20	6.45	9.20	9.30
No. 28	5.70-9.00	9.86@12.50	6.75	9.50	9.60

Acute scarcity in sheets, particularly black, galvanized and No. 16 blue enameled.

Automobile sheets are unavailable except in fugitive instances, when prices are 9.45c per lb. for No. 16; 9.50 for Nos. 18 and 20, and 9.55c for Nos. 22 and 24.

COLD FINISHED STEEL—Warehouse prices are as follows:

	New York	Chicago	Cleveland
Round shafting or screw stock, per 100 lb. base	$6.36	$5.90	$6.00
Flats, square and hexagons, per 100 lb. base	6.86	6.40	6.50

DRILL ROD—Discounts from list price are as follows at the places named:

	Per Cent.
New York	50
Cleveland	50
Chicago	50

NICKEL AND MONEL METAL—Base prices in cents per pound F.O.B. Bayonne, N. J.

Nickel	
Ingot and shot	43
Electrolytic	45

Monel Metal			
Shot and blocks	35	Hot rolled rods (base)	42
Ingots	38	Cold rolled rods (base)	56
Sheet bars	40	Hot rolled sheets (base)	55
Special Nickel and Alloys			
Malleable nickel ingots			45
Malleable nickel sheet bars			47
Hot rolled rods, Grades "A" and "C" (base)			60
Cold drawn rods, grades "A" and "C" (base)			72
Copper nickel ingots			42
Hot rolled copper nickel rods (base)			52
Manganese nickel hot rolled (base) rods "D" — low manganese			64
Manganese nickel hot rolled (base) rods "D"— high manganese			67

Domestic Welding Material (Swedish Analysis)—Welding wire in 100-lb lots sells as follows, f. o. b. New York: 5/32, 8½c. per lb.; ¼, 8c.; 5/16 to ½, 7¾c Domestic iron sells at 12c. per lb.

MISCELLANEOUS STEEL—The following quotations in cents perpoundare from warehouse at the places named:

	New York Current	Cleveland Current	Chicago Current
Openhearth spring steel (heavy)	7.00	8.00	9.15
Spring steel (light)	10.00	11.00	12.25
Coppered bessemer rods	9.00	8.00	6.85
Hoop steel	6.68	6.50	5.43
Cold-rolled strip steel	12.50	8.25	11.00
Floor plates	6.91	6.00	6.88

WROUGHT PIPE—The following discounts are to jobbers for carload lots on the Pittsburgh basing card:

BUTT WELD

Steel Inches	Steel Black	Steel Galvanized	Iron Inches	Iron Black	Iron Galvanized
¼ to 3	54–57½%	41½–44%	⅜	15½–25½%	+1½–11½%
			½	19½–29½%	1½–11½%
			¾ to 1½	24½–34½%	8 –18½%

LAP WELD

2	47 –50½%	34½–38%	1¼		
2½ to 6	50 –53½%	37½–41%	1½		
7 to 12	47 –50½%	33½–37%	2	20½–28½%	6½–14½%
13 to 14	37½–41 %		4½ to 6	22½–30½%	9½–17½%
15	35 –38½%		2½ to 4	22½–30½%	9½–17½%
			7 to 12	19½–27½%	6½–14½%

BUTT WELD, EXTRA STRONG PLAIN ENDS

¼ to 1½	52 –55½%	39½–43%	¼ to 1½	24½–34½%	9½–19½%
2 to 3	53 –56½%	40½–44%			

LAP WELD, EXTRA STRONG PLAIN ENDS

2	45 –48½%	33½–37%	1¼		
2½ to 4	48 –51½%	36½–40%	1½		
4½ to 6	47 –50½%	35½–39%	2	21½–29½%	8½–16½%
7 to 8	43 –46½%	29½–33%	2½ to 4	23½–31½%	11½–19½%
9 to 12	38 –41½%	24½–28%	4½ to 6	22½–30½%	10½–18½%
			7 to 8	14½–22½%	2½–10½%
			9 to 12	9½–17½%	5½–+2½%

	New York Black	New York Galv.	Cleveland Black	Cleveland Galv.	Chicago Black	Chicago Galv.
⅜ to 3 in. steel butt welded	38%	22%	39%	30%	54%40%	40]@30 %
2½ to 6 in. steel lap welded	33%	18%	41%	26%	50@40%	37½@27½%

Malleable fittings. Classes B and C, banded, from New York stock sell at plus 45%. Cast iron, standard sizes, plus 5%.

METALS

MISCELLANEOUS METALS—Present and past New York quotations in cents per pound, in carload lots:

	Current	Month Ago	Year Ago
Copper, electrolytic	18.50	19.00	22.50
Tin in 5-ton lots	44.50	49.00	56.50
Lead	8.50	9.50	6.25
Zinc	8.50	8.35	7.60
ST. LOUIS			
Lead	8.00	8.90	6.00
Zinc	7.70@8.05	7.70@8.40	7.15

At the places named, the following prices in cents per pound prevail, for 1 ton or more:

	New York Cur-rent	New York Month Ago	New York Year Ago	Cleveland Cur-rent	Cleveland Year Ago	Chicago Cur-rent	Chicago Year Ago
Copper sheets, base	29.50	33.50	33.50	34.00	35.50	36.00	36.50
Copper wire (carload lots)	31.25	31.25	30.75	29.00	30.50	29.00	26.00
Brass sheets	28.50	28.50	32.00	36.00	33.00	27.00	28 00
Brass pipe	33.00	33.00	36.00	34.00	39.00	34.00	3, .00
Solder (half and half) (case lots)	35.00	38.00	45.00	40.50	41.00	38.00	38.50

Copper sheets quoted above hot rolled 16 oz., cold rolled 14 oz. and heavier, add 2c.; polished takes 5c. per sq.ft. extra for 20-in. widths and under; over 20 in., 7½c.

BRASS RODS—The following quotations are for large lots, mill. 100 lb. and over, warehouse; net extra:

	Current	One Year Ago
Mill	25.00	24.00
New York	27.00	28.00@29.75
Cleveland	27.00	29.00
Chicago	30.00	27.00

SHOP MATERIALS AND SUPPLIES



ZINC SHEETS—The following prices in cents per pound are f.o.b. mill + less 8% for carload lots..... 12.50

	Warehouse			
	In Casks		Broken Lots	
	Current	One Year Ago	Current	One Year Ago
Cleveland	15.30	12.50	14.70	13.00
New York	14.00	11.50	14.50	12.50
Chicago	15.00	16.50	15.00	16.00

ANTIMONY—Chinese and Japanese brands in cents per pound, in ton lots for spot delivery, duty paid:

	Current	One Year Ago
New York	7.25	9.50
Chicago	9.00	9.75

OLD METALS—The following are the dealers' purchasing prices in cents per pound:

	New York			
	Current	One Year Ago	Cleveland	Chicago
Copper, heavy, and crucible	15.00	17.00	14.00	14.00
Copper, heavy, and wire	14.00	16.00	13.50	14.00
Copper, light, and bottoms	12.50	14.00	12.00	12.50
Lead, heavy	7.00	4.75	7.00	6.50
Lead, tea	5.00	3.75	4.00	5.00
Brass, heavy	9.00	10.50	10.00	14.00
Brass, light	7.00	7.50	7.00	7.00
No. 1 yellow brass turnings	8.00	10.00	7.50	7.50
Zinc	4.50	5.00	4.50	5.50

ALUMINUM—The following prices are from warehouse at places named:

	New York	Cleveland	Chicago
No. 1 aluminum, 98 to 99% pure, in ingots for remelting (1-15 ton lots), per lb	$33.00	$30.00	$33.50

COPPER BARS—From warehouse sell as follows in cents per pound, for ton lots and over:

	Current	One Year Ago
New York (round)	38.00	32.00
Chicago	29.00	31.00
Cleveland	34.00	35.00

BABBITT METAL—Warehouse price per pound:

	New York		Cleveland		Chicago	
	Current	One Year Ago	Current	One Year Ago	Current	One Year Ago
Best grade	90.00	90.00	54.00	70.00	50.00	60.00
Commercial	50.00	50.00	20.50	16.50	12.50	13.00

SHOP SUPPLIES

NUTS—From warehouse at the places named, on fair-sized orders, the following amount is deducted from list:

	New York		Cleveland		Chicago	
	Current	One Year Ago	Current	One Year Ago	Current	One Year Ago
Hot pressed square	+ $6.00	$1.50	List net	$2.25	+1.15	1.85
Hot pressed hexagon	+ 6.00	1.50	List net	2.25	+1.15	1.85
Cold punched hexagon	+ 6.00	1.50	List net	2.25	+1.15	1.30
Cold punched square	+ 6.00	1.50	List net	2.25	+1.15	1.30

Semi-finished nuts, ⅜ and smaller, sell at the following discounts from list price:

	Current	One Year Ago
New York	30%	50–10%
Chicago	40%	50%
Cleveland	50%	60–10%

MACHINE BOLTS—Warehouse discounts in the following cities:

	New York	Cleveland	Chicago
½ by 4 in. and smaller	+ 20%	25%	20%
Larger and longer up to 1¼ in. by 30 in.	+ 20%	25%	10%

WASHERS—From warehouses at the places named the following amount is deducted from list price:

For wrought-iron washers:

New York..... list Cleveland..... $2.00 Chicago..... $1.90

For cast-iron washers, ⅜ and larger, the base price per 100 lb. is as follows:

New York..... $7.00 Cleveland..... $4.50 Chicago..... $5.50

CARRIAGE BOLTS—From warehouses at the places named the following discounts from list are in effect:

	New York	Cleveland	Chicago
½ by 6 in. and smaller	+ 20%	25%	10%
Larger and longer up to 1 in. by 30 in.	+ 20%	20%	5%

COPPER RIVETS AND BURS sell at the following rate from warehouse:

	Rivets		Burs	
	Current	One Year Ago	Current	One Year Ago
Cleveland	20%	20%	10%	10%
Chicago	net	20%	net	20%
New York	25%	40%	net	20%

RIVETS—The following quotations are allowed for fair-sized orders from warehouse:

	New York	Cleveland	Chicago
Steel ⅜ and smaller	List Net	40%	30%
Tinned	List Net	40%	30%

Boiler, ¾, ⅞, 1 in. diameter by 2 to 5 in. sell as follows per 100 lb.:

New York..... $6.00 Chicago..... $5.73 Pittsburgh..... $4.5

Structural, same sizes:

New York..... $7.10 Chicago..... $5.83 Pittsburgh..... $4.60

MISCELLANEOUS

SEAMLESS DRAWN TUBING—The base price in cents per pound from warehouse in 100-lb. lots is as follows:

	New York	Cleveland	Chicago
Copper	$34.00	$36.00	$35.00
Brass	33.00	36.00	34.00

The prices, of course, vary with the quantity purchased. For lots of less than 100 lb., but not less than 75 lb., the advance is 1 c.; for lots of less than 75 lb., but not less than 50 lb., 2½c. over base (100-lb. lots); less than 50 lb., but not less than 25 lb., 5c. should be added to base price; quantities from 10-25 lb., extra is 10c.; less than 10 lb., add .15–20c.

Double above extras will be charged for angles, channels and sheet metal mouldings if ordered in above quantities. Above extras also apply to brass rod other than standard stock sizes—stock sizes being considered as ⅛-2 in. inclusive in rounds, and ⅛-1½ in., inclusive, in square and hexagon—all varying by thirty seconds up to 1 in. by sixteenths over 1 in. On shipments aggregating less than 100 lb., there is usually a boxing charge of $1.50.

LONG TERNE PLATE—In Chicago No. 28 primes from stock sell, nominally, for $12.50 per 100 lbs.

In Cleveland—$10 per 100 lbs.

COTTON WASTE—The following prices are in cents per pound:

	New York			
	Current	One Year Ago	Cleveland	Chicago
White	15.00@17.00	13.00	16.00	11.00 to 14.00
Colored mixed	9.00@14.00	9.00–12.00	12.00	9.50 to 12.00

WIPING CLOTHS—Jobbers' price per 1000 is as follows:

	13½x13½	13½x20½
Cleveland	55.00	65.00
Chicago	41.00	43.50

SAL SODA sells as follows per 100 lb.:

	Current	One Month Ago	One Year Ago
New York	$2.00	$2.00	$1.75
Philadelphia	2.75	2.75	1.75
Cleveland	3.00	3.00	2.50
Chicago	2.00	2.75	2.00

ROLL SULPHUR in 360-lb. bbl. sells as follows per 100 lb.:

	Current	One Month Ago	One Year Ago
New York	$3.90	$3.90	$3.65
Philadelphia	3.65	3.65	3.87
Chicago	4.10	5.00	4.12½

COKE—The following are prices per net ton at ovens, Connellsville:

	October 11	October 4	September 27
Prompt furnace	$16.00@$16.50	$17.00@$18.00	$17.00@$18.00
Prompt foundry	17.00@ 18.50	18.00@ 20.00	18.00@ 20.00

FIRE CLAY—The following prices prevail:

		Current
Ottawa, bulk in carloads	Per Ton	$8.00
Cleveland	100-lb. bag	1.00

LINSEED OIL—These prices are per gallon:

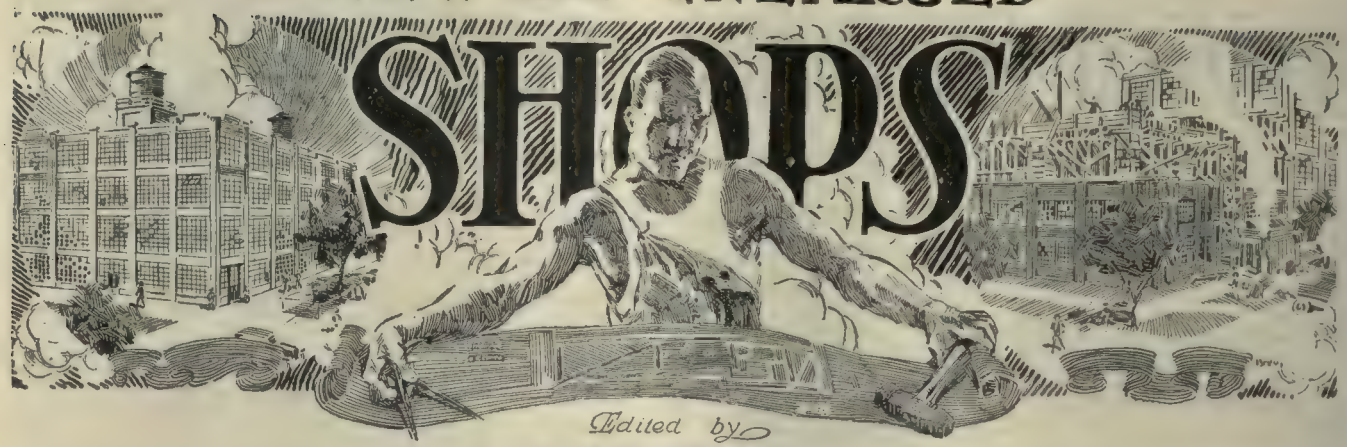
	New York		Cleveland		Chicago	
	Current	One Year Ago	Current	One Year Ago	Current	One Year Ago
Raw in barrels, (5 bbl. lots	$1.20	$2.15	$1.45	$2.50	$1.30	$2.37
5-gal cans	1.35	2.30	1.65	2.75	1.55	2.57
1-gal cans (6 to case)	1.40	....	....	....	....	....

WHITE AND RED LEAD—Base price per pound:

	Red				White	
	Current		One Year Ago		Current	One Year Ago
	Dry	In Oil	Dry	In Oil	Dry and In Oil	Dry and In Oil
100 lb. keg	15.50	17.00	13.00	14.50	15.50	13.00
25 and 50-lb. kegs	15.75	17.25	13.25	14.75	15.75	13.25
12½-lb. keg	16.00	17.50	13.50	15.00	16.00	13.50
5-lb. cans	18.50	20.00	15.00	16.50	18.50	15.00
1-lb. cans	20.50	22.00	16.00	17.50	20.50	16.00

500 lb. lots less 10% discount. 2000 lb. lots less 10–2½% discount.

NEW and ENLARGED



Edited by
L-V-FLETCHER

Machine Tools Wanted

If in need of machine tools send us a list for publication in this column

Md., Fairfield (Baltimore P. O.) — The Union Shipbuilding Co., R. M. Mueller, Purch. Agt.—general machine tools.

Md., Westport (Baltimore P. O.)—The McNamara Bros. Co., Inc., manufacturers of tanks and boilers, G. I. Donovan, Purch. Agt.—bending machine, similar to Geis & Krump, about 11 ft. long for plate about ¾ in. thick (used).

N. J., Jersey City—The Brady Brass Wks. Co., 170 14th St.—one turret lathe equivalent to No. 2A Warner & Swasey.

N. Y., Buffalo—W. Brauer, 265 Hoyt St. (metal worker)—one band saw and one 12 in. joiner.

N. Y., Buffalo—The Day Machinery Co., Exchange and Ellicott Sts.—
One 60 in. to 72 in. power squaring shear, ¼ in. cap.
One 3 in. or 3½ in. bolt heading machine.
One 42 in. x 42 in. x 14 ft. open side planer.
One 48 in. x 12 ft. to 16 ft. lathe.
One 36 in. x 16 ft. lathe.
One 30 ton Lucas forcing press.
One table or knee type horizontal boring mill. About 3 in. bar to take 60 in. between head and outboard support.
One open back inclinable press. Bolster 16 in. x 20 in., 3½ in. to 4 in. stroke.
One Grays sheet metal cutter.
One 48 in. x 48 in. x 12 ft. double housing planer, two rail heads.
One 60 in. x 60 in. x 16 ft. double housing planer, four heads.

N. Y., Buffalo — Schiffmacher-Fillinger, Inc., 257 Mills St., manufacturer of tools and stampings — general machine shop equipment.

N. Y., New York (Borough of Manhattan)—I. Blackman, 479 1st Ave.—general equipment for metal working shop.

N. Y., New York (Borough of Manhattan)—R. W. Cameron & Co., 23 South William St.—three 7 in. radial drilling machines.

N. Y., New York (Borough of Manhattan)—A. Stroud, 327 Bway. (exporter)—
One 24 or 30 in. Gisholt vertical boring mill (used).
One locomotive wheel lathe, capacity 59 in. wheel (new).
Twenty 14 or 26 in. column drills with or without back gears (new).
One 34 in. Gisholt vertical boring mill (new).
One 42 in. Gisholt vertical boring mill (new).
Several Landis bolt cutters (new).
Several turret lathes for brass work (new).
Several No. 4 Universal Warner & Swasey turret lathes (new).

N. Y., Rochester — G. C. Humbert, 301 Cornwall Bldg. (jeweler) — metal slitting and bending machine.

N. Y., Rochester—The Rochester Barrel & Machine Co., St. James Pl., T. M. Teal, Purch. Agt.—general machine tools.

Pa., Lebanon—The Cornwall R. R., Donaghmore St.—machine shop equipment.

Pa., Williamsport—The Valley Iron Wks., 209 West St.—one large boring mill to accommodate castings up to 13½ ft.-14 ft. in diameter.

Tenn., Memphis — The Rechman Crosby Co., 223 South Front St.—bolt heading machine ¼ in. to 2 in. capacity, and a bolt heading machine ¼ in. to 1½ in. capacity.

Ill., Chicago — A. Lawder & Sons, 6910 Lafayette Ave.—bar bending machine.

Ill., Chicago — L. G. Neff, 1045 West Washington Bldg.—one pipe cutting off machine with variation of approximately 3/32 of an in. in the diameter of larger sizes of pipe.

Ill., Chicago—The Sinclair Refining Co., 111 West Washington St. — one universal patternmaker's bench wood trimmer with swinging gages to cover angles from 30 degrees to 135 degrees capacity, 4 in. vertical 8 in. horizontal cut (new).

Mich., Detroit—The Detroit Brass & Malleable Wks., 331 Holden St.—several No. 22 New Britain tapping machines (used).

Mich., Detroit—The Union Cap Screw Co., 684 Hendrie St.—screw machine and miscellaneous equipment.

Mich., Rogers—The Michigan Limestone & Chemical Co. — 15 ft. universal radial drill, 16 in. swing lathe with 6 ft. bed, and a 42 in. to 52 in. lathe.

Wis., Algoma — The Algoma Fdry. and Machine Co.—machine tools for manufacturing ensilage cutters.

Wis., Milwaukee—The Amer. Valve Rotator Co., 917 Chestnut St., H. Danischefsky, Purch. Agt.—milling machine.

Wis., Milwaukee — The Holm Radiator Co., 340 1st Ave., W. Laitsch, Purch. Agt. —hand bench shear, punch drill press to drill 1 in. hole, 30 in. to 36 in. folder, 40 in. to 42 in. squaring shear and 30 in. x 2 in. slip roll.

Wis., Milwaukee — The Modern Grinder Co., 53 Oneida St., A. Strauss, Purch. Agt. —2 milling machines, medium sized.

Wis., Milwaukee — The Utility Hoist & Mfg. Co., 829 Forest Home Ave., C. Worden, Pres.—shaper, planer, lathe and drill press for plant at Prairie Du Sac.

Wis., Milwaukee—The Viktry Mfg. Co., 38th St. and Hillside Lane, manufacturer of spark plugs—machine tools.

Wis., Milwaukee—M. J. Walsh Co., 141 Sycamore St.—four 11 in. Gleason bevel gear finishers, Erie double frame hammers, No. 1 Ajax bull dozer, No. 405 Bliss double crang toggle drawing press with stroke of draw in slide 12 in., stroke of blank holder 18 in.

Wis., Washburn—The Anchor Shipbuilding Co., R. Curr, Purch. Agt.—machine shop equipment.

Minn., Albert Lea—The Amer. Gas Machine Co., Inc.—punch press with adjustable table, 1½ in. stroke and flywheel of about 500 lbs. (new).

Cal., San Francisco—The Koster Co., 433 California St.—machine tools for bolt and nut manufacturing plant.

Ont., London—J. L. Bell, P. O. Box 396—one crankshaft grinding machine for auto work, one internal grinding machine for auto cylinders, en bloc., two and three grinding machines for auto pistons (new or used).

Machinery Wanted

Conn., Hazardville—A. D. Bridges Sons, Inc. (contractors) — cement block machine for making concrete blocks.

Md., Baltimore — The Natl. Bituminous Enamel & Paint Corp., Keyser Bldg., G. L. Sleight, Gen. Mgr.—laboratory equipment, paint grinding and mixing machinery, etc.

N. J., Newark—A. R. Jealous, 759 Degraw Ave.—one 9-10 in. lathe, 36 in. between centers, hollow spindle and screw cutting attachment.

N. Y., Lewiston—The Riverside Pulp and Paper Co., W. Burke, Purch. Agt.—general paper mill machinery.

N. Y., New York (Borough of Manhattan)—New York Post Office, Park Row—one hollow chisel mortising machine.

S. C., Darlington — The Young Tucker Mfg. Co., Box 291—one machine for bending band steel to cover wooden wheels from 5-17 in. in diameter, one small lathe for turning rollers for cotton planters (wooden rollers, about 15 in. long by 6 to 8 in. in diameter), also for smaller work in woodwork.

O., Cleveland — The Natl. Power Mchy. Co., 1914 Scranton Rd.—electric traveling crane for handling electrical machinery.

O., Cleveland Heights (Warrensville P. O.) — The Bd. Educ., Lee Rd. — manual training equipment, etc.

Wis., Chippewa Falls—The South Brown Co., 222 South Main St., H. Schneider, Purch. Agt. — broom making and wire working machinery.

Wis., Milwaukee—City Sewerage Comn.—traveling crane.

Wis., Milwaukee — The Modern Steel Castings Co., 1400 33d St.—modern steel foundry equipment.

Wis., New London — The Wolf Valley Dairy Co., G. Putnam, Purch. Agt. — ice cream making machinery.

Wis., Prairie du Chien—Phoenix Parfrey Co.—machinery for manufacture of veneers.

Wis., Tomah—Bd. of Educ., C. B. Drowatska, Clk.—woodworking machinery for manual training department.

Minn., Austin—G. A. Hormel & Co.—one hand power hoop flaring machine (new).

Minn., Minneapolis—Cleveland Wrecking & Contg. Co., 1221 6th Ave., N., S. G. Rosenstein, Mgr.—one complete sawmill outfit, either gasoline or electric driven (new, or used if in good condition).

Mo., Joplin—The Eagle-Picher Lead Co., Smelter Hill—one 100 ft. crane for plant at Galena, Kan.

Col., Denver—The Great Western Sugar Co., Sugar Bldg.—machinery for sugar refinery at Minatare, Neb.

Col., Denver—The Great Western Sugar Co., Sugar Bldg.—machinery for sugar factory at Johnstown.

Tex., Dallas — The Trinity Paper Mills, 401 Marvin Bldg.—machinery for the manufacture of paper pulp from cotton seed linters.

Tex., Gonzales—F. E. Shuler Grain Co.—grain elevator equipment, mill for grinding feed, corn shelling outfit, etc.

Ont., Midland—The Copeland Flour Mills, Midland Ave.—flour milling equipment.

Ont., St. Thomas—The Canadian Edison Phonographs, Ltd. — machinery for the manufacture of phonographs and cabinets.

N. S., Chester—The Hawboldt Gas Engine Co.—machinery to replace equipment destroyed by fire.

Metal Working

NEW ENGLAND STATES

Conn., Ansonia — The Amer. Brass Co., 58 Liberty St., will soon award the contract for the construction of a 1 story, 340 x 400 ft. addition to its factory. Estimated cost, $700,000.

Conn., Hartford—The Arrow Electric Co., 99 Hawthorne St., has awarded the contract for the construction of an addition to its factory for the manufacture of electric supplies. Estimated cost, $12,000.

Conn., Hartford—The Bd. of Contract and Supply will soon award the contract for the construction of a 2 story 50 x 120 ft. machine shop on John St. Estimated cost, $125,000. Noted July 29.

Conn., New Britain—The New Britain Lumber & Coal Co., 301 Park St., has awarded the contract for the construction of a 2 story, 35 x 150 ft. garage on Park St. Estimated cost, $50,000.

Conn., New Britain — The Vulcan Iron Wks., 63 John St., has awarded the contract for the construction of a 1 story, 90 x 100 ft. foundry. Cost between $45,000 and $50,000.

Conn., New Haven — D. Levine, 191 George St., plans to build a 1 story, 60 x 60 ft. garage on Commerce St. Estimated cost, $15,000. J. Weinstein, 6 Church St., Archt.

Me., Auburn—Fitz Bros. Co., Minot Ave., manufacturer of shoe lasts, has awarded the contract for the construction of a 2 story addition to its plant on Starberry Ave. Estimated cost, $30,000.

Me., Farmington—The Morton Motor Co. plans to build a 1 story, 60 x 115 ft. garage, etc. Estimated cost, $25,000. O. P. Stewart, Archt.

Me., Portland—The Maine Central R.R., St. John St., has awarded the contract for the construction of a 1 story, 20 x 32 ft. addition to railroad shop at Thompsons Point here. Estimated cost, $10,000.

Mass., Athol—The Union Twist Drill Co. has awarded the contract for the construction of a 1 story, 40 x 100 ft. factory. Estimated cost, $30,000.

Mass., Everett—The Boston Elevated Ry. Co., 108 Massachusetts Ave., Boston, is having plans prepared for the construction of several car repair shops. Estimated cost, $3,000,000. D. P. Robinson, 125 East 46th St., New York City, Archt. and Engr.

Mass., Fall River—The Fall River Bobbin & Shuttle Co., 821 Cambridge St., has awarded the contract for the construction of a 4 story, 41 x 100 ft. addition to its plant. Estimated cost, $50,000.

Mass., Lynn—The General Electric Co., 84 State St., West Lynn, has awarded the contract for the construction of a 1 story, 180 x 240 ft. addition to its factory, to have 12 x 20 ft., 16 x 40 ft. and 40 x 40 ft. ells. Estimated cost, $150,000. Noted Sept. 9.

Mass., Somerville—The Amer. Tube Wks., Somerville Ave., will soon award the contract for the construction of a 1 story addition to its drawing mill. Cost to exceed $75,000. C. R. Makepiece & Co., 430 Butler Exch. Bldg., Providence, Archt. and Engr.

Mass., Watertown — The Walker Pratt Mfg. Co., 31 Union St., Boston, has awarded the contract for the construction of a 1 story, 120 x 160 ft. addition to its plant on Cypress St. here for the manufacture of stoves. Estimated cost, $70,000.

Mass., West Springfield (Springfield P. O.)—The C. H. Smith Co., 43 Lynn St., Springfield, manufacturer of rolls for watermarks and cylinder molds for paper making machines, has awarded the contract for the construction of a 1 story, 39 x 85½ ft. factory on Slyvan St. here. Estimated cost, $10,000.

Mass., Worcester—The Conroy Motor Co., 671 Main St., will soon award the contract for the construction of a 2 story, 90 x 150 ft. garage and service station on Wellington St. Estimated cost, $100,000. A. F. Gray, 53 State St., Boston, Archt. and Engr.

Mass., Worcester—H. Robbins, 57 Lamartine St., will soon award the contract for the construction of a 1 story, 32 x 42 ft. machine shop and a 1 story, 21 x 30 ft. garage on Lamartine St. Estimated cost, $10,000. E. T. Chapin, 340 Main St., Archt.

Mass., Worcester—The Worcester Fdry. Co., Inc., 180 Prescott St., will build a 1 story, 60 x 150 ft. addition to its foundry. Estimated cost, $30,000. Private plans.

N. H., Keene—A. E. Fish & Co., 8 Elm St., plans to build a 3 story, 40 x 60 ft. addition to its factory for the manufacture of screens. Estimated cost, $20,000. Private plans.

R. I., Providence—G. F. Berkander, Lexington Ave., has awarded the contract for the construction of a 1 story, 30 x 45 ft. garage. Estimated cost, $10,000.

R. I., Providence—Blazer Bros. plan to build a 1 story garage on Troop St. Estimated cost, $10,000. Private plans.

R. I., Providence—G. Colicci, Ridge St., plans to build a 1 story garage and service station. Estimated cost, $20,000. Private plans.

Vt., Manchester—N. D. Cass Co., Athol, will build a 2 story, 30 x 100 ft. factory here for the manufacture of toys. Estimated cost, $15,000.

MIDDLE ATLANTIC STATES

Md., Baltimore — The Columbia Graphophone Co. has awarded the contract for the construction of a 234 x 290 ft. plant on Loneys Lane and Chase St. Estimated cost, $250,000.

Md., Baltimore—J. J. Lacy Co., Philpot and Wells Sts., has awarded the contract for the construction of an addition to its foundry. Estimated cost, $14,000.

Md., Baltimore—Myers Bros., 3931-3943 Falls Rd., have awarded the contract for the construction of a 2 story, 48 x 118 ft. addition to their garage. Estimated cost, $10,000.

N. J., Pennington—The Peerless Insulated Wire & Cable Co. is building a insulated weatherproof wire plant. C. E. Miller, Supt.

N. J., Trenton—The Gasser Mfg. Co. is having plans prepared for the construction of a 1 story, 100 x 100 ft. factory for the manufacture of hoists, etc. Estimated cost, $85,000. W. A. Klemann, 1st Natl. Bank Bldg., Archt.

N. Y., Buffalo—F. N. Trevor, 1382 Niagara St., will build a 2 story, 35 x 75 ft. factory for the manufacture of metal specialties. Estimated cost, $10,000.

N. Y., New York (Borough of Brooklyn)—P. Adler, c/o E. M. Adelsohn, Archt., 1778 Pitkin Ave., will build a 1 story, 100 x 100 ft. garage on 59th St. Estimated cost, $40,000.

N. Y., New York (Borough of Brooklyn)—The C. & K. Bldg. Co., c/o E. M. Adelsohn, Archt., 1778 Pitkin Ave., will build a 1 story garage and shop. Estimated cost, $60,000.

N. Y., New York (Borough of Brooklyn)—H. Katz, 146 Prospect Ave., will build a 1 story, 50 x 90 ft. garage on 9th St. near 3d Ave. Estimated cost, $20,000.

N. Y., New York (Borough of Brooklyn)—W. G. Lahn, 57 East 15th St., will build a 1 story, 100 x 160 ft. garage on 87th St. near 4th Ave. Estimated cost, $55,000.

N. Y., New York (Borough of Brooklyn)—I. Stalman, c/o P. Caplan, Archt., 16 Court St., will build a 1 story, 85 x 250 ft. garage on 65th St. near 5th Ave. Estimated cost, $75,000.

N. Y., New York (Borough of Manhattan)—The Bway. and 126th St. Corp., 1057 Bryant Ave., will build a 2 story, 100 x 150 ft. garage on Bway. and 126th St. Estimated cost, $150,000.

N. Y., New York (Borough of Manhattan)—A. C. Chesley & Co., 277 Rider Ave., plans to build a 2 story, 50 x 200 ft. factory for the manufacture of metal doors on 132d St. near Cypress Ave. Estimated cost, $100,000.

N. Y., New York (Borough of Manhattan)—Gallagher & Shand, Inc., 1731 1st Ave., will build a 1 story, 100 x 110 ft. garage on 105th St. and 1st Ave. Estimated cost, $40,000.

N. Y., New York (Borough of Manhattan)—Rechnitz Bros., 143 Liberty St., will build a 1 story, 100 x 195 ft. garage at 302 East 45th St. Estimated cost, $150,000.

N. Y., New York (Borough of Manhattan)—J. Ruppert, Inc., 1639 3d Ave., has awarded the contract for the construction of a 2 story, 50 x 200 ft. auto repair shop at 243 East 90th St. Estimated cost, $50,000. Noted Sept. 30.

N. Y., Tonawanda — The Stanley Steel Welded Wheel Corp., 40 Court St., Boston, Mass., will soon award the contract for the construction of a 1 story, 100 x 200 ft. plant. Estimated cost, $100,000. Private plans.

Pa., Butler—The Standard Steel Car Co. plans to build a 2 story, 45 x 85 ft. research laboratory which will include chemical, physical, foundry, heat treatment and industrial laboratory divisions. Plans also include a complete machine shop, etc.

Pa., Lebanon—The Cornwall R.R., Donaghmore St., has awarded the contract for the construction of a 1 story, 150 x 200 ft. machine shop.

Pa., Philadelphia—The Amer. Mfg. Co., Water and Morris Sts., has awarded the contract for the construction of a 1 story, 50 x 100 ft. garage on Front and Shunk Sts. Estimated cost, $10,000.

Pa., Philadelphia—J. Boreh, c/o H. H. Kline, Archt., 1612 South 4th St., will soon award the contract for the construction of a 40 x 93 ft. garage at 3056 Salmon St. Estimated cost, $10,000.

Pa., Philadelphia — The Daniels Motor Co., 3d St., Reading, has awarded the contract for the construction of a 1 and 2 story, 40 x 100 ft., 80 x 125 ft. and 80 x 485 ft. factory, office and assembling plant on Westmoreland St. and Huntingdon Park here.

Pa., Philadelphia — C. B. Porter, 126 North 2d St., has awarded the contract for altering its garage and tinware factory at 123 North Broad St. Estimated cost, $75,000.

SOUTHERN STATES

Fla., Moncrief (Jacksonville P. O.)—The Federal Ice & Refrigerating Co., Chicago, has awarded the contract for the construction of a 2 story, 100 x 400 ft. plant here. Estimated cost, $150,000. Equipment to cost about $100,000.

Fla., Jacksonville — The H. Ford Motor Co., Highland Park, Detroit, Mich., will soon award the contract for the construction of a 2 story assembling plant here. Estimated cost, $250,000.

W. Va., McDowell—The New River Co. will soon award the contract for the construction of a 1 story factory and machine shop, to cover 35,000 sq.ft. floor space. Cost between $225,000 and $250,000. Private plans.

MIDDLE WEST

Ill., Chicago—Kroeschell Bros. Co., 460 West Erie St., is having plans prepared for the construction of a 1 and 2 story, 220 x 388 ft. ice machine factory on Diversey St. along tracks of Chicago, Milwaukee & St. Paul R.R. Estimated cost, $800,000. Davidson & Weiss, 53 West Jackson Blvd., Archt.

Ind., Fort Wayne—The International Harvester Co. of America, Inc., 606 South Michigan Ave., Chicago, has purchased a 140 acre site here and plans to build the first unit of its motor truck manufacturing and assembling plant. Day & Zimmerman, 611 Chestnut St., Philadelphia, Engrs.

O., Cincinnati—The Truck Delivery Co., 4424 Ashland Ave., Norwood, has had plans prepared for the construction of a 1 story, 140 x 229 ft. garage on Hopkins Ave. and Montgomery Rd. Estimated cost, $70,000. C. M. Foster, 112 East 4th St., Archt. and Engr.

O., Cleveland—The Accurate Machine Co., 13306 Coit Rd., has awarded the contract for the construction of a 1 story, 60 x 180 ft. factory. Estimated cost, $75,000.

O., Cleveland — The Bamberger Reinthal Co., 2621 East 9th St., has awarded the contract for the construction of a 1 story, 31 x 78 ft. garage on Kinsman Rd. and East 60th St. Estimated cost, $25,000. Noted Oct. 7.

O., Cleveland—W. R. Bossinger Battery Co., 1301 West 117th St., has awarded the contract for the construction of a 1 story, 50 x 60 ft. addition to its factory at 1301 West 117th St. Estimated cost, $25,000.

O., Cleveland — Greenwald & Sprecher, 12201 Madison Ave., have awarded the contract for the construction of a 1 story, 40 x 60 ft. garage on East 17th St. and Payne Ave. Estimated cost, $20,000.

O., Columbus — The Amer. Rolling Mill Co., Parsons Ave. along tracks of Toledo & Ohio Central R.R., has awarded the contract for the construction of an addition to its plant. Estimated cost, $300,000.

O., Sidney—The Wagon Mfg. Co. is having plans prepared for the construction of a 1 story, 80 x 180 ft. foundry. Estimated cost, $75,000. E. McGeorge, 1900 Euclid Ave., Cleveland, O., Archt. and Engr.

Wis., Horicon—The Van Brunt Mfg. Co. will build a 1 story, 80 x 200 ft. foundry addition and a 40 x 80 ft. dry kiln.

Wis., Milwaukee—The Milwaukee Boiler Mfg. Co., 220 Oregon St., has awarded the contract for the construction of a 1 story, 140 x 180 ft. boiler shop on 35th Ave. Estimated cost, $150,000.

Wis., Milwaukee—The Modern Steel Castings Co., 1400 33d St., will receive bids in November for the construction of a 1 story, 80 x 500 ft. or 70 x 350 ft. foundry. Private plans.

Wis., Milwaukee—The Viktry Mfg. Co., 38th St. and Hillside Lane, plans to build a 1 story, 59 x 158 ft. factory for the manufacture of spark plugs. C. Malig, 745 45th St., Archt.

Wis., Neillsville — The Neillsville Auto Co. has awarded the contract for the construction of a 1 story, 90 x 120 ft. plant.

Wis., Oconomowoc—J. S. Birdner, West Ave., has awarded the contract for the construction of a 1 story, 60 x 90 ft. garage. Estimated cost, $12,000.

Wis., Prairie Du Sac—The Utility Hoist & Mfg. Co., 829 Forest Home Ave., Milwaukee, is building a factory here. C. Worden, Pres.

WEST OF THE MISSISSIPPI

Kan., Ottawa—Washburn & Sons, Engrs., Ottawa, have completed plans for the construction of a 2 story, 20 x 120 ft. garage. Estimated cost, $15,000. Owner's name withheld.

Minn., Duluth — The Duluth Water & Light Dept., City Hall, will soon award the contract for the construction of a 3 story, 50 x 140 ft. warehouse and office building on West 1st St. Basement of same will be used as a garage. Estimated cost, $120,000. F. G. Phillips, City Comr. Halstead & Sullivan, Paladio Bldg., Archts. and Engrs.

Mo., St. Louis—The Metallic Industries, Inc., 2209 Pine St., plans to build a toy factory. Estimated cost, $100,000. G. C. Hosch, Pres.

Tex., Eastland—The Ringling, Eastland & Gulf R.R. Co. plans to build a roundhouse, machine shops and warehouse. C. H. Chamberlain, Eastland, Ch. Engr.

WESTERN STATES

Wash., Seattle — School Dist., Central Bldg., will soon award the contract for the construction of a 3 story, 126 x 250 ft. warehouse, machine, plumbing and general shop building on 8th Ave. and Valley St. Estimated cost, $310,000.

CANADA

Ont., London—The Bogert Carlough Co., 28 Peach St., Paterson, N. J., manufacturer of steel sash, plans to build a factory here.

Ont., Toronto — The Exide Battery Co., 101 West End Ave., has awarded the contract for the construction of a 2 story, 80 x 200 ft. garage.

Que., Montreal — The Aircraft Mfg. Co., Ltd., 11 Place de Armes, will soon receive bids for the construction of a plant for the manufacture of aeroplanes, seaplanes, flying boats and airships.

Que., Montreal—The Canadian Steel Foundries, Ltd., Longue Pointe, plans to build an extension to its plant.

Que., Montreal — The Canadian Tube & Iron Co., Ville Emard, has awarded the contract for the construction of a 2 story, 38 x 50 ft. addition to its nut and bolt factory on Hamilton St. Estimated cost, $18,000.

Que., Montreal — V. Fortier, 4031 Berri St., will soon award the contract for the construction of a garage on Notre Dame St., E. Estimated cost, $25,000.

General Manufacturing

NEW ENGLAND STATES

Conn., Bridgeport—The Huber Ice Cream Co., 800 Seaview Ave., will soon award the contract for the construction of a 2 story addition to its plant. Estimated cost, $30,000. L. Asheim, 211 State St., Archt.

Conn., New Haven—The Connecticut Adamant Plaster Co., River St., plans to build a 2 story plant. Estimated cost, $150,000. Private plans.

Me., Portland—The Natl. Biscuit Co., 98 Chestnut St., will soon award the contract for the construction of a 1 story, 60 x 100 ft. addition to its plant on Chestnut St. Estimated cost, $25,000. Private plans.

Mass., Cambridge—A. R. Hyde & Co., 432 Columbia St., is having plans prepared for the construction of a 3 story, 50 x 100 ft. addition to its factory, for the manufacture of shoes. Estimated cost, $75,000. Tuck & Gilman, 34 School St., Boston, Archts.

Mass., Cambridge—The Kingston Knitting Co., 37 Kingston St., Boston, plans to build a 3 story textile mill. Private plans.

Mass., Gardner—C. H. Hartsborn, Main St., manufacturer of chairs, will soon award the contract for the construction of a 3 story, 60 x 65 ft. addition to his plant. Estimated cost, $35,000. Private plans.

Mass., Roxbury—The Childrens Hospital, 300 Longwood Ave., has awarded the contract for the construction of a 2 story addition to its laundry on Longwood Ave. Estimated cost, $25,000.

Mass., West Springfield (Springfield P. O.)—Company is being organized and plans to build a large plant on Park St. for the manufacture of envelopes, etc. A. Laubscher, 77 Ft. Pleasant Ave., Pres.

MIDDLE ATLANTIC STATES

Md., Baltimore—Levenson & Zenitz, Howard and Ostend Sts., manufacturers of furniture, has awarded the contract for the construction of a 3 story, 49 x 91 ft. addition to their plant. Estimated cost, $15,000.

Md., Baltimore—The National Bituminous Enamel & Paint Corp., Keyser Bldg., has awarded the contract for the construction of a factory. Estimated cost, $23,000.

Md., Baltimore — The U. S. Printing & Lithographing Co., 429 East Cross St., has awarded the contract for the construction of a 130 x 150 ft. addition to its plant.

Md., Cumberland—The Amer. Cellulos & Chemical Mfg. Co. plans to build an addition to its plant.

Md., Curtis Bay (Baltimore P. O.)—The Rasin Monumental Co., subsidiary of the Virginia-Carolina Chemical Co., Fulton St., Richmond, Va., manufacturer of fertilizer, is having plans prepared for the construction of 4 buildings which will cover from 30,000 to 40,000 sq.ft. of floor space. Above buildings will replace the present plant, which comprises 20,000 sq.ft. of floor space.

Md., Fairfield (Baltimore P. O) — The Union Shipbuilding Co. plans to build a 2 story, 70 x 200 ft. carpenter shop.

N. Y., New York (Borough of Brooklyn) —The Grand Corrugated Paper Co., 30 Crosby St., will soon award the contract for altering its factory on 32d St.

N. Y., Syracuse—The Crown Oil Co., 310 West Jefferson St., has awarded the contract for the construction of a 1 story, 30 x 110 ft. gasoline and oil plant on Van Rensselaer St. Estimated cost, $30,000.

Pa., Johnstown—The Johnstown Sanitary Dairy Co. had plans prepared for altering and building a 2 story addition to its ice cream factory on Somerset St. Cost between $50,000 and $60,000. McCormick Co., Century Bldg., Pittsburgh, Engrs.

Pa., Pittsburgh — The Antonoff Bakery Co., c/o McCormick Co., Engrs., Century Bldg. , is having plans prepared for the construction of a 2 story bakery on Spring Garden Ave. Estimated cost, $25,000.

SOUTHERN STATES

Tenn., Memphis — The Dixie Rubber Co. has awarded the contract for the construction of a 1 story, 75 x 290 ft. plant.

W. Va., Phillippi—The Phillippi Blanket Mills has awarded the contract for the construction of a 1 story, 25 x 45 ft. plant.

MIDDLE WEST

Ind., Indianapolis — The Capitol Lumber Co., 1712 Wes New York St., will build a 1 story, 60 x 100 ft. and 20 x 150 ft. lumber mill on 48th St. Estimated cost, $50,000.

Ind., Indianapolis—Kingan & Co., Ltd., Maryland St., will build a 6 story, 40 x 56 ft. pickling factory on West Georgia St. Estimated cost, $74,000.

O., Cleveland — The Cleveland Worsted Mills Co., 5900 Bway., has awarded the contract for the construction of a 1 story, 17 x 87 ft. addition to its factory. Estimated cost, $15,000.

O., Cleveland — Glenville Hospital 701 Parkwood Drive, is having plans prepared for the construction of a 2 story, 40 x 50 ft. boiler house and laundry addition. Estimated cost, $40,000. J. M. Benson, 701 Parkwood Drive, Engr.. H. E. Shimmen, 2031 Euclid Ave., Archt.

O., Cleveland—The Commercial Bookbinding Co., 2231 West 110th St., has awarded the contract for the construction of a 2 story, 48 x 110 ft. plant to replace the one which was destroyed by fire. Estimated cost, $50,000.

Wis., Arcadia—The Holton Tobacco Co. plans to build a 2 story, 60 x 300 ft. tobacco factory and warehouse on Main St. Estimated cost, $45,000.

Wis., DePere — The Clover Leaf Dairy Co. plans to build a 1 story, 40 x 160 ft. creamery and dairy products factory on Main St. Estimated cost, $100,000. M. C. Connors, Pres.

Wis., Fond du Lac—J. B. Fellrath, 180 North Main St., will build a 1 and 2 story, 70 x 120 ft. plant for the manufacture of concrete blocks on Brook St.

Wis., Goodman—The School Dist. plans to build a 2 story high school, to include a manual training department. Estimated cost, $100,000. J. Gomber, Clk.

Wis., Manitowoc — The Drost Box Mfg. Co., 1116 South 9th St., has awarded the contract for the construction of a 3 story, 60 x 250 ft. box factory on 8th St. Cost between $50,000 and $60,000. Noted Oct. 7.

Wis., Manitowoc—F. H. Weise Mfg. Co., 714 Huron St., is having plans prepared for the construction of a 2 story, 60 x 150 ft. furniture factory. Estimated cost, $40,000. Private plans.

Wis., Milwaukee—The Shope Brick Co., 216 West Water St., will soon award the contract for the construction of a 1 story, 90 x 150 ft. factory on State St. for the manufacture of cement bricks. Backer & Pfaller, 216 West Water St., Archts.

Wis., Sheboygan — The Textile By-Products Co., Calumet and Seamen Aves., plans to build a 3 story, 60 x 185 ft. textile factory. Estimated cost, $30,000. W. C. Weeks, 730 Ontario Ave., Archt.

Wis., West Bend—The Schmidt & Storck Wagon Co. has awarded the contract for the construction of a 1 story, 100 x 300 ft factory. Noted Sept. 30.

WEST OF THE MISSISSIPPI

Col., Johnstown — The Great Western Sugar Co., Sugar Bldg., Denver, will build a factory here to have a capacity of 1,200 tons of beets per day. Estimated cost, $2,000,000. E. F. Morrison, Sugar Bldg Denver, Engr.

Mo., Kansas City — The Corn Products Refining Co., 17 Battery Pl., New York City, will build a plant here. Estimated cost, $500,000.

Neb., Minatare — The Great Western Sugar Co., Sugar Bldg., Denver, Col., will build a factory here to have a capacity of 1,200 tons of beets per day. Estimated cost, $2,000,000.

Okla., Henryetta—The Cogswell Refining Co., Parsons Bldg., has had plans prepared for the construction of an oil refinery, 2,000 bbl. daily capacity. Estimated cost, $250,000. J. C. Beitsch, Lucerne Apts., Tulsa Engr.

Okla., Tulsa — Boley Bros., 110 West California Ave., Oklahoma City, plans to build a barrel factory here. Estimated cost, $150,000.

Tex., Austin—The University of Texas, Bd. of Regents, is having plans prepared for the construction of a 3 story, 70 x 200 ft. school of chemistry. Estimated cost, $350,000. G. A. Endress, Littlefield Bldg., Archt.

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The Kansas Industrial Court

By K. H. CONDIT
Managing Editor, *American Machinist*

It is not the intention of this brief sketch to supply a critical analysis of the new Industrial Court of the State of Kansas. It has not had time as yet to prove itself one way or the other. Other legislatures are considering similar action, however, and consequently a knowledge of the law itself and the steps leading to its adoption will be useful to employers and managers who may soon be called upon to face the problems involved in its application.

"WHEN a dispute between capital and labor brings on a strike affecting the production or distribution of the necessaries of life, thus threatening the public and impairing the public health, has the public any right in such a controversy, or is it a private war between capital and labor?" This is the question propounded to Samuel Gompers by Governor Allen of Kansas in their so-called debate in New York several months ago. Mr. Gompers claimed the question was a catch question and evaded it, his action being generally interpreted as an indication that he considered the right to strike paramount. Governor Allen and the Kansas legislature have taken the opposite view and the law authorizing the Industrial Court is the result. It is not so very different from some other laws dealing with the same subject but it has very business-like teeth and has been very carefully drawn to resist the inevitable attacks upon its constitutionality. Just how it will stand the test of time is problematical and depends to a large extent upon the wisdom of the appointments of the three judges who compose the court.

A word about the conditions that led to the passing of the bill will perhaps throw some light on a situation that has been misrepresented by interested parties on both sides of the fence.

Judge Curran, of the Kansas Supreme Court, in his decision adjudging Alexander Howat, the head of the United Mine Workers in Kansas, guilty of contempt of court in refusing to testify before the Industrial Court, gave a vivid picture of conditions in Kansas in December, 1919, when the coal miners were on strike for a 60 per cent increase in pay, a six-hour day and a five-day week. "We find the state, by reason of being deprived of fuel, in a paralyzed condition in practically all of its industries. The streets of the cities were dark; the schools were closed and education was interfered with; the unfortunates confined in the hospital for the insane, threatened with the hazard of freezing. We find in the school for the feeble minded the same condition. The hospitals that dot the State of Kansas, where the sick, the weak, the crippled, the maimed and helpless were confined, threatened with the hazard of freezing for want of fuel; the school for the deaf and dumb, and the school for the blind and helpless, and every institution in the state, threatened and doubly threatened; transportation paralyzed; the means of distributing food and other necessaries of life did not properly function as a result of not having fuel. Whenever you paralyze transportation you make a strong bid for starvation and suffering. This was at the beginning of winter and without fuel."

The Birth of the Industrial Court

The miners defied the governor to do anything and he promptly replied with the call for volunteer strike-breakers which was answered by ex-service men, students from the state university and other citizens. They had an awful time of it but they mined coal and got things running again. But Kansas had been badly scared and Governor Allen decided it was time to do something to prevent a recurrence of the danger. He called a special session of the legislature to consider the Industrial Court Bill which had been prepared by William Huggins, a member of the old public utilities commission and an excellent constitutional lawyer.

Organized labor, or rather its leaders, took one good look at the new bill and let out an agonized howl of protest. The big employers also took a look at it but said nothing just then. They spoke later.

It is no great wonder that these labor organizers took fright at Governor Allen's bill for they were wise enough to see an early end to their usefulness if this law accomplished what it set out to do. Under the terms of the bill any group of workers may present a grievance to the court for relief, either through their own representative or through the attorney general of the state. Unlike other courts, the industrial court is financed by the state, thus making it available to the poorest laborer.

One of the first moves of the union element probably had a good deal to do with the early passage of the bill. Shortly after the bill had been introduced before the house, Judge Frank L. Martin, who was making an address on the constitutional features of the measure, read a letter which had been sent out by the local lodge of the Boiler Makers' Union at Newton, Kan., a division point on the Santa Fé railroad. The letter included this resolution:

"Resolved, that Local Lodge No. 404 of the International Brotherhood of Boilermakers, Iron Shipbuilders and Helpers of America, of Newton, Kan., do most urgently protest any 'anti-strike' legislation which may be considered at this session, or any other session of the legislature of the State of Kansas, and be it further resolved that we stand true to the dictation of our international officers, and should they order us to protest this legislation, should it be enacted, by striking, or by other means, we would not hesitate to obey their orders."

As might have been expected the letter created a sensation but had quite the opposite of the desired effect. The open threat stiffened the resolution of some of the waverers and only made the passage of the bill a little more certain.

Strong Objections of Labor Leaders

This was only one of many letters sent out by unions, labor leaders and individuals to Governor Allen, to members of the legislature and to the local press. Howat, the radical head of the coal miners' organization, sent out a statement to the unions on Dec. 29 in which he characterized the proposed legislation as the most drastic and vicious bill against labor ever heard of. He also said that its passage meant "absolute slavery for the coal miners and all other classes of labor in the state," and the destruction of "the usefulness and effectiveness of the organized labor movement in the State of Kansas." Most of the usual arguments in favor of the right to strike were also included.

At the same time the governor and some of the legislators received personal letters from members of the unions strongly favoring the bill as "individuals" but stating that they must be against it as members of the unions.

To the outside spectator these letters are significant. It does not require a great stretch of the imagination to see that what the union leaders and organizers feared was an agency that would supplant them in securing justice for the workmen and thus put an end to some very easy "pickings." On the other hand it seems quite as apparent that the more thoughtful of the rank and file of the unions saw a chance to rid themselves of the virtual slavery imposed upon them by union dictation.

Washington headquarters of the American Federation of Labor saw the "danger" of this Industrial Court bill and sent Frank P. Walsh to address the Kansas legislature in opposition to the bill. Mr. Walsh came well-prepared and talked for five hours on Jan. 8 without the least apparent effect. He was followed the next day by J. I. Sheppard, of Fort Scott, whose remarks were equally ineffective.

So far nothing had been heard from capital, but on Jan. 13, when the hearings before the senate judiciary committee were opened, the coal operators, the millers and the Kansas Employers' Association, through their attorneys, appeared to protest against certain features of the bill. The employers were strong for the section of the bill prohibiting the calling of strikes but were equally strong against the one permitting the state to take over essential industries during emergencies and run them for the protection of the public.

Opinion of the Employers

The fluent staff correspondent of the *Kansas City Star* in describing the hearing says, "The objection of the industries that come under the provisions of the measure is that it is 'clearly unconstitutional' in that it declares private industry to be public utilities. It will, according to the employers, drive capital from the state, take property without due process of law, and several other calamities are threatened in its provisions. It is the cat that threatens the industrial cream, the fly in the industrial butter; the bulldog in the state's backyard to chase industry up a tree or drive it over the state-line fence into other fields of operation."

But in spite of hours of fervid oratory and reams of written and printed matter, the two houses passed the bill separately on Jan. 16 and sent it to conference. It was soon patched up and was signed by Governor Allen on Jan. 23.

The governor wasted no time after the bill became a law in selecting his appointees. He met with two or three refusals, among them that of William Allen White who admitted that he was sorely tempted to break his iron-clad rule of never accepting public office, but on Feb. 2 the three judges were sworn in and the same afternoon Attorney General Hopkins filed the first case in behalf of 60 miners who had been locked out for 30 days.

The three judges, shown with Governor Allen in our illustration, are William L. Huggins, framer of the bill; Clyde M. Reed, the governor's former private secretary, and ex-Senator George M. Wark of Caney County.

Outstanding Provisions of the Bill

Apparently much of the adverse criticism of this Industrial Relations Court bill has been based on a very sketchy acquaintance with its provisions, as some of it seems rather illogical when the bill is carefully analyzed.

The court consists of three judges appointed by the governor and approved by the Senate. The term is three years and the salary $5,000 per year. The senior judge presides.

The court supersedes the public utilities commission and takes over all its duties in addition to the new ones provided for in the act.

The industries declared to be affected with a public interest and over which the court has jurisdiction are specified as follows:

(1) The manufacture or preparation of food products whereby, in any stage of the process, substances

are being converted, either partially or wholly, from their natural state to a condition to be used as food for human beings; (2) the manufacture of clothing and all manner of wearing apparel in common use by the people of this state whereby, in any stage of the process, natural products are being converted, either partially or wholly, from their natural state to a condition to be used as such clothing and wearing apparel; (3) the mining or production of any substance or material in common use as fuel either for domestic, manufacturing, or transportation purposes; (4) the transportation of all food products and articles or substances entering into wearing apparel, of fuel, as aforesaid, from the place where produced to the place of manufacture or consumption; (5) all public utilities as defined by Section 8329, and all common carriers as defined by Section 8330 of the General Statutes.

Section 7 of the act, stripped of its legal verbiage, states that in the case of a controversy which seems likely to endanger the functioning of one of the above-mentioned industries, the court may hold an investigation to settle and adjust this controversy. Also that either party to the controversy or any ten taxpayers may appeal to the court to hold such an investigation. Section 8 gives the court authority to order changes in the industry under its jurisdiction in the matters of working and living conditions, hours of labor, rules and practices, and a reasonable minimum wage or standard of wages, provided such changes are fair to labor, to the industry and to the public. Either party to such a change may apply for relief if the order is found unjust, unreasonable or impracticable after a fair trial of sixty days or more and the court is then required to reopen the case.

The next section concedes the right of capital to a fair return on the investment and the right of workers to a fair wage and healthful and moral surroundings while working. It also recognizes the right of every person to choose his occupation and to make and carry out fair and reasonable contracts in connection with it.

In Section 11 the court is authorized to proceed against any person who refuses to obey its summons or subpœna, in any court having jurisdiction. At the time this is written, Alexander Howat is out on bond for refusing to testify before the court in one of its investigations. The case was decided against Howat in the Kansas Supreme Court and was appealed to the United States Supreme Court. Section 12 permits the court to proceed against either party to a controversy upon its refusal to obey the orders of the court, in the Kansas Supreme Court and also permits either party to appeal to the Supreme Court if it feels itself aggrieved. Such cases in the Supreme court take precedence over other civil cases.

Because of its importance, Section 14 is given in full: "Any union or association of workers engaged in the operation of such industries, public utilities or common carriers, which shall incorporate under the laws of this state shall be by said Court of Industrial Rela tions considered and recognized in all its proceedings as a legal entity and may appear before said Court of Industrial Relations through and by its proper officers, attorneys or other representatives. The right of such corporations, and of such unincorporated unions or associations of workers, to bargain collectively for their members is hereby recognized: Provided, that the individual members of such unincorporated unions or associations, who shall desire to avail themselves of such right of collective bargaining, shall appoint in writing some officer or officers of such union or association, or some other person or persons as their agents or trustees with authority to enter into such collective bargains and to represent each and every of said individuals in all matters relating thereto. Such written appointment of agents or trustees shall be made a permanent record of such union or association. All such collective bargains, contracts, or agreements shall be subject to the provisions of Section 9 of this act."

Section 15 declares it to be illegal for either employer or employee to discriminate in any way against any member of the other party to a controversy because of any action connected with the operation of the court such as testimony, appeals for investigation, etc.

The willful restriction or limitation of service or output of the essential industries is declared unlawful in Section 16, but provision for an appeal to the court for permission to limit output or service is made to take care of possible emergencies.

Section 17 makes it unlawful for any person, firm or corporation, or for any association of persons, "to disobey the orders of the court in relation to the hindrance of the essential industries, provided "that nothing in this act shall be construed as restricting the right of any individual employee . . . to quit his employment at any time." This section goes on to say that conspiracy with other persons to quit their employment or to induce others to quit, to indulge in "picketing" or to intimidate any persons with the intent to make them quit work or to prevent them from accepting work is unlawful.

Section 18 makes violation of the provisions of the act a misdemeanor punishable by a fine of $1,000, imprisonment in the county jail for one year or both.

Section 19 goes after officials of corporations or labor unions or associations who may use their authority to cause others to violate the provisions of the act; in other words, to declare a lockout or call a strike. Such an action is a felony punishable by $5,000 fine, two years at hard labor in the state penitentiary or both.

Section 20 contains the provisions most seriously objected to by the employers. Here it is: "In case of the suspension, limitation or cessation of the operation of any of the industries, employments, public utilities or common carriers affected by this act, contrary to the provisions hereof, or to the orders of said court made hereunder, if it shall appear to said court that such suspension, limitation, or cessation shall seriously affect the public welfare by endangering the public peace, or threatening the public health, then said court is hereby authorized, empowered and directed to take proper proceedings in any court of competent jurisdiction of this state to take over, control, direct and operate said industry, employment, public utility or common carrier during such emergency: Provided, that a fair return and compensation shall be paid to the owners of such industry, employment, public utility or common carrier, and also a fair wage to the workers engaged therein, during the time of such operation under the provisions of this section."

The court is still very young and its ultimate success is of course in doubt. The employers have accepted this situation and are giving the law a fair trial with the hope that it may provide the solution of the labor troubles of Kansas.

Unfortunately the same cannot be said for the labor leaders. As was stated before, the head of the United Mine Workers refused to testify in an investigation into conditions in the coal fields conducted by the court, and is now out on bond pending the decision of the Supreme Court of the United States.

In his remarks before the Chamber of Commerce of the United States at Atlantic City last spring, Governor Allen made the statement that up to that time the court had done more to improve the condition of the mine workers of Kansas than had organized labor in twenty years. Of the twelve cases decided up to that date, eleven had been in favor of the men, a record which has probably done much to convince the doubtful ones that their interests would be taken care of.

The constitutionality of the act creating the court has been upheld by the Supreme Court of Kansas and the vast majority of the people of the state are for it, as shown by the large majority by which Governor Allen was renominated at the primaries. Many other state legislatures are seriously considering the enactment of similar legislation and several have sent special investigators to get complete information on the problems encountered and the results obtained.

The machine industry does not rank with the essential industries denominated in the Kansas act and consequently will not be directly concerned with the provisions of the Kansas law or any similar ones passed by other states. The indirect effects, however, are important for what manufacturer would not benefit by the elimination of the strike blight on transportation and the production of coal? Therefore it behooves employers to be familiar with this effort to provide a substitute for the wasteful strike method of settling controversies between labor and capital, in order to be prepared to meet the problems which are sure to follow when the industries of their own state become subject to similar regulation.

Fixture for Milling an Ellipse

By P. A. FREDERICKS

The necessity of milling small elliptical shapes on a production basis caused the making of this fixture, by the use of which ellipses are milled without the use of a dividing head. The writer states that the form of the work produced approximates an ellipse very closely, although it may not be a true ellipse.

WHEN an elliptic shape requires finishing as a manufacturing proposition, something other than that old stand-by, the master cam, has to be provided, for the percentage of rise on some points of the surface is altogether too great to allow the mechanism to work properly.

Ellipses can easily be turned on a lathe, either the work or the tool being caused to reciprocate to trace the proper outline as the work revolves. Such methods, when applied to milling, are considerably complicated by the interference with the work of the teeth around the periphery of the cutter, the cutting action being different from that of the single-pointed lathe tool.

The writer was recently shown an arrangement in which the cutter interference was actually taken advantage of to help produce the elliptical form, and the device was so simple and effective that it seems worth passing on. Figs. 1 and 2 show, respectively, a front view of the device mounted on the milling machine table, and a vertical side section.

The action is as follows: A knuckle shaft *A*, driven from the feed box of the milling machine, drives an eccentric shaft *B* through a worm and worm gear and a clutch *C*, used for tripping the feed. Rotation of the eccentric causes the pivoted table *D* to move up and down under the cutter *F*, the throw of the eccentric being just half the difference between the large and small axes of the ellipse it is desired to cut. The work *E* is suitably clamped, as shown, under the cutter *F*, and it is geared to the eccentric shaft to revolve once for each two revolutions of the eccentric *B*.

The feed trip pin *G*, adjustably mounted in a tee-slot in the driving gear on the work spindle, trips the clutch *C* and stops the cut by operating against the pivoted lever *H* when one revolution of the work has been completed. The milling machine table is then run to one

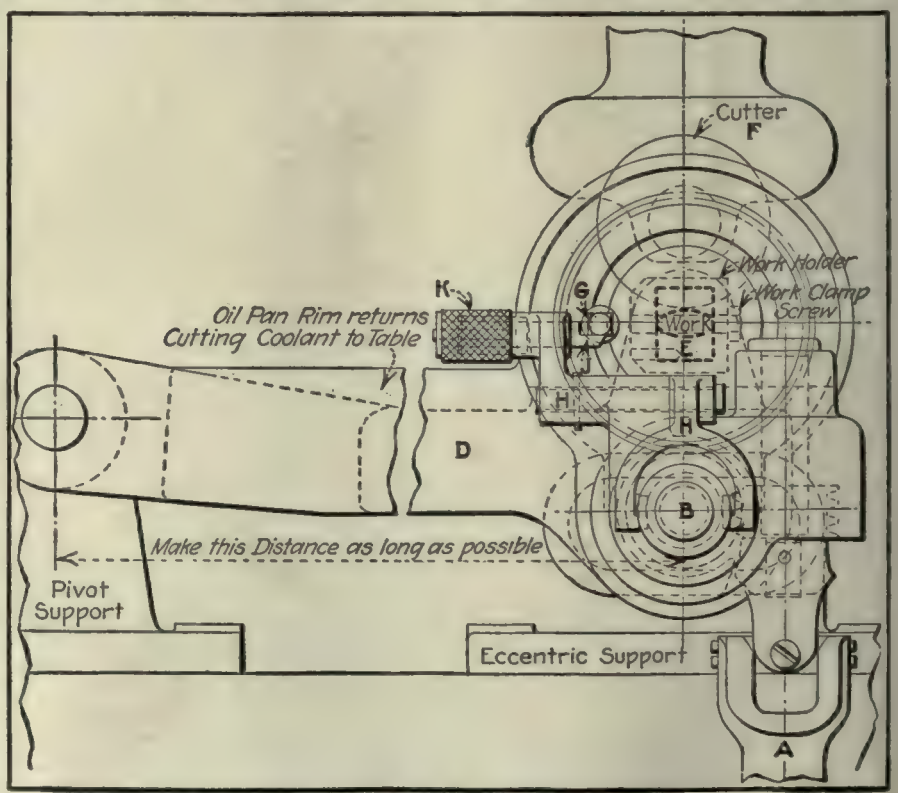


FIG. 1. FRONT VIEW OF ELLIPSE-MILLING FIXTURE

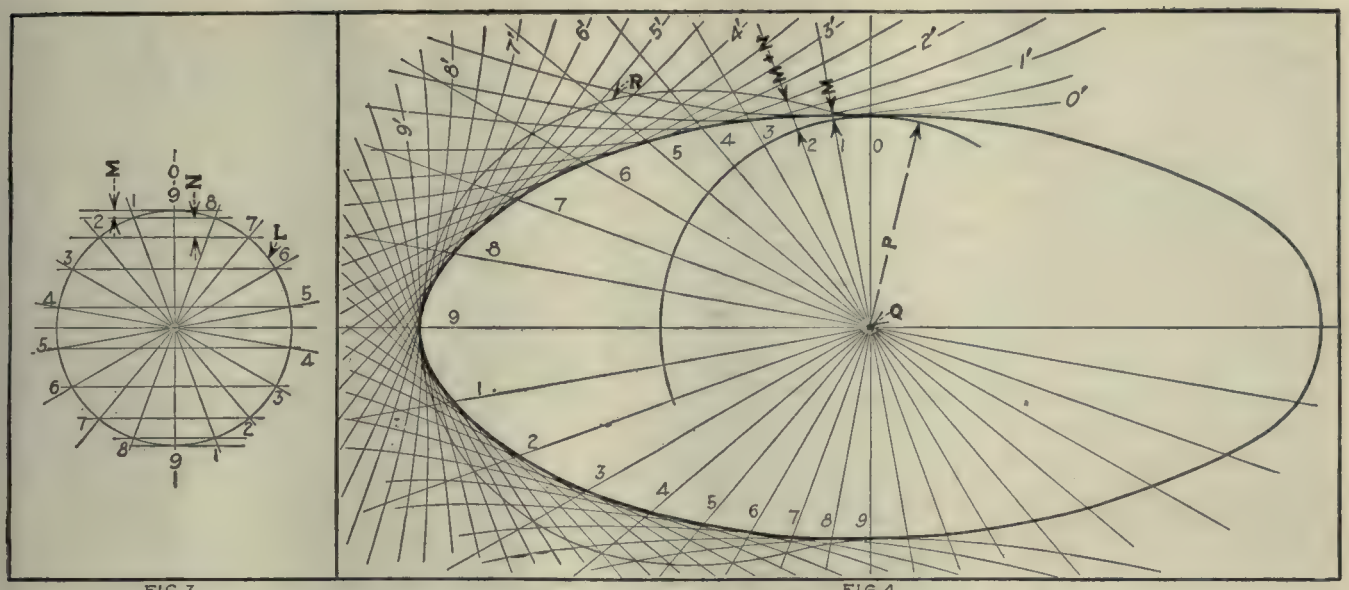


FIG 3 FIG 4

FIG. 3. PATH OF CENTER OF ECCENTRIC

FIG. 4. OUTLINE MILLED ON WORK

side and fresh work inserted, after which the table is run back against a stop and again clamped in the position shown. In order that the automatic feed can be started again at the exact zero point, the pin *J*, which trips the clutch when struck by pin *G*, can be withdrawn by the knurled knob *K*, and the clutch *G* again engaged.

The forming action and the resulting ellipse are shown in Figs. 3 and 4. In Fig. 3, the circular path *L* of the eccentric center is divided into sections marked *0*, *1*, *2*, etc., and representing a movement of 10 deg. on the work. Spaces *M*, *N*, etc., then, represent the movement of the work away from the cutter.

Lines *0*, *1*, *2*, etc., in Fig. 4, represent 10 deg. of movement of the work. Assume that the cutter is originally set at a distance *P* from the center *Q* of the work axis (when work and eccentric are in positions represented by the zero lines). Then, the outline which would be formed, if the eccentric and the work were set in motion and if the cutter were a single point, is represented by curve *R*, obtained by adding to the radius P, Fig. 3, the distances *M*, *MN*, etc., along the lines *1*, *2*, etc. (Fig. 4).

However, owing to the circular shape of the cutter, the form of *R* is partly cut away as the work revolves, the shape which is left being determined by drawing in the cutter outlines (lines *0′*, *1′*, *2′*) for the various positions of the work. The position of the center of the cutter for each position of the work is found by laying off the cutter radius along the various radial lines, *1*, *2*, etc., from the point where the line *R* intersects them. The resulting shape left on the work, as will be seen from Fig. 4, is an ellipse.

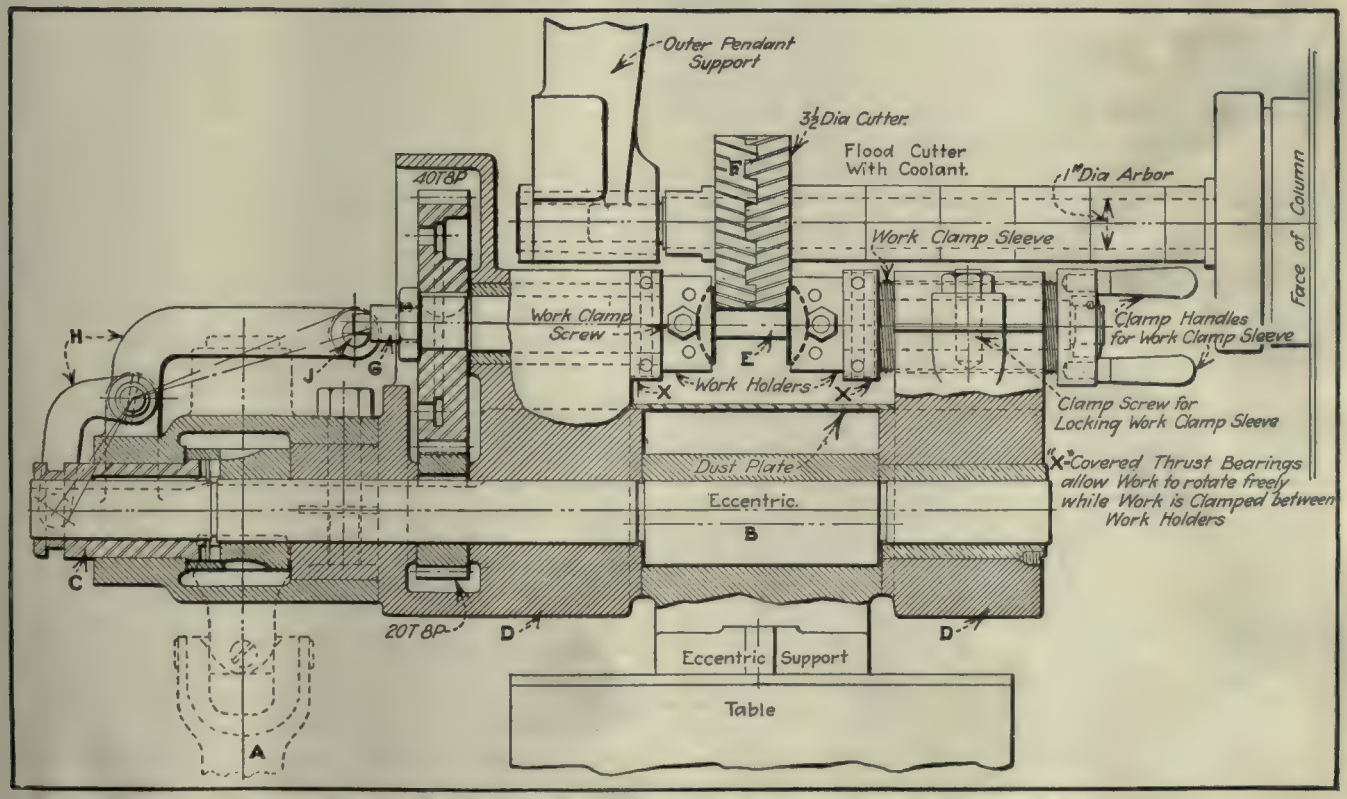


FIG. 2. SECTIONAL ELEVATION OF ELLIPSE-MILLING FIXTURE

There is a very nice problem here for some one with a mathematical turn of mind to prove that the outline thus formed is or is not a true ellipse. The writer has concluded that it is not, because the outline produced must vary slightly with different cutter diameters. Since only one outline could be a true ellipse, it is extremely unlikely that any cutter diameter would exactly produce an ellipse. However this may be, the outline in Fig. 4 comes so close that it apparently coincides with an ellipse laid out according to accepted methods. The variation in the outline caused by changing the cutter diameter makes so little difference that it is not apparent between 3½ and 5-in. cutters on a layout of 10 to 1 scale, though the outline would probably approach line *R* quite rapidly as the cutter diameter approached close to zero.

The above method originated in the customers' engineering service department of the Kempsmith Manufacturing Co., Milwaukee, Wis., for use on one of the milling machines built by that firm.

Know Your Sprinkler Valves

By L. L. Thwing

Some years ago a fire started in the stockroom of the plant where I was employed and various things happened that are likely to happen in almost any shop. In the first place the watchman had no key to the stockroom, as there was no station there for him to ring in on, with the consequence that the fire had quite a start when the water from the sprinkler heads, running out under the door, attracted his attention. It was Sunday morning about church time and it was only after some trouble that the watchman was able to get the storekeeper on the telephone. In the meantime the fire department had forced the door and found the fire had been extinguished by the sprinklers. The storekeeper and assistant superintendent arrived within a short time and their first thought was to shut off the sprinklers, which were going at full force over the stock of finished parts and the file rack. But when it came to doing it nobody knew where the valve was. The engineer was away in his flivver, so that source of information was not available. After shutting off all the valves in sight, together with the indicator posts that controlled the entire building, the flow was finally stopped but not before considerable damage had been done by the water, which in addition to doing damage in the stockroom had gone through to the sheet iron shop on the lower floor. As soon as the engineer could be located and rush back to the shop he pointed out the proper valve. It was located under a bench and had one or two tons of castings piled in front of it.

Last winter I was in a large plant in the middle west and had an excellent opportunity to observe how accidents happen to confirm my belief that the average shop, for one reason or another, is not able to shut off the sprinkler heads as promptly as it should. This company used a number of portable, oil-fired rivet furnaces. The oil supply was in the base of the forge, a tank that would hold at least a half-barrel of oil. The oil in the tank had been exhausted, and the sweeper had been told to fill it from the barrel in the adjacent oil house. The oil was brought to the forge in pails and emptied into the tank through a globe valve in the top. One or two pails had been thus emptied and the man was on his way to the oil house for another, when someone who wanted to use the forge came along and throwing a burning piece of waste into the furnace turned on the compressed air. The air found vent through the open globe valve and carried enough of the oil with it to make a very pretty blaze. The man who had started it was of course covered with the burning oil and started to run, but had gone only a few steps when he was felled by a blow over the head with a piece of 2 x 4 wielded by a quick-witted workman, who then turned the fire extinguisher on him.

The oil burned out in a few minutes and then came the question of shutting off the sprinklers. There was a great running around but nothing happened. An attempt was made to shut off that section of the building at the indicator post in the yard, but it was found that the valve had rusted so firmly in its seat that it could not be moved. In fact the riser was loosened at the tee by the torsional effort and began to leak badly. The flood was finally stopped, how I do not know, as I did not think it expedient to ask too many questions.

Do your night and day watchmen all know where the shut off valves for your sprinkler system are located, and do they know just what each one of them controls?

Scheduling Jig, Fixture and Repair Work

By Henry Lee

Scheduling of such work as is found in making and repairing jigs and fixtures should be done in the shop. To follow up orders in the shop many and various systems have been adopted. The one that I find works out the best is as follows:

A card tickler is made up of plain white cards 3 x 5½ in., the index being numbered from 1 to 31, representing days in the month. As an order is scheduled its estimated finishing date is recorded on one of the cards and the card is filed under that date. As an auxiliary to this tickler there is used a piece of white cardboard 12 x 20 in. ruled into 31 parts to represent the days of a month.

Each order coming into the plant is recorded upon the 12 x 20 in. sheet in a space representing its starting date. This sheet is referred to every day for new orders.

Immediately a holdup or interference, as it is called, occurs on account of hardening, models, samples, change in design or anything else, a horizontal red line is placed at the side of the order number and when the interference is cleared a vertical blue line is drawn through the red one. After clearing up an interference the job is rescheduled.

At the end of each month all orders having interference, or red lines, that have not been cleared by blue lines are carried into an interference column on the cards, written with red ink. As the interference is cleared a blue line is drawn through and the order is rescheduled.

Interferences are usually of two kinds, "local" and "foreign." A local interference is one originating in the shop and it is up to the schedule clerk to remove it. A foreign interference is one that is beyond the shop's control. Three copies of a report on a foreign interference are made. One copy is held in the shop and two sent to the main scheduling office, which retains one and forwards the other to the firm or individual responsible for the hold up, who in turn informs the scheduling office concerning the date when the interference will be cleared. The order is then re-scheduled from that date. In the meantime the originator of the order is notified of the re-scheduled date and governs his work accordingly. When an order is re-scheduled it is so indicated by a red R placed at the right of the order number.

SEVEN CENTURIES of BRASS MAKING



By O. A. KENYON
ENGINEER RAY D. LILLIBRIDGE, Inc.,
NEW YORK*

STUDIES of the most ancient and primitive ruins indicate that the metallurgy of copper, tin and iron was practiced in its crudest form in the earliest periods of man's development. Of these three metals, copper, on account of the ease with which it is smelted, refined, and worked, was probably the first to be used. There is no definite proof of this except that so far as historic times are concerned, although iron was known, copper and bronze were in common use long before iron. Neither the name of the man who discovered the reduction of copper by smelting nor the method he employed will ever be known because he lived long before men began to make records of their discoveries and doings. We have, however, some evidence of prehistoric metallurgy in the many "founders' hoards" or "smelters' hoards" of the Bronze Age which have been found in Western Europe. These hoards indicate that in those days charcoal and ore were burned in a simple shallow pit in the ground and the fire continued until the copper was melted; then it was allowed to cool in the bottom of the pit, forming a rough round cake of from 8 to 10 in. in diameter. Another indication of prehistoric metallurgy is the fact that copper from this period analyzed by Professor Gowland and others shows a small percentage of sulphur, signifying that the copper was derived from smelting oxidized ores.

I. Historic Notes

This series constitutes a brief history of the ancient art of making brass and its early (and even recent) method of production, contrasted with that of the electric furnace process, a twentieth-century achievement. Part I relates the chief authenticated historic facts, from the fourth dynasty (3800-4700 B. C.) to comparatively recent times.

Prehistoric Evidences

Copper objects appear in the pre-historic remains of Egypt. In fact, they were common throughout the first three dynasties, and bronze articles have been found that date from the fourth dynasty (from 3800 to 4700 B. C. according to the authority adopted). In Egyptian hieroglyphics the crucible is the emblem of copper, which would indicate that crucibles were used for refining. The earliest source of Egyptian copper was probably the Sinai Peninsula, where crucibles have been found in ruins. There, too, are found reliefs dating as far back as the time of Senefern (about 3700 B. C.) indicating that he worked the copper mines. Our knowledge of Egyptian copper metallurgy is limited to deduction from metal objects found, and to a few pictures of crude furnaces and bellows, which, however, indicate a considerable advance over the crude hearth method.

The remains of the Mycenaean, Phoenician, Babylonian, and Assyrian civilizations stretching over a period from 1500 to 500 B. C. have yielded endless copper and bronze objects, the former of considerable purity and the latter of fairly constant proportion of from 10 to 14 per cent tin.

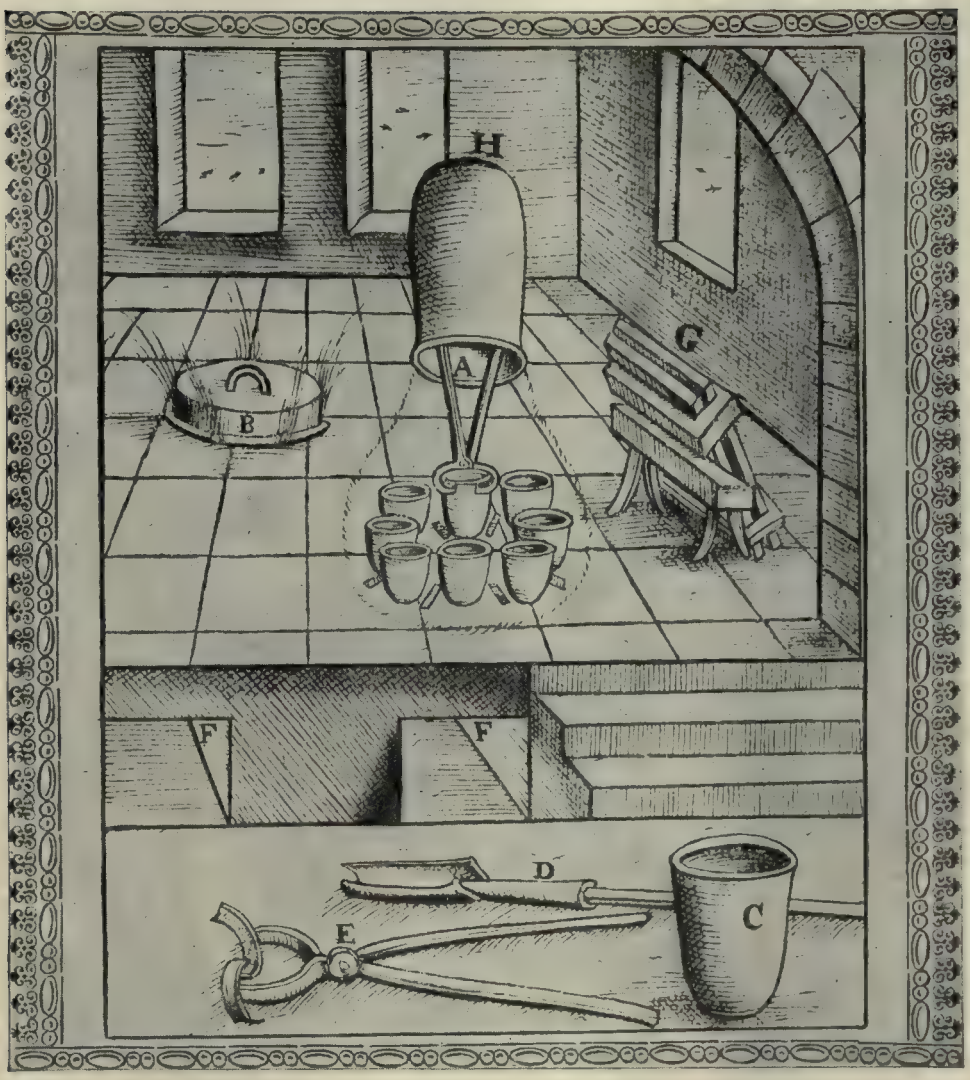
Copper

Apparently the first copper used by the ancient people came first from Sinai and then later from Cypress. Research in Cypress shows that it produced copper from 3000 B. C., and largely because of its copper it passed successively under the domination of the Egyptians, Asyrians, Phoenicians, Greeks, Persians and Romans. Our word "copper" was derived by the Romans, shortening aes cyprium (Cyperian copper) to cuprum.

Tin

As to the tin used in the bronzes, there is some difference of opinion as to its origin. Professor Gowland, for instance, believes that the early bronzes were the result of direct smelting of stanniferous copper ores. However, there is considerable evidence to the effect that this was not true of the Egyptian and other ancient bronzes. As to the source from which the tin was

*Booklet published by the Bridgeport Brass Co., Bridgeport, Conn.

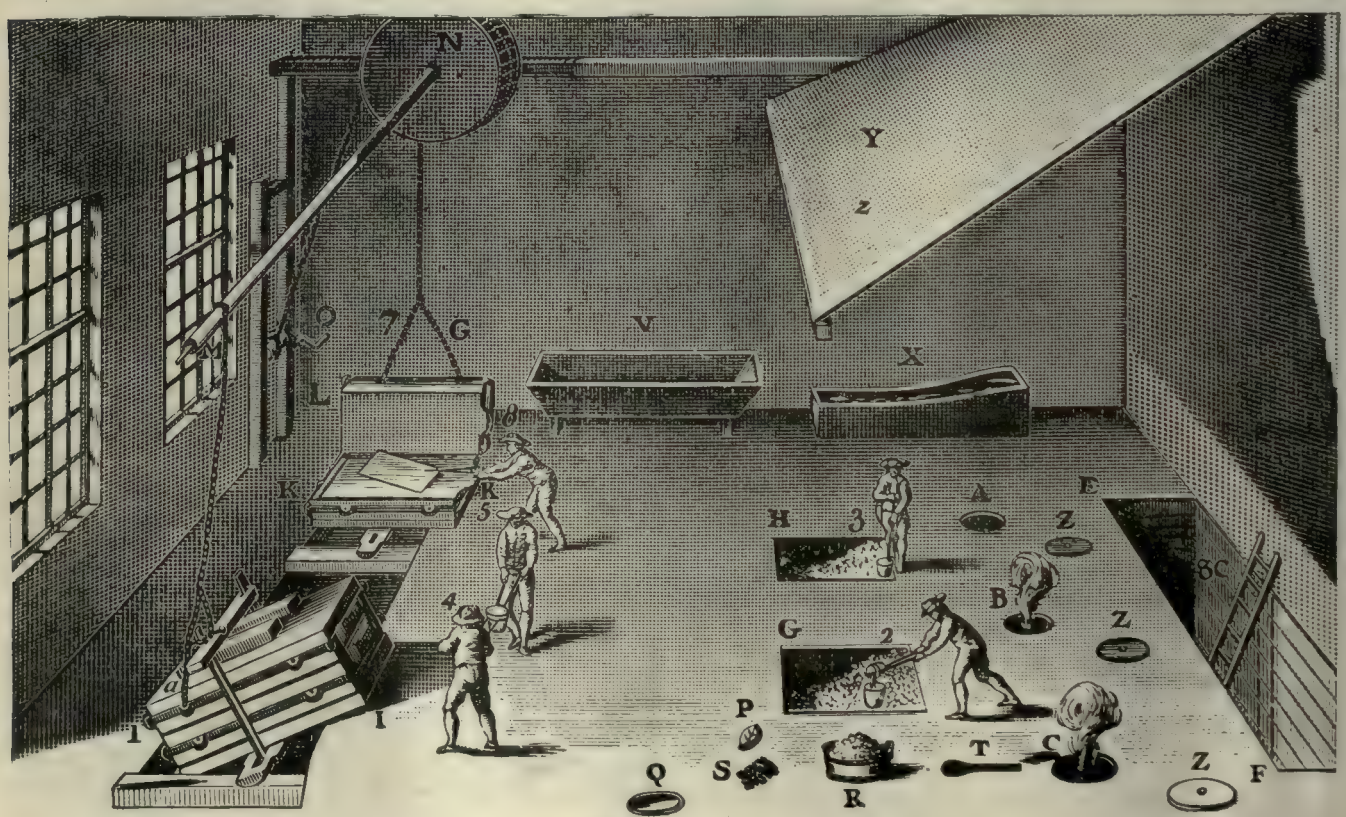


obtained, Spain and Great Britain were used by the ancients. In fact, the name Britannic Isles is derived from the two Phoenician words, *breta-nac*, meaning land of tin.

The early history of brass itself is much beclouded on account of the fact that brass is often confused with bronze and other copper alloys. There are a great many references to brass in the Bible which are undoubtedly due to faulty translation, either bronze or copper being meant. For instance, Rev. John Hodgson, in a paper published by the Society of Antiquaries, Newcastle-upon-Tyne, in 1822, and entitled "An Enquiry into Aera When Brass was Used in Purposes to Which Iron is Now Applied," said: "In tracing the connection between ancient implements of brass discovered in Britain and the mercantile people along the

FIG. 1. (UPPER) BRASS FOUNDRY
Illustration taken from Ecker's *Untererdische Hofhaltung*, page 261, published in 1672

FIG. 2. (LOWER) INTERIOR OF A FOUNDRY IN COUNTY OF NAMUR ON THE MEUSE
Illustration from paper by Galon before the Academie Royale Des Sciences, 1764



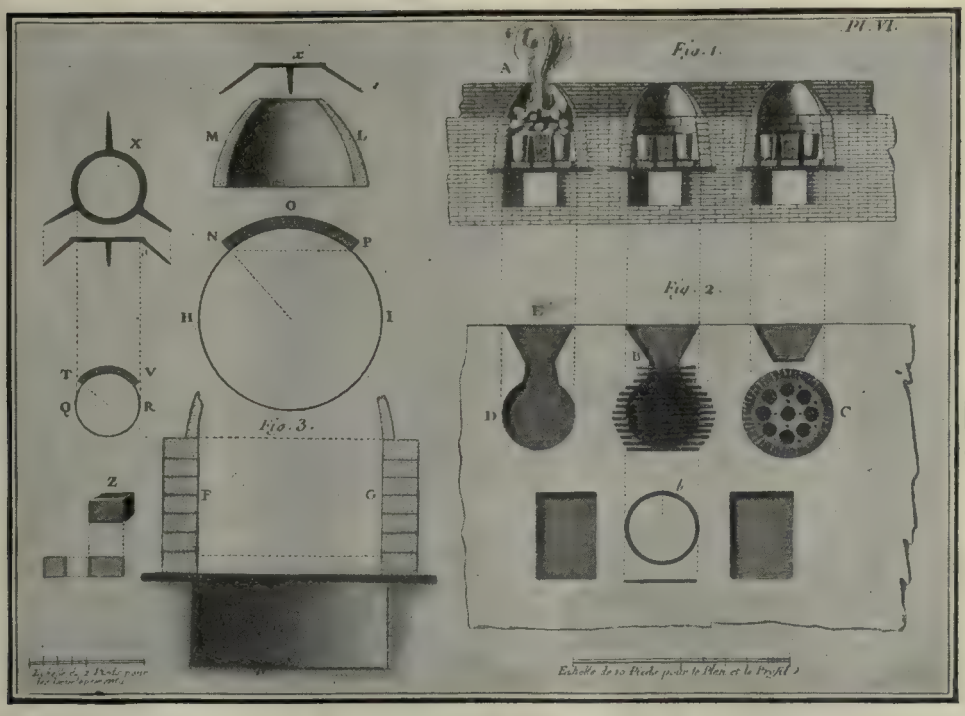


Illustration from paper by Galon before the Academie Royale Des Sciences, 1764
FIG. 3. BRASS MELTING FURNACE CONSTRUCTION

shores of the Mediterranean Sea, it will be necessary to direct our attention to the information which the ancients have left us concerning their knowledge of tin, which is by far the most common of all the alloys which they used with copper in making brass. This would indicate that even in his time there was confusion in the designation of brass as we understand it today.

The earliest accounts of brass making describe the use of calamine (a zinc ore) with copper and it is not until the eighteenth century that the practice of making brass with metallic zinc came into use. Zinc as a metal was known in the Far East long before the Europeans had succeeded in separating it from its ores, and it was imported from the East in considerable quantities as early as the sixteenth and seventeenth centuries. Spiauter, from which our term "spelter" was derived, is one of the names under which Easterners marketed zinc.

Although brass objects dating back to pre-historic times have been found, and many references are made to brass in the earliest literature the confusion of terms makes it impossible to be certain that brass is meant. The first unmistakable reference to brass in literature is made by Dioscorides in the first century; and the first accurate technical description of brass making does not appear until the thirteenth century, when Theophilus described the calcining of calamine and its mixture with finely divided copper in glowing crucibles. This process was described many times subsequently, and was in general use, substantially as described by him, down to the eighteenth century.

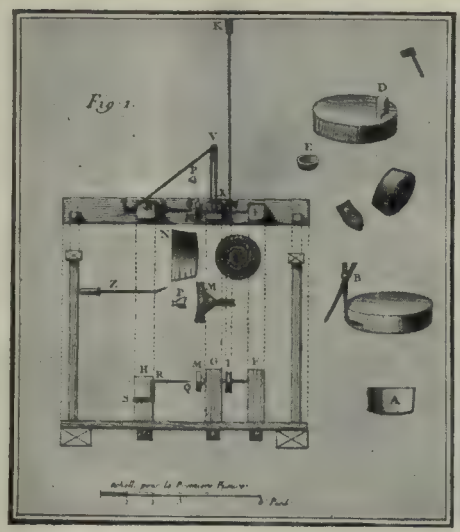


FIG. 6. MACHINE FOR FINISHING BRASS KETTLES



FIG. 7. MACHINE FOR SHEARING BRASS STRIPS

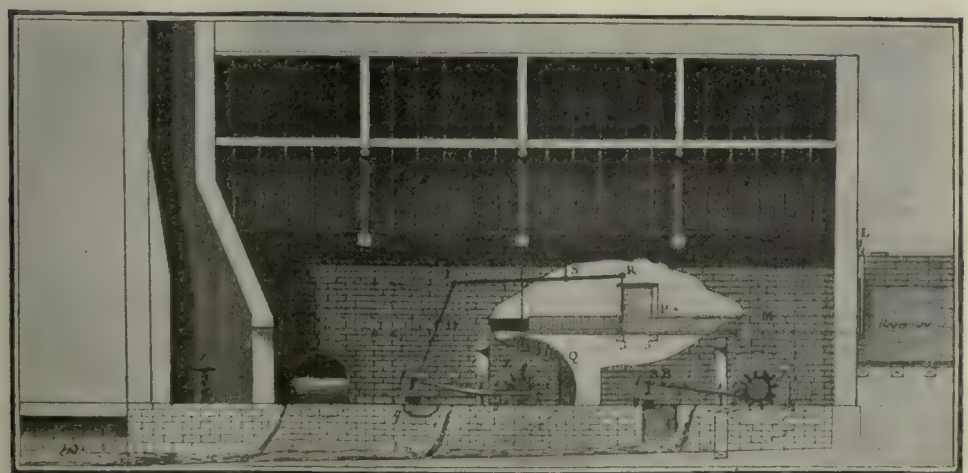


FIG. 4. ANCIENT FORGING PLANT OPERATED BY WATER POWER

The earliest picture of brass making equipment that we have been able to locate is reproduced in Fig. 1 from Ecker's *"Unterердische Hofhaltung,"* page 261, published in 1672. According to the author's description, which is

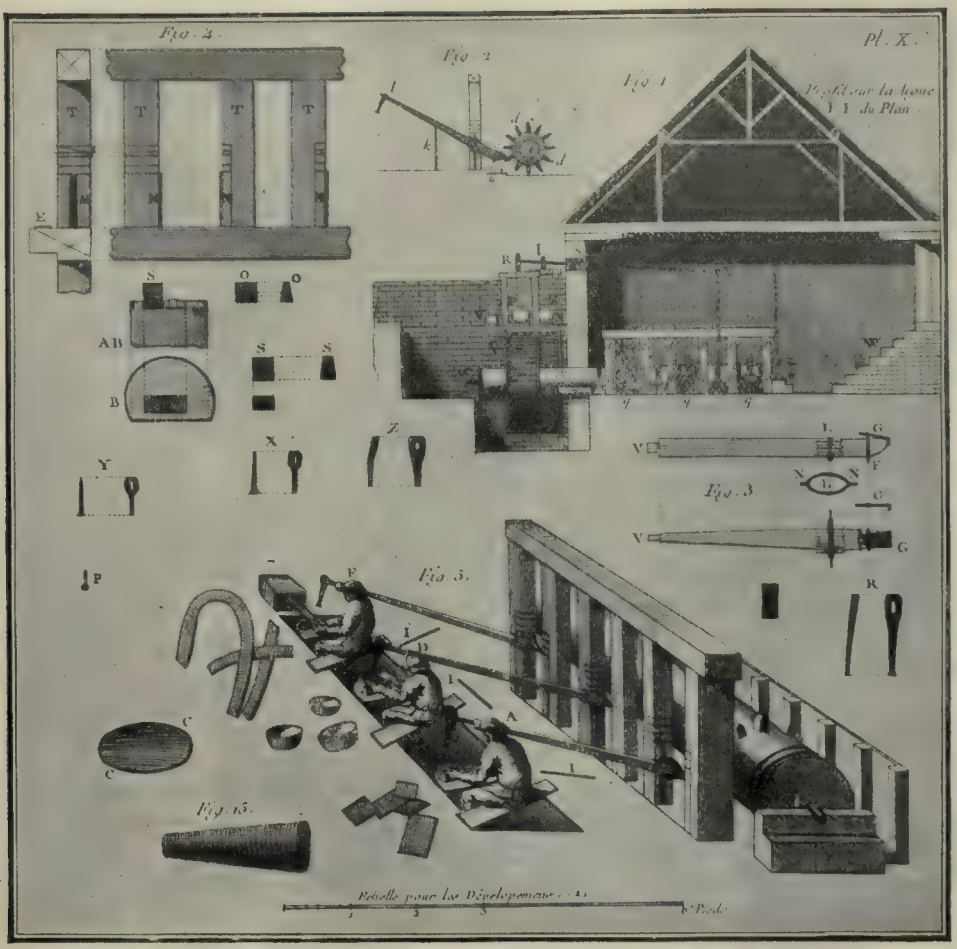


FIG. 5. DETAILS OF BRASS FORGING PLANT AS SHOWN IN FIG. 4

very meager, calamine and fine coal were mixed together, with water and salt added. After heating the pots, 46 lb. of calamine were divided among eight pots, and then 8 lb. of copper were put in each pot. The heat was applied for 9 hr., when the mixture was well stirred, and then allowed to stand for an hour, when it was poured into a mold made of Britain stone, so called because it was imported from Great Britain. Though this book was printed in 1672, the process it describes is the same as revealed by Theophilus, four centuries before. Referring to the figure, *A* is an interior view of a brass furnace, showing the arrangement of the crucibles and how they are set in place; *B* the furnace in action; *C* the crucible; *D* a shovel for the calamine; *E* a pair of tongs for handling the crucibles; *F* the draft opening of the furnace; and *G* a mold made of British stone. *H* represents the master caster.

A very much better illustration of a brass foundry of this type is contained in an article by Galon, printed in 1764 in Volume V of the *Proceedings of the Academie Royale des Sciences*. In this article Galon described the art of brass making as practiced at that time. This was followed by two other contributions in the same volume, one by Swedenborg which covered briefly the practices of the various countries of Europe, and another by M. Duhamel du Monceau who described in detail the equipment and operation of a works in Ville-Vieu. These three articles, together with beautiful illustrations, give a very complete technical description of brass founding work as carried on during the seventeenth and eighteenth centuries.

According to Galon, foundries were built in units of three furnaces each, and usually not less than two such units were involved in any single installation. Fig. 2, which shows the interior of a foundry in County of Namur on the Meuse, is explained as follows: *A*, *B* and *C* are openings to the furnace in which the crucibles are heated; *E* and *F* space from which the fires are tended; *G* and *H* receptacles in which the crucibles are skimmed (the skimmings afterward being worked over to reclaim valuable metal); *I*, *K* and *L* molds made by stone, held together by iron frames; *N* and *O* parts of the hoisting equipment for handling the molds; *R* tub for measuring calamine; *S* small pieces of copper about 1-in. cube; *T* paddle used for mixing and handling the calamine; *V* tub in which calamine and pulverized charcoal are mixed; *X* bed, of which there are three in each foundry, as the founders stay on the job 24 hr. for five days in the week; *Y* apron for catching gases from the skimming pots and the furnaces and leading them to the chimney flue; and *Z* covers to the melting furnaces.

Pulverized charcoal and calamine were mixed in the

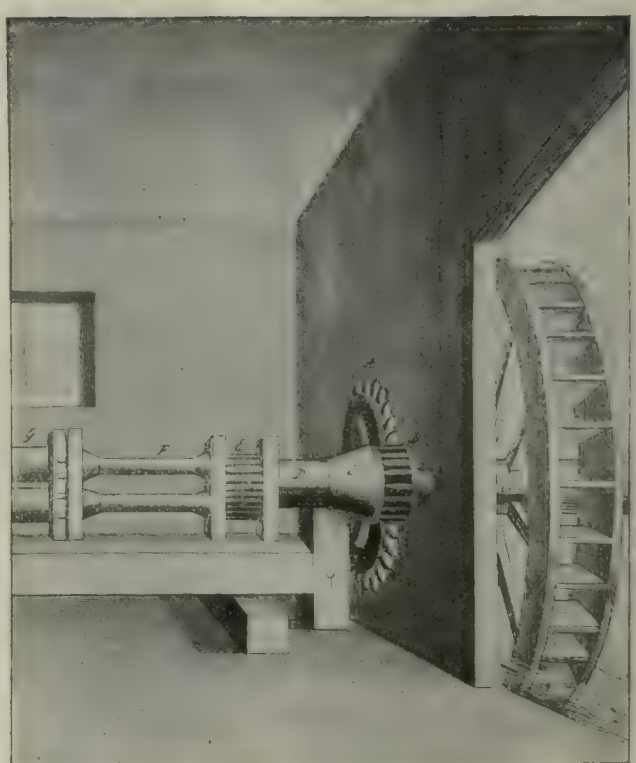


FIG. 8. ROLLS FOR COPPER AND BRASS SHEET

large tub, and inserted in the crucibles from the small tub by means of the mixing paddle. Copper was used in the form of small cubes, or in small balls or shot, as in this way a more intimate mixture could be made with the calamine. Having melted the charge, the crucible is removed from the furnace and skimmed in one of the pits. The man at *3* is skimming one of the crucibles while the man at *2* is pouring the contents of the crucible into a larger crucible which was used as a ladle. After the contents of the various melting crucibles had been skimmed and poured into the ladle, two men with special tongs, carried the ladle and poured its contents into the mold while the latter was in the position at *1*. As soon as the pouring was completed the mold was hoisted to a horizontal position, the fastenings undone, and the upper part hoisted. The workman *8* is seen removing the slab of brass from the mold.

The furnaces are fired from the pit, each furnace containing eight or nine crucibles, as shown in Fig. 3.

The principal difference between these furnaces and the modern pit furnace is the method of taking care of gases of combustion. Here they were allowed to pass on through the top of the furnace into the casting shop, where they were caught under a large apron which led them into a common flue; while in the modern furnace the gases are led through the side of the furnace directly into the flue. The stirring of crucibles in furnaces such as these must have been an extremely disagreeable task.

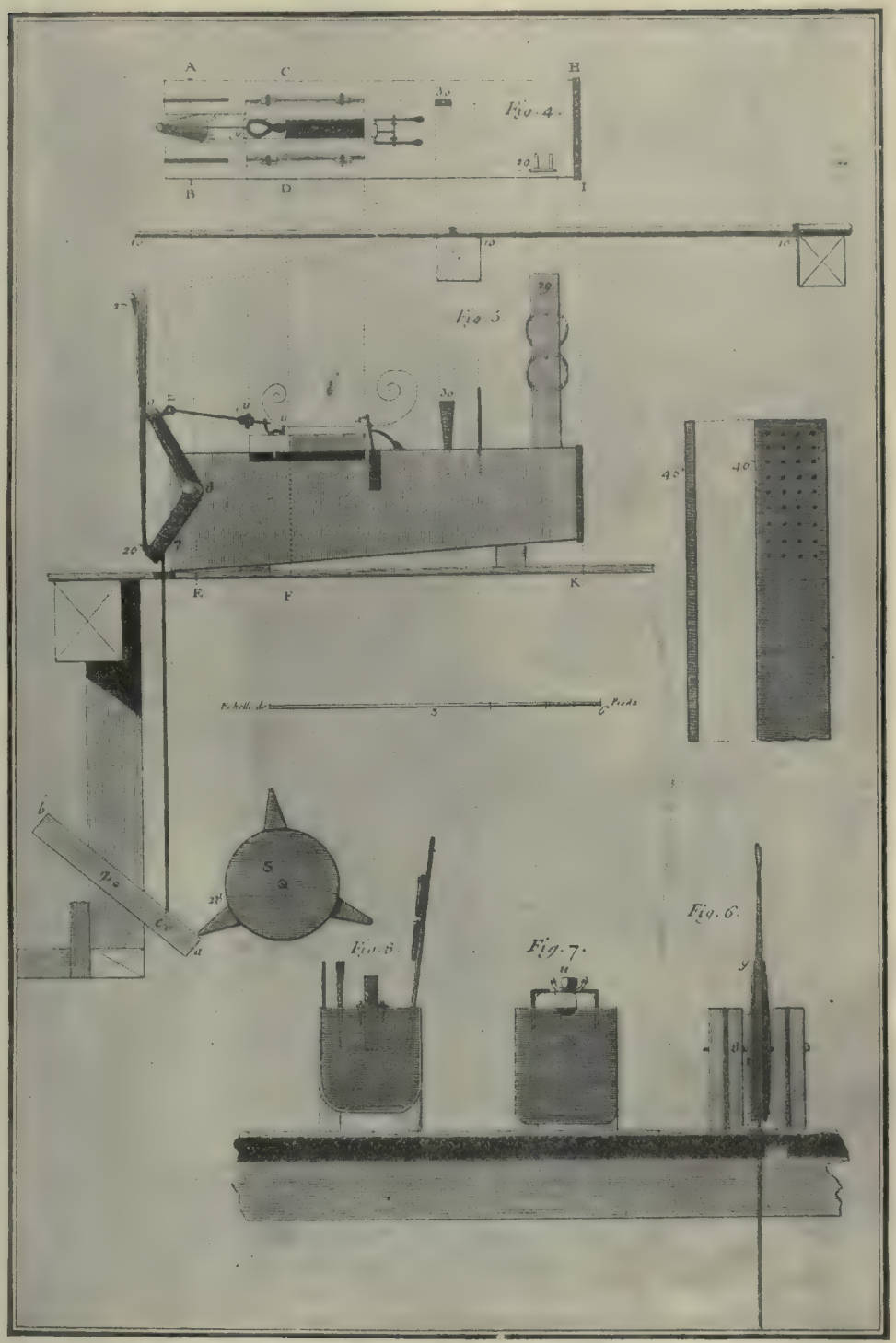


FIG. 9. DRAW BENCH FOR WIRE-DRAWING

Those familiar with present practice in brass making will be struck by the remarkable resemblance of methods employed by these early brass makers to the ones in use today. Our modern pit furnaces are constructed for more efficient combustion, but in principle they are similar to the ones shown in Fig. 3. Compare these old practices with present day practice as shown by Figs. 13, 14 and 15. Although no smoke or fumes such as seen in these pictures are shown in the old illustrations, the fact that they were there is attested to by the following quotation from Galon: "The doors and windows of the foundry are kept tightly closed while pouring. The workmen hold the ends of their neckties between their teeth when they skim or when they carry or pour metal. By this precaution they diminish the effects of the fire and facilitate respiration."

Incidentally, the labor conditions existing at that time are extremely interesting. It is stated that there were three couches similar to the one shown at *X*, Fig. 2, in each foundry, for the use of the workmen, as they spent the whole twenty-four hours of five days each week in the foundry, having Saturday and Sunday off. Quoting from Galon, "the ordinary hours of work are: Pouring the slabs between 2 and 3 o'clock in the afternoon. The crucibles are put into condition and the fires started at 5 o'clock in the afternoon. At 10 o'clock in the evening the fires are replenished and the second

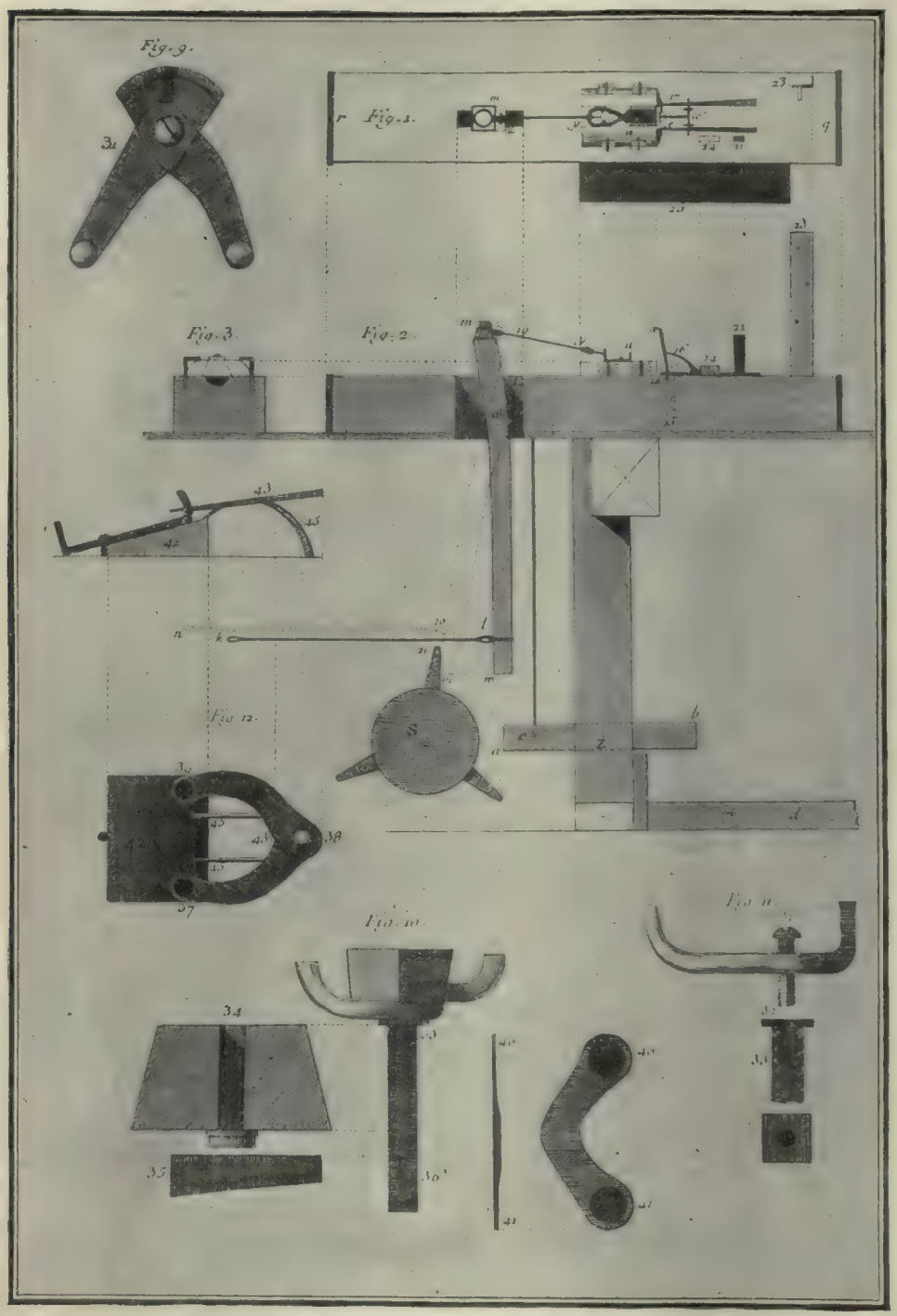


FIG. 10. ANOTHER FORM OF DRAW-BENCH

pouring is made at 2 or 3 o'clock in the morning. In other words, a complete operation requires 12 hours."

According to Galon there were three workmen in each foundry—a master founder and two assistants—and the work was so laid out that when operations were to be performed which required more than three men, help could be obtained from one of the other foundry units. As far as the pay was concerned the assistants received about 12 cents for a day of 24 hr. work. They were also supplied with beer, which was considered to be a necessity for all foundry men, and coal for heating their dwellings was furnished to them.

Evidently master founders were paid on the production basis because Galon says: "It is estimated in 1748 and during the war that the master founders earned, after expenses were covered, 4 florins for each slab of 85 pounds." With regard to the skill necessary, Galon says: "Work in a foundry demands continual care in order to feed the fires and maintain the necessary degree of heat for casting." He also mentions the various duties in connection with the care of the molds and disposition of the product, all of which fell upon the master founder.

Duhamel du Monceau, previously mentioned, refers to the skill required as follows: "The founders learn by long practice to care for the fires of the furnaces and to know when the material is in proper fusion and ready for casting." . . . "The skillfulness of founders consists in knowing the mixture and above all knowing the degree of heat which it is necessary to give. In order to be more certain they take, with a small ladle, a portion of molten metal and throw it on a stone and when this thin layer is cold then hammer it. If it breaks they continue the fusion or add a little Flanders scrap. If they use too much heat, the metallic part of the calamine which is zinc will be dissipated and there will remain only brittle metal which will break before it will stretch."

In attempting to explain how to judge when the metal is ready to pour, Duhamel du Monceau says: "The color of the flame indicates the material is in fusion. At first it is red as in ordinary forges. It becomes blue when the scrap is in fusion. then after a short time it becomes clear, in which state it is ready to pour. One also determines the state of fusion by plunging into the metal a stirring rod. When the metal runs to the end of the iron, the material is in condition to be poured."

From the illustrations and the meager descriptions of technique that are available it is evident that the practice of making brass several hundred years ago was little different from that of the present day, except as regards the constituents of the mixture. If we omit that part of the practice which refers to the preparation of calamine and substitute spelter, there has been very little improvement except in minor details.

The ancients worked brass mostly under the hammer. Fig. 4 shows a forging plant operated by water power. The details of the equipment are shown in Fig. 5. The practice here shown, according to Galon, was instituted about 1695. Each waterwheel operates a gang of three



FIG. 11. MODERN BENCH INSTALLATION FOR WIRE-DRAWING

hammers. The cast bars and other shapes are worked into final form under the hammer. The descriptions which accompany these illustrations in the original manuscripts, tell how the metal is heated and annealed between the successive reductions under the hammer.

Fig. 6, a reproduction of an illustration made in 1764, shows two views of a machine for finishing brass kettles and other vessels. The process is interesting, in that it resembles the modern process of spinning brass. The work-head is driven by belt *K* through the pulley *I;* the vessel is mounted in the work-head *M* by clamping between *M* and a movable center *P* which is engaged by the fixed center *Q*. *Z* is the tool used by the workman in forming the interior of the vessel. After the brass is hammered into long wide strips, it is cut into narrow strips preliminary to subjecting it to a drawing operation. The shears, Fig. 7, are operated by pressure from the knee of the workman, and the width of the strip is determined by a limit guide *D* carried on one of the blades of the shear, as shown in the sketch at the right. The illustration is taken from Galon, 1764. Although practically all copper and brass was worked under the hammer, we find in Swedenborg's *"Regnum Subterraneum Sive Minerale de Cupro et Orichalco,"* 1734, a description of a set of rolls for rolling copper and brass sheet. An illustration taken from this book is shown by Fig. 8.

The strips of sheet brass referred to in Fig. 7 were drawn into wire in draw-benches similar to the one shown in Fig. 9. The pulling power was derived from a rotating shaft, *S* the return stroke being accomplished by the retraction of a spring pole *10*. A die plate with the different size holes located in the one plate is shown at *46*. The clamping mechanism, *u*, is shown in detail in Fig. 10, which is a reproduction of an illustration used by Galon in an article printed in 1764. It shows another form of drawbench which is interesting on account of the details. The gripping tongs *31* are specially interesting when compared with those shown in Fig. 11, a photograph of an installation in use in a modern plant. The lever which comes up through the floor and carries the tong-grip, travels back and forth along the bench, giving a short-stroke draw. In a modern plant it is used to draw the first few feet of wire through the die, so as to get enough wire to permit fastening it to the drum, then the tongs are laid aside and the drum does the drawing. Comparison between this illustration and Figs. 9 and 10, shows remarkable similarity between the method here used to start the drawing operation and the method used by the ancients for all wiring drawing.

Economical Press Work in Small Lots

BY FRED. H. COLVIN
Editor, *American Machinist*

Punch and die work, to say nothing of forming or drawing, is usually a matter of long runs, with thousands or hundreds of thousands of pieces to make it profitable to make the dies. And yet in a country with but little manufacturing on a large scale, it is often necessary to do work of this kind in small quantities.

Where the number wanted goes up into millions, as is often the case, the cost of dies is distributed over such a large number that it becomes negligible. This justifies us in spending almost any amount of money for dies if we can reduce the time per piece by a few seconds or even a single second at times.

But if we put a man who is an expert in this kind of work, up against an order for one or two hundred—rarely more than a thousand—with only one punch press in the shop on which all work must be handled, we have an entirely different proposition.

This is the kind of work which comes to the Wahlstad Machine Co., of Tacoma, Wash., and A. N. Wahlstad has devised some very ingenious methods of doing work of this kind.

COMBINATIONS OF DIES

Elaborate dies are not to be thought of, as the expense must be kept as low as possible. And to reduce costs to the lowest limits, Mr. Wahlstad has developed a

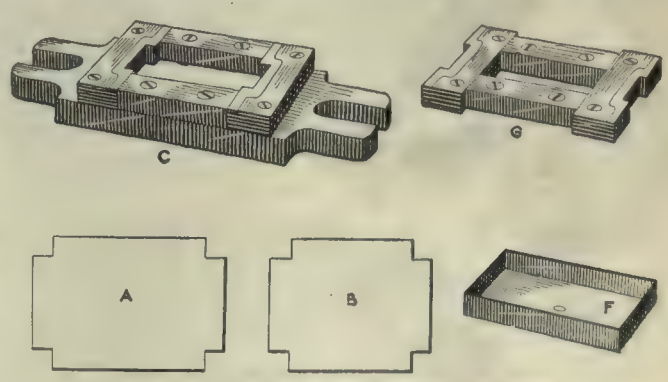


FIG. 1. DIE FOR TWO SIZES OF CAP

system of built up or combination punches and dies which is extremely interesting to any small shop man.

He has what might be called standard bolsters or bases, on which he can assemble various combinations of dies or sections of dies, that he can often combine to secure what he needs for a new job. Most dies are sectional, built up by screwing pieces to a suitable bolster, and combinations are often possible.

After a job is done, a sample is always left with

the dies or die parts, and in many cases the dies are wired to a strip or sheet of steel, together with the sample piece. This piece is stamped with the number of the bolster on which the parts were used, with the numbers of other die parts if any were used, and the number of the punch or punches used on the job.

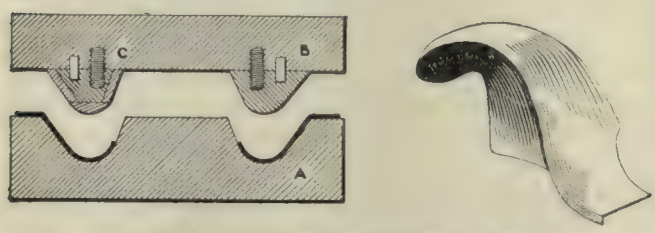


FIG. 2. BABBITT DRAWING PUNCH

Should a repeat order arrive, this method makes it easy to re-assemble the punches and dies for another lot. It also makes it easy to make up new combinations as the sample shows exactly what kind of work, punching, bending or cutting was done on the piece, and just how much of this die, if any, can be used on a new job. This plan also reduces the amount of idle metal in bolsters, etc., which would otherwise be necessary. A few examples of work done in this way are shown herewith.

Two Sizes in One Die

A good example of ingenious die design and construction for small runs, was made for tent-pole caps as in Fig. 1. The order was for 200 of two sizes, which meant that the dies must be made quickly and cheaply. The two blanks are shown at *A* and *B*, the sizes being the same except for length.

This made it possible to use a sectional die, as at *C*, for punching the blanks, and by changing the pieces *D* and *E* for shorter ones, to cut both sizes with the same die. The punch was made to cut both sizes by inserting a central piece or "spreader" to cut the long blank.

These blanks then had to be drawn into cups, as at *F*, and to do this the cutting blocks of the die were reversed, as at *G*, presenting the proper opening for cupping the pieces. Plain punches, square and oblong, were used, locating the work by the hole punched in the center, making it easy to draw the caps into the desired shape.

Dies of this kind can be readily adapted to a variety of shapes, making it possible to handle quite a variety of work of this kind with a few dies.

Drawing Punches of Babbitt

Another unusual and interesting die is shown in Fig. 2. This is for pressing up fenders for toy motor trucks, but the requirements were not large enough to warrant an expensive die.

A model was made for right and left fenders and a block made of cast iron, as at *A*, with the two cavities. The cavities were smoothed up with a file and scraper and then it was in order to make the punches.

A base or punch block was provided with threaded studs as at *B* and *C*, and also one or two dowel holes. This punch block was suspended over the die block, with the studs in the depressions, and provisions made for pouring babbitt into the depressions. A hard mixture was used, and flowing around the threaded studs and into the dowel holes, locked the babbitt to the punch block as at *B*. This gave the punches the same shape as the depressions.

Knowing that the babbitt would not stand the pressure, it was trimmed up all around and steel plates *C*, fastened to it with screws to take the wear and to support the babbitt. This has proved very satisfactory; about 11,000 pieces having been formed to date. The cast-iron die is still O.K. but the babbitt had to be refaced after 5,000 stampings. The new plates were case hardened and are standing up better.

Two Wire-Bending Jobs

Two examples of wire bending may show ways and means devised to get work out with few dies and by utilizing anything that is available in the shop. The piece shown in Fig. 3 is perhaps 15 in. long and of about $\frac{1}{8}$-in. wire or rod. The end bends are made in simple built-up dies as at *A* and *B*. These operations leave the piece far from square in the corners which have to be finished in another operation.

A simple die *D* is made to the proper shape, the block *C* is inserted and a stroke of the press squares the corners and straightens the back. The piece *C* can be made loose enough to be inserted without difficulty.

A somewhat similar piece, but one in which the bottom had a large V in it, was finished in a shaper. The first bends, which were more complicated than shown,

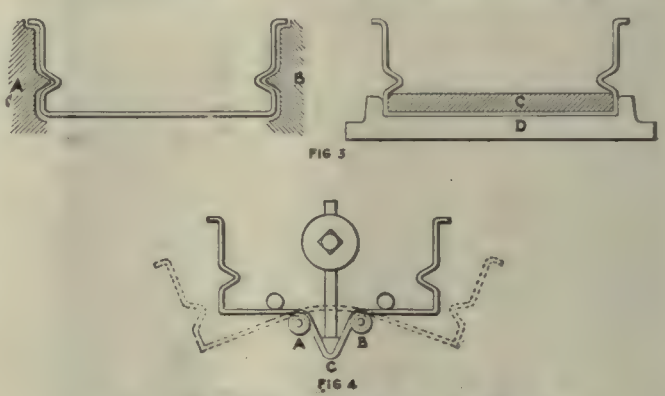


FIG. 3. SQUARING BOTTOM OF WIRE LOOP
FIG. 4. WIRE WORK IN A SHAPER

left the piece rather badly bowed in the long portion. The corners were square, however, and it was found that a good job could be done as shown in Fig. 4.

The two grooved rollers *A* and *B* were fastened the proper distance apart on the shaper table. Then a tool *C* was fastened in the toolpost and the ram travel set so as to force the wire the correct distance. When this was done, it was an easy job to form the V in the wire and leave the work in good shape for its future use.

Efficient Pattern Work

By A. E. Holaday

Referring to the article published on page 516 of the *American Machinist* under the title "Efficient Pattern Making," I will cheerfully admit that this is a quick way to produce the pattern in question, but I think that a great deal of credit is due the molder who made the mold. It is no easy matter to anchor cores in the cope, and if the molder did not fully understand his work the pattern would have been of little use.

Give the molder fifty-fifty on this job.

Labor-Saving Methods in the Foundry

By PETER F. O'SHEA

The different methods of pouring used for different classes of work in a certain foundry are described. The arrangement of the departments and the direction of movement of the materials is treated, so that an idea of the method of operating the foundry can be gained from the article.

THE foundry of the Chapman Valve Manufacturing Co. is laid out into sections or floors so that different classes and sizes of work can be handled. In each section the method of handling the ladles while pouring is different, so that it is suited to the work being done. The building consists of three parallel bays, with a monitor roof over the center bay, giving room for a large electric crane. Flasks are laid out in one end of the building in all three bays. The middle bay or floor is used for sweep molding. Here big ladles are carried by the large crane.

The bay along the south side is for standard-sized flasks of medium dimensions. The flasks are placed at regular intervals, with all those of the same size in the same rows. The ladle is brought by an electric hoist on a trolley track from the cupolas, which are at the middle of the long building, along the aisle just outside the posts which divide the side bay and the central bay. At the end of the row of flasks which are to be filled the electric hoist stops and transfers the ladle to a smaller air hoist which runs on a trolley track of its own in a direction at right angles to the length of the building. The transfer is made by bringing the hook of the air hoist under the ladle handle beside the hook of the electric hoist, and relieving the latter of its load. By means of the air hoist the ladle can then be adjusted to the exact height necessary for pouring each flask. In each row from aisle to wall the flasks are as nearly as possible of the same height, so that little or no adjusting of the height of the ladle has to be done along each row. The pouring from the ladle can be quickly done. One man handles the ladle, the other assists him and handles the valve of the air hoist.

A series of these transverse trolley tracks runs across the ceiling of the bay, with a header track connecting them so that the air hoists may be transferred from row to row. Each transverse track is above the narrow cross aisle between two rows of flasks, so that in laying out the flasks, care must be taken to arrange the rows to correspond to the tracks above. Since this floor is long, several air hoists may be at work at once. The electric hoist travels back and forth to the fires for new ladles and acts as a feeder for the pouring gangs to keep all parts of the floor supplied.



SMALL-CASTINGS BAY, SHOWING POURING DEVICE

In the bay on the other side of the building, smaller sizes of standardized flasks take up half the floor. Overhead tracks again support the ladles above the flasks, and the same sort of electric hoist employed in the other bay is used to bring ladles along the length of the building. The track of the hoist can be seen in the accompanying illustration. But the small hoists used here to take the ladles from the main hoist and bring them along each row of flasks are different, being really ratchet-operated pouring devices. Since the

flasks here are smaller and there are more of them in the same length of row, the ladle has to tip oftener on its way down the row, the ratchet device being better adapted for quick handling under these conditions than the air hoist. Of course the flasks are laid out strictly level with each other, as the illustration shows.

The other half of the same bay, shown in the right back ground, is used for pouring miscellaneous-sized small molds. Here the flasks are not laid out so regularly, and the ratchet pouring device would not be practicable. Consequently, hand ladles, filled from a supply ladle carried on a hoist down the main aisle, are used, each hand ladle being handled by two men as usual.

The standardization of size of most of the flasks saves a great deal of time in pouring and handling. There are three standard sizes, and for each size all the halves of the flasks are interchangeable. In selecting the proper size of flask for a given pattern, care is taken to pick the smallest which will contain the work, so as to save weight and time in molding and handling.

The layout of the iron foundry is such that the movement of castings is from the south to north of the building. Molten iron and a few cores are the only things that move in the other direction. Coke and pig iron come in from the side. The cupolas are at the middle of the building, on the west side. Just outside the west wall runs the railroad track, by means of which coke, pigs and sand are brought to the plant. The track is on a higher level than the molding floor, the difference in height being about fifteen feet. Core sand is dumped from the cars through holes in the wall into pits, at the inner ends of which the sand is discharged on the foundry floor as wanted. The pile of sand is lower than the cars, but higher than the floor of the foundry, so that gravity does most of the moving. The core sand is cut in a mixer at the foot of the piles. Large cores are made at this part of the floor, within a short distance from the mixer. Small cores are made upstairs, for they are light and easy to handle.

Pig iron is taken from the cars by a lifting magnet, and either brought directly to the furnaces or stacked on the ground on the side of the tracks. The magnet lifts the iron from the pile or the car to the floor of a steel superstructure, where it is transferred to dumping cars which run inside of the building and dump it into the cupolas. The railroad tracks are thus on a level midway between the foundry floor and the tops of the cupolas between the core sand pits below and the pig feeding platform above.

On the other side of the railroad tracks opposite the foundry building is a row of low brick pits for reserve supplies of molding sand. On the floor at the southern end of the molding floor is a pile of molding sand, which is replenished by the aid of a small movable belt-conveyor run by an electric motor. This piler is also used in handling coal and sometimes coke, and in evening up the piles of core sand in the pits.

Large cores and molten iron are therefore distributed from the middle of the building. Small cores, molding sand and flasks are distributed from the southern end forward over the three parallel molding floors. After the iron is cool and the flasks are taken off the castings, the castings continue to move forward toward the northern end of the building. The northern end beyond the cupolas is used for cleaning, tumbling, snagging and pickling.

As soon as the castings are made and the molders have gone, that is, at 4 o'clock in the afternoon, the floor-cleaning gang comes and cleans up the molding floor, putting it in condition for the next day's work.

Cutting Off Bars in Multiple

By E. C. Brandt

The accompanying illustrations of a 42-in. cold saw show a set-up for cutting off a number of $3\frac{3}{4}$-in. diameter axle steel bars, which were necessary to be square and within about $\frac{1}{32}$ in. of length to suit fixtures to be used on succeeding operations.

With the fixture, as shown in Fig. 1, it can be seen that only a short length of travel is necessary to cut off all the pieces, the stock being held so as to permit the topmost piece to be cut off $\frac{1}{2}$ in. in advance of the bottom piece. This is considered much more advantageous than having all of the five pieces cut off at the same time, as it gives the operator a chance to remove one piece after another. If he fails to do this, however, no damage is done, as the fixture retains the piece cut off.

A general view of the set-up of the long bars on a trolley extended from the machine is given in Fig. 2, and it will be noted that a container having the same contour as the holding fixture is used for holding the rear ends of the bars. The bars are securely clamped in the container on the trolley so that they are all brought forward together and the pieces from any one cut will be of the same length.

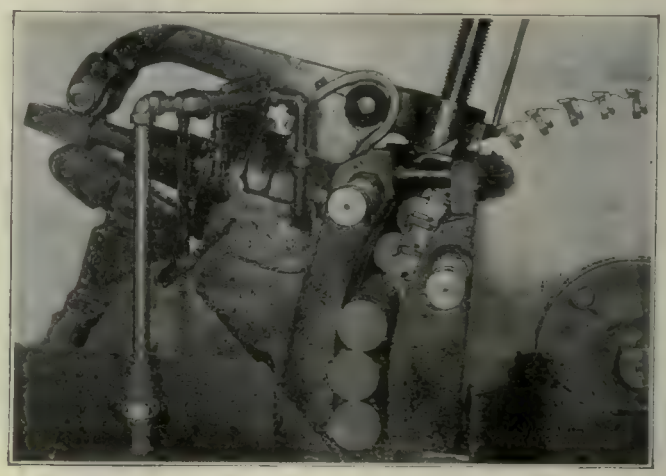


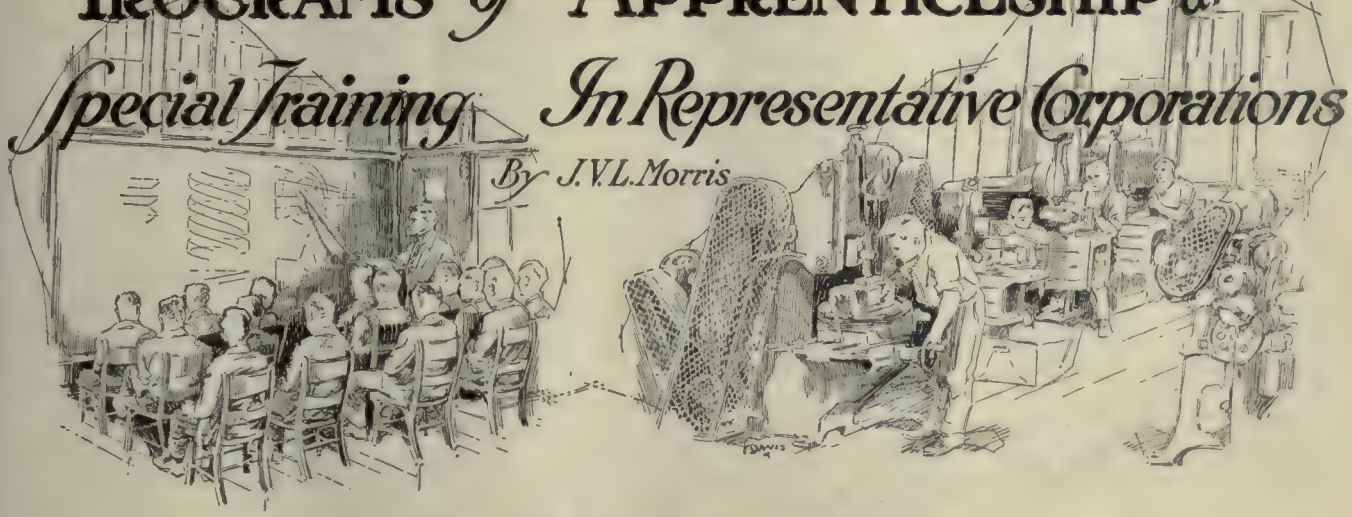
FIG. 1. FIXTURE FOR HOLDING THE BARS



FIG. 2. GENERAL VIEW OF THE SET-UP

Programs of Apprenticeship and Special Training In Representative Corporations

By J. V. L. Morris



THE Mergenthaler Linotype Co. offers an example of a moderate-sized plant in which a wide variety of training is given to employees. The product of the plant is the very intricate linotype machine, requiring for its production and constant improvement an engineering staff, a corps of machinists and, chiefly, a large number of specialist mechanics. Altogether some 3,000 people are now employed, including 500 females. The plant is, however, expanding, which is a condition that even more urgently suggests the desirability of special training facilities along the lines peculiar to the concern. To consider first the provision for apprenticeship, there are in the plant at present fifty-five apprentices in the machinists' and toolmakers' trade. This corresponds to the reasonable ratio of one apprentice to five journeymen, there being a total of 269 employed in the toolroom at the time that this plant was visited by the author. Boys, aged sixteen to twenty, are admitted to the four-year course provided and it is preferred that they come directly from school. The usual requirements of sound health, good morals and the completion of a grammar-school education are insisted upon. Selections are made from the waiting list, on which there are at present twenty-two enrolled.

III. The Mergenthaler Linotype Co., Brooklyn, N. Y.

The company under consideration in this article trains not only trades apprentices and machine specialists, but also operators for the machines which it builds. The system of instruction in the different lines has been developed to suit the special conditions existing in the plant. This article deals chiefly with the training given the machinist apprentices.

(Part II was published in the Oct. 7 issue.)

There is no part-time supplementary school provided, though there is a limited opportunity for after-work instruction in blueprint reading, shop arithmetic and gage reading, and in the public night schools there is plenty of opportunity for further study. Careful instruction is, however, given on maintenance work, which provides the opportunity for the greater part of the practical experience.

After the trial period of the first six months of employment, if the boy is judged satisfactory, an agreement is signed between the company and both his parents, if living, or his guardian, to complete the period of apprenticeship, the company binding itself to "carefully and skilfully teach every branch of the business of machinist and toolmaker" with the reasonable conditions stipulated. These conditions, except for the limited amount of supplementary instruction, seem particularly satisfactory.

The rate of wages per hour is based upon the prevailing hourly rate paid to toolmakers by the company, the rate being classified according to six-month periods. For the first period it is 25 per cent of the journeyman's rate, for the second 31 per cent, and for the third 37 per cent. For the remaining five periods the respective percentages are 50, 55, 60, 75 and 85. The company employs a novel basis for bonus payment on satisfactory completion of the course, in that the amount is not fixed, but is 10 per cent of all wages paid during the period of apprenticeship. Also, a set of toolmaker's tools valued at $20 and which is loaned during the period of apprenticeship, is presented to each boy with the diploma when he graduates.

Careful records are kept of each apprentice, "including his efficiency, initiative, progress, obedience, attendance, etc., and at the expiration of the third year if, in the opinion of the company, the record of the apprentice warrants it, this company will permit said apprentice to graduate three months from that date and present him with his diploma;" that is, nine months are deducted from the term of service because of good record, making the full term three years and three months.

The schedule of training, modifiable at the discretion of the management according to the record of the apprentice, is as follows: One month, tool crib; eight months, lathes; eight months, plain and universal milling machines; five months, grinding machines; three months, planers and shapers; six months, bench work and assembling; one month, radial drilling machines and boring mills; and twelve months, tool work. Fig. 1 shows the form which the foremen use

in reporting upon the apprentices, while Fig. 2 shows the type of report card which is sent to the parents of the boys. One feature of the agreement is that, "Graduates of the State Education Shop of New York, or any other equally good training school, shall be allowed the same number of satisfactory hours which they spent in that school to be applied on this apprenticeship. They will also receive the regular bonus given on the satisfactory completion of this apprenticeship." It should be said, however, that the management prefers boys coming directly from the elementary or high school.

Another of the company's interesting schools is that maintained to train operators for its customers' machines. A six-week course is provided, during which the student receives instruction in operating and repairing the linotype machine, including its assembling and dis-assembling. The equipment of the department used for this purpose consists of twelve machines, which fixes the limit to the size of the classes. There is provided also a variety of models for amplifying and illustrating the instruction, which is given by two experienced operator-mechanics.

The equipment of the school for operators just described was used during the past winter to provide a type of technical extension course. Fifteen of the engineers and departmental heads met after office hours two nights a week for an hour to get direct first-hand instruction on the operation and construction of the machine.

Special night classes for general machinists were also provided two nights per week, with units in blueprint reading, shop arithmetic, and gage reading. There were during the past term classes of seventy for six one-hour periods in blueprint reading, and of twenty-five for similar courses in shop arithmetic and gage reading.

The engineering department is conducting a school for breaking in novices as specialists on one type of machine. Those in training are usually "floaters," but only young, ambitious fellows of ages running from twenty-two to thirty are selected. The course lasts five to six weeks, and fifteen men are now constantly going through it.

A rather informal system of foreman training is provided, the foremen meeting with company officials once a week, when the various problems of production and employee control are discussed and suggestions for their solution are made.

1288-6-9-9-1000 P-408

Name .....

Department .....

	Grade	A 90-100	B 80-90	C 70-80	D 60-70	E Below 60
INTEREST	Interest	Enthusiastic	Very Interested	Interested	Lacks Interest	Disinterested
APPLICATION	Application	Very Industrious	Good Worker	Steady	Fair	Lazy
APTITUDE	Aptitude	Very Quick to Learn	Apt	Learns Readily	Slow to Learn	Dense
RELIABILITY	Reliability	Trustworthy	Reliable	Satisfactory	Irregular	Unreliable
CONFIDENCE	Confidence	Excellent	Self-Reliant	Confident	Lacks Confidence	Timid
CONDUCT	Conduct	Exceptional	Very G'tlemanly	Well Behaved	Troublesome	Unsatisfactory
ACCURACY	Accuracy	Except'ly Accurate	Accurate	Average	Inaccurate	Careless
SPEED	Speed	Very Rapid	Rapid	Good	Slow	Very Slow
KNOWLEDGE OF WORK	Knowledge of Work	Excellent	Very Good	Good	Fair	Poor
INITIATIVE	Initiative	Excellent	Very Good	Good	Fair	Poor
ATTENDANCE	Attendance	Excellent	Very Good	Good	Fair	Poor

REMARKS: .....

.....

Dated .....

Please Fill Out and Return Promptly to Employment Dept.

FIG. 14. CARD USED BY FOREMEN IN GRADING APPRENTICES

1287-8-9-9-1000 P 407

QUARTERLY REPORT

EMPLOYMENT DEPT.

.....has earned the

following standing for the Quarter ending..... APR-1 '20 .....19 .....

SHOP RECORD											SCHOOL RECORD										
Interest	Application	Aptitude	Reliability	Confidence	Conduct	Accuracy	Speed	Knowledge of Work	Initative	Attendance	Mathematics	Science	Drawing	Shop Practice	Note Book	Civics	Industrial History	Commercial Geog.	Absences	Times Tardy	Conduct

SCALE OF MARKING

A—90-100 D—60-70

B—80-90 E—50-60

C—70-80 F—Failure

(Over)

APPRENTICESHIP DEPARTMENT

MERGENTHALER LINOTYPE CO.

.....

Foreman Tool Dept.

FIG. 15. REPORT CARD SENT TO PARENTS OF APPRENTICES

Reminiscences of an Old School Machinist

BY R. THOMAS HUNTINGTON

The apprentice of half a century ago was not overburdened with money. When I started in I received three dollars per week for the first year; four dollars and fifty cents for the second year and six dollars each week during the third year. Following this period there was one year "under instructions" at the rate of one dollar and a half a day, after which a boy was supposed to have become a journeyman and worth all he could get. Ten hours per day, six days a week, was the rule, there being little overtime in the shop where I was employed. In winter and on dark days a small tin hand lamp, burning whale oil, was supplied to each man, and these lamps constituted the only source of light, except daylight. The shop was heated (?) by coal stoves, there being usually two to each room of 12,000 square feet of floor space.

Accommodations for washing were provided by water buckets of which the company furnished one to each three men, who used it in common and took turns in filling and cleaning it—when they didn't forget it, or put off the job until tomorrow. If a man was too fastidious to use a community bucket he was privileged to go buy a bucket of his own and clean it whenever he felt like it. One man I knew

used to replenish the water in his bucket regularly—once a month.

If we wanted warm water we could always manage to get a piece of scrap iron in the fire just before quitting time, and after the whistle had blown there would be a great hissing and spluttering about the shop as these pieces were dumped into the buckets to heat the water.

Some of the machinery in use in the shop dated from 1834 or earlier, as my uncle, William Norris, the predecessor of the firm by which I was employed, built six locomotives in that year, said to be the first of such machines to be built in America. The shop of that early day was a barn on what was then called "Bush Hill" in Philadelphia, about where the mint now stands at 17th and Spring Garden Streets.

The article on pages 1 to 8 of the current volume of *American Machinist* shows some very good illustrations of the class of machinery with which my boyhood was familiar. The rich carvings and curlicues were fine receptacles for grease and dirt which we boys were required to clean out each week, and that ceremony did not add to the respect and veneration in which we held these works of art. The painting was very gorgeous, hardly any two machines being painted alike; and whenever there was a space for a panel some very interesting scenery would be depicted.

At the time I commenced to work there (1863) the plant covered about six squares, three on each side of 17th St., reaching from Spring Garden St. to the Reading Railroad. A force of nearly 1,200 was employed. There were machinists, blacksmiths, copper-smiths, sheet metal workers, pattern-makers, boiler-makers, carpenters, molders in both iron and brass—in fact every kind of tradesman whose work was necessary to locomotive construction at that time was represented. Everything except sheet metal and tubing was produced in the plant.

The proprietors of the shop were Richard Norris and Son (Henry L. Norris). The entire office force was summed up in the persons of Mr. Norris, Sr., who attended to all the correspondence; Mr. Norris, Jr., who was timekeeper and paymaster; one bookkeeper and accountant, and one office boy.

Mr. Norris paid off the help every Saturday morning and, believe me, he had some job. Two laborers would carry a booth from department to department and each man would come up in turn to the booth, giving his name and the number of hours he worked. Mr. Norris would turn to the page in the big ledger where the man's account stood, and if the figures given by the man tallied with the book, the amount due him would be counted out from a tin cash box where each denomination of bill and coin was stacked in its respective compartment.

There was seldom any error or disagreement; if there was, the man would step out of line and in the afternoon would go to the office where the difference would soon be adjusted. Payment was made in bank bills and specie (when the banks had any) and small change was mostly in what they called "shin-plasters" in denominations of 5, 10, 15, 25 and 50 cents.

Each of the apprentices was given an opportunity to try his hand at all the work there was, according to his stage of advancement. The turning of the long connecting rods of the locomotives is a job I shall always remember. The forgings were first planed on two sides, the finish being a "water-cut" which left them quite smooth. The stub ends were also planed on the edges to receive the strap that served to take up the wear of the pin brasses.

The rods were then centered by means of two large center punches, one being ground to an angle of 90 deg. while a somewhat sharper-pointed one was used for a starter. A center would be about $\frac{5}{8}$ in. in diameter at the outer end; the smaller punch leaving it deep enough so that the lathe center could not bottom on the point.

Turning was done on two long lathes, one of which had only a hand feed. The rods were first squared to the length indicated by a wooden template, on which was also marked the diameters. From the inner ends of the rectangular parts they would be filleted down to the smaller diameter and turned from there in two long tapers meeting in the center of the rod at the largest diameter.

All dimensions were given on the wooden template; the only drawing was in the possession of the foreman and there were no blueprints for each of the workmen in those days.

The preliminary work was done in the lathe with the hand feed, and the turning of the long tapers in the other lathe which was equipped with a "chain-feed." On the longer rods we had to use a center rest holding the rod steady by means of a "cat," which was a large collar supported and trued up on the center of the rod with eight headless setscrews.

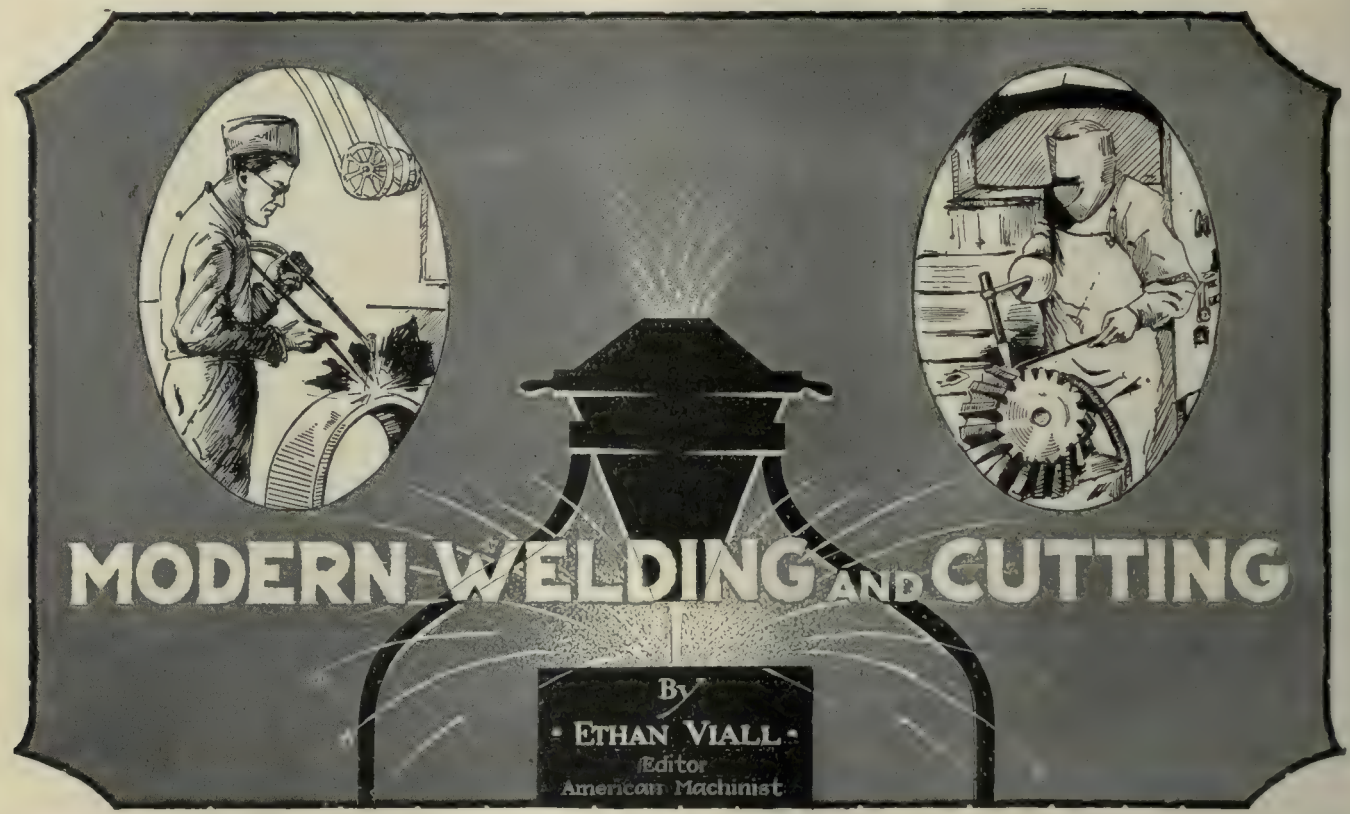
By dividing the work between the two lathes in this manner the workman was kept pretty busy. While one lathe was turning the tapers on one rod, the man would have his hands full in centering up, squaring the ends, and otherwise making the next rod ready, meanwhile keeping one eye on the lathe that was running, for the light construction of the machine in conjunction with the uncertain movement of the carriage by reason of the long chain connection did not inspire confidence in the reliability of its performance.

After the lathe work was finished, the rods were finished by drawfiling, and the foreman was very particular about this part of the work. The boys used to say that he could see a scratch from clear across the room, and woe betide the unlucky wight who failed to get them all out.

In fitting the straps there were two bolt holes to drill through strap and rod, and these had to be a nice driving fit for the bolts where the latter passed through the rod ends. The holes in the strap were afterwards elongated to allow for end movement of the strap to take up wear of the pin brasses.

Besides the bolt holes there was a large hole rectangular in shape and tapered from the top to bottom of the rod, to take the key and liner. These holes must be nicely fitted to the key and this was no easy job with no tools but flat drills, chisels and files. Advanced apprentices were expected to be able to do all this work satisfactorily, but it was sometimes necessary to invoke the services of a journeyman in order to save the rod from the scrap pile.

The foreman was the busiest man on the job. Not only did he have all the drawings there were and have to transmit instructions verbally to the workmen, but he was inspector as well and was held responsible for all work coming from his department. With from 30 to 50 men and boys to look after, ten hours per day, he had few idle moments.



ASIDE from arc-welding machines, which have already been described, electric welding machines may be all included under one head—RESISTANCE WELDING MACHINES. These are divided into butt-, spot-, seam-, mash- and percussive-welding classes. The first three are sometimes, for manufacturing purposes, used in combinations in the same machine, such as a spot-and-seam machine or a butt-and-spot-welding machine, and so on. This does not mean that these different methods of welding are carried on at the same time, but that a welder can do work on the same machine by simply shifting the work, or a part of the fixture. In butt-welding, alternating current, single phase, of any commercial frequency such as 220, 440 or 550 volts, 60 cycles, is commonly used. Lower voltage and lower frequencies can be used, but they add to the cost of the machine. The machine can be used on one phase of a two-phase or a three-phase system, but cannot be connected to *more* than one phase of a three-phase circuit. Direct current is not used because there is no way of reducing the voltage without interposing resistance, which wastes the power. As an example, a d.c. plating dynamo will give approximately 5 volts, which will do for certain kinds of welding, but for lighter work, less current is needed. If resistance is used to reduce the current this resistance is using up power just as if it were doing useful work. The voltage at the weld will run from 1 to 15 volts, depending on the size of the welder and work. To obtain this low voltage, a special transformer inside the machine reduces the power line voltage down to the amount required at the weld. The transformer is placed within the frame of the machine, as shown in Fig. 361. The secondary winding of the transformer is connected to the platens by means of flexible copper leads. From the platens the welding current travels to the work clamps and through them to the pieces to be welded. As the parts to be welded are brought into contact a switch is thrown in and the current traveling across heats the ends of the work and when the proper welding heat is reached the operator pushes the two parts together and the weld is completed. Since the current value rises as the potential falls in the secondary circuit, and since the heating effect across the work is directly proportional to the current value it will be easily seen why a transformer is necessary to produce a heavy current by lowering the line potential. Due to the intermittent character of the load, there is no standard rating for welding transformers, and different makers frequently give entirely different ratings for their machines. However, regardless of the rating given in kilowatts capacity, there can be very little difference in the actual amount of current consumed unless an especially bad transformer design is used. To heat a given size stock to welding temperature in a given time requires an approximately invariable amount of current.

XXX. Electric Butt-Welding Machines and Work

Some points regarding butt-welding are omitted from this article for the reason that they were covered in the article "Electric Welding of High-Speed Steel and Stellite," which was published in Vol. 50, page 425. The present article deals principally with the more common of the standard makes and the work done by them.

(Part XXIX appeared in last week's issue.)

The machine just illustrated, is shown at a slightly different angle and with two pieces of rod in the jaws, in Fig. 362. This is the Thomson regular No. 3, butt-welding machine. It has a capacity of rod from $\frac{1}{8}$ to $\frac{3}{4}$ in. in diameter or flat stock up to $\frac{1}{4}$ x 2 in., in two separate pieces, or rings of $\frac{1}{16}$-in. stock and not less than

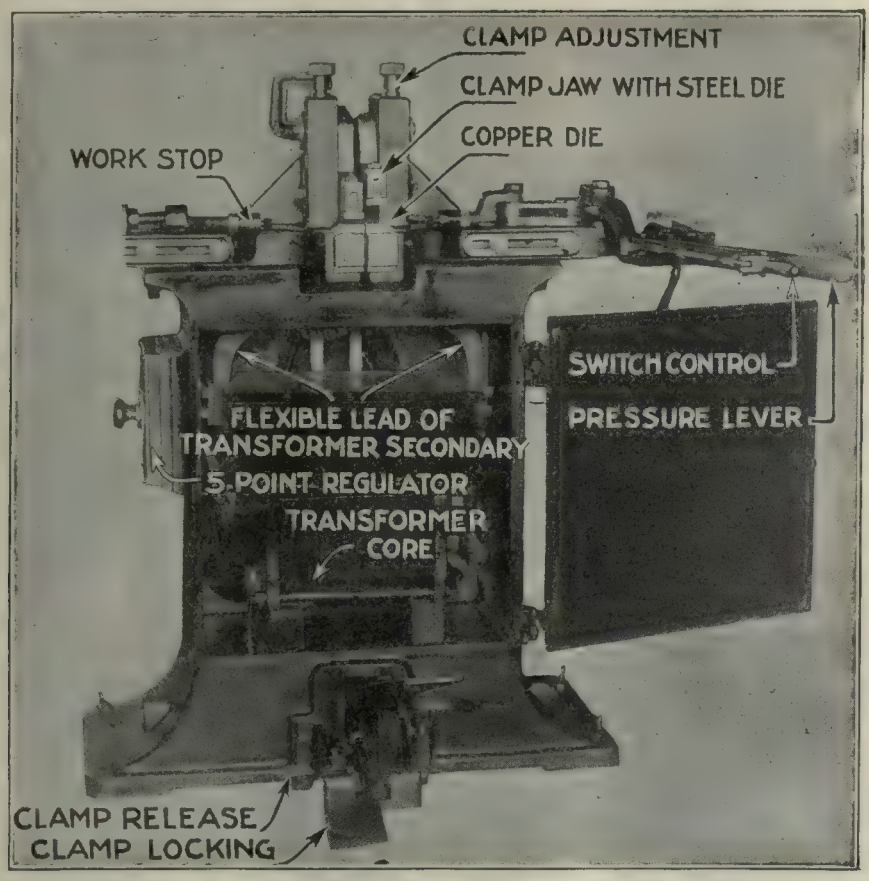


FIG. 361. PRINCIPAL PARTS OF A BUTT-WELDING MACHINE

2 in. in diameter. Hoops and bands up to $\frac{1}{16}$ x $1\frac{3}{4}$ in. and not less than $9\frac{1}{2}$ in. diameter when held below the line of welding, may also be welded. With jaws specially made to hold the work above the line of welding a minimum diameter of $4\frac{1}{2}$ in. is necessary. This machine will produce from 150 to 200 separate pieces, 150 to 300 hoops, or 300 to 400 rings per hour. The lower dies are of hard drawn copper with contact surfaces $1\frac{1}{8}$ x 2 in. x $2\frac{1}{16}$ in. thick. Standard transformer windings are for 220, 440 and 550 volts, 60 cycle current. Current variation for different sizes of stock is effected through a five-point switch shown at the left. Standard ratings are 15 kw. or 22 kva., with 60 per cent power factor. The dies are air cooled but the clamps to which the dies are bolted are water cooled. This type of machine occupies a floor space 40 x 33 in., and is 53 in. high. The weight is 1,750 lb. A close-up view of the treadle-operated clamping jaw mechanism is given in Fig. 363.

The method of operating the clamping jaws differs according to the size of the machine and the work that is to be done. On some of the smaller machines the type of hand-operated clamp shown in Fig. 364 is used. On some machines, intended to handle round stock principally, the toggle lever clamp shown in Fig. 365 is used. For very heavy flat stock, the hand-lever clamping mechanism, shown in Fig. 366, is used. On some of the machines used on small repetition work the clamps and switch are automatically cam-operated as shown in Figs. 367 and 368. The first machine is a bench type used for welding on twist drill shanks, and the second machine is used for welding harness rings. These jobs are, of course, merely examples as the machines are adapted for all sorts of the smaller welding jobs. Spring pressure, toggle-lever or hydraulic pressure are used to give the final "shove-up" according to the machine used or weight of stock being welded. In welding hard steel wire of over 35 per cent carbon content, it is necessary to anneal the work for a distance of about 1 in. on each side of the weld. This is due to the fact that the wire on each side is rendered brittle by the cooling effect of the clamping jaws. To accomplish this annealing, all the small Thomson machines used for this work are equipped with a set of V-jaws outside of the clamping jaws, as shown in front in Fig. 369. The wire is laid in these V's with the weld halfway between and the current is thrown on intermittently by means of a push button until the wire has become heated to the desired color, when it is removed and allowed to cool. The annealing of a small drill is shown in Fig. 370. The process of welding and annealing 12 gage, hard steel wire, requires about 30 sec. when done by an experienced operator. Copper and brass wire are easily welded in these same machines. The machine shown will weld iron and steel wire from No. 21 B & S to $\frac{1}{8}$ in. in diameter and flat stock up to No. 25 B & S X $\frac{1}{2}$ in. wide. Production is from 150 to 250 welds per hour, the actual welding time being $1\frac{1}{2}$ sec. on $\frac{1}{8}$-in. steel wire. The clamps are spring-pressure, with adjustable tension released by hand lever. The standard windings are furnished for 110, 220, 440 and 550 volts, 60 cycles. Five variations are made possible by the switch. The ratings are $1\frac{1}{2}$ kw. or 3 kva., with 60 per cent power factor. The weight is 120 pounds.

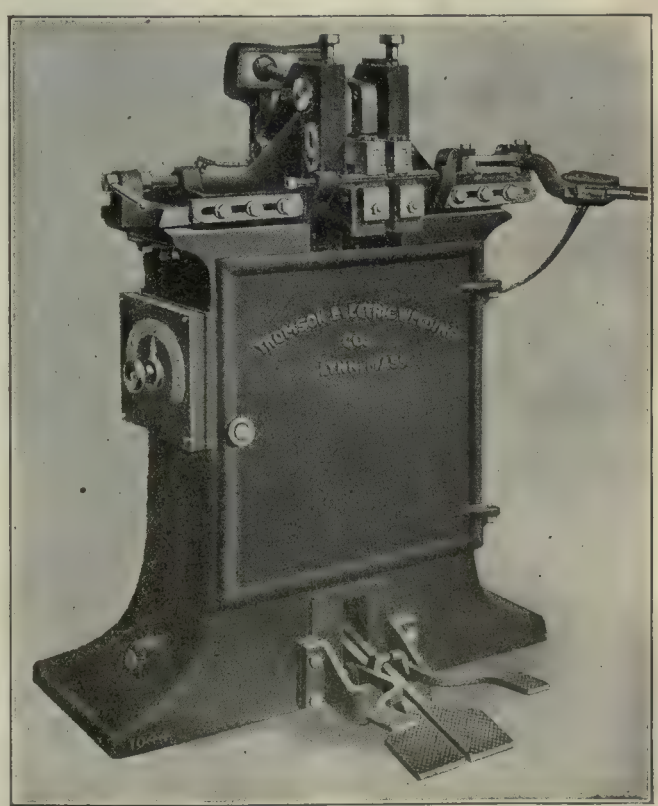


FIG. 362. BUTT-WELDING MACHINE WITH WORK IN JAWS

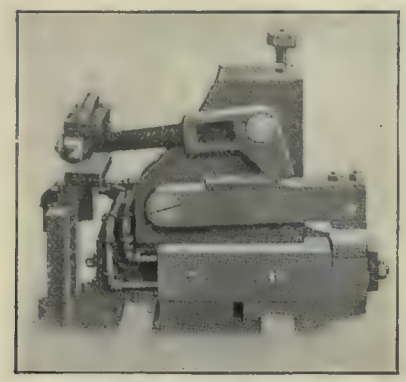


FIG. 363. DETAILS OF FOOT-OPERATED CLAMPING MECHANISM

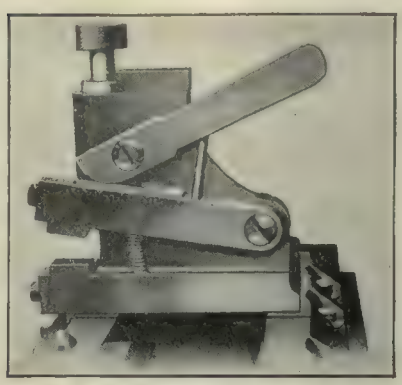


FIG. 364. A HAND-OPERATED CLAMP



FIG. 365. TOGGLE-LEVER CLAMP FOR ROUND STOCK

For use in wire mills where it is desired to weld a new reel of wire to the end of a run-out reel on the twisting or braiding machines, it has been found convenient to mount the machine on a truck or small bench on large casters. This enables one to move the welder from one winding machine to another very easily, to splice on new reels of small wire, the electrical connection to the welder being made by flexible cord, which is plugged into taps arranged at convenient points near each winding machine. It is also desirable to mount on this same bench a small vise in which to grip the wire to file off the burr resulting from the push-up of the metal in the weld. The average time required to weld, anneal and file up a 16-gage steel wire with this bench arrangement is only about one minute. The only preparation necessary for welding wire is that the stock be clean and the ends be filed fairly square so that they will not push by one another when the pressure is applied.

In connection with welding wires and rods up to $\frac{7}{8}$ in. in diameter, Table XXVI will be found very handy. For sizes from $\frac{1}{4}$ to $2\frac{1}{4}$ in. the reader is referred to page 431, Vol. 50.

While as a rule, it is only necessary to have clean and fairly square ends for butt-welding in some cases where

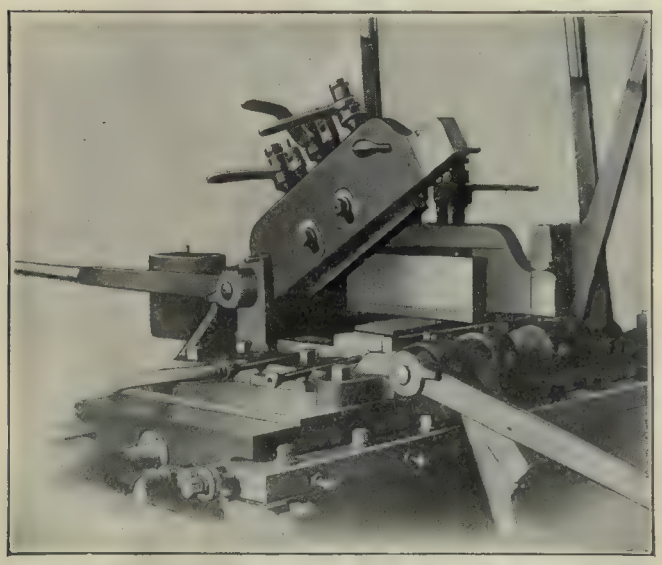


FIG. 366. CLAMPING DEVICE FOR HEAVY FLAT STOCK

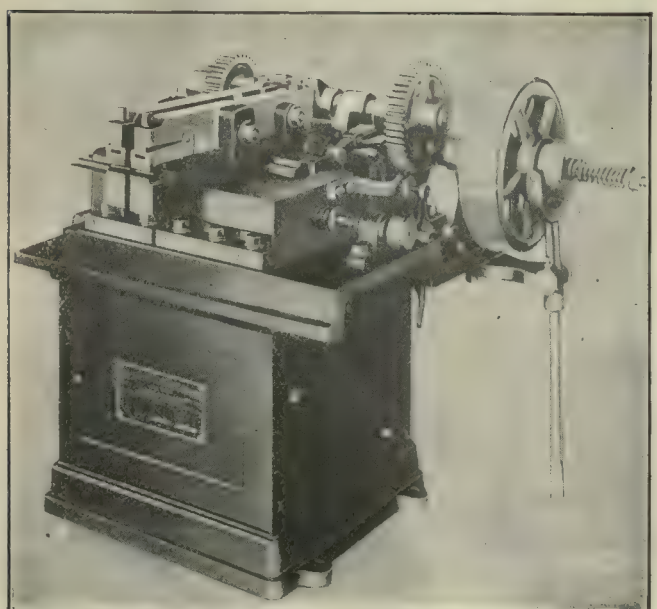


FIG. 367. A CAM-OPERATED MACHINE

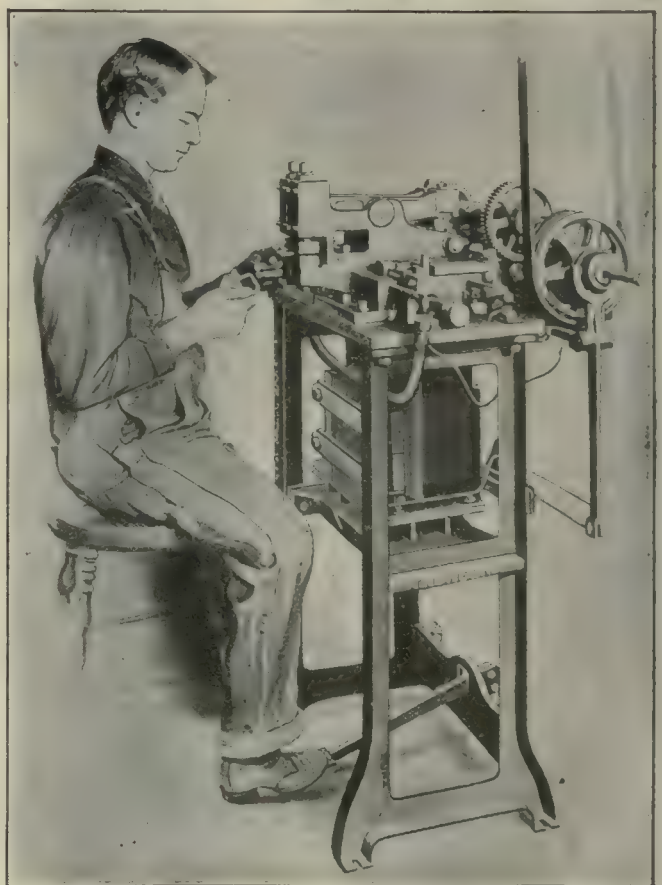


FIG. 368. AUTOMATIC-OPERATED MACHINE WELDING HARNESS RINGS

Dia. of rod in inches		Wire gauge		Dia. of rod in millimeter	Area of section in square inches	Current consumption per 1000 welds in K.W.H.	Cost per 1000 welds at 1 c. per K.W.H.*	Dia. of rod in inches		Wire gauge		Dia. of rod in millimeters	Area of section in square inches	Current consumption per 1000 welds in K.W.H.	Cost per 1000 welds at 1 c. per K.W.H.*
Dec.	Frac.	B. & S.	Birm.					Dec.	Frac.	B. & S.	Birm.				
.03196		20			.00079	2	$0.02	.2043		4			.03277	7	$0.07
.035			20		.00095	2	.02	.2362				6	.0438	8	.08
.0394				1	.00121	2	.02	.238			4		.0448	9	.09
.0403		18			.00127	2	.02	.25	1/4				.04909	10	.10
.049			18		.00169	2	.02	.2576		2			.0521	10	.10
.0508		16			.00205	2.5	.025	.2755				7	.0596	11	.11
.0625	1/16				.00307	2.5	.025	.284			2		.0633	11	.11
.0641		14			.00326	2.5	.025	.3125	5/16				.0767	12	.12
.065			16		.00332	2.5	.025	.3149				8	.0779	12	.12
.0787				2	.00486	2.5	.025	.3249		0			.0829	12	.12
.0808		12			.00513	2.5	.025	.34			0		.0908	13	.13
.083			14		.00678	2.5	.025	.3543				9	.0987	14	.14
.1019		10			.00817	3	.03	.375	3/8				.11045	15	.15
.109			12		.00934	3	.03	.3937				10	.1217	16	.16
.1181				3	.01025	3.5	.035	.4724				12	.1753	19	.19
.125	1/8				.01227	4	.04	.5	1/2				.19635	20	.20
.128		8			.01287	4	.04	.5612				14	.2472	26	.26
.134			10		.01411	4.5	.045	.625	5/8				.3068	30	.30
.1575				4	.01948	5	.05	.6299				16	.3115	34	.34
.162		6			.02061	5.5	.055	.7087				18	.3946	45	.45
.165			8		.02139	5.5	.055	.75	3/4				.44179	52	.52
.1875	3/16				.02761	6	.06	.7874				20	.487	60	.60
.1968				5	.03043	6.5	.065	.8661				22	.585	80	.80
.203			6		.0327	7	.07	.875	7/8				.60132	85	.85

*Multiply these values by the rate you are paying per K. W. Hour for current, to determine what the cost per 1000 welds for any size would be at your plant.

TABLE XXVI. APPROXIMATE CURRENT CONSUMPTION FOR WELDING UP TO ⅞ IN. ROD

small welding is to be done it has been found best to bevel or V the abutting ends. This is more apt to be the case with non-ferrous metals however, than with iron or steel. A notable example in the larger work is in the scarfing of the ends of boiler tubes when butt-welding is done. This phase of the question has apparently not been given the attention it deserves, and some cases where welding has been declared a failure in manufacturing may be laid to the fact that the parts to be welded were not scarfed and consequently would not stand the required tests after being welded. As a general rule, a properly executed butt-weld should, when reduced to the size of the original section, have practically the same strength.

Although copper and brass rod and strip can be welded with perfect success, owing to the nature of the metal it requires a specially constructed machine to secure the best results. Since copper has a very low specific resistance as compared to iron or steel, it requires much more current to melt it on a given size rod. A longer time is required also to heat a given size of rod as compared to steel, but when the plastic stage is reached the metal flows so rapidly that it must be pushed up with tremendous speed or the molten copper will flow out between the abutting ends. To effect this rapid push-up of stock the platen on which the movable

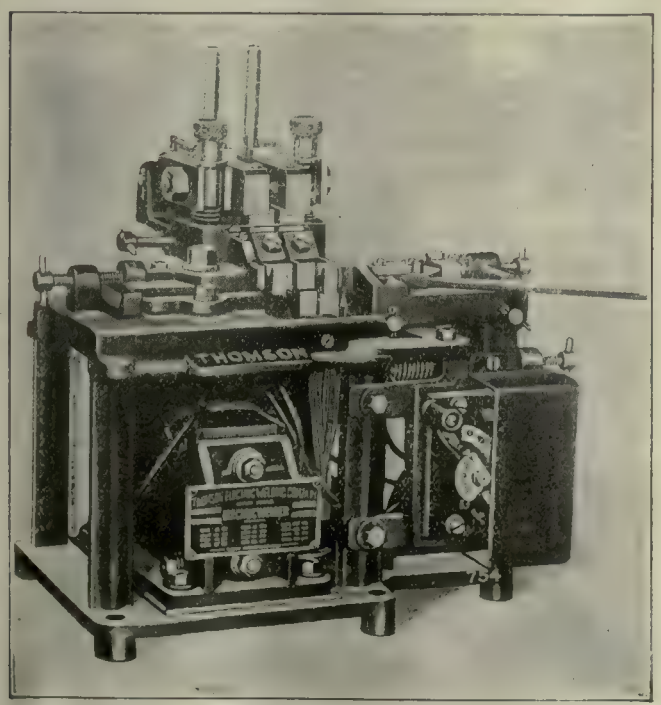


FIG. 369. MACHINE EQUIPPED WITH ANNEALING DEVICE

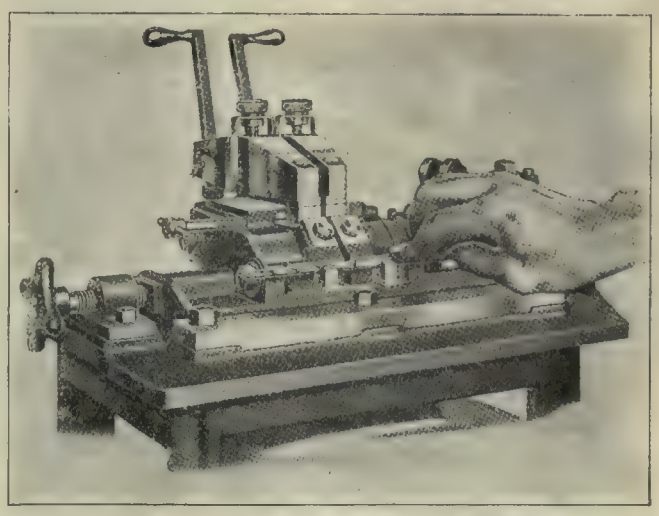


FIG. 370. ANNEALING A SMALL DRILL



FIG. 371. TYPICAL COPPER WELDS

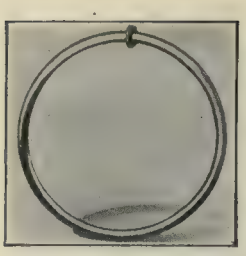


FIG. 372. WELDED ALUMINUM RING

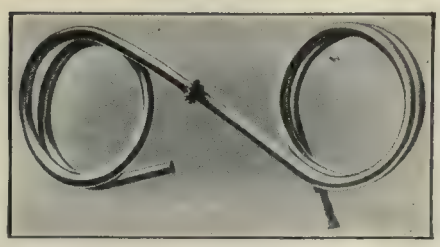


FIG. 373. A STEEL WIRE WELD

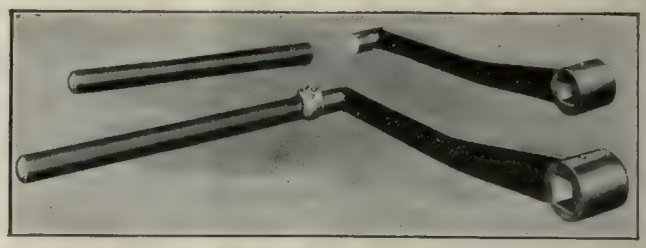


FIG. 374. WELDED HOISTING DRUM CRANK FORGING

right-hand clamp is mounted must move very freely indeed, necessitating roller bearings on the larger sizes of machines. The pressure spring on the smaller machines must also be capable of maintaining its tension through a longer distance than on a machine for iron and steel, since more metal is pushed up on a given size of copper rod than would be on steel or iron.

The properties of brass and also aluminum are practically the same as those of copper and therefore this special type of machine is just as well adapted for these metals.

Typical copper welds are shown in Fig. 371. The one at the left shows it just as it came from the machine, and the one at the right with the flash partly removed. Fig. 372 shows an aluminum ring immediately after welding. A steel wire weld is shown in Fig. 373, and a welded hoisting drum crank in Fig. 374. This last illustration shows how some drop forgings may be simplified and the cost of dies and production lessened. A large pinion gear blank is shown in Fig. 375. Made in this way, a large amount of time and metal is saved. The way to weld pieces of large and small cross section is described in the article on tool welding.

Band saws may be welded as shown in Fig. 376. The way a band saw looks after welding and after the flash is removed is shown in Fig. 377.

Automobile Rim Work

One of the largest applications of butt-welding today is to be found in the automobile-rim industry. The special form of clamp shown in Fig. 366 was especially designed to handle rims of all kinds and sizes. It is not adaptable for any type of work other than flat stock, as the amount of jaw-opening is much smaller than the diameter of equivalent section of round stock.

No backing-up stops of any kind are built for these machines with rim-clamps, as stops are unnecessary for this class of work. In order to secure sufficient gripping effect of the stock to prevent it slipping in the clamp-jaws, the upper dies are made of self-hardening steel with the gripping surface corrugated. The lower dies, which carry all the current to the work, are made of copper with Tobin-bronze shoes on which the work rests, so as to give good conductivity and yet present a hard wearing surface to the steel rim. These lower dies must not only bear the gripping effort exerted by the steel dies above, but also the weight of the rim, which, in large sizes, amounts to considerable.

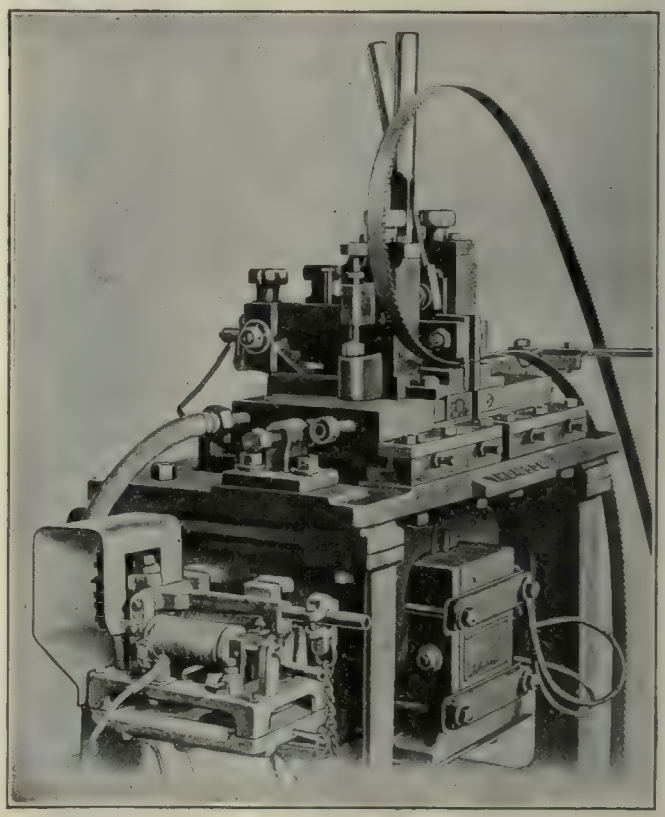


FIG. 376. WELDING A BAND SAW

The method employed in welding automobile rims is the "flash-weld" principle, wherein the current is first turned on with the edges to be welded pulled apart. The



FIG. 375. LARGE WELDED PINION BLANK

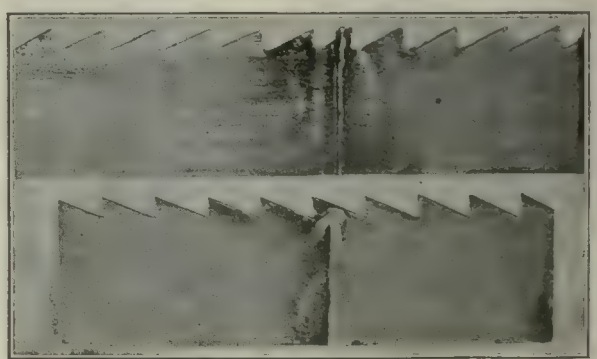


FIG. 377. BAND SAW WELDED AND SMOOTHED OFF

pressure is then applied gently to bring the abutting ends slowly together. As uneven projections come into contact across from opposite edges they are burned or "flashed" off, which is evidenced by flying particles of burning iron. The pressure is gradually increased, bringing more of the length of the opposite edges into contact and when the "flash" throws out for the full width of the rim which indicates the abutting ends are touching all the way across, the final pressure is quickly applied as the current is turned off, thereby completing the weld. It has been found that experienced operators on this kind of work do not look at the weld itself but govern their actions by the appearance of the amount of flash or sparks thrown out. When this assumes the

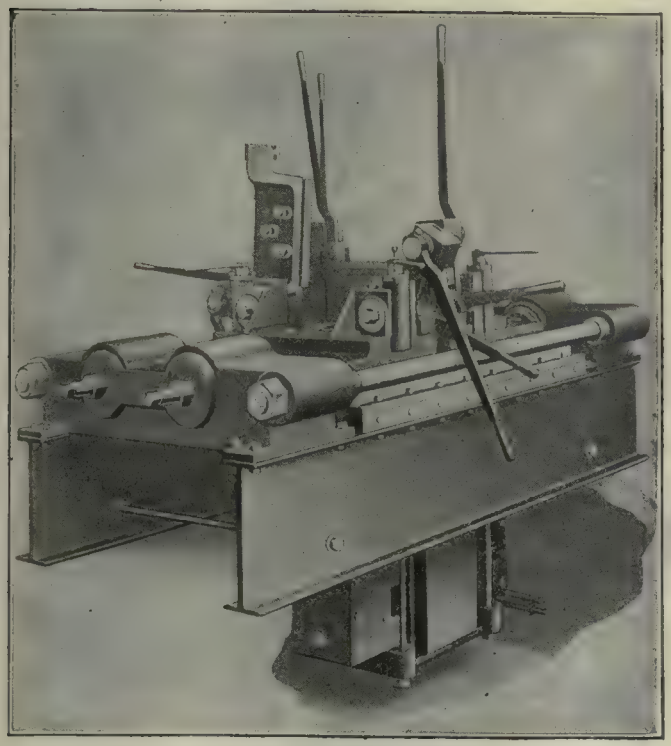


FIG. 378. TRUCK RIM WELDING MACHINE

shape of a complete fan they know it is the right moment to cut off the current and apply the final pressure.

The burr or fin thrown up in this type of weld is very short and very brittle, making its removal much easier than would be the case with the heavy burr resulting from a slow butt-weld. It is the common practice in rim plants to remove the burr while it is still hot and with a pneumatic chisel or a sprue cutter. The slight amount of burr then remaining is ground off with a coarse abrasive wheel and the rim is ready for the forming process. In most rim plants the operations of rolling, welding, chiseling burr, grinding burr, forming, shaping, etc., fit in so closely to one another that a rim is practically kept moving continuously from the time the flat stock is put into the rolls until a finished rim emerges. The welding operation itself on a rim blank for 30 x 3½ tire size, for instance, has an average production rate of 60 rims per hour, some concerns doing even better than this. On large truck rims for solid tires, having a section of 16 x ⅞ in. thick, a production of 10 rims per hour is considered very good, although there are concerns doing even better than this on such heavy work. The machine shown in Fig. 378 was designed for handling heavy truck rims only. The lower jaws on this welder are placed very low in order that the

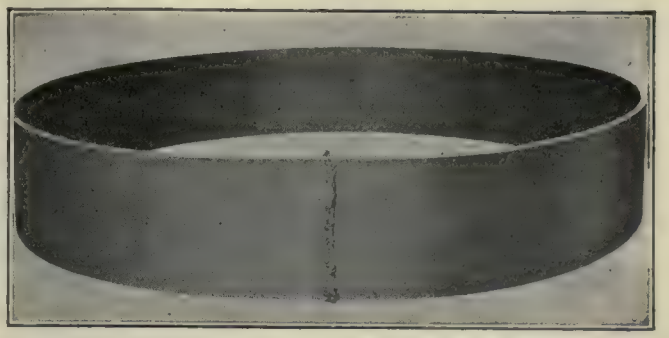


FIG. 379. A HEAVY WELDED RIM

machine can be set in a comparatively shallow pit to bring the line of weld on a level with the floor. This makes it possible, with proper tracking arrangements, to roll heavy rims right onto the lower dies without any lifting, the rim being rolled out again after welding. The double oil-transformers used in this welder hang below the base line, which necessitates a small pit directly under the center of machine. Owing to this and also the weight to be supported, a concrete foundtion only should be employed.

This machine has a capacity for stock ¾ x 8 to ⅞ x 16 in., or a maximum thickness of 1 in. with a cross-sectional area of not over 7 sq.in. Rims with a minimum diameter of 30 in. can be welded. The pressure is effected by twin hydraulic cylinders operated from an external accumulator giving a maximum pressure of 24 to 37 tons on the work. The voltage windings are of the same capacity as for other machines. The transformer is of the oil cooled type, and the ratings are 160 kw. or 266 kva., with 60 per cent power factor. Primary windings of transformers are submerged in cooling oil contained in casings. Platens on which the clamps are mounted and the bodies of the lower jaws to which the contact shoes are bolted, are water cooled. This machine is 66 x 101 in. and 66 in. high. The net weight is 14,000 pounds.

A heavy rim after welding, is shown in Fig. 379.

Welding Pipe

In order to weld pipe and tubing in the form of coils for condenser systems cooling tubes, heating coils, etc., as shown in Fig. 380, it was found necessary to employ a special form of clamp wherein the jaws could be set

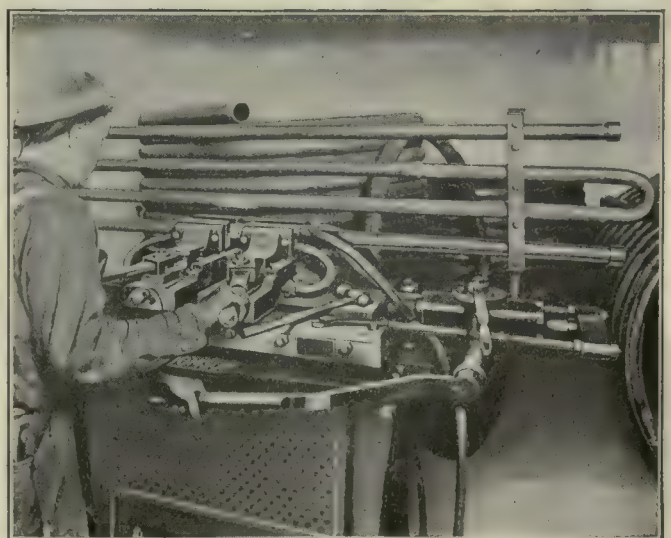


FIG. 380. WELDING PIPE COILS

Ordinary Sizes				Extra Heavy				Double Extra Heavy				Miscellaneous Data			
Diameters			Pipe Wall Thickness	Diameters			Pipe Wall Thickness	Diameters			Pipe Wall Thickness	Square Inch Cross-Section	Weight in Lbs. per Foot	Current Consumption per 1000 Welds	Cost per 1000 Welds at 1 c. per K.W.H.*
Nominal Internal	Actual Internal	Actual External		Nominal Internal	Actual Internal	Actual External		Nominal Internal	Actual Internal	Actual External					
⅛	.27	.405	.068									.0717	.241	12	$0.12
				⅛	.205	.405	1					.086	.29	13	.13
¼	.364	.54	.088									.1249	.42	16	.16
				¼	.294	.54	123					.161	.54	18	.18
⅜	.494	.675	.091									.1663	.559	19	.19
				⅜	.421	.675	.127					.219	.74	21	.21
½	.623	.84	.109									.2492	.837	26	.26
				½	.542	.84	.149					.323	1.09	35	.35
¾	.824	1.05	.113									.3327	1.115	37	.37
				¾	.736	1.05	.157					.414	1.39	50	.50
1	1.048	1.315	.134									.4954	1.668	60	.60
								½	.244	.84	.298	.507	1.7	70	.70
				1	.951	1.315	.182					.648	2.17	90	.90
1¼	1.38	1.66	.14									.668	2.244	100	1.00
								¾	.432	1.05	.314	.727	2.44	110	1.10
1½	1.611	1.9	.145									.797	2.678	130	1.30
				1¼	1.272	1.66	.194					.893	3.	160	1.60
2	2.067	2.375	.154									1.074	3.609	210	2.10
				1½	1.494	1.9	.203					1.082	3.63	220	2.20
								1	.587	1.315	.364	1.087	3.65	230	2.30
				2	1.933	2.375	.221					1.495	5.02	340	3.40
								1¼	.885	1.66	.388	1.549	5.2	360	3.60
2½	2.468	2.875	.204									1.708	5.739	410	4.10
								1½	1.088	1.9	.406	1.905	6.4	460	4.60
3	3.067	3.5	.217									2.243	7.536	570	5.70
				2½	2.315	2.875	.28					2.283	7.67	590	5.90
3½	3.548	4.	.226									2.679	9.001	740	7.40
								2	1.491	2.375	.442	2.686	9.02	760	7.60
				3	2.892	3.5						3.052	10.25	850	8.50
4	4.026	4.5	.237									3.174	10.665	940	9.40
4½	4.508	5.	.246									3.674	12.35	1150	11.50
				3½	3.358	4.						3.71	12.47	1190	11.90
								2½	1.756	2.875	.56	4.073	13.68	1300	13.00

* Multiply these values by the rate you are paying per K.W. Hour for current, to determine what the cost per 1000 welds for any size would be at your plant.

TABLE XXVII. APPROXIMATE CURRENT CONSUMPTION FOR WELDING PIPE UP TO 4½ IN.

up high to give clearance above the pressure-device. The thickness of the die and die-block to which it is bolted also had to be reduced to a minimum so as to insert the jaws between coils, since the pipe is coiled through each length and then another length is welded on, which in turn is coiled, and so on. In order to secure the best gripping effect with a comparatively light die, it is necessary to make this form of die considerably longer than those used in the other types of horizontal-acting clamps. Moreover, since there is not enough space in the narrow block to which the die is bolted to permit water circulation, the die itself must be water-cooled to prevent softening of the copper from continued contact with the hot pipe just in back of the weld.

This type of clamp, Fig. 381, is designed for welding of pipe and tubing only, which requires a much lighter pressure to push up than solid stock of the same cross-sectional area, and since the line of weld is considerably above the line of pressure, the slides will be quickly worn on the movable platen if heavy pressure is used continually. For this reason the welding of any solid stock with this class of machine is not advisable. The machine shown will weld iron and steel pipe from ¾ to 2 in. in diameter, ordinary pipe sizes and 1½ in. extra heavy pipe, or double heavy 1 in. in diameter. Standard steel tubing from 1 to 2¼ in. diameter may be welded. Pressure is supplied by a hydraulic oil jack exerting a maximum of 5 tons. The standard ratings are 30 kw. or 50 kva., with power factor of 60 per cent. The machine will weigh about 2,500 pounds. For welding pipe, Table XXVII will be found useful for reference purposes. This table was compiled by the Thomson Electric Welding Co., with special reference to their machines.

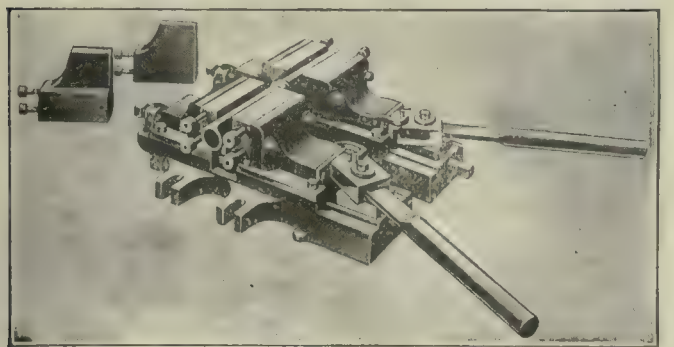


FIG. 381. CLAMP USED FOR PIPE WELDING



FIG. 382. WINFIELD PORTABLE BUTT-WELDING MACHINE

The Winfield Electric Welding Machine Co., Winfield, Ohio, makes a complete line of butt-welding machines but only a few representative of their line, will be shown. A very convenient portable or bench type is shown in Fig. 382. This is especially useful for light manufacturing work. It has a capacity of 18 to 6 gage wire. It is equipped with a 1 kw. transformer, hand clamping levers and a 3-step self-contained regulator for controlling the current. It occupies a floor space of 13½ x 16 in., is 35 in. high from floor to center of welding dies, and weighs about 130 lb.

Diameter of Stock	Area in Square Inches	K. W. Required	Horse Power	Time in Sec. Per Weld	Cost Per 1000 Welds at 1c per K. W. Hour	Average No. of Welds Per Hour	Labor Cost Per 1000 at 30c Per Hour
¼ Inch	.05	2	3	3	.02	400	.75
5/16 "	.08	3	4	4.5	.05	375	.80
⅜ "	.11	4	5	6	.07	350	.85
7/16 "	.15	5	7	6.5	.10	300	1.00
½ "	.20	6	8	7	.12	250	1.20
9/16 "	.25	7	9	7.5	.15	200	1.50
⅝ "	.31	8	11	8	.18	150	2.00
11/16 "	.37	9	12	9	.23	130	2.30
¾ "	.44	10	13	10	.28	100	3.00
13/16 "	.52	10.5	14	12	.35	95	3.20
⅞ "	.60	11	15	15	.46	90	3.30
15/16 "	.69	11.5	15.5	17	.55	85	3.50
1 "	.79	12	16	18	.60	80	3.70
1⅛ "	.99	16	21	20	.89	75	4.00
1¼ "	1.23	19	25	25	1.32	70	4.30
1⅜ "	1.48	25	33	30	2.08	65	4.60
1½ "	1.77	31	41	35	3.00	60	5.00
1⅝ "	2.07	38	51	37	3.90	55	5.50
1¾ "	2.41	45	60	40	5.00	48	6.20
1⅞ "	2.76	53	71	43	6.34	40	7.50
2 "	3.14	60	80	45	7.50	30	10.00

TABLE XXVIII. COST OF ¼ TO 2 IN. WELDS PER THOUSAND

The machine shown in Fig. 383 is for general all-round shop work. It has a capacity of from ¼ to 1 in. round, or ⅜ x 2 in. flat stock. It has a 25-kw. transformer, water-cooled welding jaws, enclosed non-automatic switch on upsetting lever, stop for regulating amount of take-up on each weld, ten-step self-contained regulator for controlling the current, occupies a floor space of 44 x 25 in., is 42 in. high to center of jaws and weighs about 1,800 lb. The jaws overhang as shown, for welding hoops, rings, rims, etc.

The machine shown in Fig. 384 is for toolroom work and was especially designed for handling large cross-sections. It will weld up to 2½ in. round. All clamping and upsetting operations are accomplished by means of air or hydraulic pressure. The clamping cylinders are operated independently of each other by means of separate valves, which enable the operator to clamp each piece before the current is turned on. The small air cylinder on the right-hand end of the machine keeps the work in close contact during the heating operation. The final pressure is applied by the hydraulic ram after the proper welding heat has been attained. The table at the left is equipped with adjustments for moving it up or down, back and fourth, tilting or twisting. This feature is especially valuable in experimental work and often saves buying a special machine for unusual manufacturing jobs. The terminals are cooled by a stream of water which flows from one to the other. The dies are held in place by slotted clamps which permit easy removal. Work stops and stops to regulate the amount of upset are provided. The movable table is fitted with roller bearings to insure easy operation. The transformer is a Winfield 125 kw. The machine has a ten-step current regulator, and the current for welding is controlled by a Cutler-Hammer magnetic switch which in turn is operated by means of a small auxiliary switch placed on the valve lever controlling the hydraulic ram. The floor space occupied is 60 x 90 in., and the approximate weight, ready for shipment, is 8,000 lb.



FIG. 383. A GENERAL PURPOSE BUTT-WELDING MACHINE

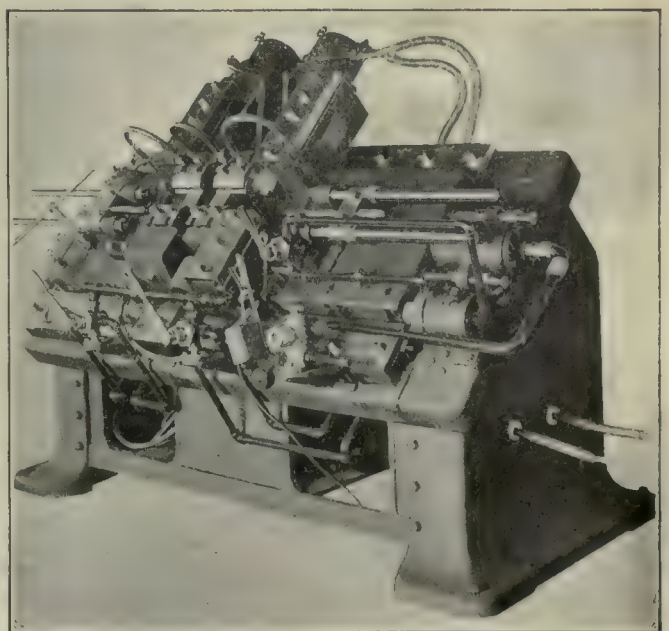


FIG. 384. WINFIELD TOOLROOM MACHINE

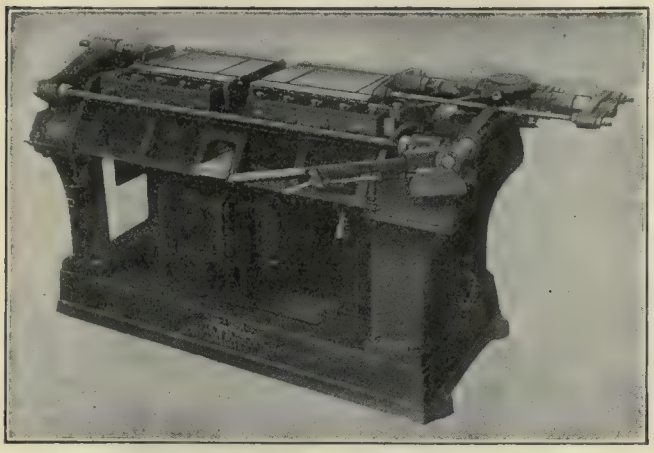


FIG. 385. FEDERAL HEAVY-DUTY BUTT-WELDING MACHINE

Table XXVIII compiled by this concern contains some useful data not given in the other tables.

The machines built by the Federal Machine and Welder Co., Warren, Ohio, do not differ in the principles of operation from the machines already described. The form of the one shown in Fig. 385, however, differs considerably from any shown. The tables, or platens, are flat and are T-slotted so that various fixtures may be easily bolted in place. The maximum capacity for continuous service, is 2¼ in. round or other shape of equal section. Flats up to ⅜ x 10 in. may be welded. The platens are of gunmetal and the T-slots will take ¾-in. bolts. These platens are recessed and water-cooled. Pressure is applied by means of an hydraulic jack, shown at the right. The switch is remote control magnetically operated. The main switch is controlled by a small shunt switch which is worked either by hand or foot, as desired. The transformer is 100 kva. It has an eight-step regulating coil. Floor space occupied is 38 x 88 in., height 50 in., weight 5,600 lb. This machine is intended to weld auto-rims, heavy forgings, steel frames, shafting, high-speed steel and work requiring accurate alignment and rapid production in quantities.

A set consisting of a tube welder and roller, is shown in Fig. 386. This will weld tubes from 1¼ to 3 in. It will also weld flat, round or square stock of equivalent

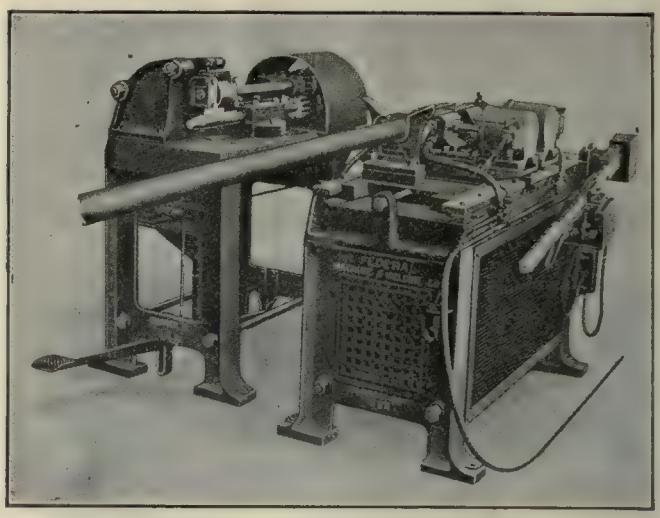


FIG. 386. A TUBE WELDING SET

cross section. The dies are water-cooled, and the work is clamped in position by air cylinders operating on a line pressure of 80 to 100 lb. The switch is on the main operating lever, so that the heat is at all times under the control of the operator. The transformer is 65 kw. air cooled. Eight current steps are obtained. The machine occupies a floor space of 30 x 51 in., is 42 in. high, and weighs 2,100 lb. By using the set, a tube may be welded and immediately transferred to the rolling machine and the flash rolled out. The time consumed in rolling down the flash on a 2¼-in. tube is given as approximately 20 seconds.

Butt-Welding Copper and Brass

In the *General Electric Review* for December, 1918, E. F. Collins and W. Jacob describe the welding of rotor bars to the end rings used in squirrel-cage induction motors, employing the machine shown in Fig. 387. This machine has a double set of welding jaws, the front set being used to butt-weld end rings to make them seamless, while the rear set is used to weld the rotor bars to the end rings. As shown, the machine is welding rotor-bars to the end-rings. The description of the

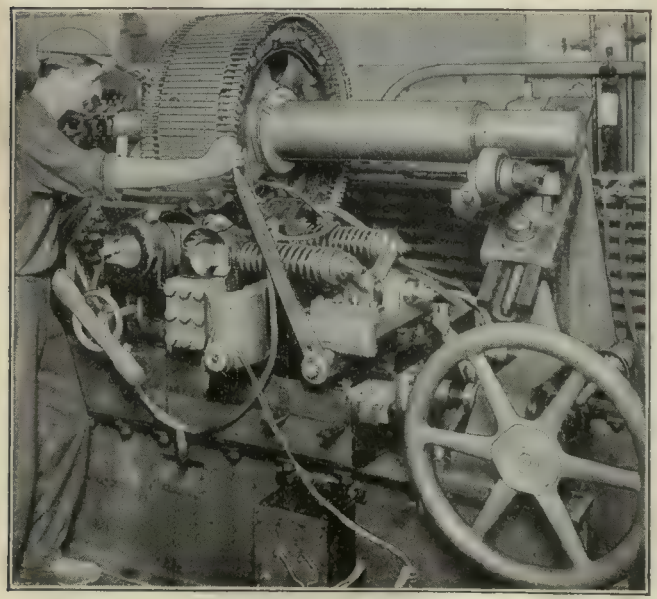


FIG. 387. GENERAL ELECTRIC MACHINE FOR ROTOR WORK

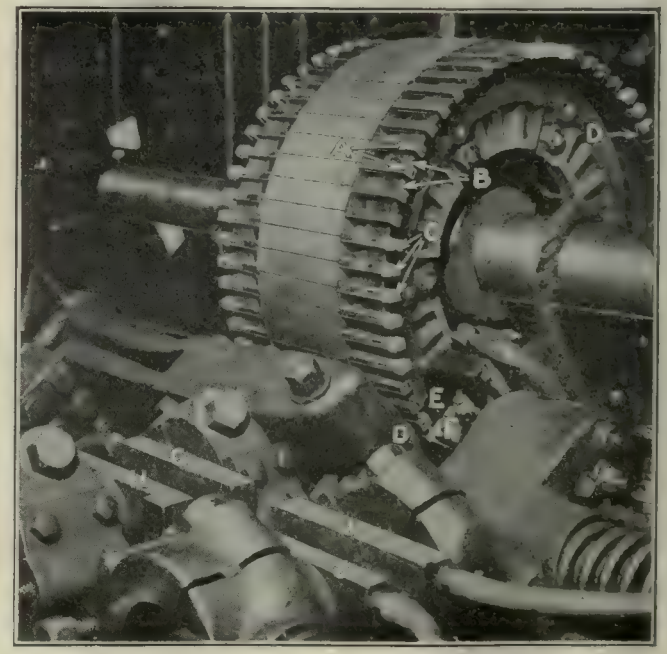


FIG. 388. DETAILS OF THE WELDING MECHANISM AND WORK

work as carried out in the General Electric shops is as follows:

"The projecting rotor bars surround a toothed end ring, which is of slightly smaller diameter than the rotor. A small block of copper is placed so that it covers the end surfaces of a rotor bar and the corresponding tooth on the end ring, after which it is butt-welded into place.

The projecting rotor bars are shown at *A* in Fig. 388 and the toothed end ring just inside the circle of rotor bars is shown at *B*. Finished welds as at *C* show blocks in place. The actual operation is as follows: A rotor bar is tightly clamped to the corresponding tooth of the end-ring between the jaws *D* and *E*. The copper-block end-connection is placed so that it covers the combined area of tooth and bar ends. The movable jaw *F* holds the end connection in place, and heavy pressure is then

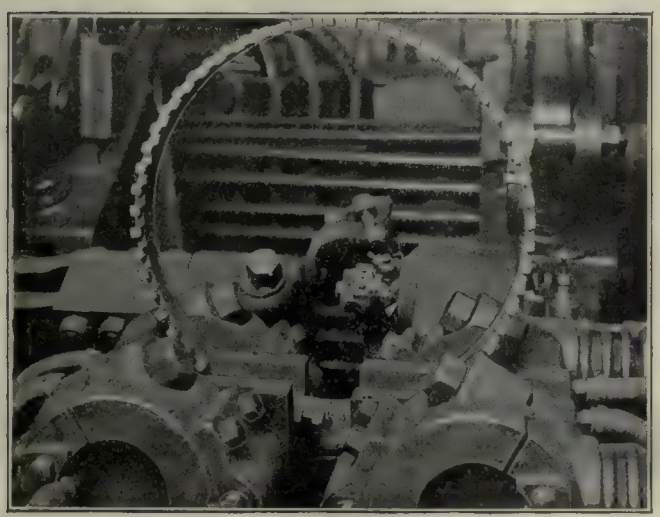


FIG. 389. BUTT-WELDING THE END RINGS

applied through compression springs. The welding current, furnished by a special transformer having a one-turn secondary, passes from jaw *F* through the surfaces and out through jaw *E*. This heavy current at low voltage causes intense heating due to the comparatively high resistance at the surface junction, and raises the temperature of the copper to welding heat, at which point the metal is plastic.

At this stage spring pressure forces the jaw *F* toward the rotor and squeezes out any oxide which may have formed between the welding surfaces. A small stream of water, playing upon the hot area, forms an atmosphere of superheated steam which prevents the formation of oxide and also guards against excessive heating of the copper. No flux is used in the operation as the mechanical squeezing-out of the oxide is sufficient to form a homogeneous connection between the two surfaces.

As the welding jaws approach one another when the metal becomes plastic, an electrical connection is automatically made which operates a solenoid-controlled switch that opens the primary transformer circuit. Thus the current is interrupted as soon as the surfaces have knitted together. The contacts of this automatic switch are placed one on each movable jaw, and are so adjusted that they are separated by the distance necessary for the jaws to approach one another in forming the weld and in forcing out the oxide. In this way, the end connection is butt-welded to the rotor bar and the end ring, forming a junction of great mechanical strength and low resistance.

Another example of non-ferrous butt welding is the making of seamless end rings, which operation is performed in the same machine. The operation is shown in detail in Fig. 389, which shows a finished end ring in place. One end of the ring is placed in the vise-jaws *G* and *H*, and the other is held in the opposite jaws *I* and *J*. As the jaws approach pressure is applied by means of the springs. In all other respects the operation is similar to that of welding the end connections.

Rotors up to 14 ft. in diameter are welded and Fig. 390 shows the rotor for a 1,400-hp. motor being welded.

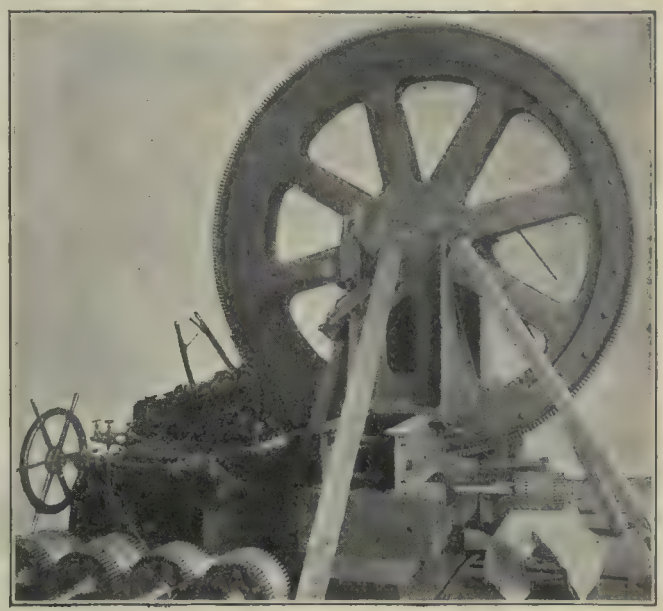


FIG. 390. WELDING END RING AND ROTOR BARS FOR 1,400-HP. MOTOR

The work is done rapidly; for example, end connections with a welding surface of about 0.6 by 0.4 in. are welded at the rate of about 90 an hour.

Welding Brass

Brass rotor bars and end rings are also butt-welded in a similar manner, but the operation is slower. Brass, being an alloy, has a lower melting point than copper, and less pressure is necessary to effect a weld. The pressure is determined by the thickness of the piece to be welded, and should be just enough to form a small "flash" at the point of union. Excessive pressure will cause the molten metal to spurt out from the point of weld.

In one fundamental particular the butt-welding of brass differs from that of copper, the pressure on brass must not be released after the stoppage of current until the metal has hardened sufficiently so that it will not crack on cooling. This delay retards the rate of welding to the extent that about 60 brass end connections, of the size previously mentioned, require the same time as 90 of copper.

Butt-welding has been the means of producing a rotor having low resistance, high mechanical strength, and ability to permanently withstand vibration and centrifugal force without excessive heating, all of which are essential factors in an efficiently operated squirrel-cage induction motor.

The Tin Dinner Pail Again?

By Entropy

Some few of the readers of the *American Machinist* undoubtedly remember carrying one of the old bright tin dinner pails with the little cup inverted over the cover. When you first opened it there was a piece of apple pie, or sometimes pumpkin, in a saucer and under that some cake and then several layers of sandwiches, that stretched your jaws wide open at every bite. Those were the happy days when no one worried over the cost of food. To be sure there was not much money in the pay envelope, but just think what you could buy with that little. Then there were not so many things to divert money from our pockets. Movies had never been heard of. If we wanted to go boating we borrowed someone's boat. He would have been insulted if we had offered to pay for it. There were no motor cars, but we could steer Old Dobbin very skillfully with one hand because there was nothing to scare him and we felt no need of haste.

The tin dinner pail was the mark of honest labor, not a badge of servitude. Its possessor was independent. He and his pail did not have to work for any one firm. He knew all parts of his trade and could fit in in any shop in a few days time.

Those who carry their dinners today do not know the tin pail. I doubt if one can be bought in any but the oldest stores. Now we are offered a leather covered box with a thermos bottle, and a little tin box that will hold about half the sandwiches that mother used to put in. We can carry hot coffee or cold coffee and be sure that we can tell which it is when we are ready to drink it, but we cannot carry a square meal any more. The alternative is to go to the shop cafeteria, or else to the one-arm-lunch down the street. The latter has had the drop on the lunch business until recently. We could get a good hearty meal for a quarter, topped off with a hunk of squash pie that alone would cost fifty cents today at any place along Broadway. We'll have to admit that the coffee was usually a very distant relative of the bean it was supposed to have come from, but there was enough of it, and by working hard all the afternoon we could sweat enough so that it did us no harm.

But today the one-arm-lunch proprietor has seen the great idea that the traffic will bear being squeezed some more and his prices look like the *à la carte* at the Biltmore of five years ago. He has been getting them too, but just recently it seems as though the time has turned, or better, possibly, the "worm" has turned and he sees more and more dinner boxes carried past his door every day. The shop cafeterias have variously met the situation by raising prices or by overlooking deficits. With the change in attitude what ought they to do? Just what is it worth to have men well fed, and how much is the loss if they are overfed?

First of all, we know that we are in the midst of a period of unrest; we also know that in an animal the easiest way to overcome unrest is by the application of music and plenty of food. Gorge the wildest man in captivity on the two and he is ready to lie down and go to sleep on the job without the slightest fear of work. The greatest trouble is that there is only one meal of the day that can be controlled by the employer, and that in the middle of the working period. The men may come in in the morning ready to fight at the drop of a hat, because of the night before or the scarcity of breakfast on the table. At noon he can be soothed and lulled into any state of mind that the dietitian sees fit, and at night we fear that his wife and children may suffer if he does not get equally well fed.

There is little doubt but that a man's ability to work and his disposition to work can be very largely controlled if his food can be controlled. The much railed-at McAdoo dinners of the time of the railroad administration were timed and weighed to the last degree of perfection. If every course was eaten they lasted a man with a healthy appetite up to about half an hour before he reached his destination. If the train was only half an hour late there was no real discomfort. They also had more or less of a soporific effect, so no matter how much we said about them before, and some time after, there were two or three hours in which the passengers were reasonably good natured.

The same thing can be done and improved on in the shops, provided the management is far sighted enough to realize that there are profits which the cost department cannot see. A diet can undoubtedly be arranged for every condition of climate and temperature, and for every variety of work, so that men will just begin to need food when the whistle blows. The mid-day meal could almost be given free if the men would follow the lead of a sensible dietitian. It would be interesting to know just how much of an undertaking it would be to get proper breakfasts and suppers served at home. My guess is that if the company were to offer wholesale rates on retail quantities of the foods which were selected it would be very easy to get almost every one in line. There is nothing that appeals to the retail buying public (now voters) more than a bargain. It would not do to advertise that these foods were good for one.

Never suggest that. Just suggest that they can be had at cut rates and not more than a limited supply to anyone.

Of course the success of this scheme would depend on the sagacity of the dietitian. There is no use offering anything on the score of its heat values. Most of us don't know what it means. I had the "pleasure" of dining for several months steadily at the restaurants of a chain which was once considered low-priced. They put on their menu the number of calories which each serving would afford. Time and again I have seen hot, heavy, not to say fat, men sit down in the middle of the day and the middle of the summer and pick out their orders to get the most calories per dollar expended, when if they had the slightest idea of what they were doing to themselves they would have ordered a bowl of crackers and milk and cooled off instead of stoking all the heat producing food that their pocketbooks would allow.

A good dietitian is one who can balance the needs of the day and the man and yet give him something appetizing and refreshing. A man who eats a hearty meal of red meat in the middle of the day needs a full noon hour and a pipe to be ready to get to manual labor. Then if he works hard enough he may come out even, but the man whose hardest duty is to adjust a micrometer screw every few hours cannot help being sleepy all the afternoon. He is the man that walks off platforms in bright daylight, and lets machines run idle because the stock is not renewed, and in many ways makes himself expensive for half the afternoon.

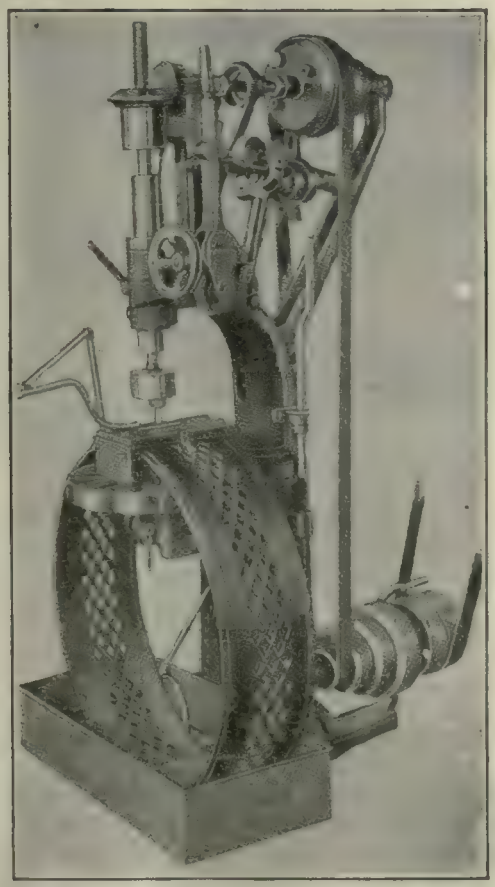


Drilling Angular Holes in Tire Mold

By J. Bainter

A rather interesting and unusual machining job recently came to the writer's attention. The illustration shows one type of mold ring used for forming the treads of automobile tires. This ring is of mild steel, $\frac{7}{16}$ in. thick, and 210 diamond-shaped holes are required in it. The machining of these holes was a slow and difficult job and several methods were tried.

It was found best to drill the holes, using an angular drilling tool, the set-up being shown in the accompanying illustration. The tool, which was made by the Watts Bros. Tool Works, Turtle Creek, Penn., was driven by an upright drilling machine of the ordinary type and was found to be well suited to the job. The machining time was cut from 260 to 50 hours per ring. Tools of this type would certainly prove to be timesavers on other jobs, as they are adapted to drilling holes of various shapes—such as, say, the hexagon holes in socket wrenches.



ANGULAR DRILLING TOOL MACHINING A TIRE MOLD

Finish Turning Some Heart-Shaped Cams

By E. A. Dixie

In Fig. 1 is shown a shrouded heart-shaped cam which was made several years ago by a friend of mine. A number of these cams were required, so dies were made to punch the heart-shaped centers out of sheet steel about $\frac{3}{16}$ in. thick. As there is nothing out of the ordinary about the diemaking end of this job it will not be described here. The method of laying out the heart was obtained from the *American Machinists' Handbook*. After the die was made it was found that the edge of the cam was not smooth enough for the purpose to which it was to be put and the question arose whether the blanks should be shaved in another punch-press operation or the work form-turned to the desired



FIG. 1. SHROUDED HEART-SHAPED CAM

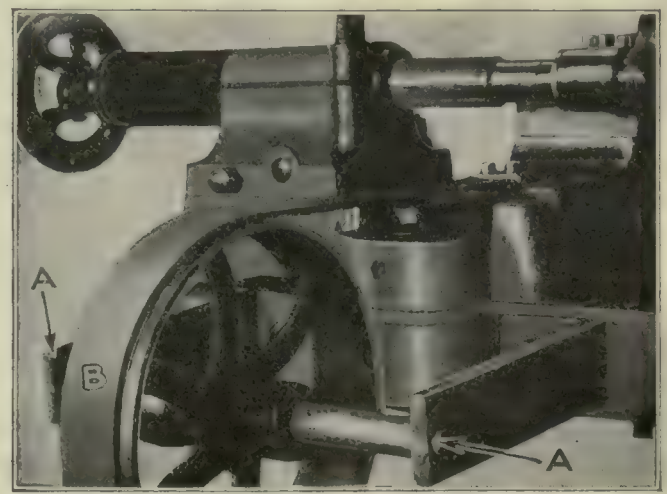


FIG. 2. RIG FOR TURNING THE HEART-SHAPED CAM

degree of smoothness, which was finally settled in favor of the turning operation. Figs. 2 and 3 show how the work was done on a small engine lathe rigged up for the purpose.

Two brackets *A*, Fig. 2, made of flat iron, were bolted to the back of the lathe carriage. They carried the cast-iron pulley over which the belt *B* for the counterweight led. The screw was removed from the cross-

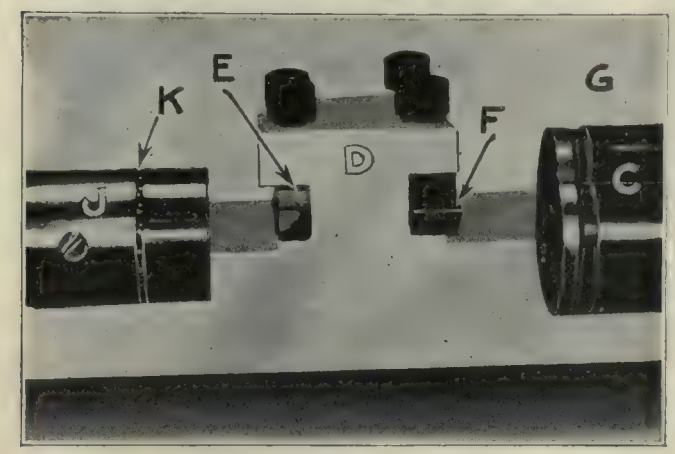


FIG. 3. CLOSEUP VIEW OF THE RIG

slide so that it was free to follow the contour of the master cam *C*, Fig. 3. A special toolpost *D* was made to carry a turning tool *E* and the cam follower *F*. The cam blank was secured to the face of the hardened master cam which was provided with a taper shank to fit the hole in the live spindle.

Only one hole *H*, Fig. 1, was required through the cam for affixing it to the mechanism in which it was used, but to locate it and to prevent it from moving during the finish-turning operation another hole was drilled as shown at *I*. A special tail center *J*, Fig. 3, was also made and provided with a ball thrust *K* which when in operation abutted against the cam blank and kept it from coming off the locating pins.

The accuracy demanded was within 0.0005 in. The time necessary for turning about was 30 seconds each. Over 500 had been turned, up to the time the photographs were taken, without any change of the tools.

The job of turning was so simple that an apprentice boy did it.

The shrouding around the periphery was made of thin sheet steel and riveted on.

An Interesting Old Micrometer

By Wm. Older

The illustration shows an interesting old micrometer that a toolmaker friend of mine found some ten years ago lying on top of one of the beams in an old machine shop. How long it had been there none of the older hands knew, and no one seems to know who made it. It is made to take a little over two inches.

It will be observed that the man who made it must have calibrated the screw before he cut the graduations on the barrel for the line runs at an angle to compensate for the shortness of the lead of the measuring screw. The small stem which looks very much like the ratchet stop on a modern tool is merely a high-speed stem provided with a screw which fits the end of the thimble. When found, the micrometer had in place of the anvil a piece of cork, and thereby hangs the tale that accounts for the appearance of the picture in the *American Machinist*.

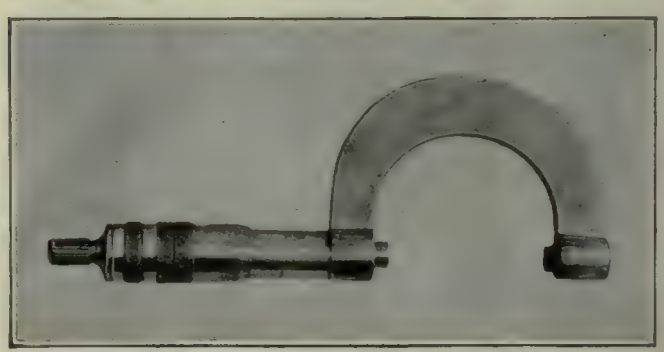
My toolmaker friend and I were swapping yarns the other day. These, as they always do, led from one thing to another till we got to the ever-popular "War Toolmaker" when my friend spilled the following:

"I was working at So and So's in 1917. We had a few good mechanics but the rest were the hardest bunch of lunkheads I ever saw. One day a fellow blew in and asked for a job. When asked what he could do, he said he had worked at Jones' shop as a toolmaker, at Brown's as a gage maker, at Smith's as a die maker, etc., so as we were in need of men no matter how little they might know if only they could do some one thing, the boss gave him a job on the cylindrical grinding machine.

"The first job given to him was to grind the outside diameter of some rough-forged rings. There was nothing particular about the job—anything within $\frac{1}{32}$ in. was quite good enough.

"After he had fussed around a bit at a job he came over to me and wanted to borrow a two-inch micrometer, giving as an excuse that his tool chest had not arrived yet. I would not have trusted him with any of my good tools but I remembered about the old two-inch "mike" in my chest so I took it out with every appearance of care and told him to be very careful with it as I was working to a "tenth" with it on certain work and had it very accurately adjusted.

"When I handed it to him I wondered how long it would be before he found out that the thing was nothing but a piece of scrap. A few minutes later I saw him try it on one of the rings, carefully turning and turning the barrel and then turning it again. Between every turn he would swing the 'mike' over the work to get the 'feel' of the work between the end of the screw and the cork anvil. At last he had run the screw down as far as it would go, so he withdrew the screw and went through the same antics with



AN OLD MICROMETER WITH A COMPENSATING SCALE

another of the rings which he had already finished and taken out of the machine. A little while later he came over to me, handed me the old 'mike' very carefully, thanked me for lending it to him and said: 'I guess I better get on my coat and quit; I got all those rings too small.' However, I suggested that he grind up the rest anyhow, as he might as well spoil the whole lot while he was about it.

"When he went out for lunch I measured the rings and found that they were about $\frac{1}{32}$ in. over size instead of too small; he had not noticed the compressing of the cork anvil and so thought that he had made them too small."

WHAT to READ
—for the man in a hurry



Suggested by the Managing Editor

THIS week's leader gives a brief account of the steps leading to the passing of the act creating the Court of Industrial Relations of the State of Kansas. The action of Governor Allen and the Kansas Legislature caused something of a stir at the time the bill was passed, but little has been heard from that vicinity lately except at the time of the Allen-Gompers "debate" in New York. Nevertheless the court is still working although one of the provisions of the original bill has been declared unconstitutional on what appears to a mere layman as a legal quibble. The statement has been made that it will be a very simple matter for the next legislature to amend the act to take care of the weak point. It is to be hoped that the steps necessary to remedy the defect will be taken so that the court may function as originally intended and receive a fair trial.

What to read was not a difficult matter to decide two hundred years ago when books were few and magazines unheard of. It is far different now when so much reading matter is offered to pass the time pleasantly or profitably as the reader chooses. We are doing our utmost to make the "American Machinist" not only profitable but indispensable as a clearing house of ideas and news of the machinery world. This page is the editors' advertisement of their section of the paper. It gives the high spots

Toolmakers, designers and foremen will be interested in an ingenious fixture for milling small ellipses on a production basis, which is described on page 752 by P. A. Fredericks. Full details of the fixture are given.

Beginning on page 755 we have a history of the art of brass-making written by Otis Allen Kenyon for the Bridgeport Brass Co. We were so impressed with the excellence of the story that we arranged to reprint the whole thing for the benefit of those of our readers who do not happen to be on the mailing list of the company. The first installment is devoted to historical notes and is confined mainly to the description of methods and equipment of bygone days.

This article is followed by another shorter one for the toolmaker in which Fred Colvin tells of some small-scale press and die work.

The men who build and keep up the linotype machines on which the *American Machinist* is printed must be thorough mechanics, and specialists on this particular work besides. How they are trained at the factory of the Merganthaler Linotype Co. is discussed by J. V. L. Morris beginning on page 765. More of R. Thomas Huntington's amusing reminiscences follow the apprentice article. Here he tells of his first shop, probably the oldest locomotive shop in this country. In those days the machining of side-rods was a man's job on the machine tools available.

Little can be said about Part XXX of the Welding Series except that it covers electric butt-welding machines and their work, in Viall's usual thorough way. Performance and cost tables are included.

Our old friend Entropy is on the job again this week taking for his theme the "carry-your-own-lunch" slogan that has had no small effect on restaurant lunch prices in many cities of late. Among other things, what he has to say about the McAdoo standardized railroad dinners will appeal to those of you who had to do much traveling during the régime of the late lamented (?) R.R. administration. Entropy has page 778 all to himself.

We have been keeping our engineer readers closely in touch with the affairs of the Federated American Engineering Societies. This week the federation is given space in three parts of the magazine. A list of additional societies joining is given in the news section on page 788g; there is a general article, page 783, which briefly outlines the reasons for an organization of engineering societies and tells of the large field open to its activities; there is also an editorial, page 782. The general article consists of excerpts from addresses by the presidents of two national engineering societies and we are certain that you will profit by reading it.

"Sparks" has accounts of several meetings and conventions that have just occurred, of major importance being the Foundrymen's convention at Columbus and the annual meeting of the American Manufacturers' Export Trade Association in New York. We are also running the chart of the exhibitors at the Olympia machine tool exhibit that was prepared for our European Edition and with it some British comment on both Olympia exhibit and the Leipzig fair. See pages 788a, b, and c. On page 783 is an account by our technical correspondent in Washington of the hearings before the Federal Trade Commission on the subject of the guaranteeing of retail sales prices. This is a big question.

EDITORIALS

A Permanent Tribunal for Labor Troubles

EVERY once in a while the much-pestered public worm turns and takes a vicious wallop at its tormentors. Out in Kansas last winter the coal miners struck once too often and the State took hold and showed them that coal could be obtained in spite of mighty labor leaders.

It really is surprising how much the common people will stand before they make up their minds to do something. If we are not mistaken there were something like seven hundred strikes in the Kansas coal fields in a little over four years and most of them over the most trivial matters. The water in the shower baths was too hot, or else it was too cold, the dynamite was the wrong color, a steam shovel was put in to save money in a strip mine, the pipe-fitter was busy somewhere else and consquently a water pipe joint could not be broken to enable a machine to keep up with the gang; the gang quit rather than unscrew the joint. These are only a few typical cases and were usually local. The strike which caused the trouble was the big one for a 60 per cent increase and shorter hours and weeks.

Most of our big strikes have been settled by a specially appointed commission and the public suffered while the commissioners familiarized themselves with the facts in the case. Governor Allen and the people of Kansas have taken the stand that a permanent commission or court will be better able to handle such cases and the country is watching their experiment with keen interest.

The platform on which the Kansans stood, and still stand, maintains that the public has rights in any dispute between capital and labor in any of the essential industries. This seems to be a rather novel idea to some people and created a storm when Governor Allen proposed his Industrial Court to insure the preservation of these rights. K. H. C.

The Federated American Engineering Societies and Its Field

THERE is an immense field in which the Federated American Engineering Societies can carry out its avowed object of furthering the public welfare wherever technical knowledge and engineering experience are involved. Individual societies have long recognized the existence of big problems concerning the welfare of the nation and have done what they could to solve them. The effects of such efforts have been two-fold—beneficial to the nation in practical results and educational to the society in making it see that for great accomplishment engineers must act as a unit.

Following the rapid crystallization during the war of the sentiment favoring united action there was organized the Federated American Engineering Societies. There has been some speculation as to just what the Federation can do. Part of the answer was contained, though it probably was not intended to be such, in the address of Herbert C. Hoover, president of the American Institute of Mining and Metallurgical Engineers at Minneapolis, an excerpt of which we publish on page 788d. Though only a part of the answer it is a large part, enumerating problems of national scope on which the Federation can be at work for some years to come.

Mr. Hoover's address is preceded by an excerpt from an address by Arthur P. Davis, president of the American Society of Civil Engineers, at the annual convention in Portland, Oregon. Mr. Davis outlined the necessity for and the organization of the Federated American Engineering Societies.

We believe, with Mr. Hoover, that certain things must be done—and with Mr. Davis that we must have united action of engineers to do them. Conservation of raw material and scientific and common-sense management must be practiced in the business of the nation as they are in the business of private plants. Believing that the Federated American Engineering Societies offers the best present constructive step toward fructifying such aims, we continue to urge that engineering societies join the Federation and take part in the forward movement. L. C. M.

Increasing the Efficiency of Our Congressional Committees

IT IS unfortunate, but true, that the results obtained from the average Congressional investigation are seldom commensurate with the effort expended. The blame should not be laid at the doors of the committee members from House or Senate, for they are working under conditions that practically preclude any other outcome. Few members are so situated that they can attend every meeting of every committee on which they may be serving. And in addition even fewer members have the necessary technical knowledge to make an intelligent investigation into each of the many widely diverse problems to be handled.

A practical remedy was suggested by Otto H. Kahn in a talk on the general subject of taxation before the American Manufacturers' Export Association. It was well received by his audience and is well worth serious consideration. The suggestion is that committees be made to include both legislators and citizens, the latter to be disinterested experts of recognized authority on the particular matters to be dealt with by the committee. According to Mr. Kahn's plan the citizen members would be in the minority, and this is probably as it should be, especially from the practical standpoint of securing enough men of the proper caliber.

Many business men and many engineers have been free in their criticism of the politician and country lawyer types of congressman, but have done nothing to send better men to take their places. And probably they never will. Hence the practicability of a plan of this kind that will attain the end sought without attempting the impossible feat of changing human nature

K. H. C.

Guarantee of Prices Against Decline

By R. S. McBRIDE
Washington Engineering Representative, McGraw-Hill Co., Inc.

Can the manufacturer or jobber properly guarantee his customer against declining markets? This is a question which the Federal Trade Commission had under consideration at its hearing in Washington during the week of Oct. 4. Many industries from all parts of the country were represented and a wide variety of opinion was evidenced.

AS STATED by the chairman of the Federal Trade Commission the subject of giving guarantees against price decline has many ramifications extending all the way from cranberries, a most perishable article, to structural steel, which even the most ardent advocates of the theory of corrosion by electrolysis cannot consider a perishable commodity. The practices of industries differ as widely as the commodities handled. For example in certain lines absolutely no guarantees of this type have ever been granted and the industry apparently vigorously opposes any opportunity for beginning the practice. On the other hand unlimited price guarantee is practiced in other fields, even to the extent of protecting the dealer with respect to the stocks on hand at the time of any decline, without regard to the time of purchase or the magnitude of the decline.

Some of the problems to be considered by the commission are as follows:

(1) Over what period of time should the guarantee extend?

(2) Should the date of determination be definite as is the practice in the case of seasonal goods or should it be based upon the time after delivery, or should the guarantee terminate with delivery and, therefore, apply only to unfilled portions of contracts?

(3) Should the guarantee extend only against decline in the price made by the seller himself or against any decline in the market made by competitors?

(4) Should the decline be limited to those commodities which are handled on a basis of publicly known prices to the consumer, or can the practice also apply to a commodity where the price involved in transactions and the price to the consumer are not generally known to the trade?

(5) Should the guarantee apply to the goods actually on hand at the time of the decline or to all goods sold to the jobber under the contract, thus permitting the jobber to afford a similar guarantee to the retailer on the goods which the retailer still has in stock?

Arguments Against Permitting Guarantees

Some of the arguments advanced against permitting continuance of price guarantees are set forth by the communications which have been presented to the commission in answer to its recent questionnaire. Among these the following claims are most conspicuous:

Results in unfair competition and is equivalent to a form of rebating.

Leads manufacturers to encourage dealers in overstocking thereby eliminating their competitors.

Puts a hardship on manufacturers with small capital.

Gives jobbers an unfair advantage in relations with manufacturers.

Encourages jobbers to take too great risks as to probable sales, that is, encourages overstocking.

Creates speculative buying.

Creates a disadvantage as between large and small jobbers, the former being able to secure concessions which are denied the latter.

Tends to maintain an artificial level of prices, that is, eliminates much of the incentive for manufacturers to reduce prices.

Delays passing of market declines on to the consumer.

Injures small operators who cannot successfully maintain businesses when this speculative element remains.

Imposes a hardship upon the seller by requiring him to bear the risk which the jobber can reasonably be expected to carry.

Leads to overstocking of perishable products and thereby increases wastage or results in inferior quality reaching the consumer.

Compels a producer to use the practice in order to meet other producers, even though he believes the practice vicious.

Creates an expense to the manufacturer in the form of increased risk which he necessarily adds to his price and which the consumer ultimately pays.

Suppresses competition.

Prevents producers from offering lower prices than specified in previous outstanding contracts.

Encourages violently changing prices at the close of guarantee periods instead of normal, gradual price adjustments at intervals throughout a period of guarantee (particularly in seasonal commodities where the price guarantees expire at a given date).

Arguments Favoring Price Guarantees

Proponents of the idea, who insist that this trade practice is legitimate, necessary and in the public interest, offer among others the following arguments with respect to guarantee against price decline:

Encourages freer purchase and carrying of normal stock.

Enables manufacturer to maintain regular and continuous factory operation and shipment throughout the year.

Saves delays in delivery by distributing shipments over the year.

Permits manufacturer to anticipate his needs for raw materials and to buy on a less fluctuating raw material market.

Tends to stabilize business.

Creates business confidence.

Enables jobbers to anticipate their needs without undue risk.

Gives the manufacturer more accurate knowledge of his probable sales.

Induces the buyer to stock up, especially on seasonal merchandise, for considerable periods.

Steadies plant operation and therefore the employment of labor.

Permits wide distribution of stocks which simplifies distribution instead of concentration at the factory until demand arises.

Prevents abnormal demand creating shortage and abnormal high price because of wide distribution of stocks.

Prevents inadequate production at slack periods with the resulting subsequent shortage at seasons of greater demand.

Permits commodity to be sold by jobbers on narrower margin of profit.

Increases the percentage of car-lot shipments as compared with small shipments to meet current demands.

Justifies storage space in jobbers' warehouses, eliminating the necessity of large central warehouses at points of manufacture.

Prevents manufacturers from selling direct to retailers at lower prices than jobbers are able to quote.

Places the risk on the man who is best able to judge the hazard, that is, the manufacturer.

Gives the manufacturer ready use of his money and exempts him from payment of storage charges and expense.

Enables small retailers to carry adequate stock and thus pass the benefit to the consumer.

As a rather negative form of argument in favor of the guarantee practice it is urged that such guarantees do not in any way interfere with the functioning of the laws of supply and demand. It is insisted that no unfair or improper practice need follow and that the practice is nothing but one element in the matter of contract between buyer and seller of commodity.

Points of View Considered

In receiving these arguments and in the conduct of its hearings, the Federal Trade Commission has indicated that it will take into account the interests of the manufacturer, wholesaler, retailer, and consumer. It is considering the matter not alone from the point of view of the public service aspects. The matter of business relations, the law in the case, the question of justice between various merchandising interests and the principles of economics all were stressed by the various speakers and by the questions put to those appearing before the commissioners.

Unfortunately much of the discussion has not distinguished clearly between the differing conditions existent in different industries. Many of the generalizations presented before the commission, therefore, appeared much broader than was apparently intended by their proponents. Because of this it is difficult to draw any general conclusions as affecting all industries. Nevertheless certain outstanding features of the discussion seem to have been well established and can safely be used as a guide to the present thought in the matter.

It is worth while at this point to note that the Federal Trade Commission expressed its desire to receive additional discussion or briefs in the matter from any interests including those which have not previously been heard. This privilege was extended for a period of thirty days from the time of the hearing, Oct. 5 and 6.

Some Conditions Indicated

Even the strongest opponents of a price guarantee system did not deny that there are certain industries and certain circumstances in which guaranteeing against price decline offers certain commercial merit. It also seemed to be the unanimous opinion that if price guarantees are to be permitted in American trade there should be no effort whatsoever to make price guarantees mandatory. And, too, those in favor of having price guarantees permitted did not deny that under certain circumstances such might conceivably be used unfairly and constitute, therefore, unlawful practices in defeat of competition or in restraint of trade.

A number of the arguments which carried the greatest element of conviction related specifically to particular industries. For example, industries dealing with products of seasonal demand or seasonal production have established practices that seem to contribute uniformly to the benefit of producer, jobber, retailer and public.

The rubber footwear trade, which meets with a seasonal demand analogous to that in the electrical appliance industry where Christmas or other specialty goods are concerned, stressed the necessity of wide distribution at all seasons of the year in order to permit reasonably uniform production and transportation in advance as well as during seasons of large consumption. The canned milk and food industries where seasonal production enters as a large factor made a similar case in favor of advance sale with guarantee against price decline for the wholesaler so that certainty of plant operation and movement of goods would permit intelligent planning by the packer.

Another type of industry argued for opportunity to guarantee against price declines on orders which are necessarily taken long in advance of the times of delivery, the factory output being contracted for months in advance even under present market conditions. These and similar circumstances indicate a likelihood that insofar as business relations and the general public interest are concerned we can expect an attitude favorable toward price guarantees of this sort on the part of the commission.

Law An Important Question

The law in the matter, however, must be considered as an important question which will really determine the form of the commission's decision when it is announced. It is argued pro and con that the commission may or may not regulate trade practices on the ground solely that they may tend to restrict competition or may tend to interfere with free competitive trade. A decision of the courts affecting this point relates to a case in which it was decided that the law forbade any practice which had a dangerous tendency to unreasonably restrict competition. This type of decision, however, is not particularly significant as it leaves an uncertainty as to what is a "dangerous" tendency and what is an "unreasonable" restriction.

Unquestionably the commission has authority and presumably will exercise it in specific cases where definite evidence can be afforded of the use of a trade practice, such as the guarantee of prices against decline, for the injury of a competitor. So long as this possibility exists it can be expected that the commission will from time to time hear particular cases where this is the ground for complaint and if a good case is made will doubtless order a discontinuance of the practice of such guarantees.

Benefits to Consumer or Wholesaler

It seems to be clearly indicated by testimony that in certain industries the benefit of price declines afforded by manufacturers to jobbers, when the market changes, are passed on all the way to the ultimate consumer rather promptly in a considerable portion of the business. On the other hand, it seemed to be clearly demonstrated that in other industries or other circumstances the guarantee against price decline resulted simply in a wider margin or in elimination of hazard to the wholesaler. The length of time over which the guarantee extends and the degree of publicity or secrecy in announcing price changes seem to be determining factors in this matter.

The results of the commission's consideration of this subject will appear not only as a report or perhaps opinion on the general matter but also more definitely in connection with the numerous cases now pending where specific complaint is made against guarantee of prices. A number of these cases lie in the field of canned goods, soap and similar products, but the principles there considered will, of course, be applicable in all lines of trade.

SHOP EQUIPMENT NEWS

- Edited By -
S. A. HAND

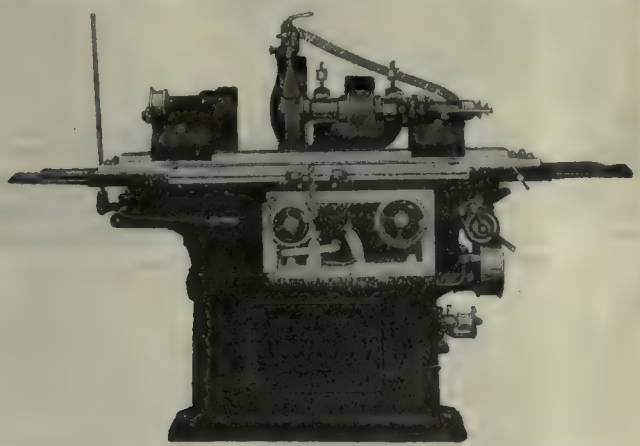
SHOP EQUIPMENT • NEWS •
A weekly review of modern designs and • equipment •

Descriptions of shop equipment in this section constitute editorial service for which there is no charge. To be eligible for presentation, the article must not have been on the market more than six months and must not have been advertised in this or any previous issue. Owing to the news character of these descriptions it will be impossible to submit them to the manufacturer for approval.

• CONDENSED • CLIPPING INDEX
A continuous record of modern designs • and equipment •

Webster & Perks Plain Manufacturing Cylindrical Grinding Machine

The Webster & Perks Tool Co., Springfield, Ohio, has added to its line the plain cylindrical grinding machine shown in the acompanying illustration. The machine is intended for manufacturing work on either straight or tapered stock held on centers, and it resembles in general features the universal grinding machine built by the company and described in the *American Machinst* of Jan. 31, 1918.



WEBSTER & PERKS PLAIN MANUFACTURING CYLINDRICAL GRINDING MACHINE

Specifications: Capacity; normal, 6 x 30 in.; maximum, 10¼ x 32 in. Swivel table graduations up to 3½ in. per foot. Headstock spindle; diameter, 2⅛ in.; hole, No. 2 Morse taper; length of bearings, front, 3⅛ in. tapered rear, 3 in. Wheel spindle, 1¾ x 22⅞ in. Wheel; face, 1½ to 2 in.; diameter, up to 14 in. Length of table ways, 50 in. Water tank capacity, 25 gal. Horsepower, 5. Wheel speeds, 1,680 and 1,920 r.p.m. Work speeds, 4, from 48 to 192 r.p.m. Table speeds, 8, from 6 to 94 in. per minute. Reduction by automatic crossfeed, minimum, 0.00025 in.; maximum, 0.005. Floor space; 43 x 116 in.; with unit countershaft, 66 x 116 in. Weight; net, 3,900 lb. with overhead countershaft, 5,050 lb. with unit countershaft; shipping, 4,300 and 5,650 lb.; boxed for export, 4,700 and 5,900 lb., respectively. Export box, with overhead countershaft, 49 x 60 x 80 in.

The bed is fastened to the base by means of capscrews, and its ways are provided with roller oilers for the purpose of lubrication. The length of travel of the table is controlled by means of adjustable dogs. Reciprocation of the table is automatic, the motion being transmitted through spur gears having a speed reduction ratio of 64 to 1. The table can be operated by hand also. The swivel table mounted on the sliding table can be swung by means of an adjusting screw.

The chrome-nickel steel headstock spindle is driven by inclosed gears with a speed reduction of 2½ to 1. Either live- or dead-center grinding can be done. The tailstock is provided with a spring center, and it carries the wheel-truing device. The wheel stand is held in place on the ways by its own weight. The wheel spindle is mounted in alloy bronze bearings held in ball-and-socket-housings,

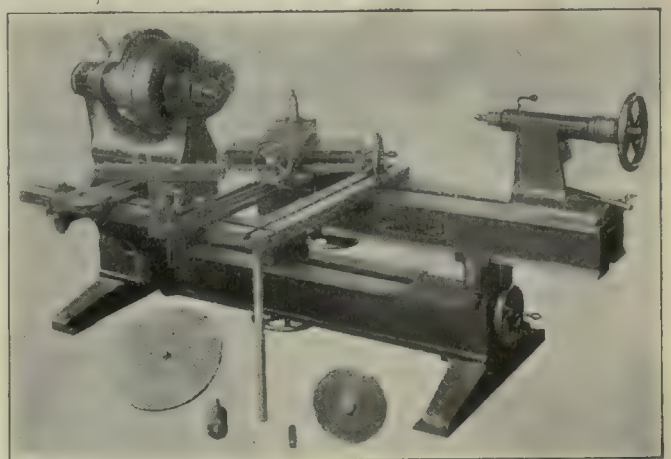
The rates of table feed and work speed can be independently varied. The headstock can be stopped without stopping the countershaft. The automatic cross-feed is provided with a micrometer adjustment and a positive stop. The controls are grouped at the front of the machine, the mechanism being assembled in a unit placed in the bed.

Provision is made for wet grinding, a Fulflo centrifugal pump providing the circulation. Two types of countershaft can be furnished, one for overhead use, and the other to be mounted on the floor in the rear of the machine and as a part of it. The countershafts are provided with Hyatt roller-bearings. Complete equipment is furnished with the machine.

Pryibil Extension Spinning Lathe and Attachments

The spinning lathe shown in the illustration has recently been built by the P. Pryibil Machine Co., 512-24 W. 41st St., New York, N. Y. It is intended for the spinning of articles of large dimensions, such as copper utensils for restaurant kitchens.

The machine is of the extension-bed type, its members having box sections. The main bed carries the headstock and supports the upper bed. The headstock is provided with a cone pulley for belt drive, and it is equipped with back gears. The front bearing of the



PRYIBIL HEAVY-DUTY EXTENSION SPINNING LATHE

Specifications: Swing, 27 and 60 in. Height of spindle, 44 in. Front bearing, 2⅛ x 9⅛ in. Horsepower required, 5 to 12. Floor space: base, 32 x 84 in.; maximum overall, 52 x 134 in. Weight; net, 4,500 lb.; with countershaft, 5,000 lb.; crated, 5,150 lb.; boxed for export, 5,600 lb. Export box, 75 cu.ft.

spindle is of white metal and the rear one is a combined radial and thrust ball bearing. The upper bed can be slid along the lower one and locked in any position, adjustment being made by means of a screw operated by the handwheel at the right. With the gap closed, work 27 in. in diameter can be swung, while with the bed extended, a 60-in. swing is provided.

The tailstock is adjustably mounted on the upper bed. A tailstock operated by a hand lever or a treadle can be furnished, instead of the screw-spindle type shown. The upper bed supports also the slide rest, while one end of the auxiliary bed supports the spinning rest. The auxiliary bed is L-shaped and is supported not only by the bed of the lathe but also by a leg resting on the floor. The T-rest is adjustably mounted and provided with holes for the insertion of the spinning pins.

The compound slide rest can be swiveled or set to any position, providing hand feed for the tool in two directions. The longitudinal feed is 16 in. and the cross feed 9 in., a $\frac{3}{4}$ x $1\frac{1}{4}$-in. tool being used.

The machine is equipped with 20-in. and 12-in. faceplates. A countershaft and a belt shifter can be supplied. Chucks can be furnished for turning and spinning oval or elliptical work. "Compound-lever spinning tools" are especially adapted for use on the machine when spinning heavy sheets.

Oakley No. 3 Universal Toolroom Grinding Machine

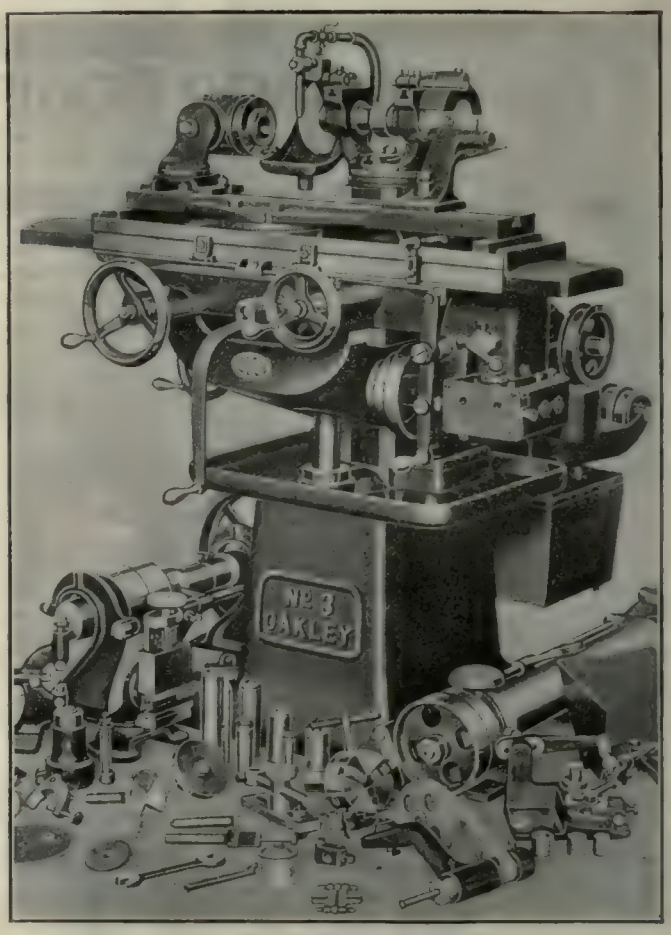
The Oakley Machine Tool Co., Cincinnati, Ohio, has brought out the No. 3 grinding machine shown in the illustration. Features are the mounting of the cone pulleys on the machine and the rack and pinion table drive. The cone pulleys are driven from the countershaft and the belt tension is maintained by an automatic belt tightener. The table drive is operated through bevel gears which are driven by a shaft from the feed-box bolted to the end of the saddle. The table driving mechanism is placed opposite the center of the grinding wheel head with the object of balancing the thrust.

The table movement is controlled by friction and may be either power or hand operated. Fast hand movement is obtained by using the large crank handle and may be controlled from either the front or rear of machine. Slow feed is obtained by using the handwheel on the front of the saddle. Table stop dogs are hinged. Three rates of power movement are available, obtained through the step-cone pulleys. The crossfeed is operated by handwheel from either front or rear of machine. The vertical feed is operated by handwheel, the thrust being taken up by a ball-bearing. Micrometer dials are provided for crossfeed and vertical-feed. The knee is of box construction to keep dust from bearings and working parts. It is dovetailed to the column, has adjustable taper gibs and is supported by a vertical screw.

The slide is aligned to the saddle by V and flat bearings which are protected by dust guards at both ends. It is oiled through a single oil cup. The taper adjustment of the slide is governed by a fine thread thumbscrew at the front of the table. The slide swivel is graduated in both degrees and inches per foot.

As shown in the illustration the workhead swivels horizontally or vertically. Adjustment of the head to take up wear may be made. T-slots are provided on the top and bottom for attaching tooth rests.

The wheelhead swivels either side of the center and has a graduated dial. The spindle runs in bronze adjustable taper bearings. A flange which is an integral part of the spindle serves as a thrust collar.



OAKLEY NO. 3 UNIVERSAL TOOLROOM GRINDING MACHINE

Specifications: Table surface, $5\frac{1}{4}$ x $33\frac{3}{4}$ in. Taper adjustment, 2 in. per foot. Distance, center of spindle to table, minimum, 0 in.; maximum, $10\frac{1}{2}$ in. Longitudinal movement, 17 in. Vertical movement, $10\frac{1}{2}$ in. Cross movement, 9 in. Maximum distance between centers, 20 in. Workhead taper hole, No. 12 B & S. Swing over table, 10 in. Wheel speeds, 3,683 and 5,950 r.p.m. Countershaft pulleys, 6 in. in diameter, $2\frac{1}{2}$ in. belt, 850 r.p.m. Floor space, 68 x 53 in.

The universal tooth rest has both flexible and rigid blade supports. Among the attachments is an extension spindle support to be used when grinding wide surfaces. A countershaft-driven, fan-type pump for circulating coolant is mounted on the tank at the rear of the machine.

Armstrong Spring Threading Tool

The Armstrong Brothers Tool Co., 317-57 N. Francisco Ave., Chicago, Ill., has recently placed on the market the spring threading tool shown in the illustration. It is claimed that the tool combines strength and convenience of adjustment and operation with the



ARMSTRONG SPRING THREADING TOOL

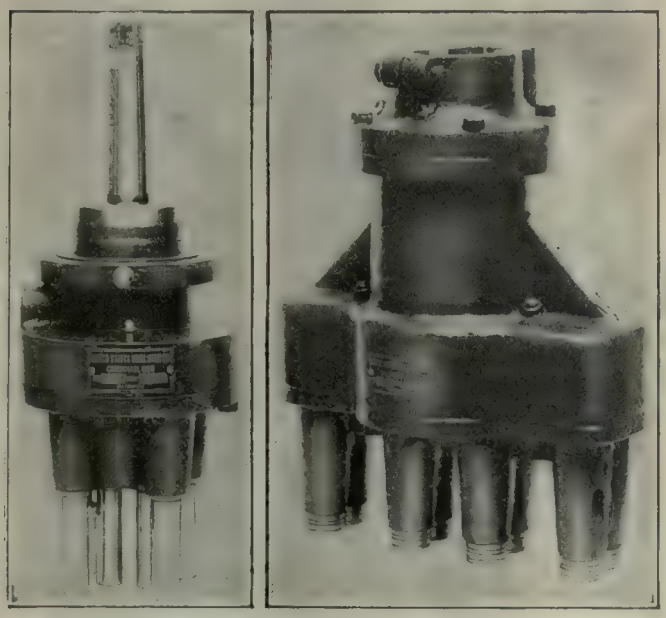
resiliency which is usually considered to be helpful in obtaining a smooth thread or finishing cut, especially on alloy steels of a tough nature. Means are provided for quickly obtaining rigidity, so that the tool can be used for roughing or ordinary turning. The cutting tool can be swung to either side of its center position.

Tools holding stock $\frac{3}{8}$, $\frac{1}{2}$, $\frac{5}{16}$, or $\frac{3}{8}$ in. square can be furnished. The holder sizes range from $\frac{3}{8}$ x $\frac{7}{8}$ x $5\frac{1}{2}$ in. to $\frac{3}{4}$ x $1\frac{5}{8}$ x $8\frac{1}{2}$ in., and the weights from $\frac{1}{2}$ to $3\frac{1}{4}$ lb.

Fixed-Center Multiple-Spindle Drill Heads

The United States Drill Head Co., Cincinnati, Ohio, is building a line of fixed-center, multiple-spindle drill heads, each head being especially designed for the piece of work upon which it is to be used. The main spindle is fitted with a bronze bearing, and both the main spindle and the drill spindle are provided with ball thrust bearings. All gears, spindles and studs are hardened steel, the gears running in grease.

There are two methods of attaching the heads to the drilling machine. The lighter heads are usually driven



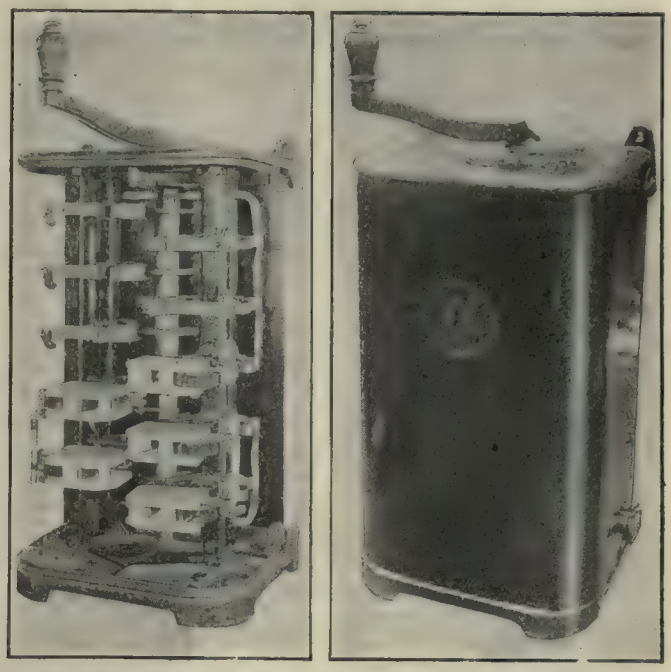
"U. S." FIXED-CENTER MULTIPLE-SPINDLE DRILL HEADS OF LIGHT AND HEAVY TYPES

by a standard taper shank, as shown at the left in the illustration. Heavy heads are driven by the method shown at the right, the head clamping to the quill and being driven by a key inserted in the drift slot of the spindle. The first method requires the use of a bar to prevent the head from turning with the spindles.

Westinghouse Type "S" Contactor Controller

The Westinghouse Electric and Manufacturing Co., East Pittsburgh, Pa., has recently brought out the drum contactor controller shown in the illustration herewith.

This controller is intended for starting and regulating the speed of shunt-series, and compound-wound d.c. motors. In operation it adjusts the resistance in series and parallel with the motor armature, and employs the same principal as the magnetic contactor type controller, except that the contactors are operated by cams mounted on the controller shaft. The contactors open and close



WESTINGHOUSE TYPE "S" CONTACTOR CONTROLLER, OPEN AND CLOSED

with a quick, positive action which reduces arcing. All arcing is limited to the contact tips by the rolling motion of the contacts, consequently there is no pitting or burning of that part of the contact where the load current is carried. The line contactors are protected by magnetic blow-outs. The controller will operate in any position as the contactors are spring actuated and their operation is not affected by gravity. This type of controller can be supplied either with or without dynamic braking and is applicable for use with motors on cranes, hoists, crushers, bridges, roll and transfer tables and practically all places employing this system of control.

"Anyangl" Lighting Fixture

The Miller Saw-Trimmer Co., Pittsburgh, Pa., has placed on the market the "Anyangl" lighting fixture shown in the illustration. The device is intended especially for attachment to machine, so that light may be concentrated upon the work. The lamp is provided with a reflector and a cage for preventing breakage. It can be swung in a complete circle either horizontally or vertically or adjusted for height, it being necessary



MILLER "ANYANGL" LIGHTING FIXTURE

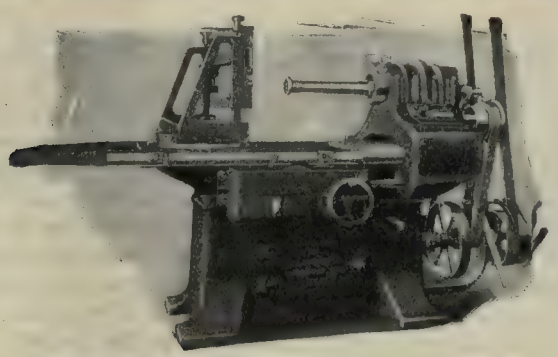
to loosen only one thumbscrew for the purpose of making the adjustment. It is claimed that, when clamped, the position of the light is not disturbed by vibration. The fixture can be furnished with a base for bench use, and different lengths of upright and crossarm can be supplied, if desired.

"Micro" Internal Grinding Machine

The "Micro" internal grinding machine shown in the accompanying illustration is manufactured by the B. L. Schmidt Co., Davenport, Iowa. The principal features of the machine are the provision made for wet grinding and the semi-automatic operation.

A heavy base is provided, a door in front giving access to the water tank and pump. The drive shaft is mounted at one end of the base, a support being provided to steady its outer end. Either belt or motor drive can be used, and an overhead countershaft is unnecessary. One of the ways is flat and the other V-shaped. Lubrication of the flat way is accomplished by means of felt pads, while the V-way has fiber rollers running in oil wells. A trough is mounted on the back of the bed to convey water from the table to the tank in the base.

The table is power driven through a rack and its reversal is automatic, although it may be operated by



"MICRO" INTERNAL GRINDING MACHINE

Specifications: Capacity; grinds holes 2½ to 10 in. in diameter up to 13 in. long (longer spindles furnished, if desired). Wheels: diameter, 2½ to 6 in.; face, ⅝ in.; hole, 1¼ in. Wheel-spindle speeds, 5,500 and 3,652 r.p.m. Main bearing, 7 x 16 in. Planetary speeds, 48 and 25 r.p.m. Table; to center of spindle, 13 in.; size, 19 x 48 in.; speeds, 11, 6½, 5⅜, 4⅝, 3⅝ and 2½ in. per minute. Cross-slide; travel, 14 in.; adjustable to 34 in. Speed of drive shaft, 265 r.p.m. Floor space; over all, 110 x 42 in.; base, 54 x 26 in. Height, 39 in. Weight, 4,000 lb.

hand. Water grooves are provided and extension plates at each end protect the ways.

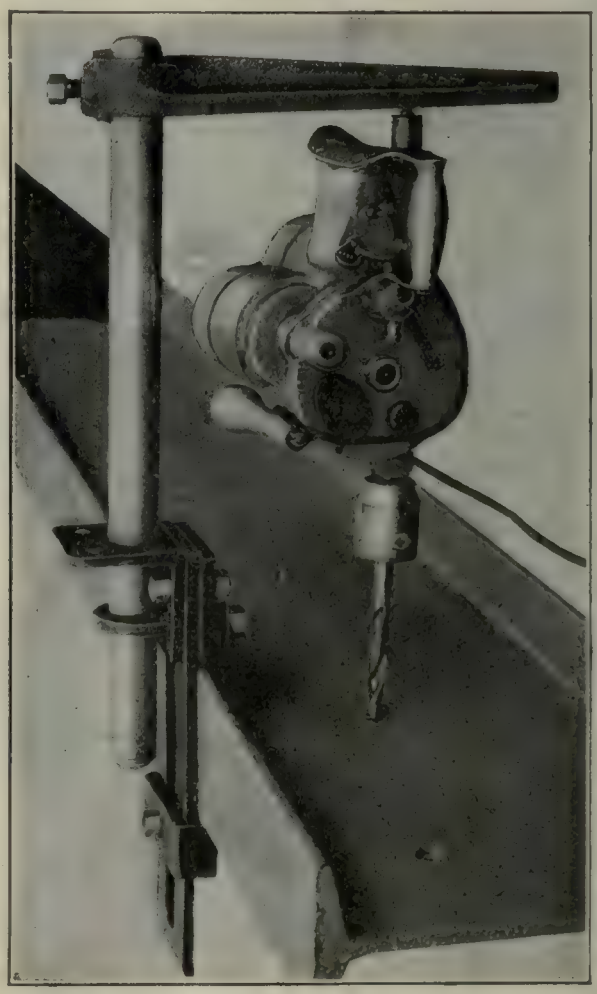
The headstock is mounted on the bed, the table traveling under it. The rotating sleeve, or main bearing, in the headstock is made of seasoned cast iron. The spindle has an eccentric motion variable from 0 to 1¼ in. By means of a clutch, the rotating sleeve can be stopped in any position. The spindle is of hardened chrome-nickel steel, 30-point carbon. It is made in two parts which are connected by means of a flexible water-tight joint, and it is supported by three bearings. The front and center bearings are bronze, the rear one being an S. K. F. ball bearing. The adjusting nut and the bearing at the front end of the spindle serve to prevent oil from reaching the wheel. A type of automatic wheel feed is provided. It is possible to feed in units of 0.0001 in. by means of push buttons provided on the headstock. Thus, very fine adjustments of the cut can be obtained without the necessity of stopping the machine.

The water or coolant is delivered through the center of the spindle, the water connection being made of brass and supported by ball bearings mounted on the rear of the spindle. The pump is operated through gears controlled by a lever mounted on the base of the machine.

The work is mounted on a cross-slide, the fixture shown being intended for holding cylinder blocks. The vertical adjustment is made by means of the screws at the top. In addition to the cross-feed, the fixture can be swivelled. Fixtures to suit special jobs can be furnished.

Canton Drill Clamp

The Poyser-Bucher Co., Canton, Ohio, has placed on the market the Canton drill clamp and support illustrated. This clamp was designed for use in conjunction



CANTON DRILL CLAMP

with portable drilling machines for drilling the flanges and webs of I-beams, etc. The method of attaching the device is shown in the illustration.

J. M. Jameson Speaks Before Philadelphia Foundrymen's Association

The 300th meeting of the Philadelphia Foundrymen's Association was held on Oct. 13 at the Manufacturers Club, Philadelphia.

Joseph M. Jameson, vice-president of Girard College, gave a talk on "Education for Industry." Some of the points he conveyed were as follows: (1) Preliminary education in the school of Girard College; (2) the training of apprentices; (3) part-time education between the school and industry; (4) continued education for those who are employed, such as night-school, etc.

The Olympia Machine-Tool Exhibition and Results

[This and the following two articles are reprinted from the European edition of the *American Machinist* and will serve to show how our English cousins regard coming machine-tool competition.]

The Machine Tool and Engineering Exhibition which closes on the date of publication of this issue must be pronounced a very distinct success as a display of engineering tools and products. Some of the technical lessons to be learned by the visitor have been indicated in these columns during the past few weeks.

Whether the success of the show in a commercial sense has been as great is a matter which is still uncertain; in any case it cannot be decided for some little time. Seed has been sown and the future will determine what develops. Undoubtedly some of the firms have met with success as measured in the most direct manner by orders received. Others have extended their circle of friends and acquaintances, the exhibition affording means by which they and their products became better known to potential clients. But it must be confessed that, unless the last few days have shown a very distinct change, a considerable number of exhibitors who judge by orders negotiated will have to regard their success as distinctly qualified.

An exhibition, even if of such a satisfactory character as that of the Olympia display, cannot really stand against a definite trade decline, with all the uncertainties of labor troubles, etc., and this is clearly shown in Germany, as explained on this page, based on information from a correspondent.

At Olympia many of the firms who have expressed themselves satisfied are relatively small or such as may be regarded as newcomers compared with firms whose names among engineers are household words. To these the merchant on the one hand and the small private buyer on the other have proved good friends, and it is possibly among exhibitors of this class that the chief successes have been gained.

The Failure of the Leipzig Technical Fair

It is openly acknowledged in Germany that from a business viewpoint the Leipzig fair was a complete failure. It cannot be said that this result was wholly unexpected, for it was clearly realized in industrial circles that in view of the business stagnation still obtaining in Germany no great volume of business would be done, but the utter absence of any buying activity worth mentioning left exhibitors almost dumfounded. There were approximately 3,440 exhibitors at the fair, which was attended by 34,000 visitors.

The various industries were well represented in separate sections in order to facilitate survey, and the machine-tool section, represented by the association of German machine-tool makers, was—as usually—the focus of the exhibition. We are assured by a correspondent that both as regards quality of material and workmanship the exhibits showed distinct signs of improvement and return to pre-war standards. Substitute material has materially decreased in use, being employed only wherever a saving could be effected without impairing the strength, quality or appearance of the part concerned. Thus the outward appearance of the fair was as brilliant as could be. Sales, however, were lagging to an unexpected extent.

Beyond this, it would appear that the detaching of the technical fair from the general sample fair—hailed with great satisfaction at its inauguration at the last spring fair has turned out anything but a success and has given rise to rather pronounced criticism and even hostility on the part of the exhibiting firms toward the management. Negotiations toward reuniting the two fairs are proceeding, and it is generally held that this will have been the last of the technical fairs held separately.

Various reasons are being advanced in explanation of the failure. The salient facts are the high prices and the overstocking of the machine-tool producing countries, not forgetting the improvement in the German exchange which, though latterly again downward, rendered buying in the German market half a year ago much more profitable.

American Machine Tools at Olympia: What Is the Lesson?

BY S. HAUGHTON.

What can the British machine-tool maker learn from the "Olympian" display? To this question we shall attempt an answer.

The exhibits are preponderantly British. The commendatory remarks of American visitors on our work have been pleasing to British ears; for the chief competitor's praise is praise indeed. That our machine-tool makers have made great strides and are still advancing is the general concession. The only doubt that remains is as to whether we have completely made up the leeway and got a little ahead, or whether the advance on both sides has been proportionate, leaving us still behind. These are the diverse asseverations, perhaps beliefs, of different people, all justifiable, no doubt, from particular viewpoints. Well, after a presentation of the whole of the evidence and an impartial summing-up, the verdict would probably be pleasing to all parties. It would, we are convinced, indicate a general improvement in which our share is unexpectedly but not overwhelmingly large; that neither side is so nearly perfect that one cannot learn from the other; that though ways differ they may lead equally directly to the same end; that, after all, seeming superiorities or inferiorities may be but differences due to dissimilar but not necessarily better or worse methods, organizations or equipment, and to dissimilar demands.

What can we learn from the display of America? Much. But when one begins to particularize selecting for study those types of machines for which America has become justly famous, the question always rises whether the lessons when learned will be of more than academic value, at least until the time has come when our conditions more nearly approach those of that country. For we still lag in mass manufacture, the very *raison d' être* for many of the lines in which America excels and probably the fount from which flowed its excellence.

Consider automatics, the name by which, unqualified, we know those machines of lathe type adapted for the production of comparatively small pieces from the bar, from castings or from forgings. Here America undoubtedly led, if not in invention at least in development, to that high degree of perfection one associates with and really finds in the Brown & Sharpe, the Cleveland, the Acme, the Bridley, the Potter & Johnson and other machines. Home (American) demands alone

FIRMS	Bending Machines	Bolt and Nut Machinery	Boring and Drilling Machines	Boring Machines	Boring and Turning Mills	Broaching Machines	Centring Machines	Cutting-off Machines	Drills, Radial	Drills, Upright	Drills, Multi-Spindle	Drills, Sensitive	Drilling and/or Tapping Machines	Drop Forging, &c., Plant	Forging Machines	Furnaces	Gear-cutting Machinery	Gear Hobbers	Grinders, Disc	Grinders, Twist Drill	Grinders, Tool and/or Cutter	Grinders, Cylind. Plain & Univer.	Grinders, Internal	Grinders, Surface	Hack Saw Machines	Hammers, Power	Keyseating Machines	Lathes, Automatic	Lathes Brassfinishing	Lathes, Boring	Lathes, Capstan and Turret	Lathes, Centre	Lathes, Crankshaft	Lathes, Precision	Lathes, Relieving	Milling Machines, Horizon. Plain	Milling Machines, Lincoln Type	Milling Machines, Plano	Milling Machines, Thread	Milling Machines, Universal	Milling Machines, Vertical	Moulding Machines	Pipe Bending Machines	Planers	Presses, Power, &c.	Punches and Shears	Saws, Metal	Saw-sharpening Machines	Screwing Machines	Shapers	Sheet Metal Machinery	Slot Drilling Machines	Slotting Machines	Small Tools	Surfacing, Boring, &c., Machines	Twist-drill Machinery	Wood-working Machinery
Alexander, G. H., Machinery Co., Ltd.															●						○	●						●			○			○									●						○			
Archdale, James, & Co., Ltd.									●																										●				●												
Asquith, Wm., Ltd.									●																																										
Associated British Machine Tool Makers, Ltd.					●			●																																				○						●
Atkins, H. F., Ltd.																				●	●	●												●													●			
Atlas Engineering Co., Ltd.				●	●																										●															●			
August's Muffle Furnaces, Ltd.																○																																		
Barnes, John W., Ltd.										●		●																			●																●			
Birch, John & Co., Ltd.																															○																		
Blacker, Ltd.																										●																			○		○			
Brayshaw Furnaces & Tools, Ltd.																○																																		
Brett's Patent Lifter Co., Ltd.														●																																●					
Britannia Foundry Co., Ltd.																○																															○				
Brooke Tool Manufacturing Co., Ltd.																																																		
Brown, David, & Sons, (Huddersfield), Ltd.																	●																																	
Brown & Ward, Ltd.																												●			●			○													●	○			
B.S.A. Tools, Ltd.																																																	
Burton, Griffiths, & Co., Ltd.			○	○	○	○	●			○	●	●	●	●				●	●	○	○	●	●		●				●			○	○		○			○	○	●	●							○		○		
Butler Machine Tool Co., Ltd.																																																	
Butterworth, A., & Co.																												●																						
Carborundum Co., Ltd.																																																	
Carr, J. W., & Co., Ltd.									○	○									○	○	○										○	○				○														○	
Centaur Tool Works, Ltd.													○										○					○	○		○	○		○		○		○												
Chelsea Precision Tools, Ltd.																																																	
Churchill, Charles, & Co.			○		●	●	○		○	○		○		○		○	●	●			○	●	●	●				●			●	○		○		●			●	●	●		○					○			
Colchester Lathe Co.																															○	●																	
Consolidated Pneumatic Tool Co., Ltd.																																																	
Craig & Donald, Ltd.																																													○				
Crossley & Co.									●	●		●					●															●															●	●	○		
Cunliffe & Croom, Ltd.				●	●																											○								○								○		
Darling & Sellers, Ltd.																																○			○															
Dean, Smith, & Grace, Ltd.																																		●																
Denham's Engineering Co., Ltd.																																●															●			
Druce, E. H., & Co., Ltd.										○	○												○											○		○												○			○
Drummond Bros., Ltd.									●			●																				●			●	●											●			
Farmer & Co.									●		●		○				●		○	○	●	●		●					●		●			○		○				●							●	○			
Firth, Thos., & Sons, Ltd.																																																	
Goodchild & Partners, Ltd.																					○	○																							○						
Greenwood & Batley, Ltd.																																																	
Harper, Sons, & Bean, Ltd.																			●		●																													
Hatch, George, Ltd.												○																				○																○			
Herbert, Alfred, Ltd.			●		●	●			●	●	●	●				○	●			●	●	●	●	●	●			●			●	●	●		●				●	●			●		●	●		○			
Herbert, Edward G., Ltd.																																														●				
Hill, Isaac, & Sons																																													●	●				
Holbrook & Sons												○																				○		●																
Holroyd, John, & Co., Ltd.		●		○			○		●		○						●				●	○		●	●				○		●				●		●		●	●	○							○			
Irwin & Jones, Ltd.												●	●								●																													

MACHINE TOOL AND ENGINEERING EXHIBITION

GRAPHIC GUIDE TO THE EXHIBITS: This chart will enable the works manager or engineer who wishes to study the va-
can see at a glance which of the firms demonstrated a particular tool by running it and not merely making a display of stationary

FIRMS	Bending Machines	Bolt and Nut Machinery	Boring and Drilling Machines	Boring Machines	Boring and Turning Mills	Broaching Machines	Centring Machines	Cutting-off Machines	Drills, Radial	Drills, Upright	Drills, Multi-Spindle	Drills, Sensitive	Drilling and/or Tapping Machines	Drop Forging, &c., Plant	Forging Machines	Furnaces	Gear-cutting Machinery	Gear Hobbers	Grinders, Disc	Grinders, Twist Drill	Grinders, Tool and/or Cutter	Grinders, Cylind. Plain & Univer.	Grinders, Internal	Grinders, Surface	Hack Saw Machines	Hammers, Power	Keyseating Machines	Lathes, Automatic	Lathes Brassfinishing	Lathes, Boring	Lathes, Capstan and Turret	Lathes, Centre	Lathes, Crankshaft	Lathes, Precision	Lathes, Relieving	Milling Machines, Horizon. Plain	Milling Machines, Lincoln Type	Milling Machines, Plano	Milling Machines, Thread	Milling Machines, Universal	Milling Machines, Vertical	Moulding Machines	Pipe Bending Machines	Planers	Presses, Power, &c.	Punches and Shears	Saws, Metal	Saw-sharpening Machines	Screwing Machines	Shapers	Sheet Metal Machinery	Slot Drilling Machines	Slotting Machines	Small Tools	Surfacing, Boring, &c., Machines	Twist-drill Machinery	Wood-working Machinery
Jones, A. A., & Shipman, Ltd.			●				●	●	●	●	●	●	●				●			●	●	●	●								●	○		●		○				●				●					○				
Joyce, Ltd.												○	○								○													○														○				
Kearns, H. W., & Co., Ltd.																																																		●		
Kendall & Gent, Ltd.																																						●				●							●				
Lang, John, & Sons, Ltd.							○	●																				●		●	○																						
Lash, Robert H., Ltd.										○		○					○			○											○																			○				
Lehmann, Archer & Co., Ltd.																																																	○				
Lloyd, Richard, & Co., Ltd.										○		○							○		○										○	○															○						
Luke & Spencer, Ltd.																					○																													○				
Lumsden Machine Co., Ltd.																					●			●																													
Macnab & Co.																○																										●												
Massey-B & S., Ltd.														○												○																												
Midgley & Sutcliffe									●																																														
Milnes, Henry																																●																			○			
New Fortuna Machine Co., Ltd.	○																								○																				○	●	○				○			
Oliver Machinery Co., Ltd								●													●			●																						●						●		○
Ormerods Tool Co., Ltd																																○																					
Osborn, S., & Co., Ltd.										●																						●																			○			
Parkinson, J., & Sons																●																											●										
Perkin & Co., Ltd.										○											●				●	●						○																		○			
Pitters Ventilating & Engineering Co., Ltd.																																																			○			
Pollard, F., & Co., Ltd.								●	●	●	●	●																																										
Pollock & Macnab, Ltd.																													●				●																			○			
Power Plant Co., Ltd.																●																																						
Pratt, F., & Co., Ltd.																																																			○			
Ransome, A., & Co., Ltd.																																																					
Redman, C., & Sons, Ltd.																																	○																					
Richards, George, & Co., Ltd.					●																						○																									●		
Robinson, T., & Son, Ltd.																																																					●
Ryder, T., & Sons, Ltd.															○														●				●																					
Selson Engineering Co., Ltd.									○		●						●					○							●	○		○	○		●		○					○				●					○				
Shanks, Thos., & Co.													●																																								
Smith & Coventry, Ltd.						●						●					●																			●	●												●				
Smith, Barker & Willson, Ltd.																																○		○																			
Stirk, John, & Sons, Ltd					●																																																
Stone, J. B., & Co., Ltd.																																																			○			
Swift, George, & Sons, Ltd.									●																							●																					
Tangyes, Ltd.																																○																					
Taylor, Charles (Birmingham), Ltd.								●													●										○	○																			●			
Timbrell & Wright Machine Tool and Engineering Co., Ltd.																													●		●																			●			
Universal Grinding Wheel Co.																																																			○			
Wadkin & Co.																																																					●
Wadkin, Mills & Co., Ltd.																						○																															
Walber, W. A., & Co.																				●											○													○						○	○		
Ward, H. W., & Co., Ltd.																															●																					
Ward, Haggas & Smith																																					●																
Wearden, Louis & Guylee (London), Ltd																																																			○			
Webster & Bennett, Ltd					●																																														○			
Wicksteed, Charles, & Co., Ltd.																								●								○																					
Wrigley, E. G., & Co., Ltd.																																																			○			

AT OLYMPIA, W., ENGLAND, SEPT. 4 TO 25

rious examples of a given line of tools or appliances to pick out the firms that displayed these particular tools, etc. Moreover, he machines. The open circles represent stationary tools, and the black circles running tools.

were probably large enough to insure that incentive, in competition, to the continual study essential to quality and quantity progress. Only by the greatest effort and the best of good fortune, in invention say, can we hope to make up the leeway. Obviously, from American automatics we have much to learn, and when we have learned, the embodying of our knowledge in practical machines can easily lead to failure, for there is the danger that by the time our machines are on the market our friends on the other side will have brought down the things they had up their sleeve ready to meet the anticipated competition of the newcomer. It is a startling fact that only to one British machine-tool concern can we attach any reputation worth the name as manufacturers of really high-grade automatics, and then only as makers of the larger chucking automatics. A few there are, however, who are making a bid by machines possessing new and claimed-to-be improved features.

Still there is hope for the British machine-tool maker, for users of automatics well know that most machines suffer from disabilities that appear inseparable from their present construction— cams and their shafts yield, chucking devices fail. There is certainly scope for radical improvements. From known weaknesses the designer can learn that room exists for invention, that invention must strike at the very roots of most current designs if success in competition with them is to be achieved.

All that has been said respecting automatics will apply with little modification to modern grinding machines. The numerous American specialists in the higher-grade machines have but one British specialist to fear, and, if one can judge from the extraordinarily rapid expansion of this firm, the competition must have been felt severely. The presence at Olympia of an American machine possessing many new and attractive features before that machine had been offered at home suggests a recognition of this competition and a will to counteract it.

The Broader Field for Engineering

Engineering in some form or other enters into or affects every business and every life. It is a profession which by its nature has to do with improving the public welfare. "The time has arrived in our national development when we must have a definite national program in the development of our great engineering problems," says one of our foremost engineers.

SOME of the reasons for forming the organization of engineering societies known as the Federated American Engineering Societies are given in the following excerpt from the address of Arthur P. Davis, president of the A. S. C. E., at the annual convention of the society in Portland, Oregon.

The demand for active participation of all engineers in civic and other work for the general benefit of mankind and the advancement of the engineering profession has been growing for many years and is greater today than ever before. Various plans for accomplishing this purpose are suggested and the pressure has been such that the American Society of Civil Engineers and the other founder societies have each taken a more or less active part in such work.

Recognizing the necessity of combining efforts in this line and also the desirability of somewhat separating such activities from the technical functions of these societies Engineering Council was formed with the idea that it would represent the four founder societies and gradually add to this number through powers conferred upon it for that purpose. It has in the three years of its existence added the American Society for Testing Materials and the American Railway Engineering Association but is still far from embracing all of the engineering societies of the country. It has some fundamental weaknesses. It lacks in representative character and democracy and is without power to raise funds, but must depend upon voluntary contributions from its constituent societies and others. Experience has shown that these deficiencies can be best remedied by substituting a league or federation designed to include all of the engineering societies, national, state, regional and local.

A constitution to this effect was adopted at the convention in Washington in June. The federation does not provide for any individual members but is merely an instrument for combining the efforts of existing societies by forming them into a federation with definite powers and provided with sufficient funds to accomplish its purpose.

Measures of great importance to the world, to our country and to our profession demand immediate and vigorous attention and it is imperative that they have behind them the unified efforts of all the organized engineers of the country and all the prestige that the greatest, the oldest and the most eminent societies can offer.

Among these measures are the unification of the engineering work of the government under one department with a technical head. This will promote efficiency and eliminate waste; and what is more important, will serve as a precedent for the reorganization of other departments along similar lines of homogeneity, efficiency and economy.

The spirit of progressive movement is summarized in the terms "service through co-operation." It means service to mankind, to our country, to our profession and to ourselves. It cannot reach its fullest expression without the active co-operation and influence of every engineering organization in the country.

We cannot act effectively unless united and by calmly reasoning together on pressing questions, guided by the pole star of righteousness, we can unite upon fundamental principles and make our influence for good a power in the land and only thus can we perform the duty we owe to ourselves to our fellowmen and to posterity.

Excerpts from Hoover's Address

Herbert Hoover, president of the American Institute of Mining and Metallurgical Engineers, in his address to the society at Minneapolis, described the field of the engineer in the broader sense. The following excerpt tells what are our great engineering problems and deals with their development.

The time has arrived in our national development when we must have a definite national program in the development of our great engineering problems. Our rail and water transport, our water supplies for irrigation, the provision of future fuel resources, the development and distribution of electrical power, all cry out for some broad-visioned national guidance. We must create a national engineering sense of provision for the nation as a whole. If we are to develop this national sense of engineering and its relations to our great human problems it must receive the advocacy of such institutions as this.

We, together with our sister engineering societies, repre-

sent the engineers of the United States. It is our duty as citizens to give voice to those critical matters of national policy which our daily contact with this, the fundamentally constructive profession, illuminates to us. Just as medical associations voice the necessity of safeguards to national health; as the bar associations safeguard our judiciary, so the engineers should exert themselves in our national engineering policies. We have none, but we need some, or the next generation will face a lower instead of a higher standard of living than ours.

Must Co-ordinate Development

The development of our transportation, fuel, power and water under private initiative has been one of the stimuli that have created the greatness of our people. It has been easy to compass when the problems were more local and filled with speculative profits. There however arises a time when this haphazard development must be co-ordinated in order to secure its best results to the nation as a whole. This system has given us a 50 per cent result; if we are to have 100 per cent we must have a national conception and national guidance. This last 50 per cent involves problems beyond individual initiative alone.

Not only is individual initiative insufficient because the problems involve political, financial, interstate matters beyond corporate ability, but we have, with practically unanimous consent of the country, adopted a policy of the limitation of profits in the operation of public transportation and power and some other utilities, and through the pressure of public opinion we are rapidly coming to a limitation of profit in the development of other large sections of national resources which tend to become natural monopolies. While the limitations of these profits makes for public good, on the other hand they also militate against individualistic development of national resources and necessitate the co-operation of the community as a whole to secure initiative for wider development in the national sense.

Conservation Is National Concern

Certain of our national resources have always been in national ownership, such as waterways. Certain others, such as reclamation, irrigation, distribution of water for power, are rapidly coming under Government control. In others, such as timber, coal, and oil, the possible exhaustion brings their conservation or provision for the nation's future into national concern. In our railway problem national action has until recently been directed wholly to limitation of profits. Latterly it has undertaken to regulate wages and give some small recognition to the necessity of equipment. But microscopic attention has been given to the greater problem of how to get more transportation, to get it so organized as to secure real economic operation in its broad sense.

Mountain Water Storage Problems

Of other problems akin to this, we are confronted throughout the West with the fact that a large portion of our average low water supply is already under engagement for irrigation and power. The time has come when that expansion of the land available for cultivation, or into more intensive cultivation, is a factor of mountain storage of water to increase our stream flows in the low season. We have thus a storage problem on a scale we have not hitherto dreamed of, and, again, it is a problem involving co-operation in financial and economic distribution and navigation—interstate questions, in which individual initiative must have the assistance of the community.

Another series of such problems lies in our oil supplies. If we are to have a mercantile marine and to maintain our navy on a basis of equivalent efficiency with foreign navies, if we are to maintain the development of the gas engine—the greatest lift in our standard of living and saving of labor in fifty years—we are confronted with the necessity of securing additional oil supplies from outside our own boundaries. Our own supplies, so far as now known, do not represent twenty-five years at our present rate of consumption. The Institute many months ago was the first to give warning to the Federal Government of the gradual absorption of all of the oil sources of the world by other great powers and that within a short time we should be dependent upon the good will of those powers for our necessary oil supplies. No private individual can compete with foreign governments in the measures that they are adopting to hog the resources of the world. This problem again is an engineering problem that requires more than private initiative.

Transportation

A problem of even more pressing importance than these is the whole question of transportation. Our inability to move the commodities which we create is stifling production. It is increasing the cost of distribution and has placed a tax on the American people in decreased production and increased cost of distribution greater than all the taxes imposed by the war.

Congressional Waste

We have been dabbling in the improvement of water transportation of the United States for 100 years, and so far as I know never yet have we considered it as a problem requiring complete co-ordination of the entire transport problem for the whole country.

One result of the policy pursued has been that our waterways have been so badly handled that they have not been able even to compete with the railways, and today, with an enormous increase in railway rates, we find ourselves utterly unable to handle the great bulk commodities of the country at the possible lower charge over our waterways. The opening of the St. Lawrence to ocean-going vessels means 5 cents a bushel to every farmer in ten states. Likewise of no less importance to the people of the entire country are our internal waterways.

These projects have a simple result in the engineer's mind; they make greater production possible with less human effort; they increase the standard of life; they provide for our children. All these problems are much akin, and the time has come when they need some illumination, guidance, and co-operation in their solution from the Federal Government. Nor do I mean a vast extension of Federal bureaucracy in Federal ownership. If in the first instance, through an agency of the central government, we could have an adequate study and preparation of plan and method made of these problems of engineering development over the next fifty years, viewed solely in their national aspects, we would have taken the first step toward the adequate provision of an increasing standard of living and a lower cost of living for our descendants.

Government of Co-operation

The second step is to determine that our government will be a government of co-operation limiting profits surely, but holding to individual initiative as the single hope of human development. In order that we shall have some central point in the Federal Government where these problems may be adequately considered, from which they can be ventilated for the verdict opinion, where the business brain of the country can be called into conference and co-operation with the government, and therefore with the people, the engineers of the United States have proposed time and again that a cabinet department should be established in Washington, either new or to replace the Interior Department, to which should be assigned the whole question of public works.

You are familiar enough with the advantages of such a department from an everyday administration point of view, and enormous saving to the government from the duplication or competition of the six or seven departments now engaged in engineering construction work of this character, but on this occasion I wish to call your attention to the fact that such a department has become an essential from the point of view of proper consideration and presentation to the American people of these broader national engineering problems, upon which the next generation must depend if our country is to march forward.

SPARKS FROM THE WORK

Valentine Francis

Annual Meeting of the American Foundrymen's Association

Convention Most Successful Thus Far Held—Ohio State Fair Association Buildings Used for the 236 Exhibits—Some of the Papers Read—W. R. Bean Selected as President for Coming Year

The success that has attended the annual meetings of the American Foundrymen's Association in the past was even more marked in connection with the convention held this year in Columbus, Ohio, from Oct. 4 to 8 inclusive. As has been customary, the Institute of Metals Division of the American Institute of Mining and Metallurgical Engineers held its meeting in connection with the Foundrymen's meeting. It will be remembered that the Metals Division several years ago absorbed the old Brass Foundrymen's Association, so that its representatives were beyond doubt equally interested in foundry problems.

This year's exhibition was in extent and number of the exhibits actually the greatest staged for the entertainment and interest of the visiting foundrymen. Its size was made possible by its location in the many buildings of the Ohio State Fair Association and these with their wide acreage of floor space offered exceptional possibilities for both spreading the many exhibits to the best advantage and permittting many to participate who have not been able to obtain accommodations in the past.

Seven Buildings Used

Seven buildings were used for the 236 exhibits entered, which were grouped to some extent in classes. As an instance of the grouping it may be mentioned that all the machine-tool and kindred supply exhibits were grouped in one building and while the exhibits there shown by no means covered all classes of machine tools, there were enough to attract considerable interest.

The molding-machine exhibitors and foundry specialists had arranged a number of exhibits, many of them with operating equipment that proved highly instructive. The various manufacturers of welding and cutting equipment had likewise made arrangement by which they were in most cases able to show their devices actually in operation.

Some comment was noted to the effect that many of the old-timers were not in evidence at the convention and many familiar faces were no doubt missing from one cause or another. However, many probably failed to meet their friends due to the scattered nature of the hotel accommodations. All hotels were far too congested for comfort, over 4,000 being registered as members and visitors.

The technical meetings were in most cases held in the Amphitheatre under the direction of the officers who were responsible for the success of this year's program. These officers included: C. S. Koch, Ft. Pitt Steel Casting Co., McKeesport, Pa., president; W. R. Bean, Eastern Malleable Iron Co., Naugatuck, Conn., vice president; and C. E. Hoyt, secretary-treasurer.

There was a total of ten technical sessions so arranged that on only two occasions were two meetings under way simultaneously. The sessions included three devoted to general topics of interest to all foundrymen, two for steel topics, two for non-ferrous and one for malleable-iron subjects and two devoted to the discussion of topics in connection with industrial relations.

Sherwin on Castings

Among the speakers at the opening session was Leroy Sherwin of the Browne & Sharpe Manufacturing Co., Providence, who spoke on the topic, "Making High Grade Castings for Milling Machine Tables." Mr. Sherwin discussed the methods used in his own plant to produce such castings, on which he stated that the service requirements were very severe. A casting is desired which is close in grain, giving a hard, smooth-polished surface after machining and it must be free from either external or internal porosity. The patterns, the design of which play an important part in obtaining good castings, are arranged so that the mold will be entirely in the drag. It was found that the V-ways and oil ways were likely to be cut and washed when the molten metal ran over them when molded in green sand, so that now these portions are cast in dry sand cores. A careful selection is made of the molding sand and the molds are faced with a mixture of sand and sea-coal in which the proportion of sea-coal to sand is seven to one. Horn sprues are used for gating the castings so that the molten metal enters the mold from the bottom through two sprues at each end. Two risers are used located at equal distances from the center of the casting.

The cupola mixture is made up of 1,000 lb. of pig iron containing 300 lb. of eastern Pennsylvania low silicon, 400 lb. of northern and 300 lb. of southern pig iron, to which are added 250 lb. of steel scrap, 250 lb. of car wheels and 500 lb. of returned sprues and scrap. This mixture is calculated on the basis of a 2,000-lb. charge, but 3,000-lb. charges are actually used in the cupola and are made up accordingly. A close check is made daily on the analysis of the resultant castings. They are found to run approximately: Silicon: 1.300; sulphur, 0.115; phosphorus, 0.440; manganese, 0.550; combined carbon, 0.760; graphitic carbon, 2.540; total carbon, 3.300.

The charging of the cupola is done by hand. The steel scrap is placed on top of the coke, the pig iron close to the lining and the remainder of the scrap over them. All sprues and scrap

Largest Welded Tank

What is perhaps the largest welded tank ever built was recently completed by the Welded Products Co. at Birmingham, Ala., for the Liquid Carbonic Co.



THE LARGEST WELDED TANK

The tank is 22 ft. in diameter and stands 30 ft. high. It was made of ¼-in. steel plate, joined at the seams by oxy-ecetylene welding. The big tank has satisfactorily withstood the required tests and has been found to be gas tight in all of the welded seams under excess-of-working pressures.

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used in the mixture are rattled before going to the cupola to reduce the amount of clay, sand and dirt carried into the charge. The cupola is tapped into a receiving mixing ladle which insures against the receipt of only a partial charge and variable mixture.

Moldenke on Zirconium in Cast Iron

Richard Moldenke spoke on the uses of the element zirconium in cast iron. He has conducted a number of experiments comparing the use of this element with vanadium, titanium and similar elements which have been used in the past as deoxidizers of cast iron. His conclusions were that while some beneficial effect could be obtained from its use in gray iron, at a strength of approximately 0.10 per cent, still the results obtained in cast iron did not compare favorably with similar results which could be obtained from its use in steel.

A plea for the standardization of the design and construction of patterns for steel castings was made by K. V. Wheeler, of the Lebanon Steel Foundries, Lebanon, Pa. He called attention to the large number of impractical patterns from the commercial standpoint which are submitted to the average steel foundry. He stated that a few foundries have taken steps to install a systematic inspection of all patterns received and then call the customers' attention to patterns which are suitable for intensive production and good castings. Among the points made was that some foundries ask for as much as ¼-in. finish allowance while others require only $\frac{5}{16}$ in. or in some cases ⅜ in. or even less finish. A standardization in this line would let the customer know better how to order his patterns to insure a good quality of finish when it came to machining. Another plea was for standardization of the pattern limits with respect to the length and breadth of average castings thus permitting better use of standard molding equipment.

Gale on Pulverized Coal

Those who have been interested in the subject concerning the substitution of pulverized coal to replace oil and gas in industrial furnaces will be interested in the experiences detailed by C. H. Gale, of the Pressed Steel Car Co., Pittsburgh. He spoke of experiences in a foundry where pulverized coal was substituted as a fuel for gas and oil in annealing furnaces. Certain changes in the physical characteristics

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Industrial Conditions in Spain

That Country Declared To Offer Greater Opportunities Than the Whole of South America—American Machinery Gaining in Popularity in Spite of Exchange Rates

Spain affords a good market for American machine tools, according to Henry S. Moos, director of the American Machinery Corporation (Sociedad Anonima Española) Madrid and the Sindicato de Maquinaria Americana, Bilbao. Just how good the Spanish market is may be judged from his statement that Spain offers opportunities greater than those of the whole of South America. Conditions pertaining in Spain are outlined in the following paragraphs, written as the result of an interview with Mr. Moos.

We are not accustomed to think of Spain as a manufacturing nation, probably because we think chiefly in terms of machine tools. The fact is that there is a great deal of manufacture of such things as cork, olive oil, clothing, sugar, paper and hardware, and more recently ships and machinery.

Eight to ten years ago, with buyers of machine tools, price was the only consideration. An 18 in. x 8 ft. lathe meant a lathe of 8 foot bed that would swing 18 in., without regard to strength, design, power or attachments. The lowest bidder got the order. The successful bidders as a rule were the Germans and the Swiss. There was not a great market because of the availability of imported manufactured goods and machines and therefore little incentive to make them. This situation when summed up means that there was before the war no machine-tool industry in Spain.

Machine Shops Started

As soon as the import supply was cut off by the war machine shops started and at the close of the war there were about a dozen real shops manufacturing such machines as lathes, drilling machines, milling machines, shapers, planers, punches, shears and stamping presses. These machines were being made to some extent on American machines, which had been bought at prices several times as great as those of the flimsy German and Swiss machines which they replaced, or which were in competition with them in the market.

With trade resumed more American machines than others are being sold. This is true in spite of the fact that the dollar is equal to 7 pesetas. The point of view of the manufacturer and the dealer has changed from one which asked "How much does it cost?" to one which asks "What will it do?" In other words, the trade is being built up on efficiency lines. The dealer who is the most successful is selling the manufacturer what he needs rather than what he thinks he wants. He is not in any way forcing sales because he has the right goods to sell and the right records of production and dollars saved on production with which to convince his customers of the truth of his statements. Let it be said here that if the dealer approaches his customer in the right manner, which means on a strictly business basis, he will find an attentive ear.

U. S. Machinery and Labor

The dealer is in a position to know methods and to know machines. It is then his business to educate his customers and to advise them. If a customer has it in mind to buy a cheap tool which will not bring results it is a part of the dealer's duty to educate him out of it; and it is just as much of a duty to prevent his buying one of the dealer's own good machines if he does not need it. It is in this way that

Five More Societies Join F. A. E. S.

The joint conference committee of the Federated American Engineering Societies announces five additional members, raising the total to nine members:

Engineering Association of Nashville. On June 7, 1920, this association voted to become a charter-member

American Institute of Chemical Engineers. At its meeting of June 29, 1920, the institute voted to join.

Engineering Society of Buffalo. At the meeting of Sept. 21, 1920, the society voted, unanimously, that it become a charter-member.

American Institute of Mining and Metallurgical Engineers. At its meeting on Sept. 24, 1920, the board of direction voted to become a charter-member.

Society of Industrial Engineers. The board of directors of the society have voted to become a charter-member.

The other four members are the American Society of Mechanical Engineers, American Institute of Electrical Engineers, Technical Club of Dallas and the Cleveland Engineering Society.

American machines are being sold in Spain today.

A further aid to the sales of American machines, which incidentally are being recognized as real producers, is the fact that their accuracy allows a less skilled class of labor to operate them. Old German machines with which Spain was equipped lacked so much in quality that they required good machinists to turn out good work on them. Such a situation made the good machinists feel indispensable with the very natural result that there were many strikes. With the modern American machine operated by a comparatively unskilled laborer and the skilled machinists confined to the "set-up" or "adjuster" class, such trouble has been reduced to a great extent.

Five to seven years ago, a good machinist was making from $1 to $1.30 a day, whereas he now gets around $3 or possibly a little more. A shop superintendent will get about $140 a month.

Import Duty

The import duty on machinery is at present $4 per hundred kilos. There is a governmental tendency to increase this duty, but there is no certainty that it will be done, because it is believed that the sound argument that machinery is one of Spain's greatest present needs will be listened to. Spain is not ready to go on her own, in fact she is in a position where she will help herself most by buying American tools and letting them into the country without being subject to high duty.

So far as concerns general conditions in Spain they rather closely parallel those in the U. S. The actual prices in American money are lower, but comparatively they are about the same. Foodstuff, clothing, rents, real estate, automobiles and machine tools are high. The government is making an attempt to lower the cost of living by buying grain and cold storage food from Argentina and is sending government freighters to get them. In some of the larger cities apartment houses have been turned into offices which means that building has been very slow and has its effect on keeping rents up. Labor unions are strong and in some cases, at least, not wise. For example, they have ruled that none of their members may engage in piece work. The government is at present giving attention to prospective legislation concerning contracts between employers and workmen. Eight hours per day is the official working day for employees of private enterprises as well as government plants.

Railroads in Poor Condition

The railroads are in poor shape. The rates are so low in comparison to wage expenditure that equipment cannot be kept in first-class condition and expansion cannot be considered. It is believed that the government will take steps to relieve this situation, at the same time in all probability keeping rates on foodstuffs and like necessities low.

Spain is well along in water-power development. The smallest village is almost certain to have electric lights. Its mayor, though he may not be able to sign his name, will in all probability have electric light and an electric iron in his home. The greater part of the electric power required is generated by water power.

Spain, though an old country, offers a large field for development and for the sale of machinery and this field is increased by the Spanish zone of Morrocco which is rich in iron and silver and is reputed to contain oil. The trend is toward modern methods of manufacture and development, which means greater requirements for machinery and according to present signs, American machinery especially.

Annual Meeting of American Manufacturers' Export Association

Membership Opened to Banks and Steamship Companies—Important Discussions on Financing of Foreign Trade, Taxation and Latin-American Markets—W. C. Redfield Elected President

One of the most successful meetings in its history was held at the Waldorf-Astoria, New York City, on October 14 by the American Manufacturers' Export Association. At the business session in the morning an amendment to the constitution was adopted opening the membership circle to banks and steamship and shipping companies. It was felt that the addition of these bodies to the organization would increase its strength and improve the chances of favorable action when it appeared before government boards or committees to request legislation or rulings in the interest of American foreign trade.

William C. Redfield, former Secretary of Commerce, was elected president of the association for the ensuing year to succeed W. L. Saunders of the Ingersoll-Rand Co. The other officers elected were as follows:

Vice Presidents—H. S. Demarest, Greene, Tweed & Co., New York; F. H. Taylor, S. S. White Dental Manufacturing Co., Philadelphia; C. K. Anderson, American Wire Fabrics Co., Chicago; J. S. Lawrence, Lawrence & Co., Boston; H. A. Koster, Koster & Co., San Francisco; C. A. Green, American Pitch Pine Export Co., New Orleans.

Treasurer—William H. Ingersoll, Robert H. Ingersoll & Bro., New York.

Directors—James A. Farrell, United States Steel Corporation; E. M. Herr, Westinghouse Electric and Manufacturing Co.; A. C. Bedford, Standard Oil Co.; W. L. Saunders, Ingersoll, Rand Co.; C. B. Wynkoop, Cosgrove & Wynkoop Coal Co.; Lewis E. Pierson, Irving National Bank; William Pigott, Pacific Coast Steel Co.; H. J. Fuller, Fairbanks, Morse & Co.; John Bolinger, National Shawmut Bank; D. E. Delgado, Eastman Kodak Co.; W. W. Nichols, Allis Chalmers Manufacturing Co.; Dwight E. Austin, Nestle's Food Co.; W. C. Durant, General Motors Co.; C. E. Jennings, C. E. Jennings & Co.; Charles A. Schieren, Charles A. Schieren & Co.; F. A. Seiberling, Goodyear Tire & Rubber Co.; George Edward Smith, Royal Typewriter Co.; Walter C. Allen, Yale & Towne Manufacturing Co.

Secretary—A. W. Willmann, New York.

The afternoon session was devoted to papers and talks on various phases of foreign trade. Mr. Saunders in his opening address sounded the keynote of the meeting, "To obtain permanent world trade American manufacturers must now take a leading part themselves." Mr. Saunders showed charts prepared by the research department of the Federal Reserve Bank of New York indicating the proportion of our foreign trade passing through the port of New York for a period of thirty years, the relation between export values and actual tonnage volume and commodity prices, the variation of exports and imports over forty years from the forty year trend, and the relation between commodity prices and exchange rates. He pointed out that foreign trade is really very close to the line of normal trend at the present time and not so abnormally increased as reports seem to indicate. Also that the departure from a gold currency basis and credit inflation are the principal causes of high commodity prices and low exchange rates.

The next speaker was James S. Alexander, president of the National Bank of Commerce. He defended the attitude of bankers toward the financing of foreign trade and pointed out that the conditions of the past that had led to the feeling against the bankers had entirely changed and that the banks were doing their share. He went on to say with regard to foreign trade:

"Just what ratio between our foreign trade and our domestic trade may come to be established as normal it is impossible to say at present. But it can be said that a closer approximation to equilibrium between our export and import trade must be expected, whether that be brought about through a decrease of our exports, an increase in our imports, or both.

"If a marked recession in our export trade should prove to be one of the corrective factors tending to stabilize international trade, it is my belief that such a recession should be accepted as economically sound and that we should not incur the dangers of seeking to stimulate by artificial measures the volume of our foreign trade. Where there is a real demand for our goods there will be a real market. It is the business of the banks to finance goods for real markets. It is not their business to attempt to maintain expanded foreign trade when it becomes manifest that there is not the continued economic basis for that expansion.

"A comprehensive view of the foreign situation indicates that the real and basic need of Europe is for our raw products. She needs them to reestablish her own industries upon a fundamentally productive basis, increasing her export powers so as to liquidate her adverse balance of indebtedness. Her need is for raw products rather than for many classes of our manufactured products which during the war period she had to purchase from us but which, as her own industrial organization is rehabilitated, she can increasingly produce for herself without reliance upon us.

"Also in financing our foreign trade we must not lose sight of our business situation as a whole. We must not finance our foreign trade on a basis that will perpetuate over-expansion in our domestic banking credit. The great bulk of Europe's debts to us is in the form of long time credits or of commercial credits which it seems impossible to realize on at once. This is a serious element of non-liquidity in our credit structure. If it is necessary to readjust our domestic credit situation,

our foreign trade also must be subject to that necessity. The liquidity of our commercial credit structure should be a chief concern. Therefore it is one of the pre-eminent duties of the banks to encouarge a return as fast as possible to reciprocal foreign trade in equilibrium financed by liquid credits.

"The most desirable foreign trade is that with countries which give most promise of being able to reestablish their own productivity and to regain at the earliest moment the ability to liquidate their debts here with goods. It is also but the part of wisdom to favor, in our trade with those countries such products of ours as will serve most rapidly to help them return to a condition of economic stability.

"These are all practical considerations for business men as well as bankers. Banks make money by helping others make money. The way for business to make money is to make sure that the profits of today shall not be wiped out by the losses of tomorrow. The only way in which this can be assured is to see to it that the business structure which is built today is not built so weakly that it will collapse under the demands of tomorrow.

"Therefore, when bankers see that business conditions have reached a stage of expansion that requires readjustment they should fearlessly take what steps are necessary in the situation. Their action must be based on self-interest, on the demands of business and above all on the best interests of all concerned. This is my conception of true banking cooperation with business."

W. A. Harriman, president of the American Ship and Commerce Corporation, told of some of the difficulties confronting American shipping companies in their attempt to break into the shipping business in the near and far east. Great Britain has such a strangle hold on the business at present that his company has so far been unable to secure the cargoes wanted. He also pointed out our great deficiency in properly trained personnel to handle not only the ships but the business on shore at both ends. This was one reason for the making of the contract with the Hamburg-American line which has caused so much criticism and comment. Mr. Harriman urged the support of American steamship companies by the private investor and pointed out the handicap to private business caused by the government-owned Shipping Board fleet. He also mentioned the high cost of operation under the American flag.

Otto H. Kahn pointed out rather briefly the bad features of our present taxation system and went on to make the following constructive suggestions:

"The road of recovery from the appalling shock of the war, intensified in its after-effects through faulty treatment by the physicians, i.e., the statesmen in charge, is necessarily slow and hard. I think the more that road is thrown open now to the ordinary travel of human-kind and the more it is freed from bureaucratic impediment and from governmental interference, except for purposes of policing and traffic-regulating, the better it will be.

"The President, the heads of the Executive Departments, and Congress are vastly overworked. It is simply inconceivable that these instrumentalities of administration and legislation can give the necessary time and thoroughness of study to the variety of complex questions which call and will increasingly call for consideration and action.

"The burden which both the Senate and the House place upon their members in the investigating and gathering of facts and the hearing of witnesses, is exceedingly heavy. A very large portion of the time and energies of our legislators are absorbed in these functions. With the best intentions and the most conscientious application, it is not possible for Senators and Congressmen to do that kind of work to best advantage.

"Moreover, experience has proved that Congressional Committees cannot give to the task that continuous and concentrated attention which it requires.

"Much relief could be obtained by our legislators and very advantageous results accomplished if part of the burden of holding hearings, gathering views and investigating economic and other non-political subjects were placed upon the shoulders of others—non-office holding citizens acting in conjunction with Senators and Congressmen.

"The best ability and ripest experience of the country could be called upon and would surely be found ready to serve. It should come to be looked upon as a distinguished honor to be asked by Congress to act as one of its instrumentalities, and the resulting sense of responsibility and of public duty and trust should—and I have no doubt would—cause those selected and honored to give service wholly free from the bias of self-interest. Such committees might be composed of say five non-office holding members and six or seven Senators and Congressmen. A great part of the work could be done without necessitating the continuing attendance of the legislative members.

"The reports emanating from the deliberations of the Committee would, it may be hoped, come to be regarded as sources of reliable information to the public on social and economic subjects and if the Committees are wisely selected and rightly conceive their functions, their conclusions would surely come to have the public's confidence for impartiality and competency, irrespective of party affiliations.

"They ought also to make it easier for the political parties to have the courage of facing squarely and dealing without too much zig-zagging and compromising, with questions of a non-political nature, because the parties could point to the backing of the reasoned judgment of particularly expert and trustworthy men without political axes to grind.

"An incidental advantage of considerable value would be thus to bring together representative men of different callings and from different sections of the country in conference and exchange of views with each other and with Senators and Congressmen.

"It is part of my suggestion that such commissions should be selected and appointed not by the Executive, but by Congress acting through the President of the Senate and the Speaker of the House, or in some other suitable way. Experience has shown that the findings of commissions appointed by the Executive, whether Federal or State, have rarely been of great influence with the legislatures and are apt to meet on the part of their members with a certain degree of prejudice or even antagonism. I should be hopeful that commissions designated and directed by Congress and containing a proportion of Senators and Congressmen, would prove more effective and that their views and recommendations would receive a more propitious reception. The decision and responsibility as to legislation would, of course, rest no less than now with the Congress and the President."

Dr. R. S. MacElwee, Director of the United States Bureau of Foreign and Domestic Commerce, spoke of the good work of our commercial attachés. He mentioned the plans for the appointment of ten additional attachés and told of the work being done at the district offices in this country.

Machinery Club of Chicago Holds Fifth Annual Picnic

The fifth annual picnic of the Machinery Club of Chicago was held at Thatcher's Grove on the Des Plaines River, Saturday, Sept. 25. The baseball game was won by Ray Jones' team of supply men which defeated Peterson's team of machinery men by the fairly close score of 19 to 10. A great time was had by everybody, the event proving to be a real "get-together."

The pictures show: (1) Robert Cutlibertson, president, and H. E. White, in rear; (2) C. J. Banbach; (3) Fred Hermann and Clyde Blakeslee; (4) A. W. Smith, Chicago manager of L. S. Starret Co.; (5) Mr. Colby of Marshall-Huschart Co.; (6) F. L. Peterson, the man facing the camera, and (7) R. A. Millholland, smiling while packing in the "eats."















of the metal annealed was noted. It was found that the tensile strength of the steel was greater with the pulverized coal fuel and that the elongation and reduction in area were less than had formerly been obtained from materially the same analysis and annealing temperature. Analysis of the steel treated showed that the carbon and sulphur content were considerably increased when using the pulverized coal fuel. The average analysis for a number of samples showed carbon before annealing 0.262 per cent and after annealing, 0.287 per cent; the sulphur before annealing, 0.041 per cent, and after annealing, 0.052 per cent. The coal used ranged high in sulpuur, showing from 2.45 to 2.80 per cent. It was thought that the fuel possibly had a case-hardening effect upon the steel and that such was the case was verified by analyses of test drillings. Both carbon and sulphur were found in much higher percentage near the surface than deeper in the section.

Entertainment had been provided for the visiting foundrymen, including a banquet at the Hotel Deshler on Wednesday evening. At the banquet one of the speakers, John A. Penton, of Cleveland, publisher of *Foundry*, announced the establishment of a fund of $20,000, the proceeds of which would be used as prizes for research work in the metallurgical industry.

A smoker was held the following evening at the Elks Club, at which prizes were given for those who had most successfully estimated on the number of foundry problems presented. At this gathering the officers elected for the coming year were announced as follows: President, W. R. Bean, Eastern Malleable Iron Co., Naugatuck, Conn.; vice president, C. R. Messinger, Sivyer Steel Casting Co., Milwaukee, Wis.; and secretary-treasurer, C. E. Hoyt, 712 Marquette Bldg., Chicago. The date and location of the next convention have not been announced.

Next Foreign Trade Convention at Cleveland

The National Foreign Trade Council, at its seventh annual meeting in New York, selected Cleveland, O., as the place at which to hold the Eighth National Foreign Trade Convention, scheduled for the spring of 1921. It was felt that as the 1920 Convention had met in San Francisco, the 1921 convention should be held in an inland city. Previous to the San Francisco meeting these gatherings had been held in Washington, D. C.; St. Louis, New Orleans, Pittsburgh, Cincinnati and Chicago.

Paterson, N. J., For Open Shop

The Associated Industries of Paterson, N. J., has gone on record as favoring the open-shop principle in the silk mills. An appropriation of $3,000 was voted for conducting a three months' educational campaign in Paterson in favor of the open shop.

Personals

E. P. WELLES, president of Chas. H. Besly & Co., Chicago, has returned from a three months' trip to Europe.

ROBERT G. BERRINGTON, for many years with the Cleveland Twist Drill Co., Cleveland, Ohio, has been appointed district sales manager in Cleveland, for the combined interests of the Reed-Prentice Co., of Worcester, Mass., the Whitcomb-Blaisdell Machine Tool Co., of Worcester, Mass., and the Becker Milling Machine Co., of Boston. The Cleveland office is located at 408 Frankfort St.

E. A. ORRELL, who has been connected with the Graton & Knight Manufacturing Co., Worcester, Mass., in the Boston sales office, has sailed recently for China, where he will pass the next two years introducing leather belting and goods to the trade.

GEORGE S. HAWLEY, who has been general manager of the Bridgeport Manufacturers' Association, of Bridgeport, Conn., has resigned his position to accept a place as vice-president and general manager of sales for the Bridgeport, Conn., Gas Light Co.

J. W. HAYES, who has been manager of the Philadelphia branch office, of the Graton & Knight Manufacturing Co., Worcester, Mass., has been transferred to the Boston office of the company.

DONALD MCSKIMMON has been made purchasing agent of the S. W. Card Manufacturing Co., division of the Union Twist Drill Co., Mansfield, Mass.

HENRY D. ROLPH, of the Yale & Towne Manufacturing Co., Stamford, Conn., has left for Vancouver, B. C., where he is to sail for Japan, on a business trip, carrying a full line of Yale products. From Japan, Mr. Rolph will go to China, French Indo-China, Siam, Dutch East Indies, Straits Settlements, Federated Malay States, etc. Mr. Rolph expects to be gone from this country for about two years.

A. A. LOEFFLER has recently been appointed by the Doehler Die-Casting Co. as its Detroit representative, succeeding F. C. SEEGER, who will now represent the company on the Pacific Coast, with headquarters in San Francisco.

L. W. CASH, purchasing agent for the Defiance Motor Truck Co., Defiance, Ohio, has severed connections with that company to take effect Oct. 1.

C. C. GRAY has severed his connections with the Farrar Advertising Co. to become manager of sales for the Pannier Brothers Stamp Co., Pittsburgh, Pa.

T. J. DAVIS, formerly representing the Union Twist Drill Co., Athol, Mass., in the states of Michigan, Illinois, Indiana, Wisconsin and Minnesota, has become connected with the W. L. Romaine Machinery Co., Milwaukee, Wis., as manager of the tool and equipment department.

JAMES R. COXEN, state director of vocational education, Laramie, Wyo., would like to get in touch with concerns willing to supply rough castings to be machined in the trade schools of Wyoming.

R. B. BENNETT, formerly connected with the Standard Steel and Bearings Corporation, Plainville, Conn., has been made mechanical superintendent of the Canadian General Electric Works, at Toronto.

F. H. SAWYER, manager at the Fall River, Mass., branch office of the Graton & Knight Manufacturing Co., leather belting manufacturer of Worcester, Mass., has been transferred to the Philadelphia sales office as manager of sales.

H. LEONARD RICHARDSON has been made resident engineer at the Birmingham, Ala., plant of the American Steel and Wire Co. Mr. Richardson was connected with the Worcester, Mass., plant for about four years in the capacity of mechanical engineer.

A. E. MURDOCK has been appointed assistant manager of the Hartford, Conn., plant (C) of the New Departure Manufacturing Co., Bristol, Conn. Mr. Murdock was formerly foreman in the tool department.

A. J. WEAVER, for nine and one-half years assistant superintendent of the Billings & Spencer Co., Hartford, Conn., manufacturer of drop forgings, machinists' tools, etc., has accepted the position of assistant chief inspector for the Pratt & Whitney Co., Hartford. Mr. Weaver left the latter to go to the former about ten years ago, and now goes back to the place where he started in as apprentice back in 1888.

FRED J. PASSINO, formerly assistant district manager of the New York territory of the Independent Pneumatic Tool Co., Chicago, Ill., has recently been appointed district manager at Pittsburgh, Pa.

R. A. BULL has resigned his position as vice president of the Duquesne Steel Foundy Co. and is now consulting metallurgist for the following steel foundries, grouped for the purpose of developing and perfecting higher standards in the production of steel castings: Electric Steel Co., Chicago, Ill.; Fort Pitt Steel Castings Co., McKeesport, Pa.; Isaac G. Johnson Co., Spuyten Duyvil, N. Y.; Lebanon Steel Foundry Co., Lebanon, Pa.; Michigan Steel Castings Co., Detroit, Mich.; Sivyer Steel Castings Co., Milwaukee, Wis.

C. G. BIGELOW has succeeded Ralph B. Dibble, as advertising manager of the Graton & Knight Manufacturing Co., Worcester, Mass.

EDWARD GROSSMAN, who has been connected with the Fairbanks Co., of New York, for a number of years and with other supply houses, is now associated with the T. P. Walls Tool & Supply Co., 25 Leonard St., New York City, in the capacity of treasurer and manager.

EDWARD CAVE has been made manager of the advertising department of the Yale & Towne Manufacturing Co. of Stamford, Conn., and has taken up his new duties.

CHARLES P. COOLEY, vice president and secretary of the Smyth Manufacturing Co., machinery manufacturer of Hartford, Conn., has been elected president of the Society for Savings Bank of Hartford, Conn., succeeding C. E. Gross, resigned.

E. KENT SWIFT, treasurer of the Whitin Machine Works, Whitinsville, Mass., will leave shortly on a European business trip.

Business Items

For the purpose of more closely cooperating with the industries of Indianapolis and vicinity the Norton Co. has opened a branch office for its grinding machine division at No. 304 Penway Building, 241 North Pennsylvania Ave., Indianapolis, Ind., under the direction of Walter F. Rogers, district representative. The establishment of this branch office will in no way affect the distribution of Norton grinding wheels. These will be handled as in the past by Vonnegut Hardware Co.

The Colonial Steel Co., Pittsburgh, Pa., has opened a warehouse in Cleveland, Ohio, and will hereafter carry its own stock of both high-speed and carbon tool steels. It will be represented in Cleveland by F. L. STEVENSON, manager, whose office will be at 1104 Prospect Ave.

The Ward Tool and Forging Co., of Latrobe, Pa., has arranged for representation in the State of Michigan and northern Ohio through John D. Scott, Inc. Associated with Mr. Scott is John E. Love. This new agency has opened offices at 1156 Penobscot Building, Detroit, Mich.

The Wickwire-Spencer Steel Corporation, of Worcester, Mass., and Buffalo, will hold its first annual sales convention at the company's office in Worcester, from Oct. 13 to 18. It will bring together sales representatives of the company from various parts of the country and a gala time and program is prepared for their entertainment, besides the talks, etc., regarding sales and other matters.

The United Manufacturing Co., Waterloo, Iowa, will change its headquarters from Waterloo to Belmond, Wright County, Iowa. Ernest F. Wege is chairman and Theodore Wege, secretary.

The New Advance Machinery Co., Van Wert, Ohio, has been incorporated at a capitalization of $100,000 and has purchased the plant and interests of the Advance Machinery Co. The company will conduct the business along modern lines, manufacturing a high grade line of band saws, wood shapers and glue room appliances.

The Hart Co., Inc., Williamsport, Pa., was recently capitalized at $100,000, to manufacture a complete line of valves, faucets, cocks, etc.

The Reed-Prentice Co., Becker Milling Machine Co. and Whitcomb-Blaisdell Machine Tool Co. combine has opened a branch office in Philadelphia under the management of G. S. Haven, who was formerly with Whitcomb-Blaisdell Machine Tool Co., Worcester, Mass. The new office is located at 514 Liberty Bldg., Philadelphia, Pa.

The business of the Luster Machinery Co. has been purchased by Fairbanks, Morse & Co., Boston, Mass., and will be known as one of its branch offices. E. J. Luster, president, and the staff of the Luster Machinery Co., have associated themselves with Fairbanks, Morse & Co. Mr. Luster will act as manager of the company's machine tool department.

The Whiting Foundry Equipment Co., Harvey, Ill., and the American Foundry Equipment Co., New York, have been consolidated under the name of the Whiting Corporation, and will be capitalized at $5,000,000. J. H. Whiting, president of the Whiting Foundry Equipment Co., becomes chairman of the board, and V. E. Minich, president of the American Foundry Equipment Co. will be president. The lines of manufacture of the two companies do not overlap; therefore it is the intention to maintain all present manufacturing facilities.

The Fairbanks-Morse Co., 30 Church St., New York, recently acquired the business of the Luster Machinery Co., of 917 Arch St., Philadelphia, and has established a branch office in that city. D. W. Dunn is the manager of the Philadelphia office and E. J. Luster has charge of the machine-tool business.

The Gilbert & Barker Manufacturing Co., Springfield, Mass., has recently announced the following additions to its Pacific Coast sales departments: J. W. Ledgerwood, at Los Angeles; Zach D. Tallman, at San Francisco; Lloyd Finck, at San Francisco; and H. D. Jamieson, at Portland, Ore.

The name of Isbecque & Co. has been changed to Isbecque, Todd & Co.; there will be no change in the personnel of the organization. It has offices in New York, and Brussells, Belgium.

The Baush Machine Tool Co., Springfield, Mass., is completing a one-story and basement brick-and-steel addition and a three-story brick-and-concrete addition to its plant on Wason Ave., Springfield.

The Lancaster Steel Products Corporation, Lancaster, Pa., has recently opened a New York office, 25 West 43d St., in charge of L. E. Vesey, district sales manager.

The American Wire Die Co., Worcester, Mass., has recently been formed and has opened a shop at 12 Parker St., to make dies, etc.

The Kennedy Corporation, Baltimore, Md., incorporated with $2,000,000 capital stock, has acquired the plant of Fairbanks, Morse & Co. near its own plant, and also the entire capital stock of the Baltimore Malleable Iron and Steel Casting Co., which also adjoins the plant. The purchase price totals $1,850,000.

The Wisconsin Foundry and Steel Works, Cedar Grove, Wis., has been merged into the Cedar Grove Stove and Machine Co. The latter company was recently incorporated with a capital of $100,000. The new concern will occupy the quarters of the Wisconsin Foundry and Steel Works and will be under the management of P. M. Ketterhofen.

The Dwight P. Robinson & Co., Inc., New York, with which Westinghouse, Church, Kerr & Co., Inc. has recently consolidated, has established a new branch office in Youngstown, Ohio, in the Home Savings & Loan Building, in charge of C. I. Crippen. The company recently moved its Cleveland office from the Leader News Building to the Citizens Building.

Announcement has been made of the change in name of the Dale-Brewster Machinery Co. It will hereafter be known as the Dale Machinery Co., New York and Chicago.

Obituary

HOMER W. MEACHEM, prominent in the machinery manufacturing world, died at his home in Syracuse, N. Y., last week. Mr. Meachem was the organizer of the New Process Rawhide Co., and later of the Meachem Gear Corporation.

Forthcoming Meetings

The New York Section of the Illuminating Engineering Society will hold a joint meeting with the American Society of Safety Engineers at the Engineering Societies Building, New York, on Oct. 22 .

The Buffalo Section of the A. S. M. E. will hold its October meeting on the twenty-sixth at the University Club. Non members are invited.

The American Gear Manufacturers Association will hold its semi-annual meeting at Lake Mohonk Mountain House, Mohonk Lake, Ulster County, N. Y., Oct. 27, 28 and 29.

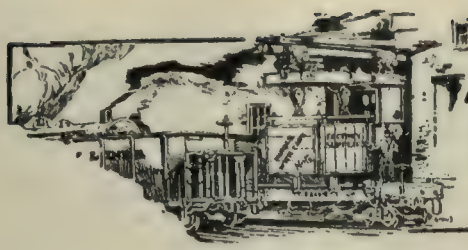
An exposition of U. S. manufacturers at Buenos Aires, Argentine Republic, S. A., has been arranged for the month beginning March 15, 1921. Information can be obtained from American National Exhibition, Inc., Bush Terminal Sales Building, 132 West 42nd St., New York.

The Federated American Engineering Societies will hold its first meeting at the Hotel New Willard, Washington, D. C., on Nov. 18 to 20 inclusive.

The National Machine Tool Builders' Association will hold its 19th annual Fall convention at the Hotel Astor, New York City, on Thursday and Friday, Dec. 2 and 3, 1920. C. Wood Walter, care of the association's offices at Worcester, Mass., is secretary.

The 1920 annual meeting of the American Society of Mechanical Engineers will be held in the Engineering Societies Building, 29 West 39th Street, New York City, from Dec. 7 to Dec. 10.

The Society of Automotive Engineers will hold its annual meeting on Jan. 11 to 13 inclusive at New York.



THE WEEKLY PRICE GUIDE

IRON AND STEEL

PIG IRON—Quotations compiled by The Matthew Addy Co.:

	Current	One Year Ago
CINCINNATI		
No. 2 Southern	$46.50	$30.35
Northern Basic	51.30	27.55
Southern Ohio No. 2	48.50	28.55
NEW YORK—TIDEWATER DELIVERY		
2X Virginia (Silicon 2.25 to 2.75)	57.12	32.40
Southern No. 2 (Silicon 2.25 to 2.75)	52.10	35.20
BIRMINGHAM		
No. 2 Foundry	42.00@45.00	29.25
PHILADELPHIA		
Eastern Pa., No. 2x, 2.25–2.75 sil.	51.25	29.00–30.00
Virginia No. 2	50.00*	33.10
Basic	51.00†	26.75
Grey Forge	48.00*	26.75
CHICAGO		
No. 2 Foundry local	47.00	26.75
No. 2 Foundry, Southern	48.67	28.00
PITTSBURGH, INCLUDING FREIGHT CHARGE FROM VALLEY		
No. 2 Foundry	49 56	28.15
Basic	48.96	27.15
Bessemer	51.96	29.35

* F.o.b. furnace. † Delivered.

STEEL SHAPES—The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses at the cities named:

	New York			Cleveland		Chicago	
	Current	One Month Ago	One Year Ago	Current	One Year Ago	Current	One Year Ago
Structural shapes	$4.30	$4.58	$3.47	$3.44	$3.37	$4.08	$3.47
Soft steel bars	4.50	4.73	3.37	4.50	3.27	3.98	3.37
Soft steel bar shapes	4.50	4.73	3.37	....	3.27	3.98	3.37
Soft steel bands	6.43	6.43	4.07	6.25	....	....	....
Plates, ¼ to 1 in. thick	4.75	4.78	3.67	3.64	3.57	4.28	3.67

BAR IRON—Prices per 100 lb. at the places named are as follows:

	Current	One Year Ago
Mill, Pittsburgh	$4.25	$2.77
Warehouse, New York	4.75	3.37
Warehouse, Cleveland	3.52	3.27
Warehouse, Chicago	4.12	3.37

SHEETS—Quotations are in cents per pound in various cities from warehouse; also the base quotations from mill:

Blue Annealed	Large Mill Lots Pittsburgh	New York Current	New York One Year Ago	Cleveland	Chicago
No. 10	3.55–7.00	7.23@8.00	4.57	6.75	7.13
No. 12	3.60–7.05	7.28@8.05	4.62	6.80	7.18
No. 14	3.65–7.10	7.33@8.10	4.67	7.35	7.23
No. 16	3.75–7.20	7.43@8.20	4.77	7.45	7.33
Black					
Nos. 18 and 20	4.20–6.20	8.41@ 9.80	5.30	8.30	7.90
Nos. 22 and 24	4.25–6.25	8.46@ 9.85	5.35	8.35	7.95
No. 26	4.30–6.30	8.51@ 9.90	5.40	8.40	8.00
No. 28	4.35–6.35	8.61@10.00	5.50	8.50	8.10
Galvanized					
No. 10	4.70–8.00	8.90@11.00	5.75	8.50	8.25
No. 12	4.80 8.10	9.00@11.00	5.85	8.60	8.30
No. 14	4.80–8.10	9.00@11.10	5.85	8.60	8.45
Nos. 18 and 20	5.10–8.40	9.25@11.40	6.15	8.90	8.75
Nos. 22 and 24	5.25–8.55	9.40@11.55	6.30	9.05	9.15
No. 26	5.40–8.70	9.55@11.70	6.45	9.20	9.30
No. 28	5.70–9.00	9.85@12.00	6.75	9.50	9.60

Acute scarcity in sheets, particularly black, galvanized and No. 16 blue enameled.

Automobile sheets are unavailable except in fugitive instances, when prices are 9.45c per lb. for No. 16; 9.50 for Nos. 18 and 20, and 9.55c for Nos. 22 and 24.

COLD FINISHED STEEL—Warehouse prices are as follows:

	New York	Chicago	Cleveland
Round shafting or screw stock, per 100 lb. base	$6.36	$5.90	$6.00
Flats, square and hexagons, per 100 lb. base	6.86	6.40	6.50

DRILL ROD—Discounts from list price are as follows at the places named:

	Per Cent.
New York	50
Cleveland	50
Chicago	50

NICKEL AND MONEL METAL—Base prices in cents per pound F. O. B. Bayonne, N. J.

Nickel	
Ingot and shot	43
Electrolytic	45
Monel Metal	
Shot and blocks	35
Ingots	38
Sheet bars	40
Hot rolled rods (base)	42
Cold rolled rods (base)	56
Hot rolled sheets (base)	55
Special Nickel and Alloys	
Malleable nickel ingots	45
Malleable nickel sheet bars	47
Hot rolled rods, Grades "A" and "C" (base)	60
Cold drawn rods, grades "A" and "C" (base)	72
Copper nickel ingots	42
Hot rolled copper nickel rods (base)	52
Manganese nickel hot rolled (base) rods "D" — low manganese	64
Manganese nickel hot rolled (base) rods "D" — high manganese	67

Domestic Welding Material (Swedish Analysis)—Welding wire in 100-lb lots sells as follows, f. o. b. New York: 5/32, 8½c. per lb.; ⅛, 8c.; 5/32 to ¼, 7½c Domestic iron sells at 12c. per lb.

MISCELLANEOUS STEEL—The following quotations in cents per pound are from warehouse at the places named:

	New York Current	Cleveland Current	Chicago Current
Openhearth spring steel (heavy)	7.00	8.00	9.15
Spring steel (light)	10.00	11.00	12.25
Coppered bessemer rods	9.00	8.00	6.85
Hoop steel	6.68	6.50	5.43
Cold-rolled strip steel	12.50	8.25	11.00
Floor plates	6.91	6.00	6.88

WROUGHT PIPE—The following discounts are to jobbers for carload lots on the Pittsburgh basing card:

BUTT WELD

Inches	Steel Black	Steel Galvanized	Inches	Iron Black	Iron Galvanized
¼ to 3	54–57½%	41½–44%	⅛	15½–25½%	+1½–11½%
			¼	19½–29½%	1½–11½%
			⅜ to 1½	24½–34½%	8 –18½%

LAP WELD

2	47 –50½%	34½–38%	1¼		
2½ to 6	50 –53½%	37½–41%	1½		
7 to 12	47 –50½%	33½–37%	2	20½–28½%	6½–14½%
13 to 14	37½–41 %		4½ to 6	22½–30½%	9½–17½%
15	35 –38½%		2½ to 4	22½–30½%	9½–17½%
			7 to 12	19½–27½%	6½–14½%

BUTT WELD, EXTRA STRONG PLAIN ENDS

¼ to 1½	52 –55½%	39½–43%	⅜ to 1½	24½–34½%	9½–19½%
2 to 3	53 –56½%	40½–44%			

LAP WELD, EXTRA STRONG PLAIN ENDS

2	45 –48½%	33½–37%	1¼		
2½ to 4	48 –51½%	36½–40%	1½		
4½ to 6	47 –50½%	35½–39%	2	21½–29½%	8½–16½%
7 to 8	43 –46½%	29½–33%	2½ to 4	23½–31½%	11½–19½%
9 to 12	38 –41½%	24½–28%	4½ to 6	22½–30½%	10½–18½%
			7 to 8	14½–22½%	2½–10½%
			9 to 12	9½–17½%	5½–+2½%

	New York Black	New York Galv.	Cleveland Black	Cleveland Galv.	Chicago Black	Chicago Galv.
¼ to 3 in. steel butt welded	38%	22%	39%	30%	54%40%	40%@30 %
2½ to 6 in. steel lap welded	33%	18%	41%	26%	50@40%	37½@27½%

Malleable fittings. Classes B and C, banded, from New York stock sell at plus 45%. Cast iron, standard sizes, plus 5%.

METALS

MISCELLANEOUS METALS—Present and past New York quotations in cents per pound, in carload lots:

	Current	Month Ago	Year Ago
Copper, electrolytic	16.50	18.62	22.50
Tin in 5-ton lots	39.50	46.50	56.50
Lead	8.50	9.00	6.25
Zinc	8.50	8.50	7.60
ST. LOUIS			
Lead	8.00	8.00	6.00
Zinc	7.70@8.05	7.70@8.05	7.15

At the places named, the following prices in cents per pound prevail, for 1 ton or more:

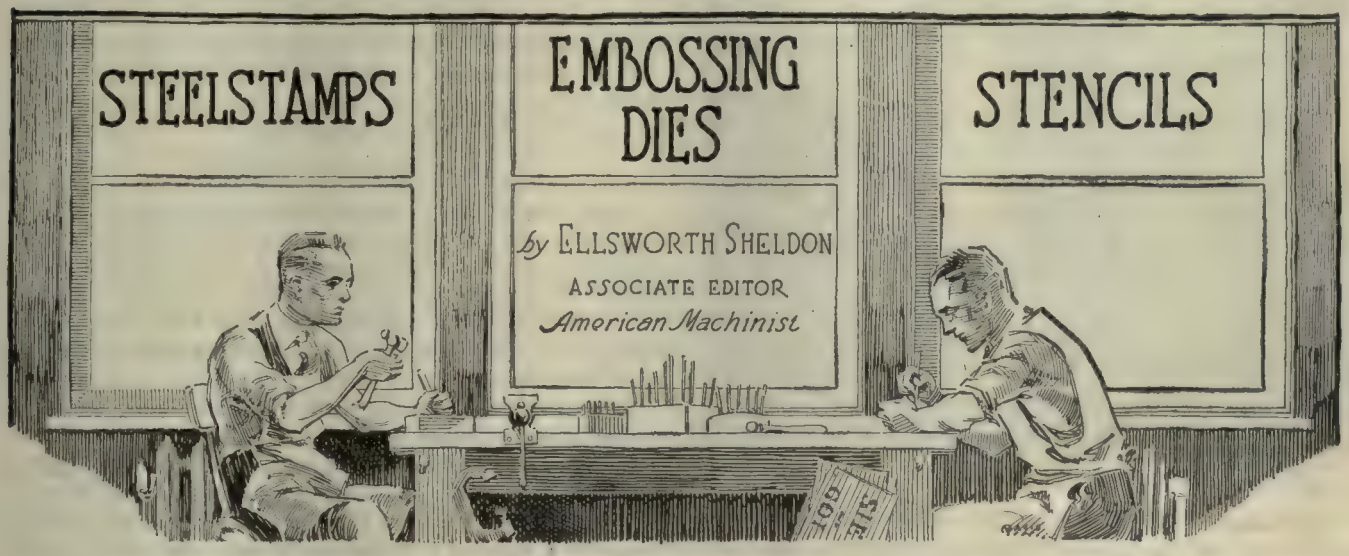
	New York Current	New York Month Ago	New York Year Ago	Cleveland Current	Cleveland Year Ago	Chicago Current	Chicago Year Ago
Copper sheets, base	29.50	33.50	33.50	30.00	35.50	36.00	36.50
Copper wire (carload lots)	31.25	31.25	30.75	29.00	30.50	29.00	26.00
Brass sheets	28.50	28.50	32.00	36.00	33.00	27.00	28.00
Brass pipe	33.00	33.00	36.00	34.00	39.00	34.00	37.00
Solder (half and half) (case lots)	35.00	38.00	45.00	40.50	41.00	38.00	38.50

Copper sheets quoted above hot rolled 16 oz., cold rolled 14 oz. and heavier, add 2c.; polished takes 5c. per sq.ft. extra for 20-in. widths and under; over 20 in., 7½c.

BRASS RODS—The following quotations are for large lots, mill. 100 lb. and over, warehouse; net extra:

	Current	One Year Ago
Mill	25.00	24.00
New York	27.00	28.00@29.75
Cleveland	27.00	29.00
Chicago	30.00	27.00

October 28, 1920 American Machinist Vol. 53, No. 18



A BUSINESS directly allied to the machine industry, but in which machinery counts for little and craftman's skill figures very largely, is the making of steel stamps and dies for pressing or embossing letters and figures upon other metals, including steel.

These stamps are made in infinite form and variety; the common steel letter or figure familiar to everyone who has to do with machinery being the simplest and most crude. From these simple tools, which leave their impression upon whatever machine or part of machine it is desired to mark with no other manipulation than holding the character in the operator's fingers and striking a blow with a hammer upon the end of the shank, the cycle of evolution comprises single characters with shanks nicely finished to fit holders that will adapt them to press or marking machines; combination of letters to make words and sentences or of figures to make numbers, or both, all upon one shank; single characters, and sometimes complete words made interchangeable to make words and sentences, capable of being taken out of their holders and others substituted therefor as a printer changes his type to keep abreast of changing conditions; interchangeable characters to fit holders of special form to keep the resultant marking always in the same place with respect to the work; characters which become parts of rotating wheels, and serve to leave their distinctive marking upon moving work or upon curved surfaces where a pressure in one direction would not suffice; and many other forms.

Every toolmaker knows that if he has the impression of a steel letter in a hardened steel block he can in a very few minutes reproduce the letter that made it by the simple processes of hammering and filing. What he probably does not know is that a majority of commercial stamps are made by the same process; somewhat refined, to be sure, over the emergency method of the man who wants his letter NOW, *but nevertheless the same in principle.*

There are two ways of making such tools, so far as the cutting of the actual design is concerned. If a sufficient quantity is to be made and it is essential that there should be no variation between individual stamps of one series, a master die, or hub, as it is called, is cut by the engraver which is an exact inverse or matrix of the letter or design that is desired. This "hub" is then hardened, and is used as a die with which to form the stamps.

To make a stamp from such a die, a piece of steel of suitable size and length is roughly shaped upon the end, located squarely over the impression in the master die and struck lightly with a hammer. This first blow will leave the outline or a part of the outline of the design upon the steel. Perhaps only one or two spots may show evidence of having been in contact with the die, but such places as do show the mark of the die are then cut away by means of chisel or file, the stamp relocated on the die in as nearly as possible the same place as before and again struck with a hammer.

By alternately striking the stamp on the die and cutting away the parts that show evidence of contact, the remaining metal soon reaches the bottom of the impression in the die and has become a steel stamp that only needs to be trimmed up and properly tempered to be capable of leaving on a smooth surface an impression that is the exact duplicate of the die that produced it. It is by this or some analogous process that most of the steel stamps are made which are used for marking trade names, designs, etc., upon the countless millions of small articles of metal or other material that are upon the market.

Whether or not a stamp made by this process is a "good" stamp—that is to say, whether or not it will stand up under constant service—depends upon several things, one of the most important of which is the nature of the material upon which it is to be used. Used as a part of a mold for forming and at the same time lettering or marking a plastic material that "sets" or becomes hard, either by baking or other process after the marking is done, such a stamp will last indefinitely.

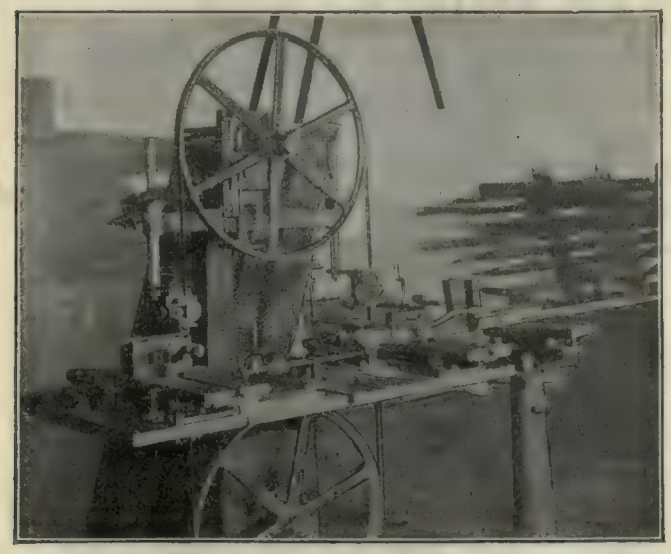


FIG. 1. THE STOCK IS CUT WITH A BANDSAW

If the stamp is to be used upon iron, steel, or similar hard material, its life will depend somewhat upon the time and skill devoted to its making. It is quite possible to make a stamp by driving it forcibly into the hub without any cutting at all.



FIG. 2. ENDS OF BLANKS ARE SQUARED BY FILING IN THIS GAGE

Such a stamp, however, would last but a very short time when used upon iron or steel, for the reason that the fibers of the metal have been broken down; the molecules have been disturbed with relation to each other and forced to flow under the pressure of the blows, the steel having been driven down in some places and raised up in others exactly in the same way as a plastic material would behave under similar conditions. On the other hand, if the blows struck by the artisan have been light and he has conscientiously cut away all the material where it has been in contact with the die, it is quite possible for him to have let the character entirely into the die without having flowed or swaged the metal. To do this well takes not only a longer time but a higher degree of skill, and such tools necessarily cost more than the same design would do if it were swaged into the die in three or four blows. The extra cost is usually justifiable on stamps that are to be used for continuous service, for they will approach in lasting qualities the strictly hand-cut characters.

Hand Cutting or Engraving

The other principal method of making such stamps is by hand cutting. Files, chisels and gravers are the only tools used after the design is on the metal.

The symmetry of hand-cut stamps is entirely dependent upon the artisan's skill of hand and eye. Though the design may be drawn upon the steel and the stamp cut by different men, it is not usually so done, for the work is engraving and the worker an artist.

Hand-cut stamps are unquestionably the best, when length of life and sharpness of impression are considered, but where a certain design must be reproduced again and again by reason of even the best of stamps wearing out from continued use, not only would the cost of such stamps be prohibitive but exact duplication could not be depended upon because, though a skillful worker might make a thousand similar stamps each artistically perfect, it would be out of the bounds of human possibility for him to make a thousand exactly alike.

Continuous Duplication

Exact duplication, even to many thousand pieces, is practical with the hub method of production by the simple expedient of letting the first stamp cut from the master die become itself the master, used only to make new master dies to replace those whose product, when examined under the microscope, show signs of variation or distortion.

Tempering is, of course, a very essential consideration in the life of a stamp that is to be used upon hard material, but as imperfect tempering would be equally disastrous to either hand-cut or hubbed stamps, it was not mentioned among the important qualifications. Tempering stamps that are to be used upon soft materials is a minor consideration; indeed, many if not most of the tools to be used on such work are made of hard bronze.

Relative Cost of Methods

The cost of *one* hubbed stamp would be more than the cost of a single hand-cut stamp of the same design. The cost of *two* hand-cut stamps would, obviously, be twice the cost of one, but the cost of the second *hubbed* stamp would be but a small percentage of the cost of the first one. This is a consideration quite as important, where continued replacement is concerned, as the comparative life of the two kinds of stamps. For this reason probably the majority of steel stamps are hubbed, while a larger proportion of brass and bronze designs are engraved.

Various grades of tool steel are used to make stamps. Any steel that will make a good cutting tool will do, but the nature of the work and life of the stamp must be considered when selecting material. As the material cost is but a small part of the expense, economy demands that the steel best suited to the work in hand be selected without reference to the cost.

In the factory of the Pittsburgh Stamp Co., 316



FIG. 3. INTRICATE DESIGNS ARE ROUGHED OUT BY ROUTING

Penn Ave., Pittsburgh, Pa., where the material for this article was obtained, the stock is received in bars from $\frac{3}{32}$ in. square up to rectangular sections 4 in. wide and is cut to length with the band-saw shown in Fig. 1.

The machine is equipped with two movable vises and both sides of the band are used. The capacity of the vises is 4 in. square and when sawing small bars the vise is filled at each pass, thus cutting off a number of pieces at a time. The vises are mounted upon a slide and a chain extends from each vise over a guiding sheave to a weight at the rear of the machine.

This method of cutting off stock leaves the ends of the pieces square and smooth without the necessity for redressing, while the gravity feed suits the rate of cutting to the hardness of the material and the sharpness of the saw teeth. On the majority of stamps there is no further work on the pieces; they go from the cutting-off saw directly to the engravers.

If the work is the cutting of standard letters or figures, or is to be of some design that has been made before, there will be a matrix or hub ready to the engraver's hand. He will take the pieces one at a time, holding them in a hand vise across the corner of his bench or filing block, and point one end roughly to the shape of the character he is to make.

Preparing the Blank

The filing gage, Fig. 2, is a V-block of suitable size and shape to hold conveniently in the hand, with a hardened steel disk so attached to one end that its surface is square with the center line of the V. Laying one of the pieces in the V with its pointed end flush with the surface of the disk, a few strokes with a flat smooth file corrects any little variation from squareness that the band saw may have left. The stock is not allowed to project from the gage, but the file is held in contact with the disk and the work pressed against it with the thumb of the left hand. One or two strokes of the file serve to accomplish the desired result and the blank is ready to be cut.

If the character is small there is no preliminary work upon it; it is placed squarely upon the matrix and struck lightly with a hammer. Sometimes the end of the piece is copper coated by dipping it in a solution of blue vitriol, the film of copper serving to show to better advantage where the work has been in violent contact with the die. The engraver then catches the piece in the bench-vise and with chisel, file or graver proceeds to cut away the metal from the contour of the character.

The engraver's skill enables him to form a pretty good letter with only the faint marks of the first impression to guide him, but if at any time the clues become too indistinct for him to follow, it is but the work



FIG. 4. ROUTING TOOLS ARE MADE FROM DRILL-ROD

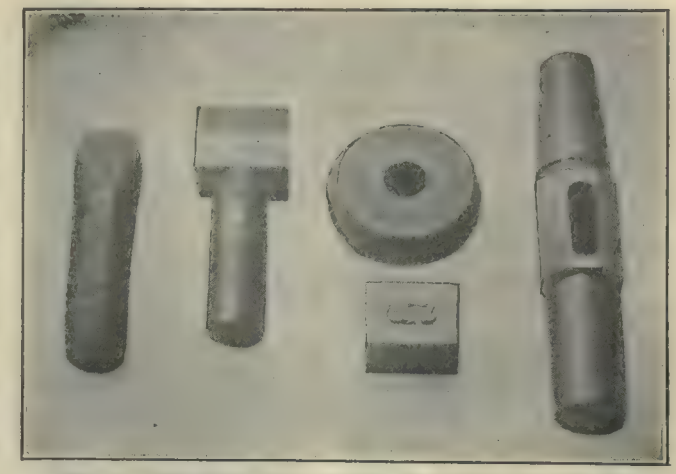


FIG. 5. STAMPS ARE MADE IN VARIOUS FORMS

of seconds to place the piece over the matrix, the latter guiding it to place by means of the partly cut letter. Three or four repetitions of this process and the engraver is ready to lay down any ordinary single character a perfectly finished letter and take up another piece.

Reversing the Process

If the work is an intricate design incorporating several letters the process, or rather the manner of applying the matrix, is reversed. The matrices for this work, instead of being cut in the face of a heavy block, will be cut on the end of a piece of square stock just large enough to receive it. The work will be held in the bench vise, the surface coppered, and the design laid out upon it. The steel may or may not be cut away before using the matrices, according to the judgment of the engraver. These men are perfectly capable (and indeed every day are called upon to do it) of laying a new design and cutting it entirely into the steel without the use of matrices at all. When such a design is to be made in raised letters there is, of course, a comparatively large area of metal to be cut away, and the routing machine shown in Fig. 3 is called into service.



FIG. 6. A COUPLE OF HAND-CUT STAMPS

Routing Surplus Metal

The router is an ordinary profiling machine having the usual movements; rotary movement of the spindle with vertical adjustment, and a rotary movement as well as horizontal movement in both directions for the table. Tools, shown in Fig. 4, are usually made from drill rod with no other aids than a file and a speed lathe, though small milling cutters are sometimes used that are made upon the milling machine. Only the roughing out is done upon the routing machine; the finishing in all cases is entirely a matter of hand work.

Samples of Stamps

Samples of steel die work are shown in Figs. 5, 6 and 7. In Fig. 5 are shown a "hammer" stamp and a hand stamp, both to be used where the accurate placing of the impression is not essential; a "wheel" stamp that is part of a special numbering machine that marks stock or parts that are continuously passed through it; and two stamps to be used in a press.

In Fig. 6 are two stamps the design for which is laid out on the metal, the excess stock routed out and the characters finished with the graver. In Fig. 7 is shown a pair of dies for a seal press. In Fig. 7 is shown a pair of dies for a seal press. In dies of this kind the embossing die is usually engraved and the matrix is made of soft metal by pressing the die into it and cutting away the metal from the points of contact with the graver. In Fig. 8 may be seen a wheel-stamp used on a special numbering machine. The characters are all finished by hand engraving. There are two characters in this wheel that require changing from time to time, and these characters are made on insert pieces which are dovetailed into the wheel and held in place with small button-head screws. A similar stamp used, to stamp succesive impressions upon a strip of metal is shown in Fig. 9. The holder is attached by screws to a disk that forms part of a special machine. The short section having the appearance of a file is for the purpose of starting the material from a state of rest and bringing it into synchronous movement with the stamp. The characters of the stamp would of themselves do this; but the chances are that the first letter or two would be blurred or distorted. Starting the material before any of the marking characters come in contact with it insures a sharp, clear-cut impression of the stamp.

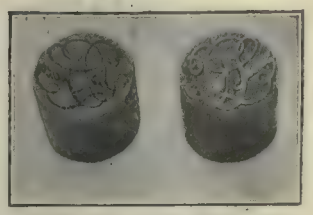


FIG. 7. A "PAIR" OF EMBOSSING DIES



FIG. 8. AN ELABORATE WHEEL STAMP HAND ENGRAVED

Printing Plates of Brass and Bronze

Another product of the Pittsburgh Stamp Co. is shown in Fig. 10 in the shape of brass plates for printing trademarks and designs on boxes or labels. These designs are sometimes quite intricate and many of them are printed in two colors, involving some very close work in matching the two plates that produce the impression, to avoid overlapping and smudging of color. These plates, like the steel stamps, are cut to line on the routing machine, the design first having been drawn on the polished surface of the brass, and are "touched up" with hand tools.

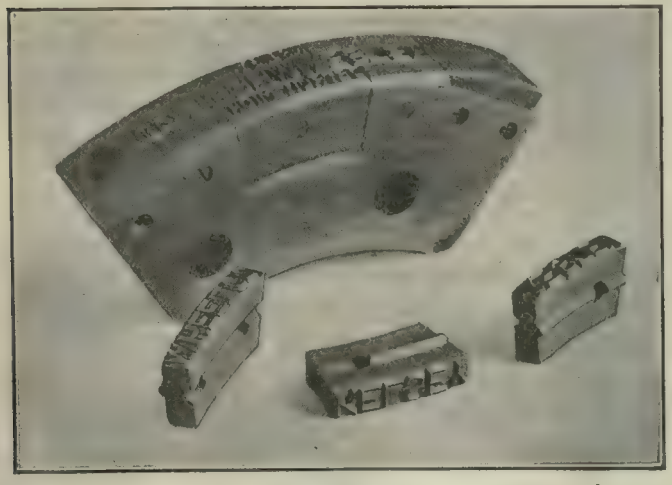


FIG. 9. A SECTIONAL WHEEL STAMP



FIG. 10. PRINTING PLATES MADE OF BRASS ARE ROUGHED OUT ON THE ROUTING MACHINE AND FINISHED BY HAND

One of the plates shown in Fig. 10 is a "figure plate" and is to be cut up into small squares, each containing one number. The individual numbers fit in the opening to be seen at the left end of the other plate and are held in by keys so they may be changed in the same manner as a printer changes the type in his forms.

Embossing Dies

Two pairs of embossing dies to be used in an ordinary punch press are shown in Fig. 11. They are for the purpose of embossing large sheets of tin. Holders are provided for the press of a size suited to the articles to be embossed and the letters are furnished in "fonts;" therefore any desired sequence of letters within the limits of the holder may be set up, and the set-up changed as often as desired. A feature of the holder prevents tripping the press when a letter is out of place and thus preserves the letters from becoming broken by reason of the upper and lower die not matching.

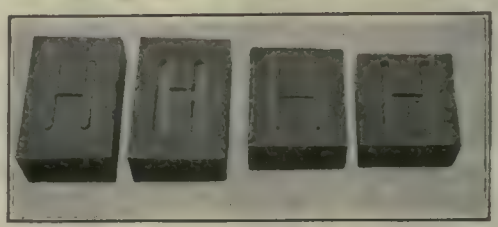


FIG. 11. MOVABLE TYPES ARE USED FOR EMBOSSING TIN AND OTHER SHEET METALS



FIG. 12. HAND STAMPS ARE MADE WITH INTERCHANGEABLE TYPE

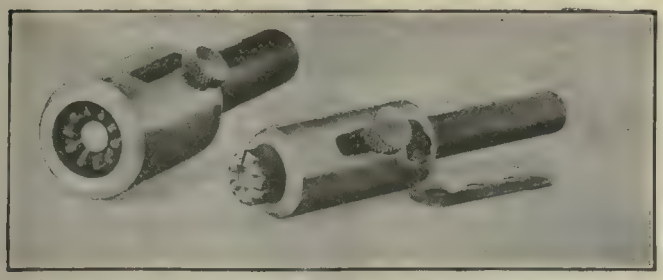


FIG. 13. HAND STAMPS ARE MADE IN MANY FORMS

Another example of the changeable stamp is shown in Fig. 12; this one being a hand stamp. Three pieces are shown to illustrate the three stages of construction, though the three pieces are obviously not the same tool. After the shank is shaped and the surface squared off, two holes are drilled as at *A*, a mill cut run across as at *B*, and then flat-sided plugs are driven into the holes to form the ends of the type-holding channel. In one of these plugs as at *C* a smaller hole is drilled not quite parallel to the axis of the plug and with one side of the hole cutting out of the flat side of the plug. Into this smaller hole is placed a coil spring and a hardened steel ball enough smaller than the hole to travel freely in it, and the hole is then closed by a plug containing a headed steel plunger *c* which rests on the ball.

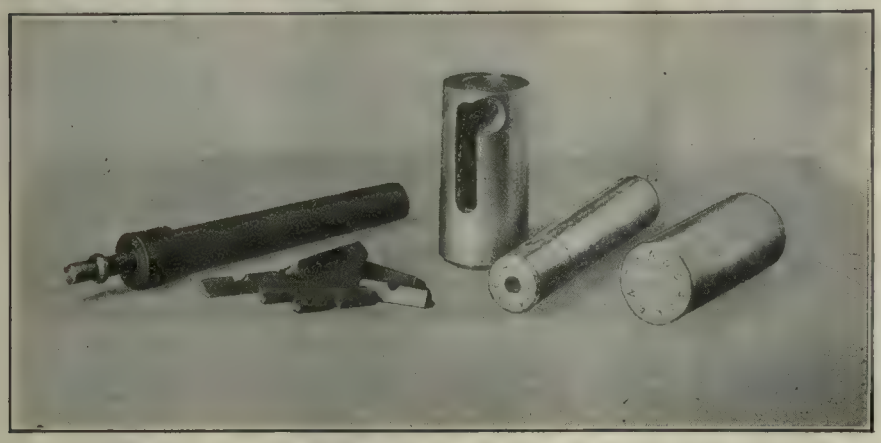


FIG. 14. DETAILS OF THE STAMP SHOWN IN FIG. 13 AND THE WORK IT DOES

The body of the type for this holder is necessarily nicely finished by grinding to exact dimensions and perfect squareness. The outer end of the inclined small hole is slightly nearer the type channel than the other end, therefore when the channel is full of type the ball presses against the line and resists any attempt to pull the type out. By reason of the inclined position of the small hole in which the ball is placed, the harder one pulls to get the type out the more strongly is the movement resisted. Pressing the thumb on the plunger *c* pushes the ball down the hole against the action of the spring, and thus releases the type. Another form of type holder is shown in the two views, Figs. 13 and 14. The individual stamps in this case are carefully milled on the sides to the exact angle that their width equires, so that whatever combination is set up will present a true circle which, if not complete with the characters alone, is filled out with spaces of various thicknesses also milled to their respective angles. The blanks for the type are made in



FIG. 15. STENCILS ARE CUT WITH LETTERS LIKE THESE



FIG. 16. STENCILS FOR WHICH THERE ARE NO CUTTING LETTERS ARE MADE WITH CHISEL AND FILE



FIG. 17. STENCILS ARE USED TO AID IN SAND BLASTING DESIGNS ON GLASS

the form of bushings, turned and bored, with an annular groove in the bore that becomes the "nick" by which the characters are retained in the holder after being separated.

More than one bushing would, of course, be required to make a complete ring of type, but these characters, like the ones previously described, are made in fonts so that any desired combination of letters and figures can be made. Fig. 14 shows very clearly the construction of the tool. The characters are set up around the central stud, and when drawn back into

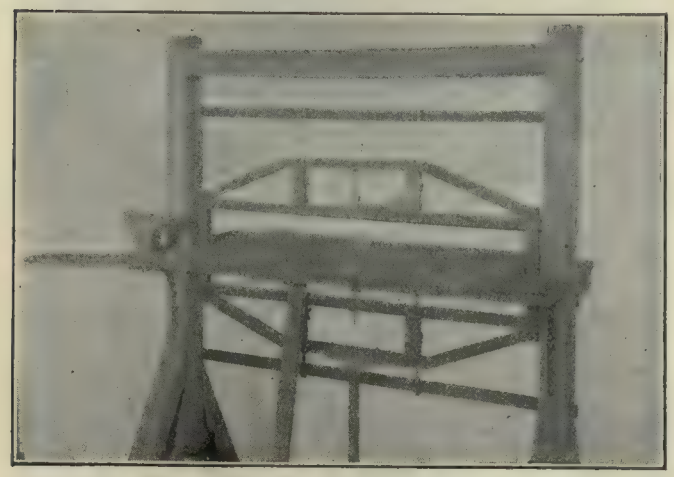


FIG. 18. SOMETIMES SMALL STENCILS OF INTRICATE DESIGN ARE MADE ON THE JIG SAW

the shell are held from dropping out by the shoulder on the stud which fits the "nick" in the type.

The small knurled screw serves to hold the central stud in position. The latter is not removed from the shell to change the setting; a partial turn of the stud after loosening the knurled screw allows the stud to project far enough from the shell to free the type.

The cutting of stencils from sheet brass is another phase of the stamp industry. The stencil cutter's outfit consists of a hardwood block exposing end grain to the surface, several sets of letters like those shown in Fig. 15, and the chisels in Fig. 16.

The stencil is first laid out on the thin sheet brass; roughly if it is to be all letters for which there is a set of stencil cutting letters, Fig. 15; carefully and accurately if it is a design that must be cut with chisels. No other tools than those above mentioned, a hammer and a mallet, are needed except perhaps a small file to smooth up refractory corners. The work of cutting a complete stencil of ordinary size is accomplished in a very few minutes.

Another form of stencil of which large quantities are used in the glass industry is shown in Fig. 17. It is for the purpose of putting the pattern on the glass lamp shade seen to the left. This particular stencil is made in five pieces superimposed and sweated together while the design is being sawed out upon the jig saw shown in Fig. 18. The pieces are then melted apart and reassembled in the form of the ring as shown.

Stencils of this kind are used in a sand blasting machine, the ring being slipped over the glass to the desired position, the shade placed in the machine, and the blast turned on. Wherever the glass is protected by the metal it will remain clear while the surface exposed by the holes in the stencil as well as outside the band will quickly be frosted.

Cutting Clutches On Spur-Gear Cutter

By A. DeAngelis

A shop had several hundred ratchet clutch rings to cut, and the only available means of accomplishing this seemed to be an ordinary milling machine with the use of a dividing head. It was very quickly discovered, however, after a start had been made to cut the rings in this fashion, that to complete the entire lot of several hundred would mean a job lasting several months, unless a new machine was bought for the work.

Incidentally it happened to be recalled that the company had an old Gould & Eberhardt automatic spur-gear cutter, which gave very good service, although unfortunately, it was idle most of the time owing to the presence of more modern machinery. A special fixture, shown together with a clutch ring in Fig. 1, was designed and applied to the old Gould & Eberhardt machine, and the result is that the 30-tooth clutches are now being turned out at the rate of one every 28 minutes. To secure the clutch ring in the fixture, an expansion mandrel, shown in Fig. 2, was made.

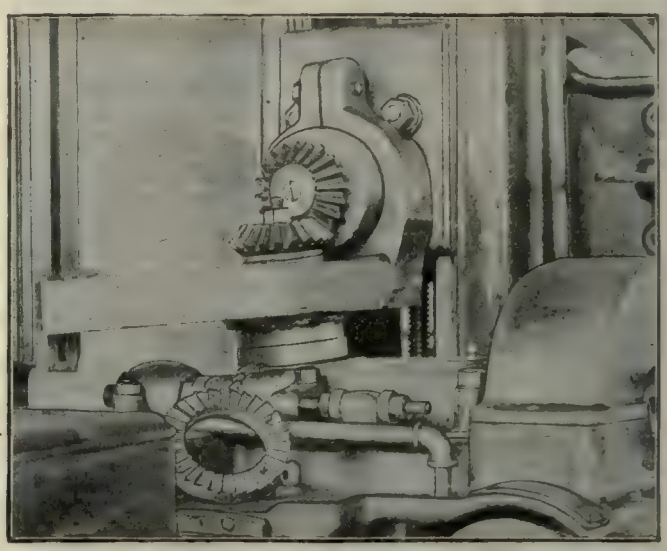


FIG. 1. CLUTCH IN POSITION AND BEING CUT

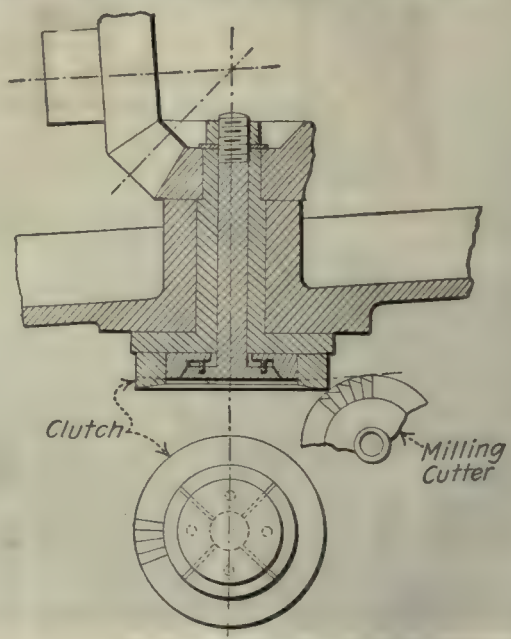


FIG. 2. EXPANSION MANDREL FOR HOLDING THE CLUTCH RING

Tools From a Railroad Blacksmith Shop

BY FRED H. COLVIN
Editor, *American Machinist*

Several machines made necessary by the usual failure to provide sufficient machinery in railroad shops are shown. Some of the methods of punching, shearing and forming metal, however, can be used in a variety of ways and with modern tools. All reflect credit on the iniative and capability of the men resvonsible for results.

RAILROAD management has always gone on the principle that if you shave the machine shop appropriations, the men will fudge up some sort of a machine to do the work. And they generally do. But almost every other kind of industrial management has learned that this is far from economical.

It has, however, developed the railroad mechanic into a sort of genius for taking a couple of angle irons or channels, a few pieces of scrap steel and an old air cylinder, and building almost any sort of a machine for bending, forging, riveting or what not. This is especially true of the blacksmith shop, and a few of the many ingenious kinks and devices developed by and under Otto Scheutze, blacksmith foreman of the Chicago, Milwaukee and St. Paul shops at Tacoma, Wash., are shown herewith. One of the simplest tools is a punch and die for making the thin nuts used on cross head pins and for similar purposes, these being about ½ in. thick when finished. They are punched out of ⅝-in. stock with the form of punch shown in Fig. 1, and a corresponding die. The center hole is first punched in a preliminary operation. Then the pilot on the punch insures the nut being properly positioned on the strip of steel to get out the blanks with but little loss of metal, as can be seen.



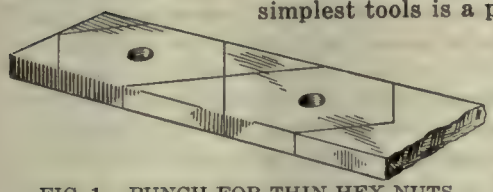


FIG. 1. PUNCH FOR THIN HEX NUTS

A somewhat different type of punch and die, and one which has possibilities in other directions, is shown in Fig. 2. This is for rounding the ends of brake levers but can be used for any similar work.

The body of the die *A*, has a round hole to accommodate the punch *B*. It is raised at the back to support the punch against the side thrust of the cut as it forces its way through the heavy metal.

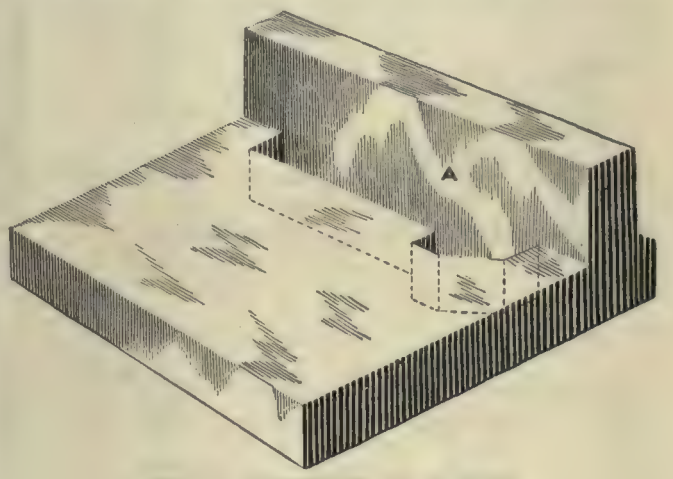


FIG. 3. PUNCHING SPLIT KEYS

The die is open at the back to allow the brake lever to be inserted and also open beneath the lever, so that it can be forced down by the punch as it clips off the end to the proper size and shape. The lever is first punched with the hole for the clevis pin and this hole becomes a guide which insures the brake lever being trimmed to the correct length.

SUPPORTING THE THRUST OF PUNCHES

Fig. 3 is a die for trimming split keys for various purposes. The two pieces are cut separately and riveted together afterward. The only feature about the die is the guide *A* which takes the thrust away from the cut. This is a feature in all of the dies designed by Mr. Scheutze.

This thrust block or slide is again noticeable at *A* in

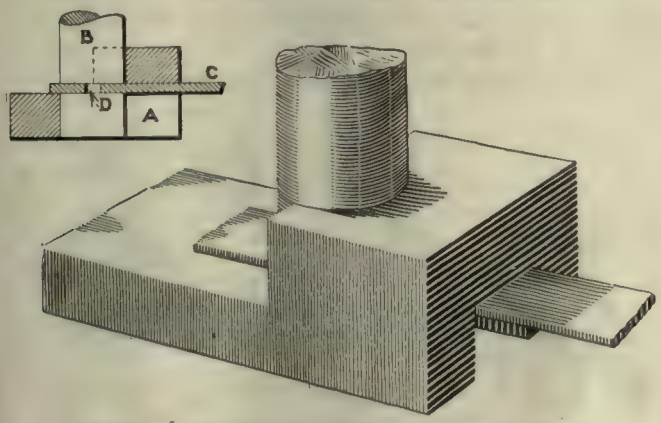


FIG. 2. TRIMMING END OF BRAKE LEVER

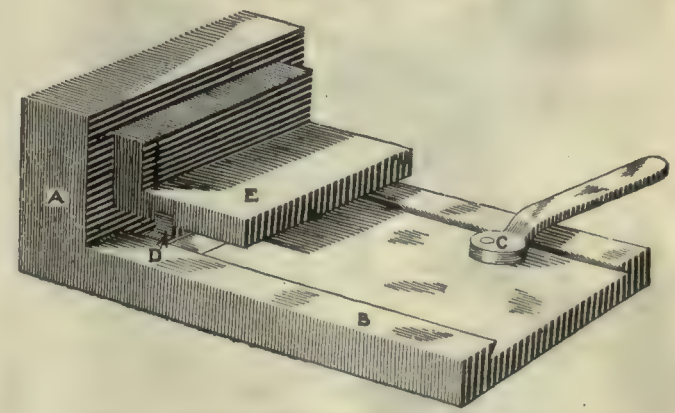


FIG. 4. SUPPORTING A HEAVY SHEARING CUT

the trimming die shown in Fig. 4. This is for squaring the ends of plates 12 in. wide and ⅛ in. thick. The plate is locked firmly against the raised edge *B* by means of the cam *C* and then the heavy press forces the knife *D* down across the end of the plate. The knife is inserted in the bolster *E* and can be readily renewed when necessary. The thrust guide insures the knife making a square instead of a slanting cut.

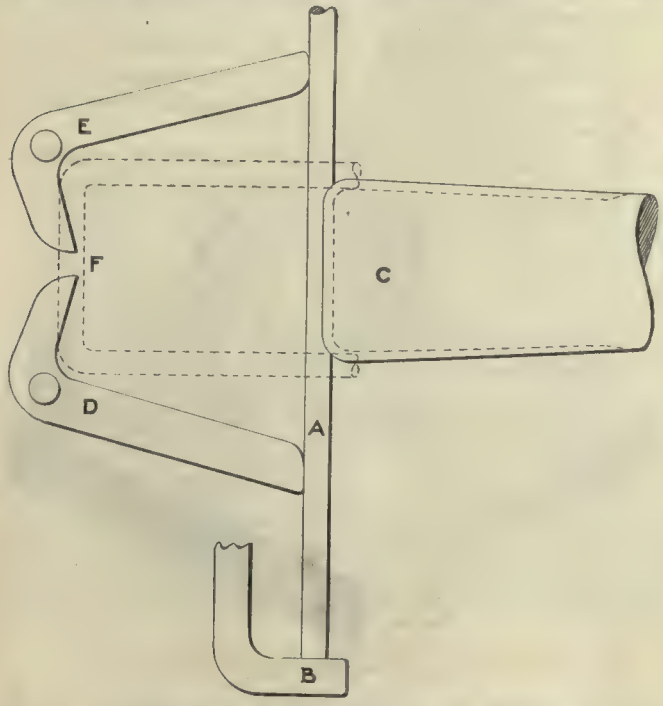


FIG. 5. DIE FOR BENDING U BOLTS

In Fig. 5 is an outline of a die for forming U-bolts in a bull dozer. The stock *A* is heated and put in position with one end against the stop *B*, which is adjustable. Then the ram *C* forces the stock between the jaws *D* and *E*, making an easy bend, until the center strikes the short ends of the formers at F. The continued movement of the ram swings the arms in and forms the work into a straight sided U-bolt with corners just a trifle rounded. The swinging arms bend the rod much more easily and with less power, than where the stock is forced down between the straight sides of a die.

In Fig. 6 is a simple but effective device for cutting off rivet heads in brake beams and similar pieces. The punch *A* has four cutting sides and is held in the ram of the press. The ring *B*, with a thrust piece *C* fastened to the outside, holds the beam while the decapitation is in process. It is a very simple device, easily adjustable for a large variety of work and capable of continuous use over long periods as by simply turning the punch a new cutting edge is provided.

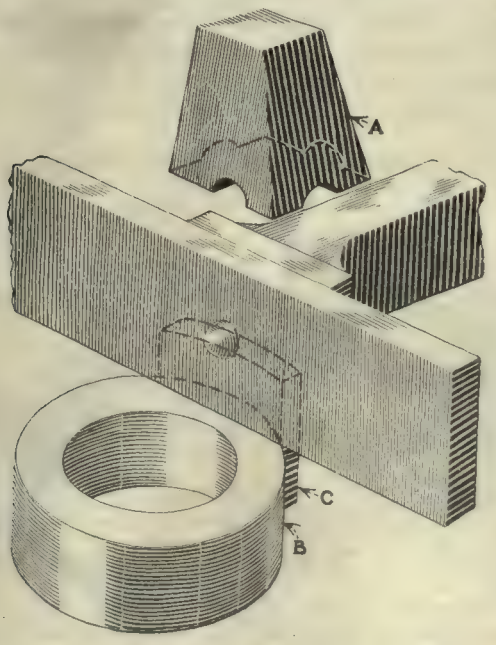


FIG. 6. CUTTING OFF RIVET HEADS

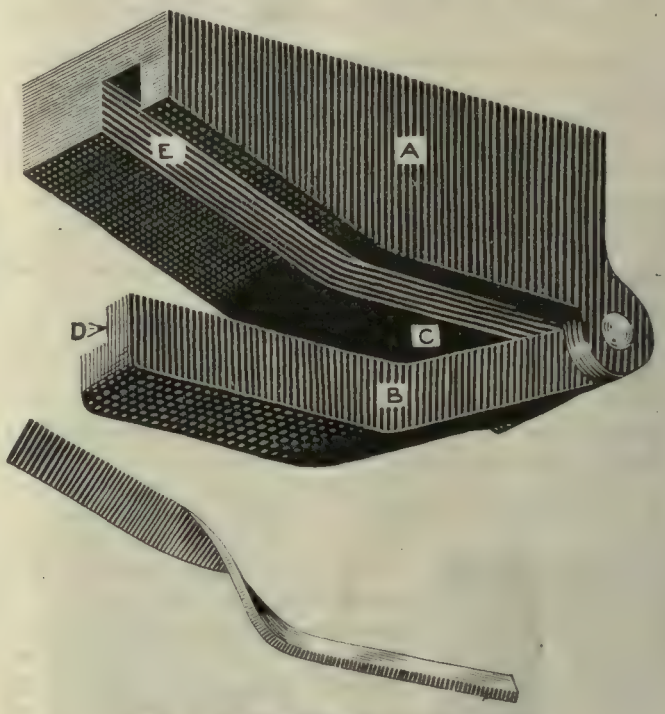


FIG. 7. QUARTER-TWISTING A BAR

A fixture for putting a quarter twist in the end of a flat bar is shown in Fig. 7. It consist of two pieces, the body *A* and the swinging arm *B*. The flat part of the bar is clamped at *C* while the lip *D* folds the end into the opening at E. Such a fixture is capable of many modifications for various kinds of work.

A Home-Made Bending Press

One of the air machines mentioned is shown in outline in Fig. 8. This is a special bending press for fairly heavy cartruck and similar work. A large air cylinder is mounted between heavy channels and a suitable bed plate used to carry the bending fixture which becomes the anvil for the press.

The particular work shown is to make a right angled

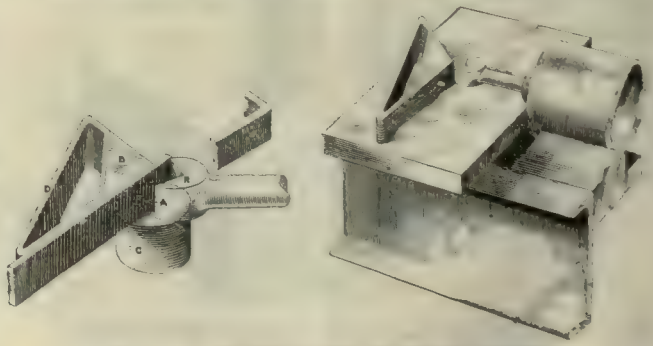


FIG. 8. A HOME-MADE FORMING PRESS

bend near the end of a heavy flat bar, the bend to be at a given distance from a bolt hole which has already been punched. After the bar has been heated the hole is placed over the guide pin *A*, which leaves the end of the bar projecting beyond the corner of the anvil block *B*. Then the air is turned into the cylinder and the ram *R* forces the end around the square corner.

The whole triangular frame is then swung on the large and substantial center *C*, which bears in the bedplate across the two channels. By moving this carefully and gradually, a heavy bar can be bent as desired. The corner of the anvil block *B* must be in the center of the center or bearing block. The triangular frame *D* can be made any desired shape according to the work to be done.

The machines built by Mr. Scheutze and shown in Figs. 9 and 10, are used in reclaiming and repairing drawheads for the modern couplers. The merits of this design were recognized by the Railroad Administration and used at other points.

The first, Fig. 9, is for shearing the heads off the two rivets in the drawhead, and as these are 1¼ in. in diameter, considerable pressure is required. The bed is made of two I-beams, 20 in. deep and with 7-in. flanges. The main uprights are steel bars, 2⅝ in. in diameter. The cylinder is 18 in. in diameter and the lever arms are respectively 43 and 3 in. giving a leverage of over 14 to 1, for the ram *C*. The ram *D* works on a 16-in. arm, making a considerably reduced leverage. This ram, however, is only for straightening plates and bars.

The air cylinder is tied into place with two 2¼-in. bars, with a heavy recoil spring at the top. The whole press is also mounted on four coil springs on a timber base, to allow it to move with comparative freedom when the reaction from the breaking of the rivet occurs.

In breaking rivets, a block *A* is placed on the bed of the press, and a drawhead put in position as at *B*, handled of course by an air hoist. The draw-head strap rests on the raised portions of the block, leaving space beneath for the drawhead casting when the rivets let go.

Both rams *C* and *D*, are guided in the double plate projection *E*, and are adjusted by screwing up or down

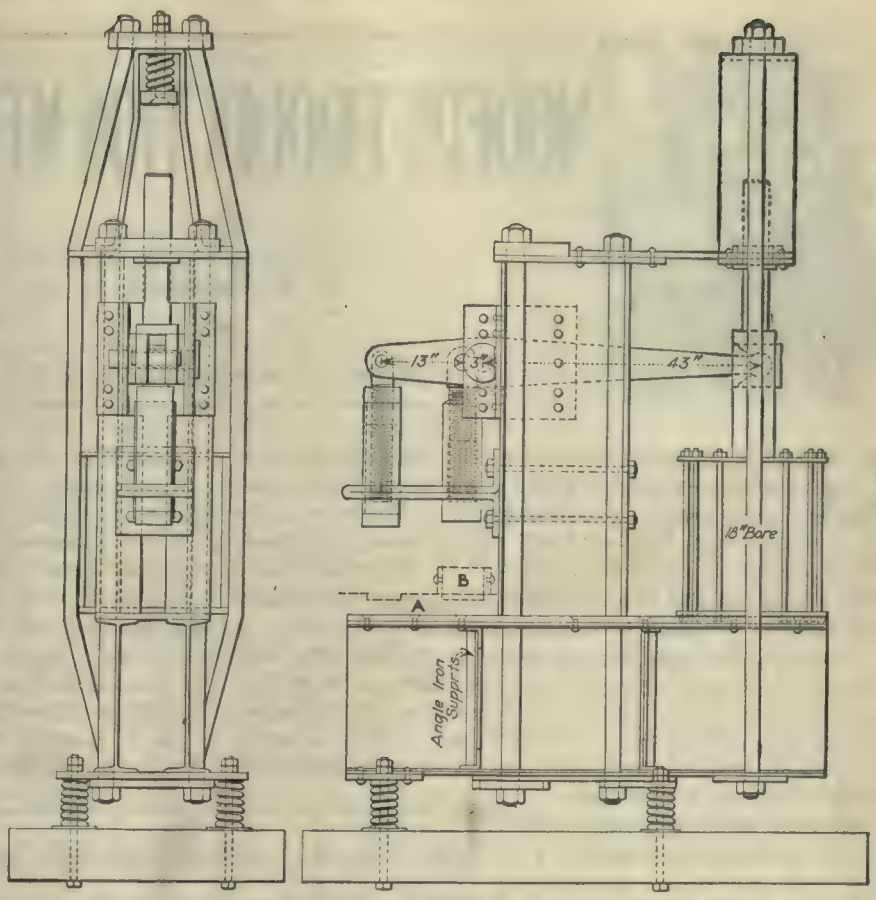


FIG. 9. MACHINE FOR SHEARING RIVETS IN DRAW-HEADS

on the threaded bar which supports and drives them. The threads are coarse square in form, 32 to 12 in. or 2⅔ per in. The fit is loose enough to be easily adjusted by hand, the ram being run down to contact with the work. Air at 100 lb. pressure is used and a heavy effective pressure built up in this way. But as there are two 1¼-in. steel rivets in double shear, considerable pressure is necessary.

Adjoining this machine, and part of the same reclaiming plant, is the riveting machine shown in Fig. 10, and used for putting new rivets into place and making the drawhead serviceable once more. The bed is of 12-in. channels, 7 ft. long and carries an air cylinder for the "holder-on" and a rock drill to do the riveting. The illustration shows the combination and leaves little to be said as to its operation. The ram or the holder-on is returned to position by the long spring in the bed, through the medium of the steel cable shown.

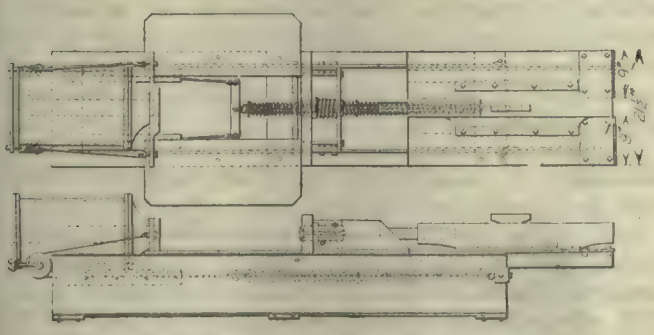


FIG. 10. A COMBINED HOLDER-ON AND RIVETING MACHINE

A. S. M. E. Organizes Materials Handling Section

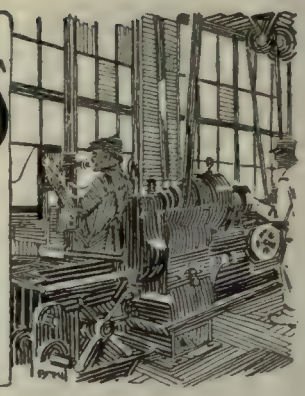
Four hundred members of the American Society of Mechanical Engineers have organized themselves into a "Professional Section on Materials Handling" and will provide primarily a common channel of intercourse between all the technical and industrial organizations cooperating in the solution of engineering problems connected with the handling and distribution of materials and products.

This section will aim to be a bureau of information—complete in its scope, specific in its knowledge of the physical and economic conditions and unbiased in its conclusions.



MODERN PRODUCTION METHODS

By
W P. Basset
of
Miller, Franklin, Basset & Co



GO OUT into your finished stockroom and examine carefully some part which has been manufactured in your plant, say a crankshaft. You can easily see in it the rough forging from which it was machined. The material, or most of it, is still in the crankshaft. That forging is the raw material, and the price paid for it is the material cost of the crankshaft.

You can also readily see, in your mind's eye, the various workmen who perform the turning, grinding and other operations on it. Perhaps this very morning you signed checks payable to these men. Those checks, or parts of each of them, include the direct labor cost of the crankshaft. You can practically see that element of cost in the finished product.

But perhaps you also signed other checks today. There was one for the foreman of the lathe department. He probably never touched the crankshaft, so you can't see in the finished product any evidence of the work done by him, but you know that his supervision and teaching were necessary.

Then there was that big check in payment of the coal bill. No matter how carefully you examine the crankshaft you will see no evidence of coal. A part of that check inevitably got into the crankshaft through a most indirect route—that of boilers, engines, shafting, belting and the lathe.

When you were making out the payroll checks, there were several to the plant watchmen. Careful scrutiny of the crankshaft shows no evidence of the money paid to them. On second thought, though, the mere presence of the crankshaft here, rather than in some thieves' fence, shows that the watchmen had something to do with manufacturing the crankshaft.

While thinking over these elements of cost you may reflectively look upward. You make a mental note that a piece of shafting is loose. You also note that the old building is showing the first signs of disintegration. Sooner or later you realize with an unpleasant jolt, you will have to build a new one to take its place. You haven't written any checks which in any way can be connected with the obvious depreciation of the plant, but you realize only too well that depreciation is a very real expense, which must be met sooner or later, and the money for erecting the new building must come from the sale of this crankshaft and the other parts which you manufacture and sell. It is therefore, an ultimate cost.

Touching the crankshaft again, you note that it is covered with a film of oil to protect it from rust. That makes you think of the other oil which you have to pay for which is used for lubricating the machines on which the crankshaft is turned. While the oil now on the crankshaft is in evidence, you can see no evidence of the lubricating oil on the finished product. It is a material however, which, although it does not appear in the finished product, is a shop supply necessary to the proper operation of the plant.

Most manufacturers I find, although they may be thoroughly conversant with their manufacturing and selling problems, have but a hazy idea of what goes to make up the cost of their products. They are inclined to look upon cost accounting as more or less of a mystery. Actually there is no mystery whatever about it. If the shop executives would only look upon cost methods in the light of their knowledge of manufacturing, they would see that each element of costs and each step in gathering them is logical, and depends upon the methods of manufacturing used in that shop. It is possible to determine the right methods of finding cost for any plant in any industry. In some, the problem will admittedly be simple; in others, it may be exceedingly complex. But it is always a problem to be solved not by accountants but by engineers familiar with manufacturing. They must, of course, know the principles of accounting, but cost finding is a manufacturing problem.

Probably a great deal of the haziness which surrounds cost accounting in the minds of otherwise capable executives, is due to the loose use of cost accounting terms. Inasmuch as it is my aim, in this series of articles, to make as clear as possible the principles involved in machine-shop cost accounting, I am going to assume that the reader knows nothing of cost accounting, and start by defining the terms we shall use throughout this series.

1. Material includes all matter which can be directly measured and identified as part of the finished product, such as castings and forgings.

2. Supplies include all matter which aids in the manufacture but is not apparent directly in the finished product. Example—files, oil, belting, brooms, etc.

In one sense, of course, both "material" and "supplies" are material, but for the sake of nomenclature we shall separate them as above.

XI. The Fundamentals of Cost

Having surveyed the generalities of cost systems in Part X of this series, the author here gets down to practical details. He gives the fundamental definitions and explanations of cost subdivision and includes practical bookkeeping suggestions.

(Part X appeared in the October 14 issue.)

3. Productive labor is that labor which can definitely be charged to the cost of making or assembling some finished part or assembly.

4. Non-productive labor is that labor which cannot be directly charged to a definite finished part or assembly. For example—janitors, watchmen, truckers, foremen.

In a way, perhaps, the use of the word "productive" and "non-productive" carries an unfair implication. Accountants are apt to refer to the two classes as direct and indirect labor. In the shop, however, the terms "productive" and "non-productive" are most common, and it is my aim to use such expressions as will tie in most closely with the common language of the shop.

5. Expense includes all items of cost which cannot be directly traced in the finished product, but which are necessary to maintain, shelter, instruct, direct or otherwise aid productive labor to produce and the sales department to sell.

Expense is sometimes called overhead or burden. There are no objections to the use of either of these terms, but it is my belief that the word expense is the one most commonly used.

6. Expense is commonly divided into two headings—factory expense, which covers those intangible items that aid production, and—

7. Selling expense, which includes all items of cost that directly or indirectly aid in distributing and selling of the product.

Certain items are sometimes difficult to assign to one or the other of these two divisions of expense. The test is this: If your product required no selling effort, if the customer came to the finished stockroom and removed the product, would this item of expense be incurred? If so, it is a factory expense; if not, it is a selling expense. In other words, the finished stockroom is the dividing line between factory expense and selling expense.

Elements of Cost Accounting

In the articles of this series which are to follow, we shall discuss the detailed methods of gathering all of the above factors of costs. At present, our only aim is to give the reader somewhat of a bird's-eye view of the subject and perhaps to clarify some of the complications which otherwise might confuse the man who is unaccustomed to solving cost problems.

My experience is that one of the most confusing things to a majority of manufacturers is the fact that oftentimes labor or materials which ordinarily are productive, finally find their way into the finished product as non-productive. For instance, the mere physical appearance of a piece of raw material is not the criterion as to whether it is productive material or a supply. It is the use to which it is put which determines how it shall show in the costs. A piece of bar steel may be either an expense or a productive item, according to the use to which it is put. Suppose that your finished product consists of an assembly containing gears. You carry a stock of bar steel from which the gear blanks are cut. The bar steel used in this way is obviously productive material. But suppose you have a repair to make for one of your machine tools. You may draw out the bar steel originally intended to be sold as part of your regular product and use it to manufacture a gear for your broken machine tool. This gear, and consequently the bar steel from which it was made, would thus not be charged into the goods in process account or to an article sold, but would be charged to expense. It would appear ultimately on the expense analysis as material used for machinery and repairs. That is a typical example of how productive materials may become expense.

Perhaps it may seem advisable, instead of buying a machine tool from an outside manufacturer, to manufacture the tool in your own shop. If so, this piece of bar steel would find its resting place in the fixed asset account.

Aside from getting accurate costs, it is important in these days of high taxes, to get the correct disposition of various materials used, for incorrect reporting may result in a considerable difference in the tax statement at the end of the year.

It is likewise with labor. It is seldom possible to assume that any given man is a productive or a non-productive worker. Rather is it necessary to analyze the activity of each man by means of his time tickets in order to determine from the statement of his activity whether his work was productive or non-productive. A man's regular occupation may be operating a milling machine on productive work, but he may be temporarily withdrawn from productive work and set to work for a few hours on a part which will be used to repair some machine. That man will have done, in the same day, both productive and non-productive work, and it is necessary to divide his time justly between the two jobs. If this same workman, instead of being put on repair work were, at a time when orders were slack, put upon operations necessary to building a machine tool for the shop, his labor would, like the material, end up as a fixed asset, and the cost of his time would ultimately appear on the equipment register. The nature of his work, whether productive or non-productive, would also determine whether a part of the expense of the department in which he worked should be carried to the goods in process account or to the fixed asset account. The point I wish to emphasize is that no one can say beforehand that the work of a given man, or that a given kind of material, is necessarily productive or non-productive. This can only be determined by the use to which it is put.

Knowledge of Plant Processes Necessary

Perhaps this makes clearer why I insist that correct cost accounting must be based on an accurate and comprehensive knowledge of the processes involved in the plant.

Because it is not always so easy to say just how an element of cost is to be gotten into the finished product, we frequently find manufacturers, when in doubt about an item, saying: "Oh! throw it into the overhead." That is a sign either of mental laziness or of a failure to grasp the fundamentals of cost accounting. Because there is bound to be a certain amount of approximation involved in distributing the expense to the product, the aim should rather be to get as many items of cost as possible charged directly to the proper unit of output. This is especially true when more than one type or size of product is manufactured, which is almost universally the condition in machine shops. It is surprising to find how, upon careful study, many items which have always been considered expense can be allocated directly to the proper product. All items of expenditure will, of course, ultimately come into the product, and it is always more accurate to charge them directly than by percentages.

CHARGE REGISTER

№	MONTH 1920	CREDITOR	ACCOUNTS PAYABLE CREDIT		DATE PAID	MATERIAL AND SUPPLIES: CASTINGS AND FORGINGS	BAR STOCK	IRON AND STEEL	HARDENING AND CARBONIZING	LUMBER AND PACK'G MAT'L	MATERIAL PURCHASED FINISHED
		AMOUNT BROUGHT FORWARD									
00	1/3	Jones Longhlyn Steel Co	10 00 00				1000 00				
01	1/3	General Electric Co	75 22								
02	1/3	General Mach Supply Co	122 36								
03	1/5	Cochran Field Co	892 39								
04	1/5	Bray Bee Cadet Co	29 30								
05	1/6	Rockford Milling Mach Co	1529 25								
06	1/7	Pay Roll	1592259								
07	1/8	Wis & Oak Lumber Co	683 00							683 00	
08	1/9	New Departure Bearing	1391 00								1391 00
09	1/10	Dyer Forge	927 50			927 50					
10	1/10	Steel Supply Co	13 50				13 50				
11	1/11	Chem Supply Co	923 00						923 00		
12	1/12	City Metal Co	79 30								
13	1/12	Ry Goods Rec	1295 13								
14	1/13	International Cook Co	72 50								
15	1/16	A J Spanlding	19 00								
16	1/16	Acme Mach Co	931 00								
17	1/17	Edison Electric Light Co	1137 25								
18	1/18	James Smith	1529 30								
19	1/18	American Machinist	5 00								
20	1/19	Gurley-American Cleaning Co	29 00								
21	1/20	C Foote	250 00								
22	1/21	Motor Service Co	19 20								
23	1/26	General Hardware Supply Co	49 20								
24	1/27	Sunt Machine Co	157 20								
25	1/25	B & C Co	175 00								
26											
27											
28											
29											
30											
31											
		AMOUNT FORWARDED									
		TOTAL	27008 27			927 50	1013 50		923 00	683 00	1391 00

SUMMARY FOR LEDGER POSTING

	Dr.	Cr.
Ledger Accounts		
Accounts Payable		27008 27
Castings & Forgings	927 50	
Bar Stock	1013 50	
Iron & Steel		
Hardening & Carbonizing	923 00	
Lumber & Pack. Mat'l	683 00	
Material Purchased Finished	1391 00	
Fuel	892 39	
General Stores	174 55	
Pay Roll	15922 59	
Mfg Expense	1824 63	
Selling Expense	29 30	
Machinery	1539 25	
Bldg Maintenance	1529 30	
Goods Finished in Stores	1317 20	
TOTAL	27008 27	27008 27

FIG. 56. CHARGE REGISTER SAMPLE SHEETS (FIRST HALF)

But good sense must govern the executive in his attempts along these lines—for instance, it is conceivably possible to allocate all power costs directly to the product turned out. Intricate calculations could be made, showing the number of horsepower hours required to turn the crankshaft in a lathe. The calculations getting all the time more and more intricate, could be carried back through the transmission system to the coal pile, taking into consideration the exact amount of lubricating oil, wear and tear on belting, and so on, caused by turning that particular crankshaft. Of course, it would be ridiculous on the face of it, to attempt such calculations. So to avoid excessive clerical expense, and avoid making ourselves ridiculous, we are satisfied to allocate power costs to the controlling section. We find out what the total cost of generating and transmitting power is; we then determine how much power each section or department uses and spread that charge over the production of that department. The detailed method of handling this subject of power will be discussed in another article. I am simply mentioning it to drive home the fact that while as a general rule we want to get as many items as possible out of expense and into the product direct, we still are governed by the rule that the result must be worth the effort, which it would not be if we were to follow the theoretically possible methods of getting the charge for coal directly into the product.

It has probably occurred to most readers while we have been discussing the nature of overhead expense, that all of the elements of overhead are not the same. For instance, the salary of the automatic machine department foreman can properly be spread over all of the production of the automatic machines. The oil and cutting compounds used for these machines are also properly chargeable to them, and to nothing else. It probably would not occur to anyone to charge any part of the salary of the automatic department foreman into the overhead of the foundry. But there are items of expense, which cannot be put directly into the overhead of any productive department. The superintendent's time, for instance, is taken up with supervision of both of these departments. He also probably gives some attention to the efficient operation of the power house. Therefore each of these departments should bear a part of this item of expense. How his salary is divided among the various departments will be discussed later. It is evident, however, that we can divide expense in two ways not previously noted. Some of it, in other words, is expense directly chargeable to a productive department, as is the case with the salary of the foreman of the automatic department. Other items of overhead, while not having a direct connection with the productive departments, are nevertheless necessary to the best functioning of the plant as a whole. Thus we consider power, for instance, as a contributory department, while the automatic machines would be the productive department.

Earlier in this article it was noted that the elements which go to make up the cost of the product may either be actual cash expense or merely book entries. We thus find that expense is of three general sorts—

CHARGE REGISTER

FUEL	GENERAL STORES	PAY ROLL	MANUFACTURING EXPENSE AMOUNT	DEP	DESCRIPTION	SELLING EXPENSE	SUNDRIES DEBIT	DESCRIPTION	CREDIT	No
			75 25	Power	Gas Burning					00
	7 25 38									01
8 92 39										02
					Trade Paper Advertising	29 30				03
							1 539 38	Machinery		04
		1 59 22 59								05
										06
										07
										08
										09
										10
										11
			99 30	Boiler	Water					12
			1 25 13	Office	Bill Heads					13
			72 50	G.F.	Time Cards					14
			12 00	G.F.	Belts + Belting					15
			931 00		Repairs to Machinery					16
			137 25	All	Lighting					17
							1 525 30	Bldg Insurance		18
			5 00	G.F.	Subscriptions					19
			25 00	G.F.	Cleaning Windows					20
			250 00	Office	Legal Services					21
			19 20	Office	Repairs to Trucks					22
	49 20									23
							1 57 20	Goodwill Purchased		24
			75 00	Boiler	Cleaning Tubes					25
										26
										27
										28
										29
										30
										31
8 92 39	1 74 58	1 59 22 59	1 82 96 63			29 30	3 22 1 78			

FIG. 56. CHARGE REGISTER SAMPLE SHEETS (SECOND H \LF)

1. The charges to the productive manufacturing departments which arise in those parts of the factory that actually work upon the product of the plant. These expense items are, however, of such a character that they cannot be charged directly into a particular product. They consist of such items as supplies, non-productive labor, foreman's salaries, etc. These charges vary roughly with the activity of the plant and are therefore sometimes referred to as controllable expense. In other words, if the plant were shut down or its activity greatly curtailed, there would be a corresponding falling off in the amount of these charges unless it happened to be the policy of the company to maintain all or a skeleton of its organization in bad times.

2. The charges against the contributory departments also vary, but not so closely with the activity of the plant. These charges are for the benefit of the factory as a whole. Chief among them are the executives' salaries, superintendents' salaries, office expense, heat, light and power, the upkeep of the stockroom, the receiving room, the shipping room, etc.

3. The fixed charges, so-called because they go on regardless of the activity of the plant and normally do not vary much from year to year unless considerable additions are made to the plant or the equipment. They are spread over the entire plant and consist of such items as rent, insurance, taxes, depreciation, etc. Obviously some of these items will appear or not, depending upon whether the plant is rented or owned.

Numerically, by far the greater number of the elements of cost which must ultimately get into the cost of the finished product, are the actual expenditures. Money is actually paid out for all materials, supplies, labor and all of the expense of overhead items except depreciation. Depreciation is calculated from what is known as a fixed charge sheet. The method of determining these charges will be described in the next article.

The Charge Register

However, it is necessary for us to have some routine by which we will be assured that all actual disbursements will find their way into the costs. For this purpose we shall use the charge register shown in Fig. 56. This form is a rather modern development in bookkeeping which greatly simplifies both the bookkeeping and the cost accounting. The form is ruled to conform with the four principal elements of cost, namely—materials, and supplies; labor; factory expense; and selling expense. The exact form of the register will, of course, depend upon the nature, extent and needs of the business. Sometimes the executive who becomes over-enthusiastic on costs, tries to minutely subdivide the headings of the charge register. I recall one man of the sort who insisted that his charge register be designed to permit a distribution among 130 accounts. This necessitated a most unwieldly book, and with all the subdivisions, was no more valuable than one with the four principal headings given above and shown in the figure. Such a book as this need have a page no more than 24 in. wide. The complex manufacturing business cannot possibly devise a charge register sufficiently subdivided to hold all the details which are needed by the cost department.

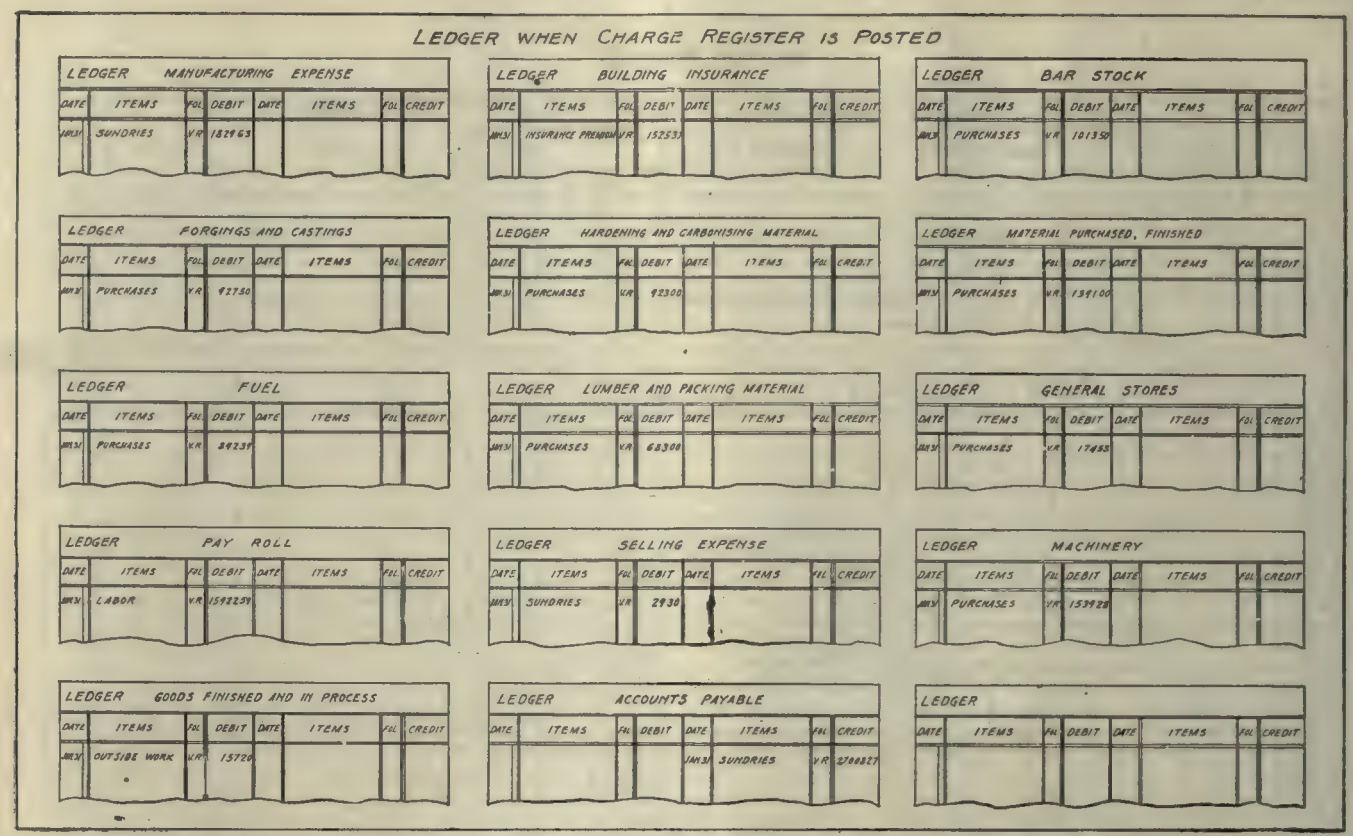


FIG. 57. SAMPLE LEDGER PAGES AFTER CHARGE RECORD ITEMS HAVE BEEN POSTED

In fact, I prefer to consider the charge register as a controlling account with broad subdivisions, and spaces left so that each item under these broad divisions can be described. In this way it is possible to analyze the items so that they will get accurately and safely to their ultimate destination. There are a great many machine shops whose conditions are such that 500 columns on a charge register would not suffice, but the four broad classifications will do.

The function of the charge register is thus seen to be that of a narrow channel through which all disbursements must pass. Because the channel is narrow, giving a close view of each item, it is possible to segregate them among the principal controlling accounts of the business, which is all that is needed at this point. In later articles we shall trace the entries on the charge register which we have reproduced, through the various steps that they take en route to their final resting place in the cost of the finished product.

The items shown on this page from the charge register are by no means all that would be entered in the course of a month in even a small business. They are meant to be typical only. All are self explanatory, I think, except perhaps that one on line 24, from the Sun Machine Co., for $154.25, an invoice for work which the Sun Machine Co. did on the product to relieve a congestion in the shop. The charge will become part of the direct cost of the part in question. The item is therefore charged directly through the charge register to the goods finished and in process account.

At the end of the month the columns of the charge register are footed and a summary is prepared such as is shown at the bottom of the charge register. As columns are maintained for each ledger account, with the exception of the general ledger debit column, no analysis of the various columns has to be made, with the exception of the general column. This should be analyzed and the amount debited to each account accumulated and shown separately in a summary, as is indicated on that which we have herewith attached.

Fig. 57 shows the various ledger pages of the general books after the items on the charge register have been grouped and posted. This is the first point at which the cost system "hooks up with the general books."

It has been my aim, in this article, merely to make clear the fundamental principles governing cost accounting. The ones I have discussed are those where executives most often go astray. It is my belief that if an executive once gets a clear grasp of these fundamentals the minor intricacies will present no difficulties.

Cost systems are seldom inaccurate because of the routine and forms used. The inaccuracies come from fundamental errors; often due to considering the subject from an accounting standpoint rather than as a manufacturing problem.

The devising of a cost system presents a series of manufacturing problems, each of which must be solved in the light of the needs and conditions of the particular business. Designing a cost system is entirely comparable to designing a bridge. There is no standard bridge which can be thrown across all streams. The nature of the ground on which the foundations will rest must be studied and the problems presented by quicksand or rock solved.

The amount and nature of the load to be carried must also be known, as a bridge is designed especially to support those loads.

In the same way, the peculiarities of the product, of plant layout and even of the personnel must be considered in designing the best cost system for any plant.

Duralumin*

It has been said that the steel age in which we have lived for the last generation will be followed by the aluminum age. Recent developments in aluminum alloys seem to indicate that the transition from steel to aluminum may possibly be at hand. Among the most important is "duralumin," which has been used in airship and airplane construction by the Germans. We offer here a translation of an article describing its composition and properties.

THE use of duralumin in the construction of aircraft renders an account of the properties of this material desirable especially with reference to its working qualities as developed by experience.

Duralumin is made in various compositions and has, with the exception of small quantities of impurities, the following composition:

	Per Cent
Aluminum	95.5 to 93.2
Magnesium	0.5
Copper	3.5 to 5.5
Manganese	0.5 to 0.8

Lead, tin and zinc which, as is well known, have an unfavorable influence upon the permanence of aluminum alloys are not found in duralumin. The specific gravity of duralumin varies according to composition and hardness from 2.75 to 2.84. The melting point is about 650 deg. C. (1,202 deg. F.).

Like other metals, duralumin can be rolled into plates and shapes and behaves in a similar manner, in that the elongation decreases as the hardness of rolling increases. Tube blanks, however, can be made only by pressing and not by the oblique rolling method.

*From a translation by Starr Truscott of an article appearing in the *Technische Berichte*, Vol. III, Sec. 6. The translation has been published by the National Advisory Committee for Aeronautics as one of its Technical Notes. Mr. Truscott, who is a member of the Society, is an aeronautic engineer in the Bureau of Construction and Repair, Navy Department, Washington. We are indebted to the Society of Automotive Engineers for the cuts.



FIG. 1. EFFECT OF COLD ROLLING ON A DURALUMIN PLATE

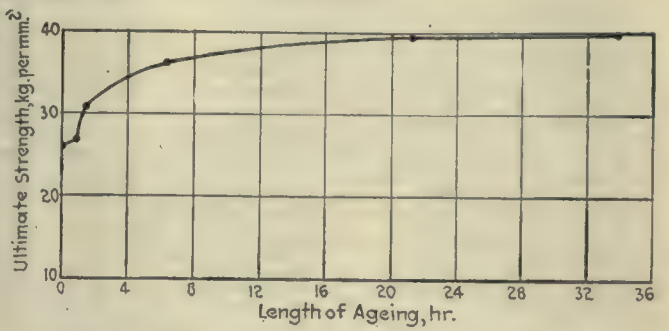


FIG. 2. INCREASE OF STRENGTH DURING AGEING

Fig. 1 shows the increase in tensile strength and decrease in elongation of a duralumin plate as its thickness is reduced by cold rolling from 7 to 2 mm. The strength increases from 41 to about 54 kg. per square millimeter, while the elongation falls from 22.7 to 2.3 per cent. The curve shows that the elongation decreases very rapidly with the very first reduction in thickness. However, duralumin can be worked hot at a temperature of about 400 deg. C. (752 deg. F.) very well.

Duralumin can be tempered, like steel, by heating and suddenly cooling. For this purpose plates, tubes, and shapes are heated to between 480 to 510 deg. C. (896 and 950 deg. F.) and quenched, then aged; that is, the treated material is simply set aside. The original strength characteristics are very nearly restored after the quenching but the tensile strength continues to grow with the time of ageing, from 35 to 50 kg. per square millimeter. The elongation does not decrease but remains at least the same and usually increases slightly. In practice the greatest strength is reached after about five days of ageing.

When heated to over 530 deg. C. (986 deg. F.) duralumin becomes unusable. Consequently the treating is carried on in a bath of nitrates whose temperature can be carefully regulated and watched. During the ageing of the metal work cannot be done on it which would change the section, as in that case the strength will not increase further. After the completion of ageing, the material can be rerolled to obtain smooth surfaces. The strength is thereby increased at the expense of elongation.

Fig. 2 shows the increase of strength during ageing. The tensile strengths were determined by the Ericson test with 0.385 as a coefficient. This value was obtained

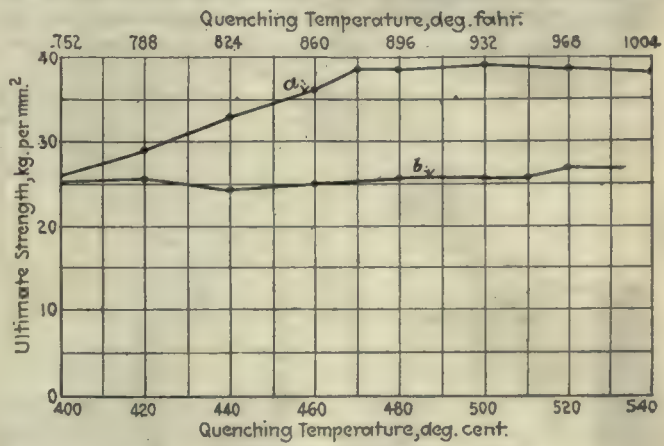


FIG. 3. QUENCHING TEMPERATURE—STRENGTH CURVES

TABLE I. STRENGTH FIGURES OF DURALUMIN COMPOSITIONS

Symbol for Composition	Condition	Method of Preparing	Elastic Limit, Kg. per Sq.Mm.	Tensile Strength, Kg. per Sq.Mm.	Elongation, per Cent	Modulus of Elasticity, Kg. per Sq.Cm.	Sections Available
681b½	Tempered only	Tempered	24 to 26	38 to 40	20	About 500,000	Tubes, plates, strips, bars and shapes.
	½ hard	Tempered and cold rolled	30	40 to 42	16 to 14	500,000	Tubes, plates, strips and bars.
681a	Tempered only	Tempered	25 to 27	38 to 40	20 to 18	600,000	Tubes, plates strips, bars and shapes.
	Hard	Tempered and cold rolled	30 to 32	44 to 46	11 to 10		
681h	Tempered only	Tempered	26 to 28	38 to 42	18 to 15	600,000	Tubes, plates, strips and bars.
	Hard	Tempered and cold rolled	32 to 34	45 to 48	11 to 10		
N	Tempered only	Forged rivets are tempered	20	32 to 34	18 to 14	Shear strength up to 6-mm. diameter 25 kg. per sq.mm.	Finished rivets.

from the experiments described below. Experiments have been made (see Fig. 3) by the Durener-Metallwerke to determine the most favorable quenching temperature. The curve *a* shows the variation in the strength of duralumin which had been aged for four days with the variation of quenching temperature. Curve *b* shows the strength immediately after the quenching. The strengths were determined in both cases by the Ericson test. As the material may warp in tempering it is not good practice to temper riveted parts. Such parts should be tempered before they are riveted.

Strength Properties

Duralumin is delivered in various compositions which have different properties according to the purpose for which it is intended to be used. It is therefore important that the concern supplying the material should be informed regarding the nature of the working proposed. In Table I below are assembled the strength figures of some duralumin compositions made by the Durener-Metallwerke.

The modulus of elasticity of the hard composition 681a was found by the Technischen Hochschule Aachen to be 700,000 kg. per square centimeter. Making allowance for the possible effect of vibration on the modulus of elasticity it appears better to use not more than 650,000 kg. per square centimeter in computations.

In judging as to the suitability of a material for use in stressed parts not only the tensile strength but also the ductility is of great importance. This can be determined by bending strips backward and forward through 180 deg. over a definite radius, usually 5 to 10 mm., the number of bends before fracture being taken as a measure. Other conclusions as to the ductility can be obtained from the Ericson test (see Fig. 4). The plate to be tested is pressed through a ring, *b*, by a head, *a*, until a tear shows on the upper surface of the sheet. The depth of the impression is then a measure of the ductility.

In Table II there are compared strength values, numbers of bends over 5-mm. radius and through 180 deg., and depths of impression as observed on Bergmetall and steel plates of equal thicknesses. Although the strength values of the latter are less than those of the duralumin plates, nevertheless one can compare the figures as to number of bends and depths of impression without correction, since it is possible to obtain steel plate with a higher strength which also possesses great ductility.

The number of bends (see curves at the left of Fig. 5) for both metals decreases with increased thickness. For steel, however, they lie considerably higher than for duralumin. The difference is least for plates under 0.5 mm. in thickness. For thicker plates of duralumin

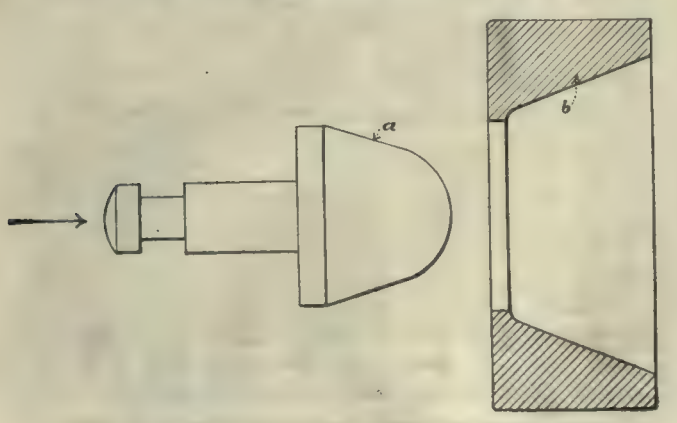


FIG. 4. APPARATUS FOR THE ERICSON TEST

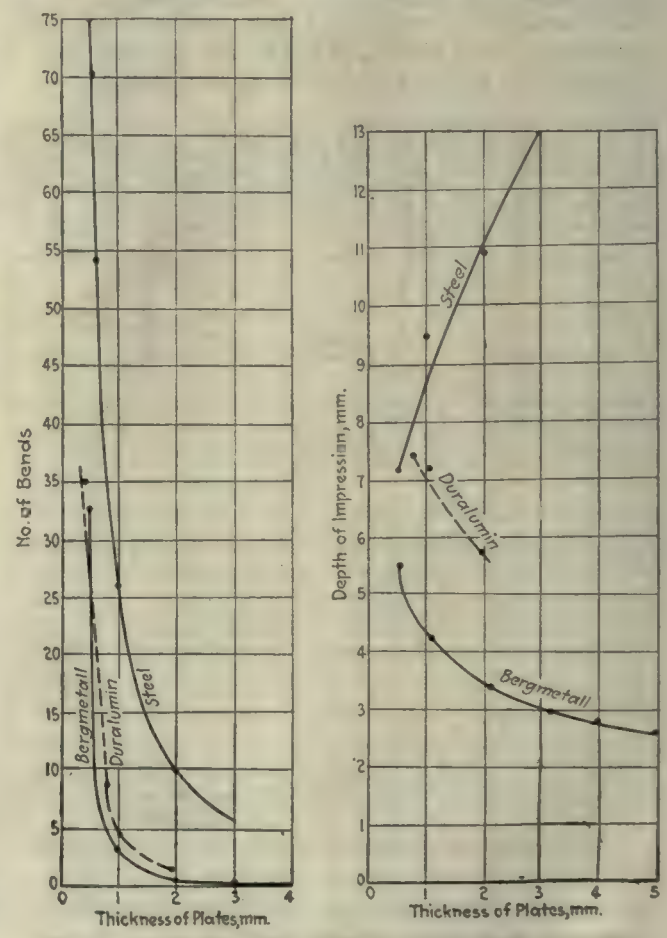


FIG. 5. FATIGUE AND INDENTATION TEST CURVES

TABLE II. COMPARISON OF STEEL AND BERGMETALL

Steel					Bergmetall			
Thickness of Plate, Mm.	Strength, Kg. per Sq.Mm.	Elongation, per Cent	No. of Bends	Depth of Impression, Mm.	Strength, Kg. per Sq.Mm.	Elongation, per Cent	No. of Bends	Depth of Impression, Mm.
0.5	36	10.5	76	7.2	47	10.5	33	5.5
1.0	34	15.3	26	95.0	47	11.0	3	4.2
2.0	39	12.0	10	10.9	45	11.0	Fractured at 90 deg.	3.4
3.0	40	17.7	6	13.0	48	14.1	Fractured at 60 deg.	3.0
4.0	..	..	..	..	48	9.7	Fractured at 45 deg.	2.8

the number of bends decreases very rapidly. A plate 2 mm. thick breaks over a 90-deg bend; a plate 4 mm. thick over a 45-deg. bend. From these results duralumin might be referred to as "cold short" for thicknesses greater than 1 mm. This property makes it unsuitable for highly stressed parts which must at the same time withstand vibrations. This is of prime importance in connection with the bent lug plates which are ordinarily used in aircraft for taking wire terminals. In these lugs vibrations undoubtedly occur during flight which would reduce the strength of the duralumin and might cause sudden fracture. Exactly how vibrations influence the modulus of elasticity has not yet been determined, although experiments along this line are already under way.

A comparison of the depth of impression of steel and duralumin from the curves at the right of Fig. 5 shows that for steel the depth of impression increases with the thickness of the material, while for duralumin it decreases. As a result of a peculiarity of the testing machine used the greatest stress occurred at a point which was from 5 to 6 mm. from the vertex of the depression. In this locality the material began to flow before cracking. It is obvious that thick plates of ductile material may be stretched more easily on the upper surfaces and consequently deeper impressions obtained than with thin plates, since for thick plates more material can flow before fracture occurs. A similar course of reasoning can be used to explain the decrease of the depth of the impression with an increasing thickness of plate in the case of material of less ductility. On the upper surface of the test-pieces there occur high tensile stresses at the point mentioned, which increase with the strength of the plate. As the material flows only to a small degree, cracks very soon appear and extend into the interior. The process described can be followed on the sections of a steel plate of about 40 kg. per square millimeter strength and a duralumin plate, shown at the left of Fig. 6. The flow before fracture of the steel plate is plainly recognizable while the duralumin plate shows hardly a sign of it. The right half of this illustration shows

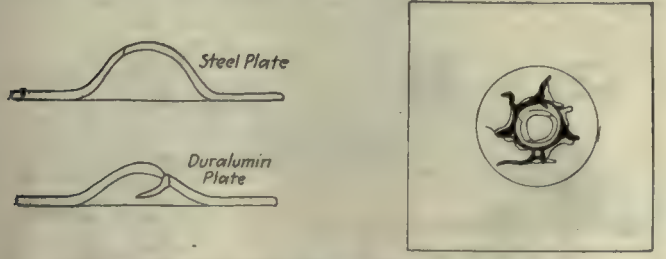


FIG. 6. RESULT OF INDENTATION TO FAILURE

TABLE III. INFLUENCE OF COLD ON THE STRENGTH OF DURALUMIN

Testing Temperature, Deg.C.	Testing Temperature, Deg. F.	The Bar Was Tested in	Limit of Stretch and Strain	Tensile Tests Ultimate Strength, Kg. per Sq.Mm.	Elongation, per Cent	Impact Test, Work of Breaking, Kg. per Sq.Mm.
+ 20	+ 68	Air	24.0	42.5	21.9	2.6
0	+ 32	Snow	23.6	43.0	21.8	2.6
— 20	— 4	Mixture of snow and table salt	24.0	43.7	23.1	2.7
— 40	— 40	Mixture of snow and calcium chloride	24.0	44.0	22.1	2.7
— 80	—112	CO_2 snow	25.2	44.4	22.7	2.7
—190	—310	Liquid air	32.3	53.7	28.7	2.6
+ 20	+ 68	Air	23.0	42.3	23.3	2.6

the appearance of a test sample of strong duralumin plate after fracture in which the material suddenly split in all directions. For flanging and pressing tempered duralumin is consequently suitable only in the thin gages.

Influence of Heat and Cold

Heat has an important influence on the strength of duralumin. According to the results obtained in tests by the Central Bureau for Scientific Investigation, Neubabelsberg, when heated the strength decreases 10 per cent for an increase in temperature of 100 deg. C. (212 deg. F.) and about 20 per cent for an increase of 150 deg. C. (302 deg. F.) (see Fig. 7). The loss in strength increases with the increase of temperature. The elongation increases on first heating to a hardly appreciable extent, while between 150 to 200 deg. C. (302 and 392 deg. F.) it decreases. At 250 deg. C. (482 deg. F.) the elongation becomes the same as at room temperature. With further heating the elongation increases with a rising temperature. Consequently wherever duralumin is exposed to heat the possible decrease of strength must always be considered.

As opposed to this the influence of cooling on the strength properties is less unfavorable. The Central Bureau for Scientific Investigation has made tests on this also (see Table III). The strength and elongation increase somewhat with the decrease in temperature. The work represented by the blow in the impact tests is not decreased when material is affected by cold so that one can safely assume that the cold encountered in flight has no unfavorable influence on duralumin.

Experiments on the influence of weathering on the strength of duralumin, which have been carried on by the Durener-Metallwerke for three years, have shown that no observable decrease in the strength properties can be noticed (see Table IV).

The Durener-Metallwerke has also carried on for about a year experiments on the influence of the elec-

TABLE IV. EFFECT OF WEATHERING ON THE STRENGTH OF DURALUMIN

	Dec., 1909		Nov., 1910		Nov., 1911		Dec., 1912	
Testing Data Alloy 681a	Strength, Kg. per Sq.Mm.	Elongation, per Cent	Strength, Kg. per Sq.Mm.	Elongation, per Cent	Strength, Kg. per Sq.Mm.	Elongation, per Cent	Strength, Kg. per Sq.Mm.	Elongation, per Cent
Round Bar.....	41.7	20.0	42.2	21.0	42.0	21.1	42.9	18.3
Bar (thick).....	39.1	20.0	38.7	19.6	39.3	18.9	40.0	20.0
Bar (thin).....	42.0	20.0	39.1	18.0	39.3	18.0	42.3	16.5
Wire (thick).....	48.0	20.1	45.0	20.1	44.3	19.7	44.5	19.8
Wire (thin).....	46.3	20.0	44.0	19.6	42.5	18.7	43.2	18.5

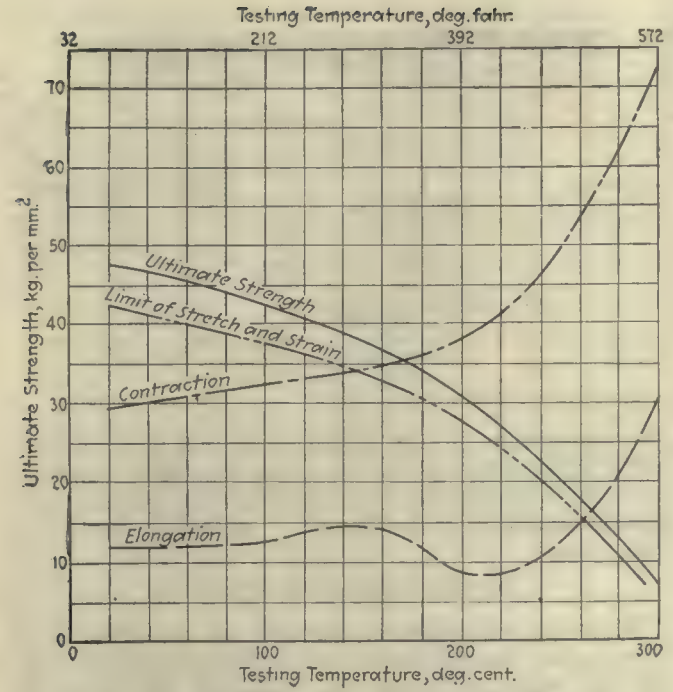


FIG. 7. EFFECT OF HEATING DURALUMIN

trolytic effect from junctions of duralumin with iron or steel. These were made by riveting duralumin bars to iron plates and then placing them in artificial sea water. There resulted only an insignificant destruction of the iron and a reduction in weight of the bars of about 0.23 per cent so that no considerations exist against the use of duralumin and iron junctions in aircraft.

Conclusions

Duralumin has a strength of 35 to 40 kg. per square millimeter and an elongation of 10 to 15 per cent. The stretching strain limit lies very high, about 28 to 32 kg. per square meter. The modulus of elasticity is about 600,000 to 700,000 kg. per square centimeter. It is very brittle especially in thicknesses above 1 mm. and consequently sensitive to alternate bending to and fro.

Bent plate fittings, with bent lugs which must resist vibration, are best not made out of duralumin but of sheet steel. For stressed parts which while in flight are exposed to an increase in temperature of more than 100 deg. C. (212 deg. F.) the use of duralumin is objectionable unless a correspondingly smaller strength value is used in computations. Cold has no harmful influence on duralumin. The joint between iron and steel and duralumin can be made without electrolytic action occurring. Pieces, which for better working must be heated, must be in all cases retempered after completion.

A Centering Device for the Milling Machine

By R. H. Kasper

A large number of pieces were to be grooved through the center with a circular cutter on the milling machine. Accurate centering was essential. These pieces were found to vary slightly in width, making accurate centering an expensive job, owing to the time consumed in measuring. To overcome this difficulty, the device shown in Fig. 1 was designed, and gave such perfect satisfaction as to make its use almost a necessity.

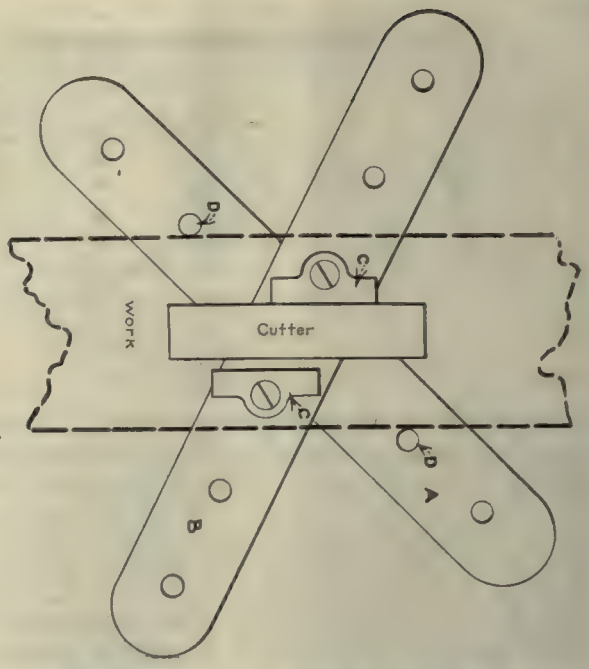


FIG. 1. DEVICE FOR CENTERING WORK ON THE MILLING MACHINE

This device consists of a bar *A* which carries another bar *B*, and this in turn carries the two swinging members *C*. The swinging members *C* are free to turn on their studs, while bar *B* is free to swing on its stud in the center. Bar *A* carries two pins *D* which are screwed into holes equally distanced on both sides of the center. Bar *B* is likewise provided with screw holes for the studs carrying the swinging members *C*. The working faces of the swinging members *C* are ground so that they will both be the same distance from the center of their respective studs.

The method of using the device is shown in Fig. 2. In this sketch, the cutter arbor and overhanging arm are omitted for the sake of clearness. The bar *A* is placed on the work so that the pins *D* bear against opposite sides of the work. Bar *B* is then swung around so that one or both swinging members *C* come in contact with the sides of the cutter. If both swinging members *C* touch the cutter, the cutter is central with the work. It will be seen that if one swinging member lies against the cutter while the other is free to swing, the cutter is not over the center of the work.

This device has also been found useful for setting work to cut grooves a specified distance off center. This is done by placing a plate in front of the working face of one swinging member. The thickness of the plate should equal twice the required distance. For example: If a plate $\frac{1}{8}$ in. thick is used, the cutter will be set $\frac{1}{16}$ in. off center.

This device not only speeds up production but it also eliminates the possibility of mistakes in measuring, which are bound to occur occasionally in large orders.

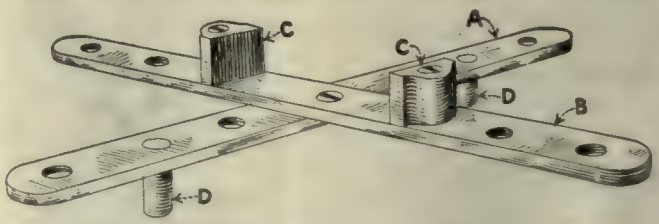
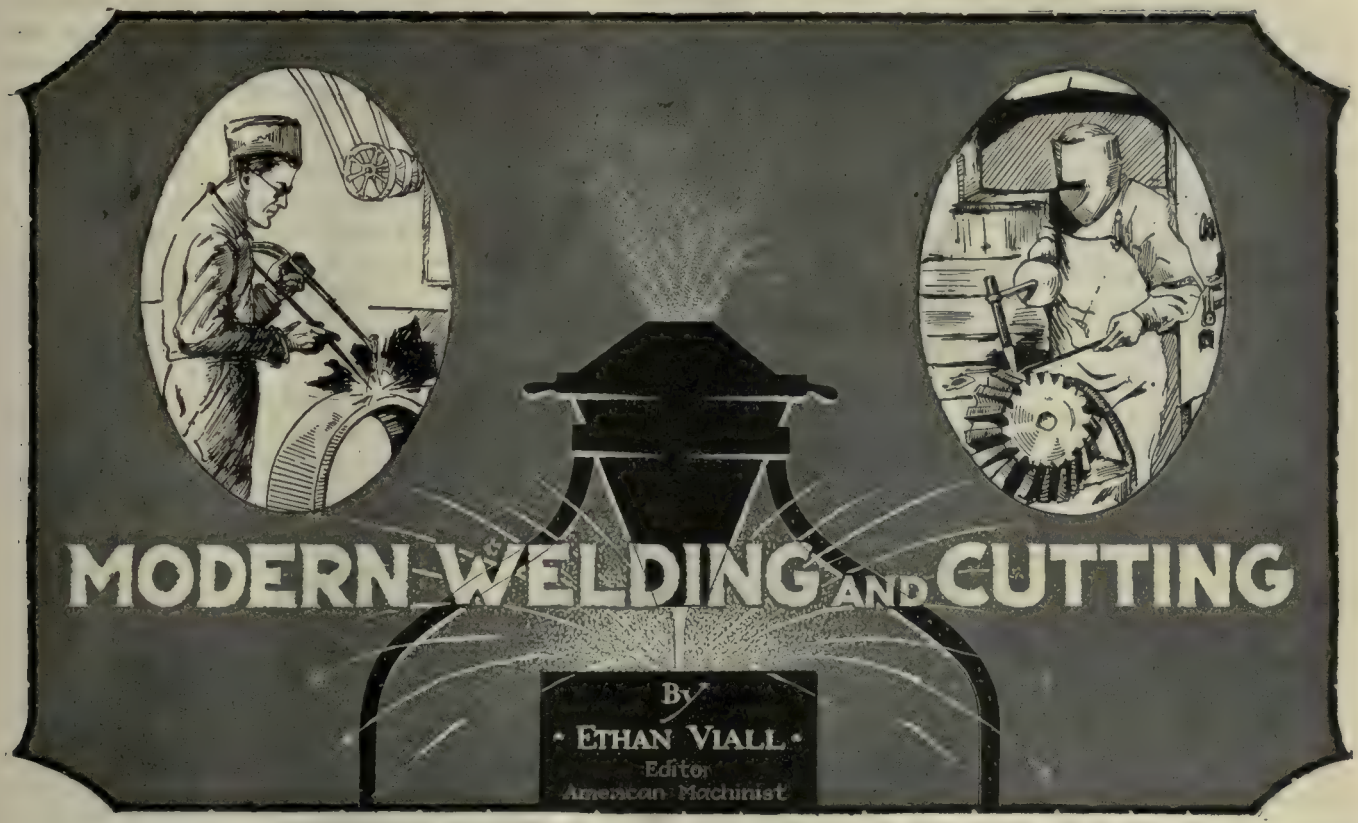


FIG. 2. METHOD OF USING THE DEVICE



Spot welding offers many opportunities to the maker of sheet metal, wire or other goods. It is also proving of great value in heavy steel construction work. This is the final article of the series; it deals principally with the various machines, although numerous examples of work are shown.

(Part XXX was published in last week's issue.)

XXXI. Spot Welding Machines and Work*

SPOT welding, as the name indicates, is simply welding in spots. Two or more overlapping metal plates or sheets may be welded together at intervals, by confining electric current to a small area of passage by means of suitable electrodes, or "dies" which are pressed against the metal from opposite sides. Spot welding is a form of resistance welding. Due to the way the metal is heated and forced together no oxidizing takes place, and in consequence no flux of any kind is needed.

While the process of spot welding is more commonly used at present for welding thin sheet iron, steel or brass articles, practical machines have been made for welding two pieces of ¾-in. ship plate together. Experimental machines have also been made capable of spot-welding three 1-in. plates together, and which can exert a pressure of 36 tons and have a current capacity of 100,000 amperes.

To weld soft cold-rolled steel in a satisfactory commercial manner, three conditions should be observed, if possible:

First, the surfaces to be welded should be free from rust, scale or dirt. If the work is not clean a higher secondary voltage will be required to penetrate through the scale or dirt of any given thickness of sheet. This means that a larger machine and more current must be used than would be required for clean stock of the same thickness.

Second, the sheets should be flat and in good contact at the spots to be welded, so that no great pressure is required to flatten down bulges or dents.

Third, the stock should not surround the lower horn, as in the case of welding the side seam of a can or pipe.

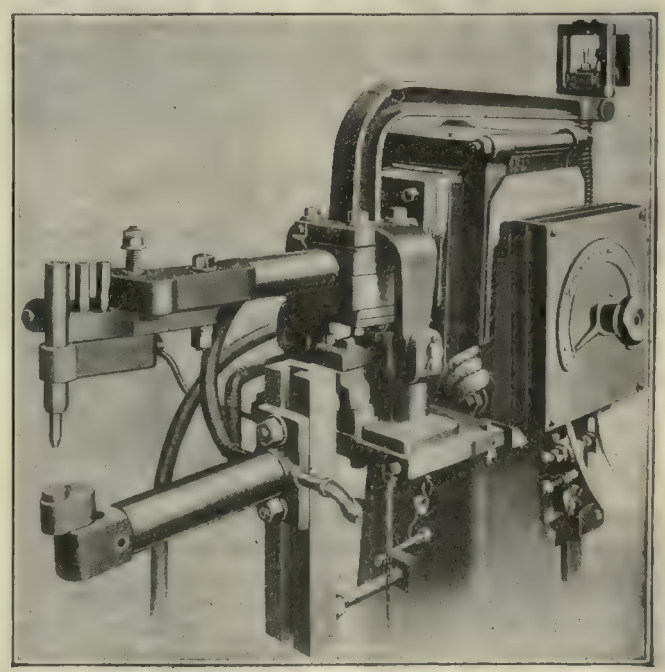


FIG. 391. TYPICAL CONSTRUCTION OF LIGHT SPOT-WELDING MACHINE

*For the author's forthcoming book "Welding and Cutting." All rights reserved.

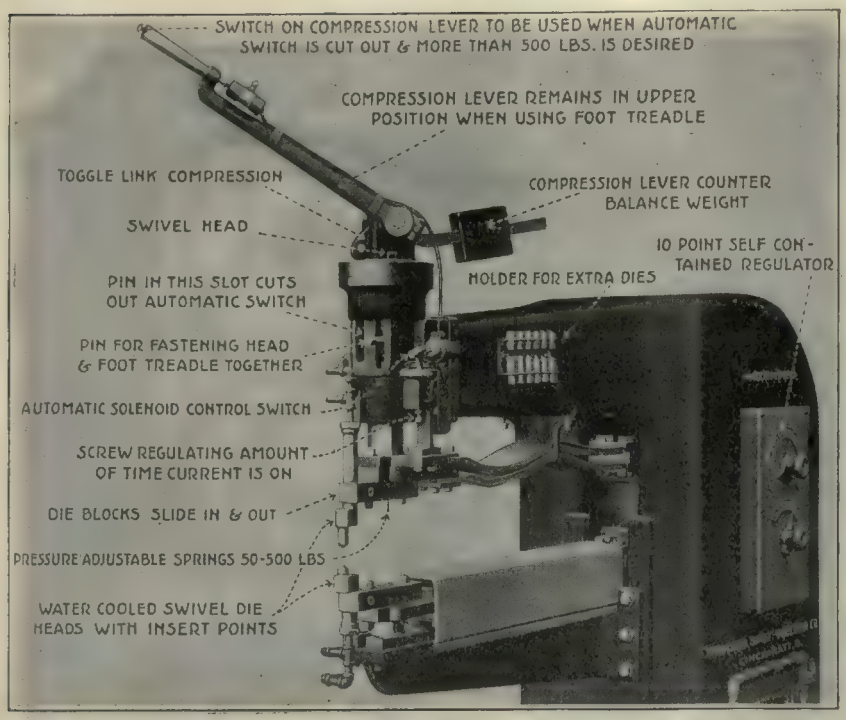


FIG. 392. SPOT-WELDING MACHINE FOR HEAVY WORK (PARTS NAMED)

It must not be understood that spot welding cannot be done except under the conditions outlined, for it can, but if the conditions named are not followed the cost of welding will be greater. However, it is often necessary to violate these conditions in actual manufacturing work. This is especially true of the third one. Where the lower horn must be surrounded by the work, as in welding can seams, the capacity of the machine is cut down because of the "induction effect" which tends to choke back the main current and in this way cuts down the heating effect at the die points. This so-called induction effect is only present when welding steel or iron, no such action being noticeable in welding brass.

Light gages of sheet metal can be welded to heavy gages or to solid bars of steel if the light-gage metal is not greater than the rated single sheet capacity of the machine. Soft steel and iron form the best welding material in sheet metals, although it is possible to weld sheet iron or steel to malleable-iron castings of a good quality.

Galvanized Iron Can Be Welded Successfully

Galvanized iron can also be welded successfully, although it takes a slightly longer time than clear iron or steel stock, in order to burn off the zinc coating before the weld can be made. Contrary to common opinion, the metal at the point of weld is not made susceptible to rust by this burning off of zinc, since by some electrochemical action it has been found that the spots directly under each die-point and also around the point of weld between the sheets, are covered with a thin coating of zinc oxide after the weld has taken place. This coating acts as a rust preventative to a very noticeable degree. On spot-welded articles used in practice for some time, such as galvanized road-culverts, refrigerator-racks and pans, rain-gutters, etc., it has been found that no trace of rust has appeared on the spot-welds from their exposure to ordinary atmospheric conditions. Extra light gages of galvanized iron below 28 B. & S. gage cannot be very successfully welded, due to the fact that so little of the iron is left after the zinc has been burnt off that the metal is very apt to burn through and leave a hole in the sheets.

Tinned sheet iron is ideal for welding, giving great strength at the weld, but the stock will be discolored over the area covered by the die-points. Sheet brass can be welded to brass or steel if it contains not more than 60 per cent copper. It is not practical to attempt to spot-weld any bronze or alloy containing a higher percentage of copper than this as the weld will be weak.

Another class of work that can be successfully handled on a spot-welding machine although it is not strictly spot welding, is the construction of wire-goods articles. This consists principally in "mash-welding" crossed wires. It may be done with the same copper die-points as are used for ordinary spot welding, except that the points are usually grooved to hold the wire in the required position. Among the common wire goods put together in this way are lamp-shade frames, oven racks, dish drainers, waste baskets, frames for floral make-ups and so on. Certain classes of butt-welding may also be done on a spot-welding machine by using special attachments.

Spot-welding machines are made in various sizes and designs to meet different requirements, but the general principle of action is the same in all. The illustration,

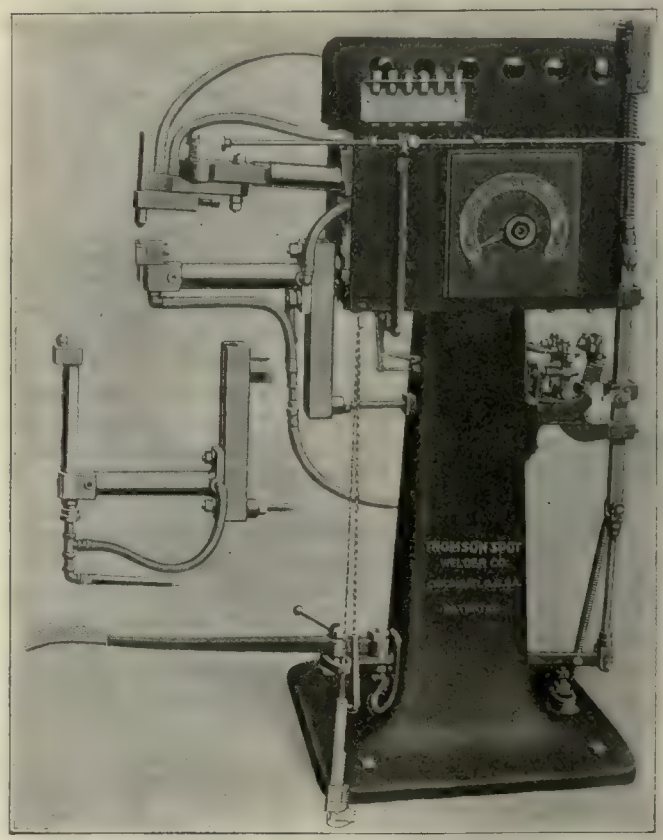


FIG. 393. THE THOMSON LIGHT MANUFACTURING TYPE SPOT-WELDING MACHINE

Fig. 391, shows a Thomson No. 124-A10 machine with the cover removed. This gives an idea of the principal mechanism of all this line of light spot-welding machines. Fig. 392 shows a typical head of one of their line of heavier machines. This type of machine is designed for heavy work on flat sheets or pieces, where considerable pressure is required to bring the parts together to be welded. To withstand heavy pressures, the lower horn is made of T-section cast iron and the current is conducted to the lower copper die-holder by flexible copper laminations, protected on all sizes having over 15-in. throat, by a brass cover, insulated on the inside from the copper by a coating of asbestos sheet.

The sliding head of the machine which carries the upper die-holder is a hollow steel plunger, sliding in a cast-iron head, which bolts to the body of the machine and on which are mounted the control-switches. The pressure is applied by a toggle-motion above the plunger, actuated both by a swiveled hand-lever on top of the head, which may be swung into any position through an arc of 260 deg., and a foot-treadle at the base, which also may be swung in an arc of 30 deg. This enables the operator to control the machine by hand or foot from any position around the front of the machine.

The current-control can be set to work automatically with the downward stroke of the upper die. In this case the pressure at the die-point is through an adjustable spring-cushion in the hollow cylinder-head. The current is automatically turned on after the die-points have come together on the work by further downward pressure of either lever. With the application of final pressure, to squeeze out any burnt metal as the weld is forced together, the current is automatically turned off. When working on pieces where more pressure is required to bring the parts together before welding than can be effected by the spring-cushion without turning on the current, it is possible to set a plug in the head of the machine so that direct connection is obtained from the hand-lever to the upper die-point while the foot-treadle still operates through the spring-cushion and with the automatic current-control. When it is desired to secure maximum pressure, the plug in the head can be set again so that both the hand-lever and the foot-treadle give direct connection to the die-point, the current being controlled by a push-button on the outer end of the hand-lever.

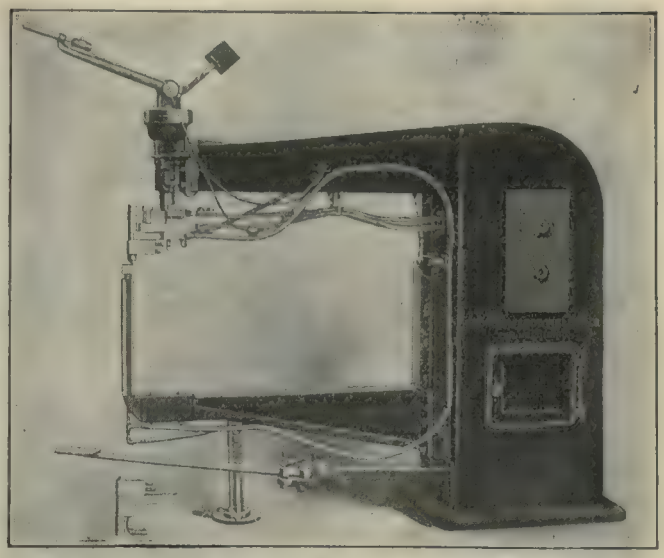


FIG. 395. A THOMSON HEAVY-DUTY SPOT-WELDING MACHINE

The regular line of spot-welding machines of different makes, operate on 110, 220, 440 and 550-volt, alternating current. A welding machine of this kind can only be connected to one phase of an a.c. circuit. The transformer must be made to furnish a large volume of current, at a low voltage, to the electrodes. For further transformer details, the reader is referred to the article on butt-welding.

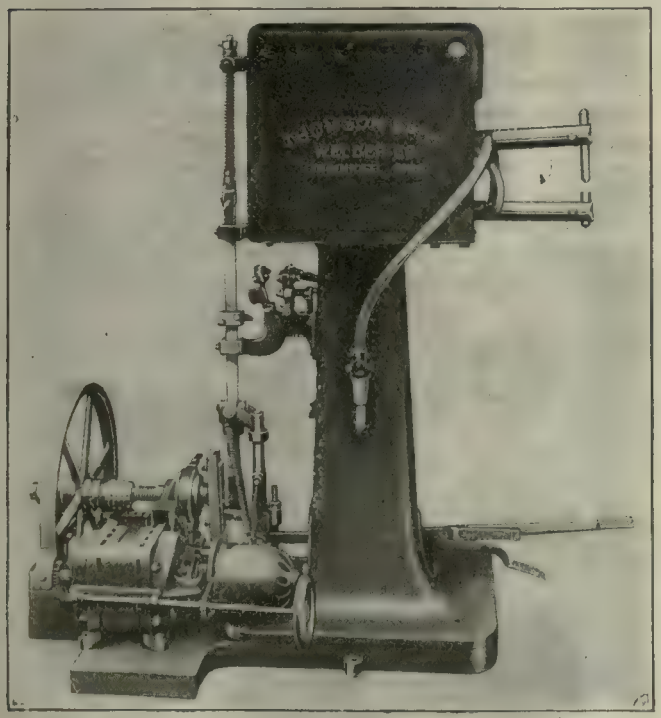


FIG. 394. THE THOMSON SEMI-AUTOMATIC TYPE SPOT-WELDING MACHINE

The Thomson Foot-, Automatic-, and Hand-Operated Machine

The machine shown in Fig. 393 is representative of the Thomson line of small, foot-operated spot-welding machines. These are intended for use on light stock where but little pressure is required. The die-holders are water cooled, and the lower horn bracket allows the horn to be adjusted up or down for the use of various kinds of holders. The automatic switch and adjustable throw-in stop are plainly shown at the back of the machine.

This model is made in several sizes. The first size will weld from 30 to 16 B. & S. gage galvanized iron or soft steel, or to 24 gage brass. It will mash-weld wire from 14 gage to $\frac{1}{4}$ in. in diameter. Its throat depth is 12 in.; the lower horn drop clearance is 9 in.; size is 22 x 45 x 51 in. high; net weight is 825 lb.; full load rating is 5 kw., or 8 kva. The largest machine of this particular series, will weld 26 to 7 gage, B. & S., galvanized iron or soft steel, or 18 gage brass; it will mash-weld 10-gage to $\frac{3}{8}$-in. diameter wire; has an 18-in. depth of throat; is 28 x 60 x 56 in. high; weighs 1,550 lb. and full load rating is 15 kw. or 25 kva.

On repetition work, where the operator has to work the foot-treadle in rapid succession for long periods, it is very tiresome. For such work, power-driven machines similar to the one shown in Fig. 394 are made.

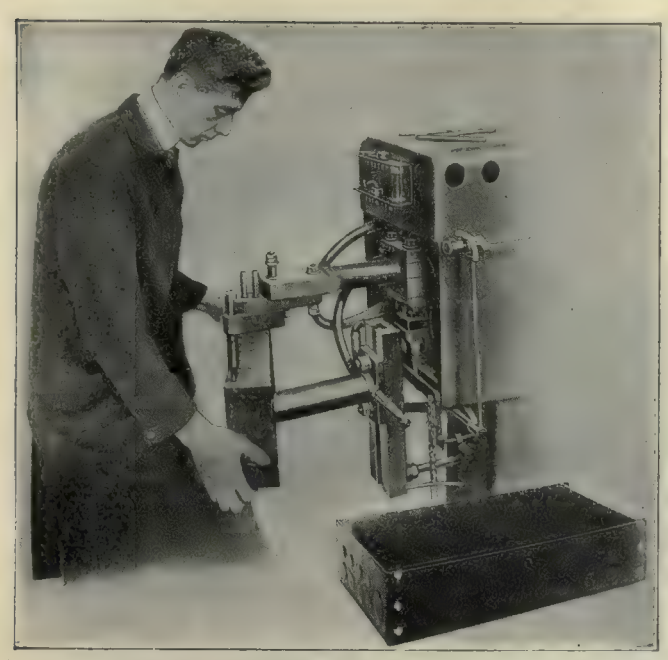


FIG. 396. SPOT-WELDING A SHEET STEEL BOX

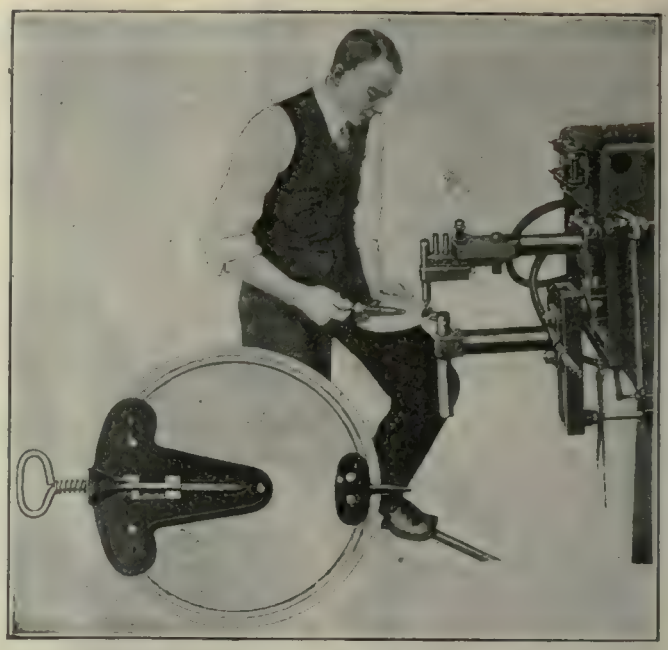


FIG. 399. WELDING STOVE PIPE DAMPERS

These machines are supplied either with individual motor drive or pulley drive, as desired. The control is effected through the small treadle shown. The regular foot-treadle is used while setting up dies, etc. If the operator desires to make but one stroke, he depresses the shorter treadle and immediately releases it, whereupon the machine performs one cycle of operation, automatically turning on the current, applying the pressure, turning off the current, and stopping. A ¼- to ½-hp. operating motor is used according to the size of the machine. Otherwise the capacity of the various sizes is the same as in the regular foot-operated machines. The lower horn and upper arm may be of either style illustrated.

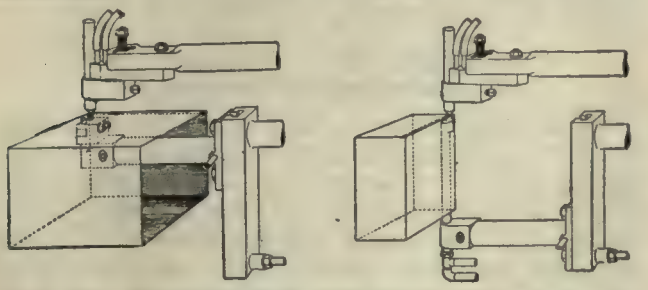


FIG. 397. SHOWING HOW THE HORN AND WELDING POINTS MAY BE SET



FIG. 398. WELDING SMALL HOE BLADES TO THE SHANKS

The machine shown in Fig. 395 is a hand-lever operated machine, although supplied with a foot-treadle which can be swung back out of the way when not needed. This machine is typical of the Thomson designs used for the heavier run of commercial work. On the various sizes, the capacity for spot-welding is from 22 B. & S. gage galvanized iron or steel up to No. 0 gage, or to 14 gage brass. Mash-welds may be made on from ⅛- to ⅝-in. diameter wire. The throat capacities run from 15 to 51 in. and the lower horn adjustment is from 12 to 24 in. The smallest size is 28 x 62 x 75 in. high and the largest size 28 x 98 x 75 in. high. The weights run from 2,335 to 3,225 and the full load ratings from 20 to 40 kw. or 35 to 67 kva. Various shaped horns, dies and other equipment is furnished to meet special demands.

Examples of Spot-Welding Work

In connection with the Thomson machines, the welding of the corners of a sheet-steel box is shown in Fig. 396. The illustrations in Fig. 397 show how the lower horn is raised for welding side seams and dropped for welding on the bottom of a box.

The welding of small hoe blades to the shanks, is shown in Fig. 398. These are welded at the rate of 840 per hour, the shanks being bent afterward. Stove-

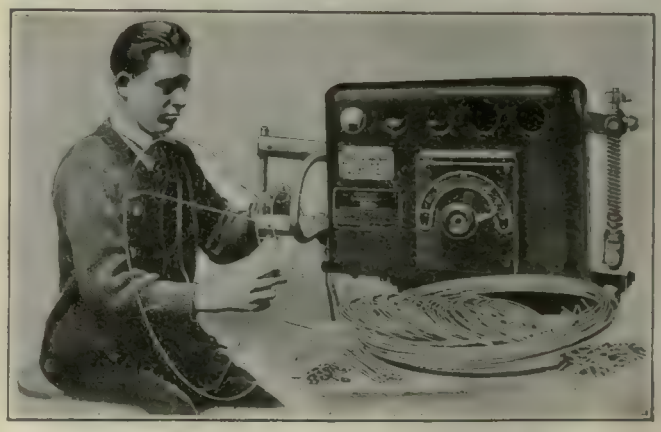


FIG. 400. MASH-WELDING LAMP SHADE FRAMES

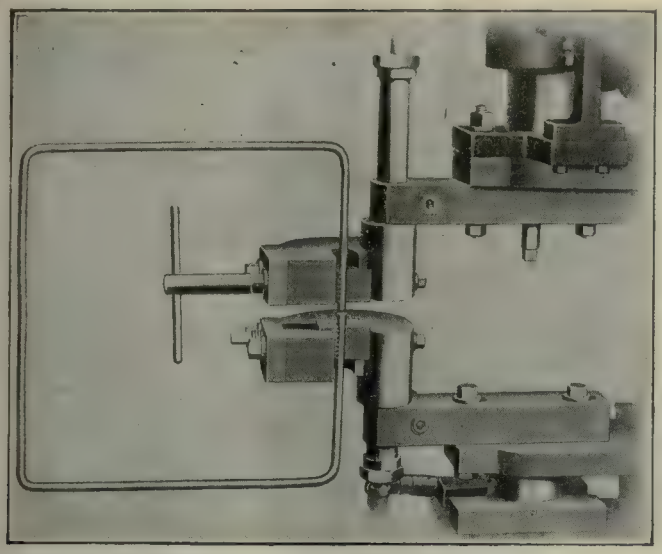


FIG. 401. BUTT-WELDING ATTACHMENT FOR A SPOT-WELDING MACHINE

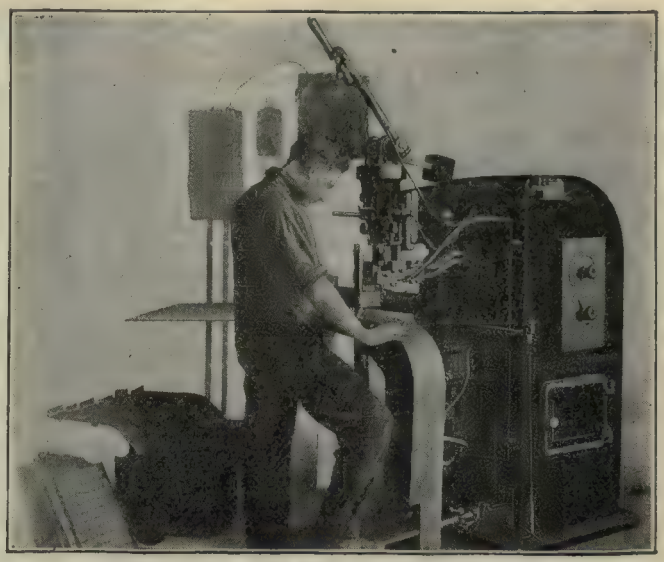


FIG. 403. WELDING 12-GAGE IRON FOR GUARDS

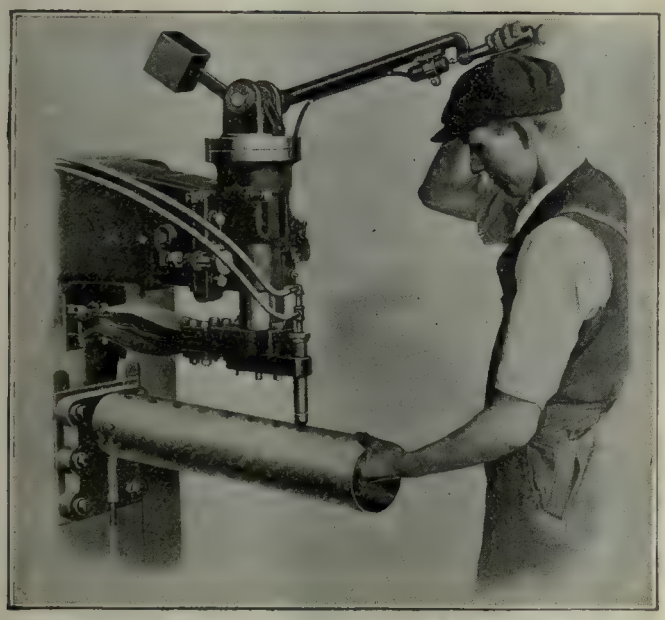


FIG. 402. WELDING GALVANIZED IRON PIPE

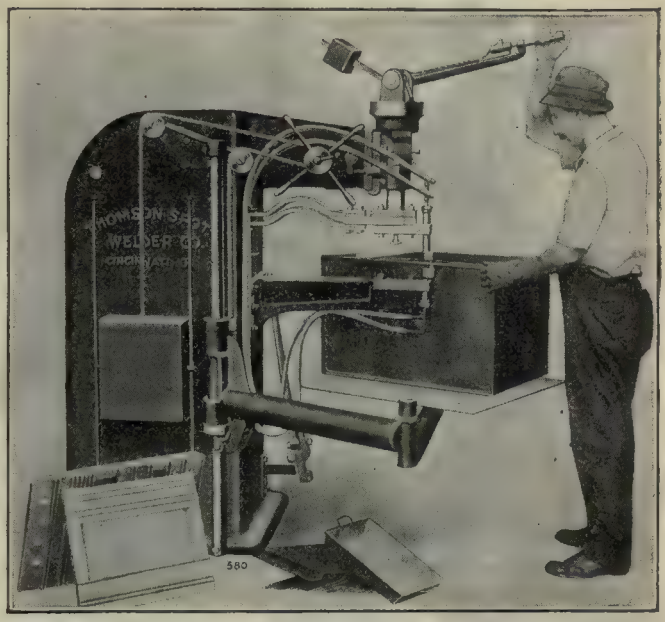


FIG. 404. WELDING STOVE PARTS

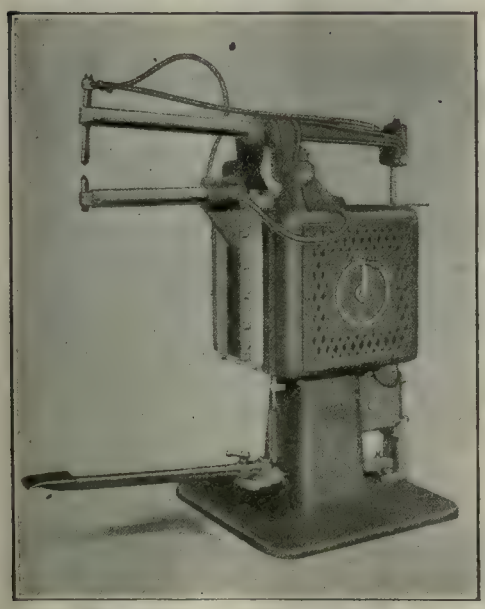


FIG. 405. WINFIELD SLIDING HORN SPOT-WELDING MACHINE

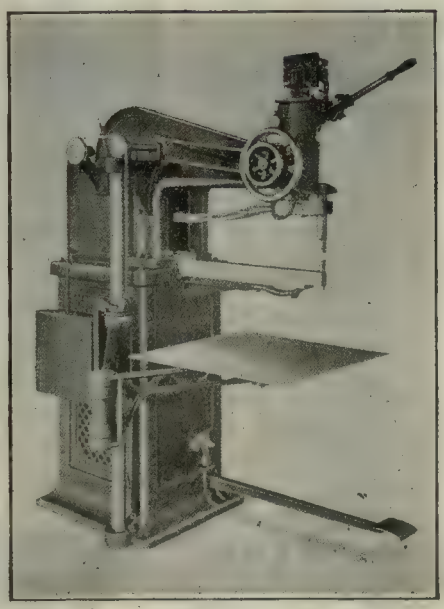


FIG. 406. WINFIELD HEAVY-DUTY MACHINE WITH ADJUSTABLE TABLE

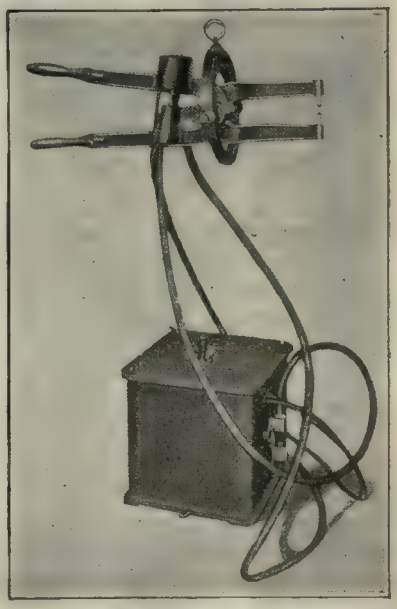


FIG. 407. WINFIELD PORTABLE SPOT-WELDING MACHINE

pipe dampers are welded as shown in Fig. 399, and wire lamp-shade frames are mash-welded as shown in Fig. 400. Ordinary wire and sheet-metal oven gratings or racks, with seven cross-wires welded to the end pieces, have been made at the rate of 100 racks per hour, or 1,400 mash-welds. On certain kinds of wire work, it is desirable to butt-weld, and for this purpose the attachment shown in Fig. 401 is used. In general, however, where any amount of this kind of work is to be done, it is better to employ a regular butt-welding machine of the small pedestal or bench type.

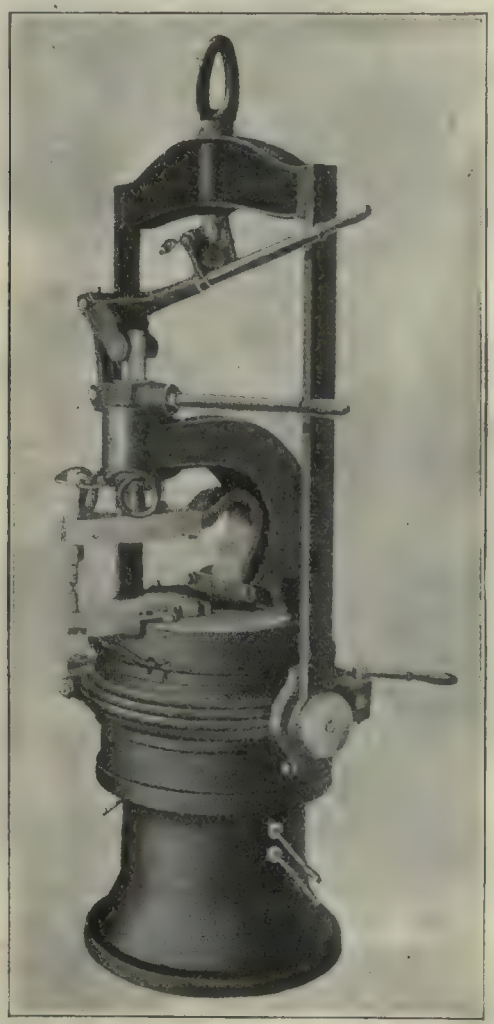


FIG. 408. WINFIELD PORTABLE MACHINE WITH SWIVEL HEAD

The spot-welding of galvanized ventilating pipe is shown in Fig. 402, and in Fig. 403 is shown the welding of 12 gage sheet steel machine guards. In this illustration the operator is using the foot-treadle which leaves his hands free to manipulate the work. In Fig. 404 the operator is welding gas-stove parts and the foot-treadle is thrown back out of the way. A special bracket is employed to hold the work. The joints of this bracket are ball-bearing, making it very easy to swing the work exactly where it is wanted to obtain the spot-welds.

The Winfield Machines

The machines made by the Winfield Electric Welding Machine Co., Warren, Ohio, comprise a varied line for every conceivable spot-welding purpose. In general, Figs. 405 and 406 may be taken as typical of their light and heavy spot-welding machines. Fig. 407 shows a

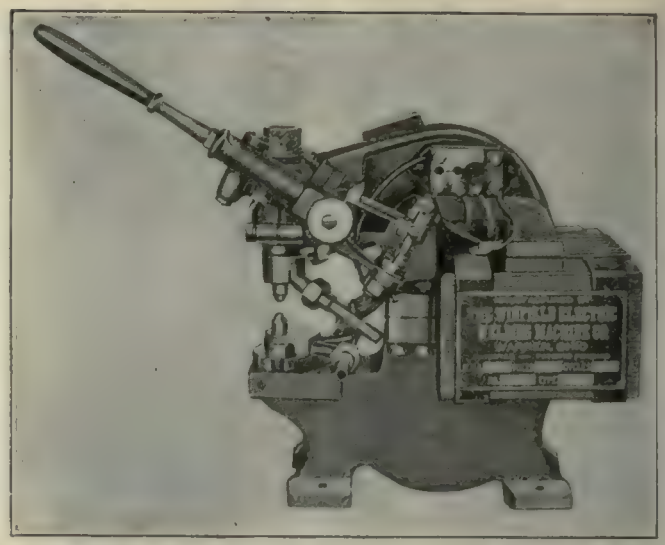


FIG. 409. SMALL WINFIELD BENCH MACHINE

very convenient form of portable machine. In Fig. 408 is shown a much heavier portable machine with swiveling head, and in Fig. 409 is a small bench machine that is exceedingly useful for light work.

A very interesting machine is shown in Fig. 410. This has the entire head suspended from the ceiling, so that work, like the automobile body shown, may be worked under it. This machine is in use in the plant of the Herbert Manufacturing Co., Detroit.

A good way to place a machine for some work is shown in Fig. 411. This is employed in the shop of the Terrell Equipment Co., Grand Rapids, Mich., in the manufacture of steel lockers, steel furniture and the like.

Federal Welding Machines

A feature of the spot-welding machines made by the Federal Machine and Welder Co., Warren, Ohio, are the "universal" welding points used on most of their output. The principle will be instantly grasped by referring to Fig. 412. Some of the different positions possible are shown in Fig. 413.

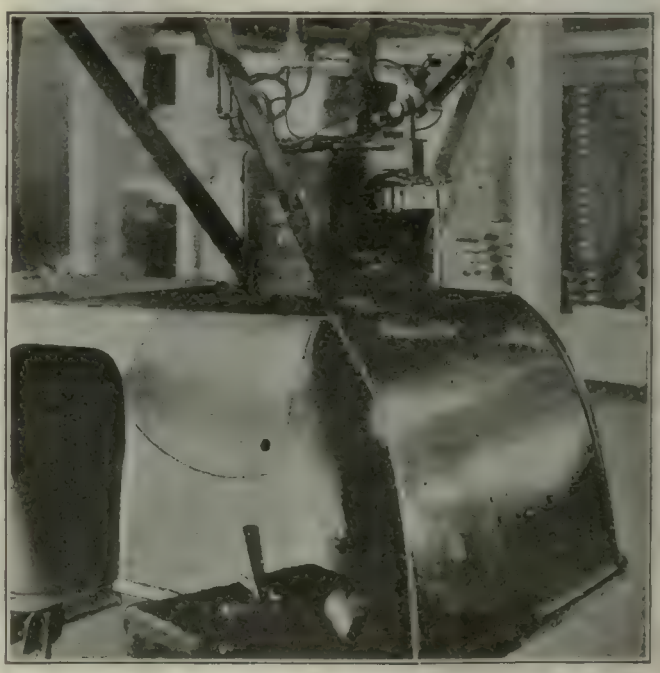


FIG. 410. WINFIELD MACHINE WITH SUSPENDED HEAD FOR WELDING AUTOMOBILE BODIES



FIG. 411. CONVENIENT SETTING OF MACHINE FOR SHEET METAL WORK

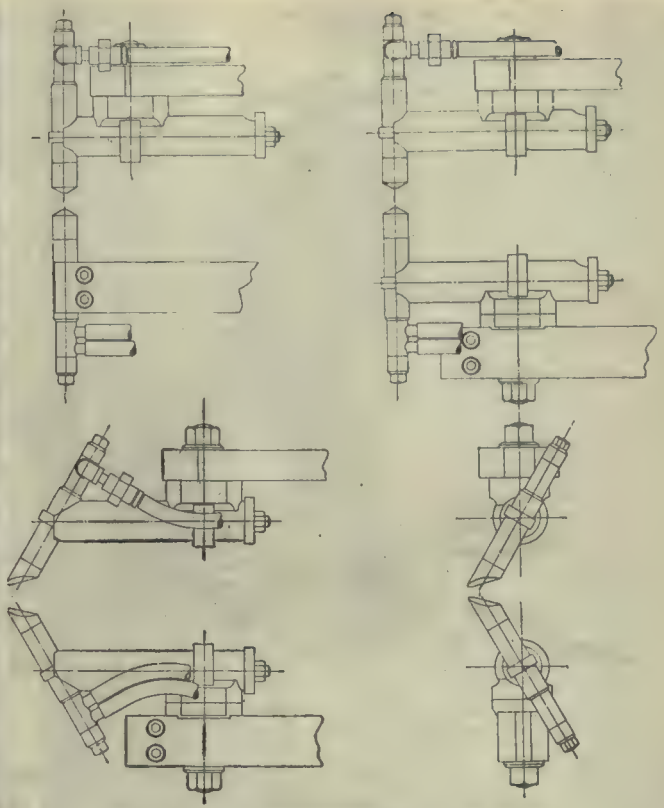


FIG. 413. A FEW POSITIONS OF THE UNIVERSAL POINTS

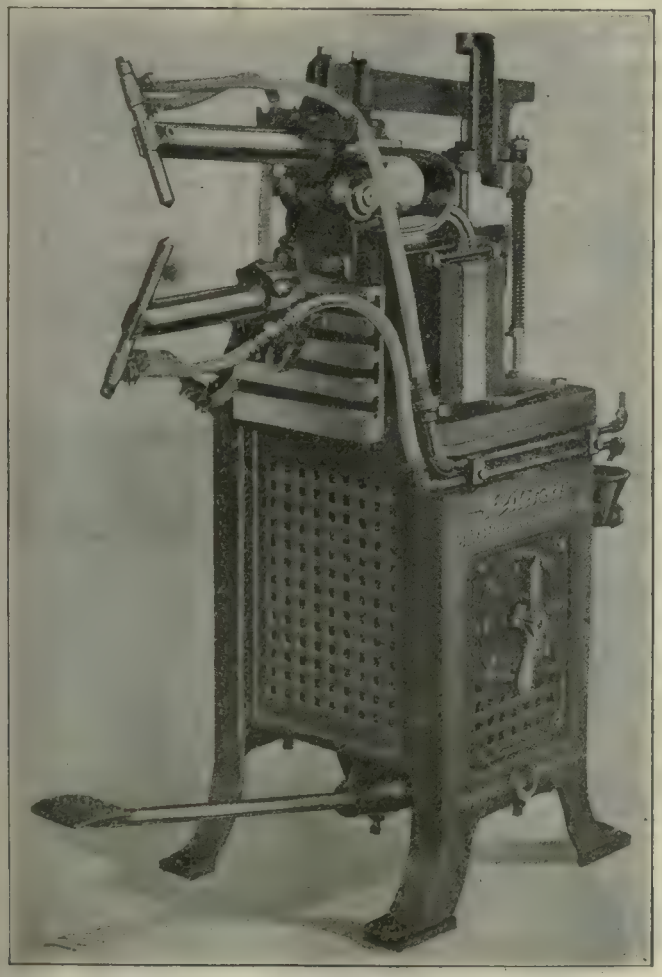


FIG. 412. FEDERAL WELDING MACHINE WITH UNIVERSAL POINTS

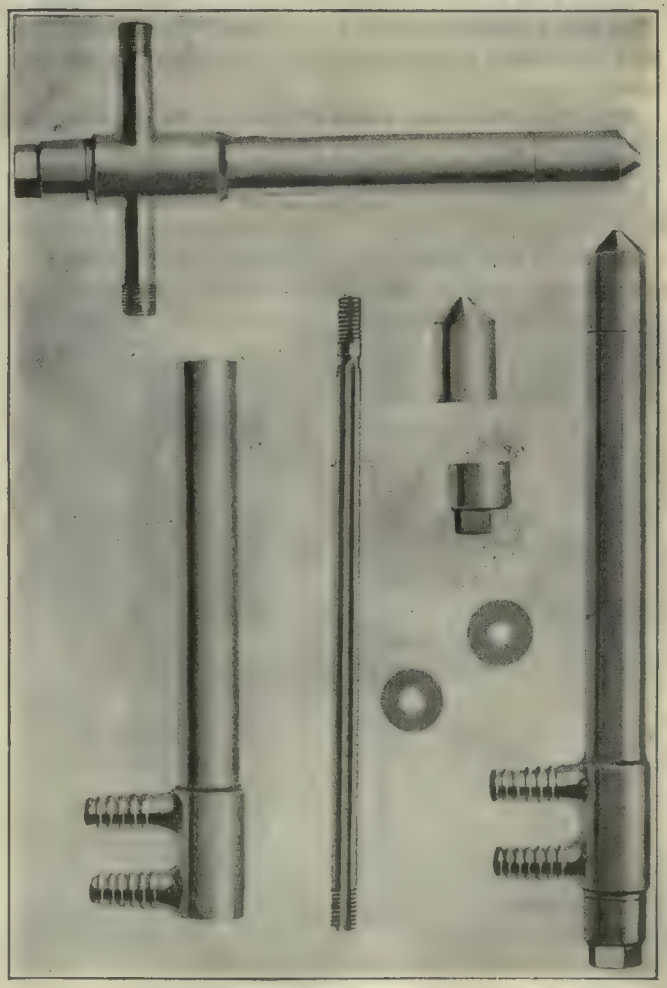


FIG. 414. FEDERAL WATER-COOLED POINTS

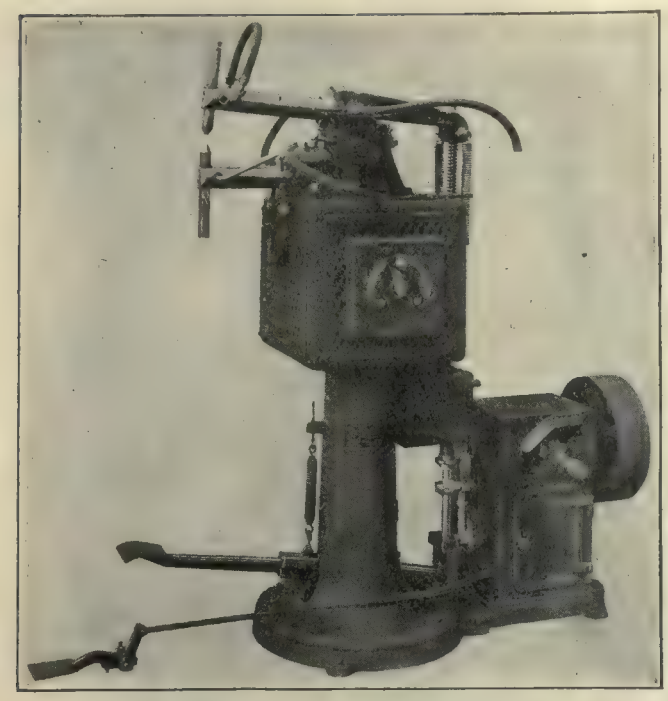


FIG. 415 TAYLOR CROSS-CURRENT SPOT-WELDING MACHINE

Another feature of these machines, is the use of the type of water-cooled points shown in Fig. 414. The welding point is copper and it is attached to the holder in such a way that the water flows within half an inch of the actual welding contact.

In general form, size and capacities, the Federal line does not differ materially from the machines already shown.

While the machines made by the Taylor Welder Co., Warren, Ohio differ radically from others on the market, in that they employ double electrodes and cross current, the forms of the machines are about the same as those previously shown. An automatic belt-driven machine of the lighter type, is shown in Fig. 415. It may be operated by the foot-treadle also when desired. This machine has a capacity up to two $\frac{1}{8}$-in. plates. The

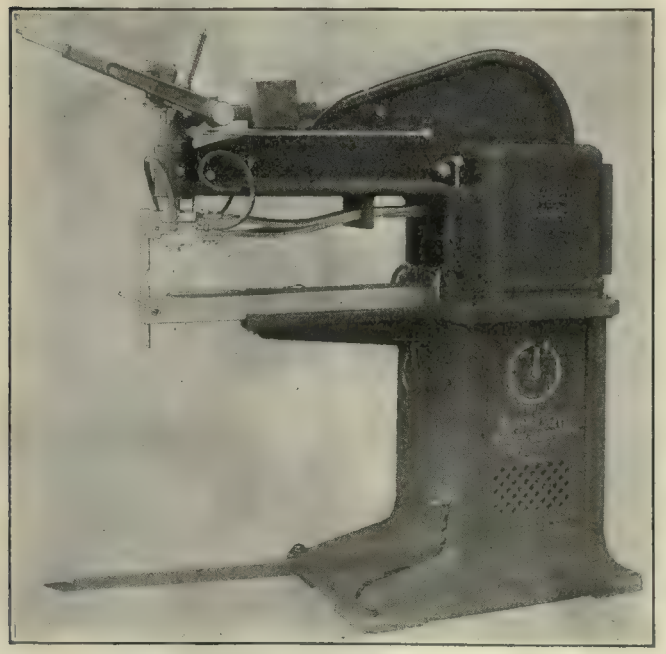


FIG. 416. TAYLOR HEAVY-DUTY MACHINE

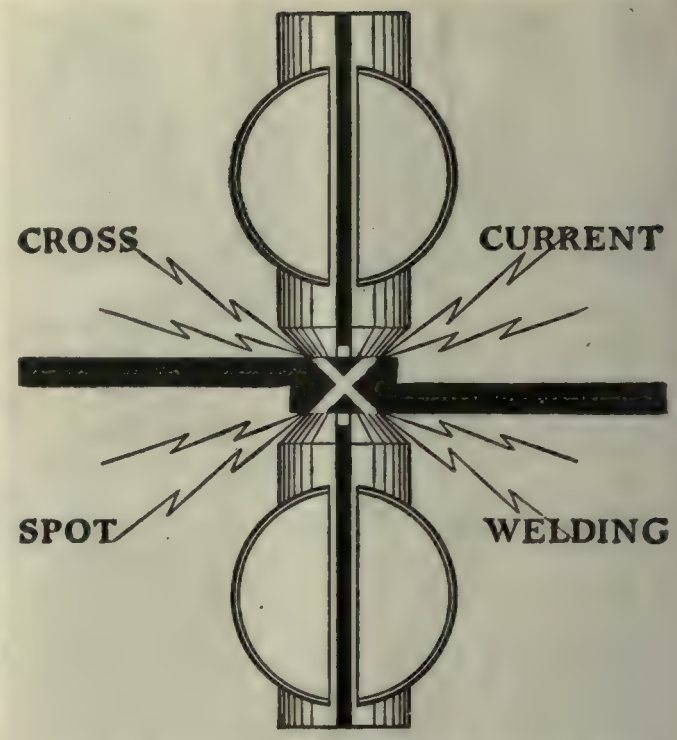


FIG. 417. DIAGRAM OF THE CURRENT ACTION IN A TAYLOR MACHINE

horns are water-cooled and the adjustable points are locked in with a wrench as shown. Fig. 416 shows a heavier type of machine. This has a capacity of two $\frac{1}{4}$-in. plates; overhang is 36 in.; distance between copper bands and lower horn, 6 in.; base, 26 x 42 in.; extreme height, 72 in.; greatest opening between welding points, 3 in.; weight about 2,400 lb. The transformer is 35 kw. and there is a ten-step self-contained regulator for controlling the current. This firm makes other sizes and styles of machines, to meet all the demands of the trade.

The general principle of the cross-current welding method employed in these machines, is illustrated in Fig. 417. Two separate currents are caused to flow in a bias direction through the material to be welded. A high heat concentration is claimed for this method. In operation, the positives of two separate welding currents are on one side of the material and the negatives

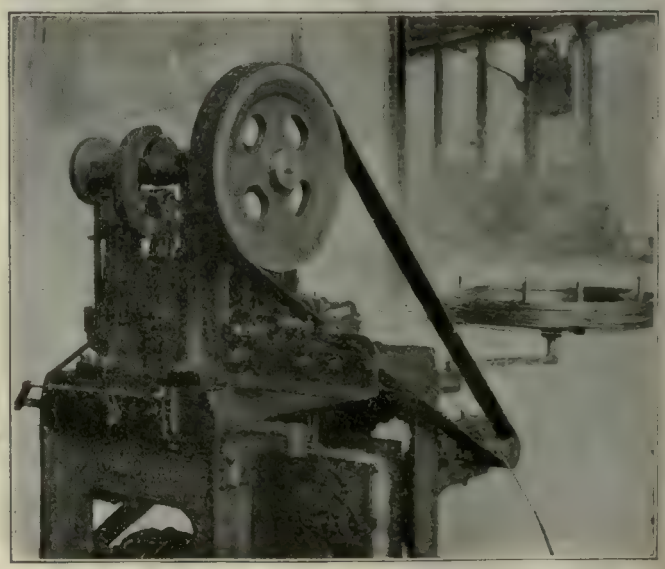


FIG. 418. AUTOMATIC HOG-RING MACHINE

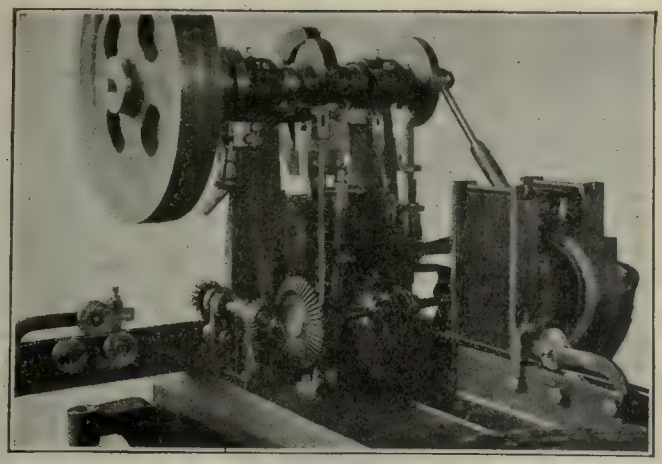


FIG. 419. PARTIAL REAR VIEW OF HOG-RING MACHINE

on the other, with the co-working electrodes of each set so that the current travels diagonally across. An advantage claimed is that the electrodes on each side of the material may be set far enough apart to allow of the insertion of some hard material which will take the pressure instead of the softer copper welding points. These hard dies may be operated independently of the copper ones and make it possible to weld heavier material without crushing the copper die points, as these need to be pressed together only enough to give good electrical contact with the work. The process is also unique in that it can be operated with a multiphase circuit without unbalancing the lines, which is not the case with any spot-welding machine employing a single current.

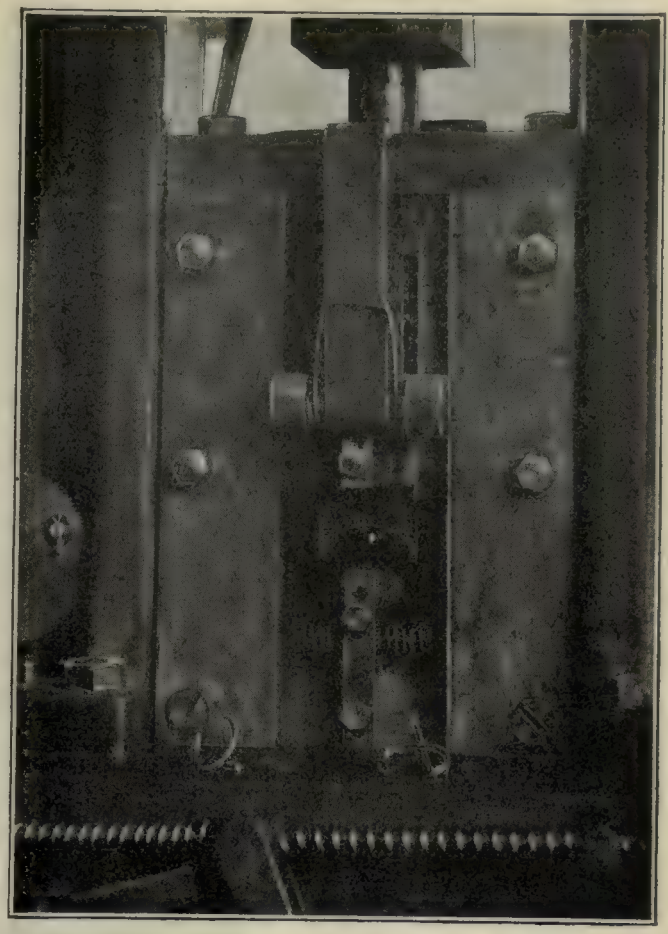


FIG. 420. CLOSE-UP OF FRONT OF HOG-RING MACHINE

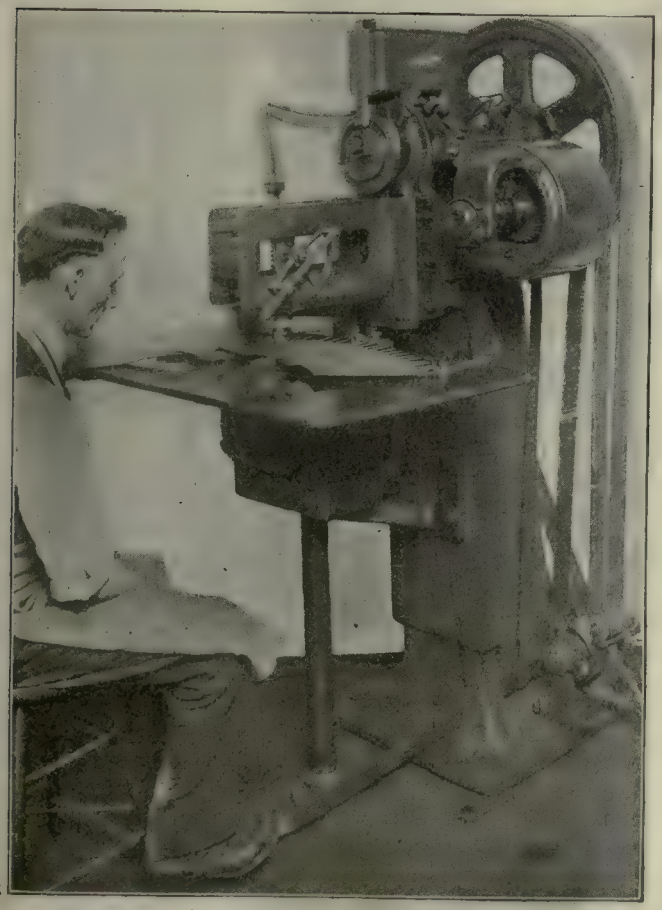


FIG. 421. GENERAL ELECTRIC SPACE-BLOCK WELDING MACHINE

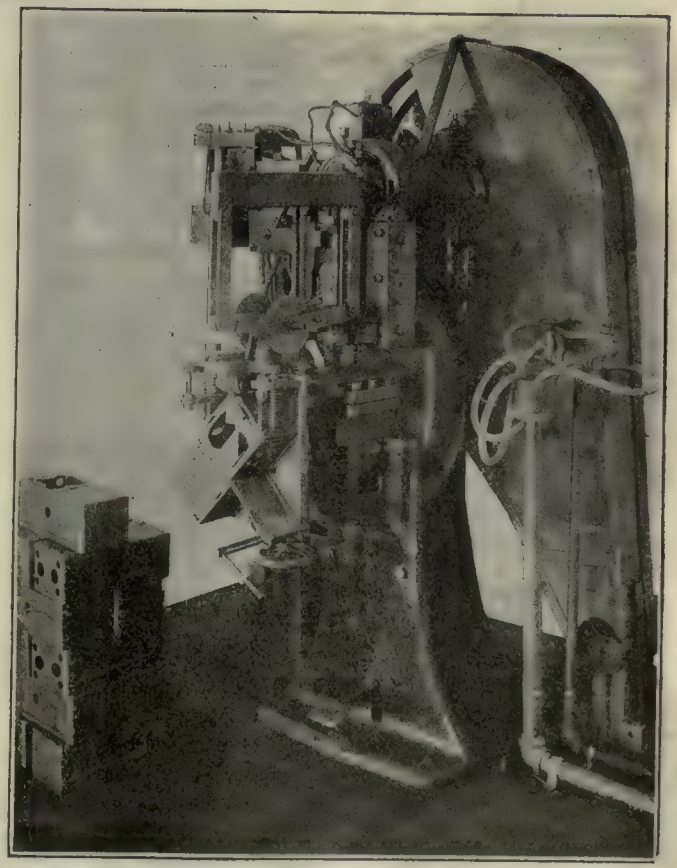


FIG. 422. COMBINATION SPOT- AND LINE-WELDING MACHINE, SET UP FOR LINE-WELDING CAN SEAMS

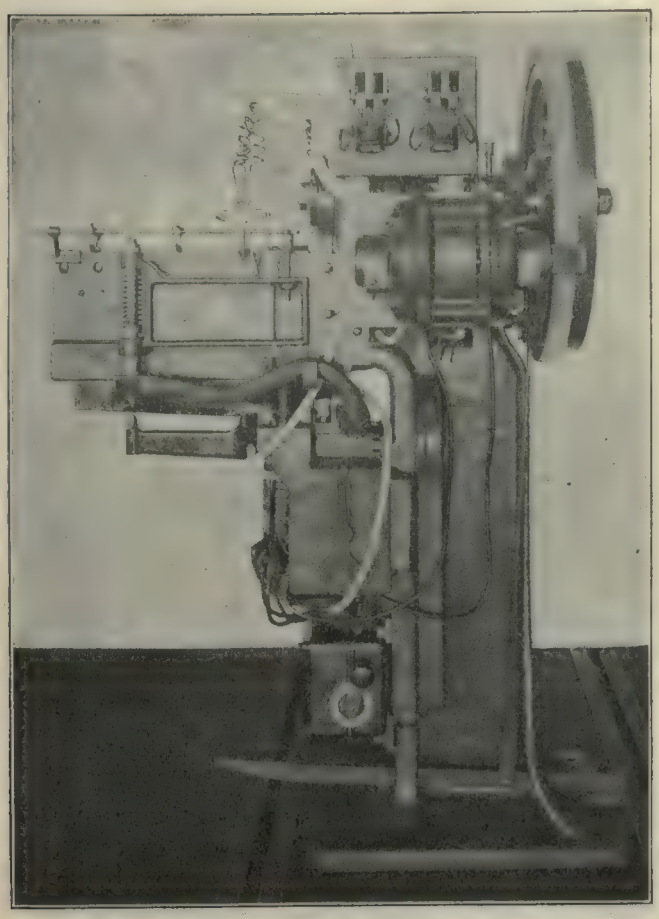


FIG. 423. A COMBINATION MACHINE FROM THE SPOT-WELDING SIDE

An automatic machine for forming and mash-welding 11 gage wire hog rings, at the rate of 60,000 per day, is shown in Fig. 418. This machine takes wire from two reels and turns out the complete hog rings. A partial rear view is shown in Fig. 419. A close-up of the front of the machine, with two hog rings lying on the platen, is given in Fig. 420.

A machine in use in the punch press department of the General Electric Co., Schenectady, N. Y., is shown in Fig. 421. This machine welds small spacers to the iron laminations for motors and generators for ventilating purposes, and hence is called a "space-block welder." A number of these machines are in use in this plant, and they are capable of welding 60 spots per minute when working continuously, not allowing for time to shift the stock.

A combination spot- and line-welding machine, used in the General Electric Co.'s shops, is shown in Fig. 422. This is employed for welding oil switch boxes up to $\frac{1}{8}$ in. thick. As shown, the machine is fitted with a fixture for holding the boxes while line-welding the seams. A separate fixture is put on for spot-welding work. A seam 6 in. long can be line-welded on this machine.

Another combination machine, used in the same shops, is shown in Fig. 423. This machine carries both the spot- and the line-welding fixtures at the same time. Fig. 424 shows the machine from the line-welding side. As shown, the machines are ready for welding straight plates. Machines of this kind should find a considerable field where it is desired to tack seams before line welding them. These machines have a capacity of 20 kva., and will weld up to $\frac{3}{16}$ in. thick, and seams 18 in. long.

Line welding machines, as developed in the Schenectady plant, comprise a transformer with a one turn secondary, through which a heavy current is delivered at low voltage to the material through the medium of a stationary jaw and rolling wheel. Both the jaw and wheel are water cooled and pressure is applied to the wheel the same as to a spot-welding tip. A small revolving switch mechanically geared to the driving motor and welding wheel operates a set of contactors or solenoid switches to throw the power on once a second, the power being on $\frac{3}{8}$ of a second, and off $\frac{5}{8}$ of a second. The mechanism is synchronized so that during the $\frac{3}{8}$ of a second the power is on, the welding wheel is rolling, and during the remaining $\frac{5}{8}$ of a second the wheel is stationary under pressure while the soft metal is solidifying, thus completing the weld.

Spot-Welding Machines for Ship Work

During the World War, welding of all kinds took huge steps forward. Spot-welding developed at least as much as any other kind. Writing in the *General Electric Review*, J. M. Weed says:

> The machines to be described are two portable welders, one with 12-in. reach and the other with 27-in. reach, for use in the fabrication of structural ship parts, and one stationary machine with 6-ft. reach designed for welding two spots at the same time on large ship plates.
>
> A preliminary survey of the structural work in shipbuilding indicated that about 80 per cent of this work could be done by a machine of 12-in. reach, and that a 27-in. reach would include the other 20 per cent. Since both the weight of the machine and the kva. required for its operation are about 33 per cent greater for the 27-in. reach than for the 12-in., it seemed advisable to develop two machines rather than one with the longer reach.
>
> These machines were to a certain obvious extent pat-

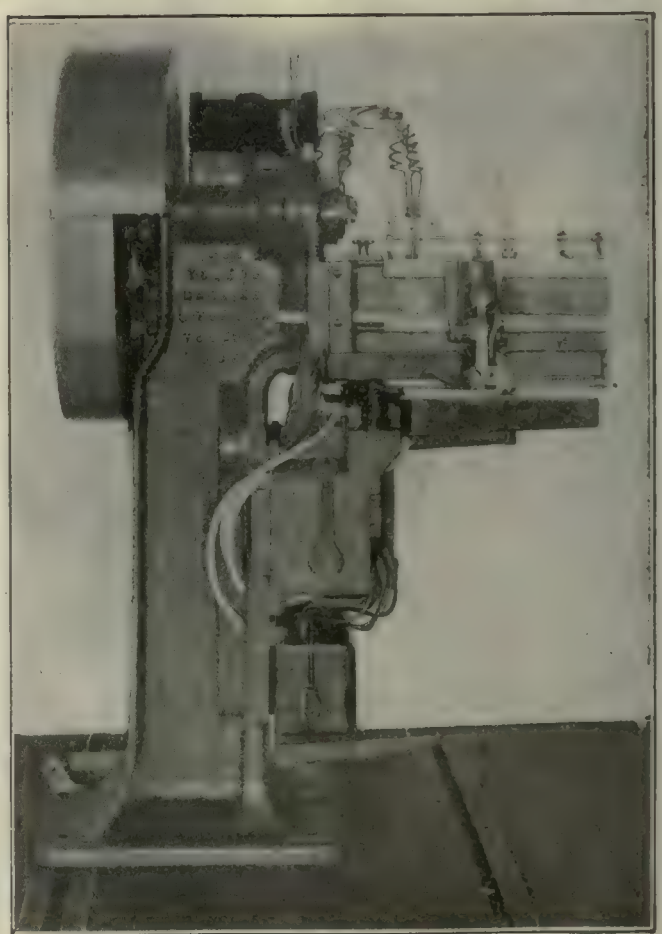


FIG. 424. MACHINE FROM THE LINE-WELDING SIDE

terned after the riveting machines, which they were intended to replace as will be seen from Fig. 425. They are necessarily considerably heavier than the riveting machines, but like these they are provided with bales for crane suspension, for the purpose of carrying the machines around the assembled work or parts to be welded.

The maximum welding current available in these machines, with a steel plate enclosed to the full depth of the gap, is about 37,500 amperes, with the maximum applied voltage of 534 volts at 60 cycles. Reduced voltages, giving smaller currents, are obtained in six equal steps, ranging from 534 down to 267 volts, from the taps of the regulating transformers furnished with the machines.

This wide range of voltage and current was provided in order to meet the possible requirements for a considerable range in thickness of work, and for experimental purposes. Tests have shown, however, that the machines will operate satisfactorily on work of thicknesses over the range on which they are likely to be used when connected directly on a 440-volt, 60-cycle circuit, with no regulating transformers. Two plates ½-in. thick are welded together in spots from 1 in. to 1¼ in. in diameter, in from 12 to 15 seconds. Thicker plates require more time and thinner plates less time.

The welding current under these conditions is about 31,000 amp.; the primary current is about 600 amp. for the 12-in. machine and about 800 amp. for the 27-in. machine, the corresponding kva. at 440 volts, being 265 and 350 respectively.

Since the reactance of the welding circuit is large as compared with the resistance, the voltage necessary for a given current, and consequently the kva. necessary for the operation of the machine, is almost proportional to the frequency. Thus, these machines operate satisfactorily from a 25-cycle circuit at 220 volts, with the advantage that where the power-factor is from 30 to 40 per cent at 60 cycles, it is from 60 to 75 per cent at 25 cycles, and the kva. required at 25 cycles is about one-half that required at 60 cycles.

The maximum mechanical pressure on the work for which those machines are designed is 25,000 lb. This is obtained from an 8-in. air cylinder, with an air pressure of 100 lb. per square inch, acting through a lever arm of 5 to

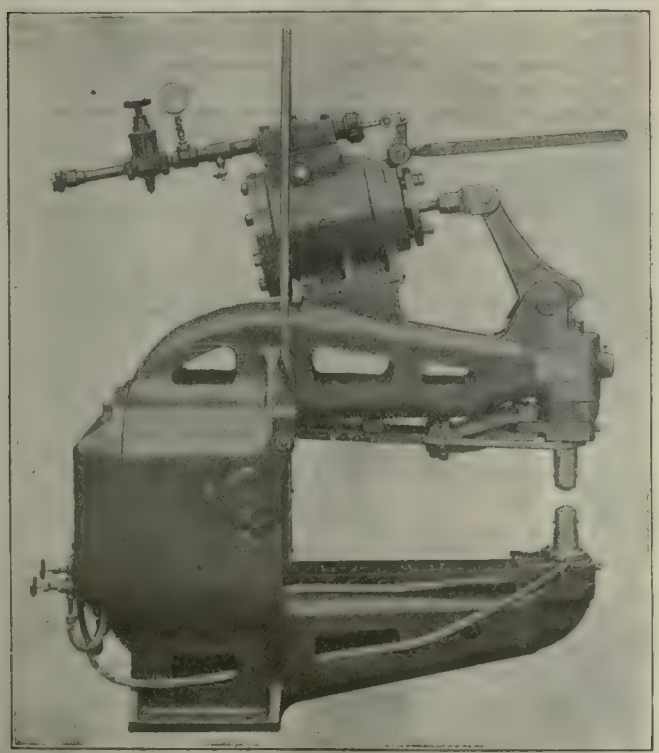


FIG. 425. PORTABLE SPOT-WELDING MACHINE, WITH 27-IN. THROAT DEPTH, CAPABLE OF WELDING TWO PLATES § IN. THICK IN SPOTS 1 IN. IN DIAMETER. MADE BY THE GENERAL ELECTRIC CO.

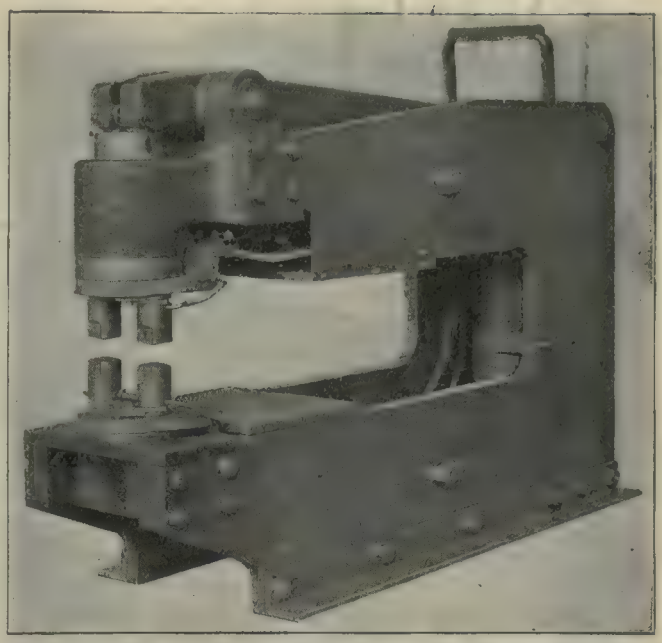


FIG. 426. DUPLEX SPOT-WELDING MACHINE, MADE BY THE GENERAL ELECTRIC CO. 6-FT. THROAT DEPTH, AND CAPABLE OF WELDING TOGETHER TWO STEEL PLATES ⅜ IN. THICK, IN TWO SPOTS 1¼ IN. IN DIAMETER

1 ratio. Lower pressures on the work are obtained with correspondingly reduced air pressures. A pressure-reducing valve is provided for this purpose, and also a pressure gage for indicating the pressure on the machine side of the valve.

The pressure required to do satisfactory welding depends upon the thickness of the plates. It is necessary that the areas to be welded should at the start be brought into more intimate contact than the surrounding areas, in order that the current may be properly localized, and the heat generated in the region where it is needed. It is therefore necessary, on account of irregularities in the plate surface, that the pressure should be great enough to spring the cold plate sufficiently to overcome the irregularities. The pressure which will do this with heavy plates is ample for effecting the weld after the welding temperature is reached.

It should be explained in this connection that the rate of heating at the surfaces to be welded depends largely upon the contact resistance, and consequently upon the condition of the plates and the pressure used. If the plates are clean and bright, and the pressure high, the rate of heating with a given amount of current is slow and the welding efficiency is poor. This makes it difficult to weld heavy plates if they are clean, since, as stated above, it is necessary to use large pressure with heavy plates to insure a better contact of the areas to be welded than that of surrounding areas. It is much easier to weld plates which carry the original coat of mill scale, or a fairly heavy coating of rust or dirt, affording a considerable resistance which is not sensitive to pressure. If this resistance is too great, the necessary current will not flow, of course, but if the scale is not too heavy it has little effect upon the current, the high reactance of the welding circuit giving it practically a constant current characteristic and making the rate of heating proportional to the resistance within certain limits. The scale melts at about the welding temperature of the steel, and is squeezed out by the high pressures used, permitting the clean surfaces of the steel to come together and effect a good weld.

A gage pressure of about 70 lb., giving 17,500 lb, pressure upon the work, has been found to give good results under these conditions in ½-in. plates.

Both the mechanical pressure and the current are transmitted to the work in these machines through heavy copper blocks or welding electrodes. The shape of the tips of these electrodes is that of a very flat truncated cone.

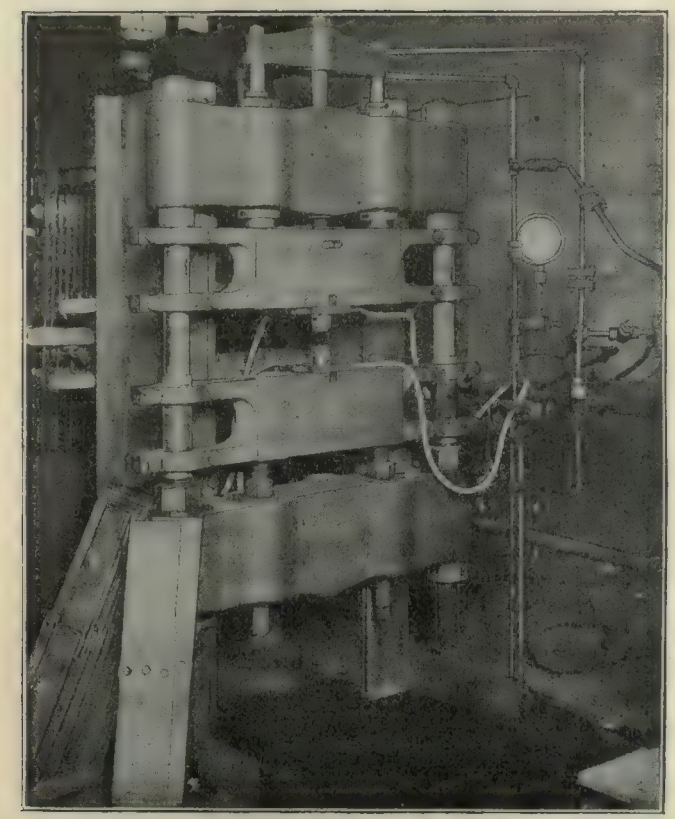


FIG. 427. GENERAL ELECTRIC CO.'S EXPERIMENTAL SPOT-WELDING MACHINE. CURRENT CAPACITY 100,000 AMP. PRESSURE CAPACITY 36 TONS. HAS WELDED THREE PLATES, EACH 1 IN. THICK

The severity of the conditions to which the tips of the electrodes are subjected will be understood when it is considered that the current density in the electrode material at this point is approximately 60,000 amp. per square inch, and that this material is in contact with the steel plates which are brought to the welding temperature, under pressures of 15,000 to 20,000 lb. per square inch. It must be remembered, also, that copper, which is the best material available for this purpose, softens at a temperature considerably lower than the welding temperature of steel. The difficulty of making the electrode tips stand up under the conditions to which they are subjected has, in fact, constituted the most serious problem which has been met in the development of these machines.

The shape of these electrodes gives them every possible advantage in freely conducting the current to and the heat away from the electrode tips, and in giving them the mechanical reinforcement of the cooler surrounding material. However, it has been found necessary to reduce, as far as possible, the heat generated at the tips of the electrodes by cleaning the rust and mill scale from the surfaces of the plates beneath the electrodes. The most convenient way which has been found for doing this is by means of a sand blast. The bodies of the electrodes are also internally water-cooled by a stream of water flowing continually through them. Still, after all of these things have been done, a gradual deformation of the tip of the electrode will occur, increasing its area of contact with the work, and thus reducing the current density in the work and the pressure density below the values needed for welding. This would make it necessary to change electrodes and to reshape the tips very frequently, and the total life of the electrodes would be short on account of the frequent dressings.

An effort has been made to overcome this difficulty by protecting the tip of the electrode by a thin copper cap, which may be quickly and cheaply replaced. As many as 160 welds have been made with a single copper cap, $\frac{1}{16}$ in. thick, before it became necessary to replace it. Unfortunately this does not entirely prevent the deformation of the electrode tip, but it stands up much better than it does without the cap.

Another method which has been tried for overcoming this trouble is by making the tip portion of the electrode removable, in the form of a disk or button, held in place by a clamp engaging in a neck or groove on the electrode body. While this protects the electrode body from deformation and wear, the tip itself does not stand up so well as does the combination of electrode and cap, where the tip of the electrode is not separated from the body.

Some electrodes have been prepared which combine the features of the removable tip and the cap. These give the advantage of a permanent electrode body, and the removable tip with the protecting cap stand up better than the unprotected tip.

Some interesting features were introduced in the design of the transformers which are integral parts of these machines, owing to the necessity for small size and weight. Internal water cooling was adopted for the windings, which makes it possible to use current densities very much higher than those found in ordinary power transformers. The conductor for the primary windings is $\frac{3}{8}$ x $\frac{1}{4}$-in. copper tubing, which was obtained in standard lengths and annealed before winding by passing it through an oven which is used for annealing sheathed wire during the process of drawing. No difficulty was found in winding this tubing directly on the insulated core, the joints between lengths being made by brazing with silver solder. The entire winding consists of four layers of thirteen turns each in the 12-in. machine and three layers of thirteen turns each in the 27-in. machine.

The U-shaped single-turn secondaries were slipped over the outside of the primary windings in the assembly of the transformers. These were constructed of two copper plates each $\frac{3}{8}$ in. thick and $6\frac{3}{8}$ in. wide, which were bent to the proper shape in the blacksmith shop, and assembled one inside the other with a $\frac{1}{4}$-in. space between them. Narrow strips of copper were inserted between the plates along the edges, and the plates were brazed to these strips, thus making a water-tight chamber or passage for the circulation of the cooling water.

At 31,000 amp. the current density in these secondaries is about 6,200 amp. per square inch, the corresponding densities in the primary windings being about 7,000 for the 12-in. and 9,000 for the 27-in. machine.

In case these machines are started up without the cooling water having been turned on, the temperature rise in these

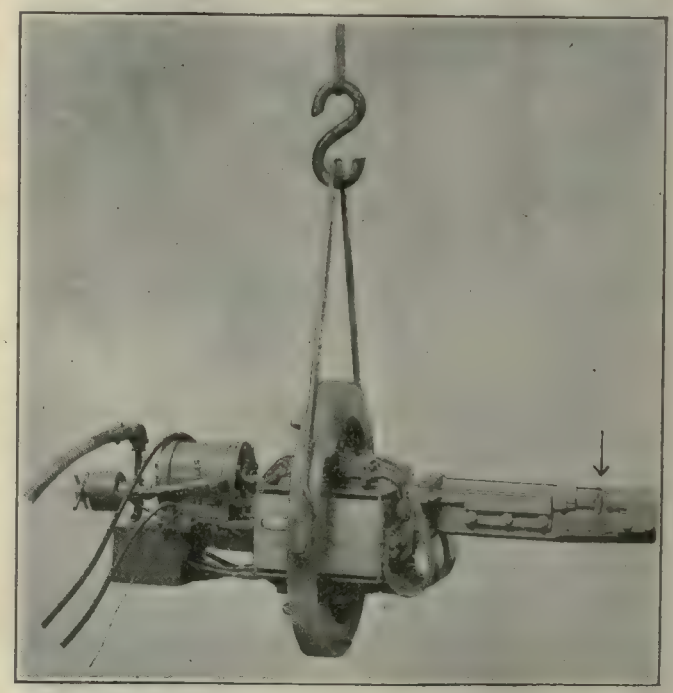


FIG. 428. PORTABLE MACHINE FOR MASH-WELDING SQUARE OR ROUND RODS

windings will be rapid, and in order to avoid the danger of burning the insulation, asbestos and mica have been used. The copper tubing was taped with asbestos tape, and alternate layers of sheet asbestos and mica pads were used between layers of the primary winding, and between primary and secondary and between primary and core. Space blocks of asbestos lumber, which is a compound of asbestos and Portland cement, were used at the ends of the core and at the ends of the winding layers. The complete transformer, after assembly, was impregnated with bakelite. The result is a solid mechanical unit which will not be injured by temperatures not exceeding 150 deg C. Several welds could be made without turning on the cooling water before this temperature would be reached.

The transformers are mounted in a chamber in the body of the frame. The long end of the U-shaped secondary runs out along the arm of the frame and bolts directly to the copper base upon which the bottom electrode is mounted. The short end connects to the base of the top electrode through flexible leads of laminated copper, to permit of the necessary motion for engaging the work.

The copper bases upon which the electrodes are mounted are insulated from the frame by a layer of mica, the bolts which hold them in place being also insulated by mica.

The cooling water for these machines is divided into two parallel paths, one being through the primary winding, and the other through the secondary and the electrodes in series. Separate valves are supplied for independent adjustment of the flow in the two paths. The resistance of ordinary hydrant water is sufficiently great as to cause no concern regarding the grounding or short-circuiting of the windings through the cooling water, although it is necessary to use rubber tubing or hose for leading it in and out.

Some pieces of ½ x 2-in. machine steel were welded in seven seconds with a current of 33,000 amp. They were afterward clamped in a vise and hammered into U-shapes. Small pieces were sheared from the seam where two ½-in. plates had been welded together in a row of spots. The pieces of the plates were then split apart with a cold chisel in one case, and an effort was made to do so in the other, with the result that one piece of plate broke at the welds before the welds would themselves break. Such tests as these show that the welds are at least as strong as the material on which the welds were made. Some samples of the ½ x 2-in. stock welded together in the same manner were tested by bending in an edgewise direction, thus subjecting the welds to a shearing torque. The ultimate strength calculated from these tests was in the neighborhood of 65,000 lb. per square inch. These tests showed also a very tough weld, the deflection being almost 45 deg. in some cases before the final rupture occurred. The maximum load occurred with a deflection of from 3 to 5 deg. with a very gradual reduction in the load from this time till the final rupture.

The Duplex Welding Machine

The machine shown in Fig. 426 was developed for the application of electric welding as a substitute for riveting on parts of the ship composed of large-sized plates, which may be fabricated before they are assembled in the ship. The specification to which it was built stated that it should have a 6-ft. reach and should be capable of welding together two plates ¾ in. thick in two spots at the same time. A machine capable of doing this work, with a 6-ft. gap, is necessarily so heavy as to preclude even semi-portability, and no effort was made in this direction.

With the welding circuit enclosing a 6-ft. gap, and carrying the very heavy current necessary to weld ¾-in. plates, the kva. required would be very large. A great reduction in the kva. and at the same time a doubling of the work done, is obtained in this machine by the use of two transformers as integral parts of the machine, and two pairs of electrodes, thus providing for the welding of two spots at the same time. The transformers are mounted in the frame of the machine, on opposite sides of the work, and as near to the welding electrodes as possible, so as to obtain the minimum reactance in the welding circuit. The polarity of the electrodes on one side of the work is the reverse of that of the opposed electrodes, thus giving a

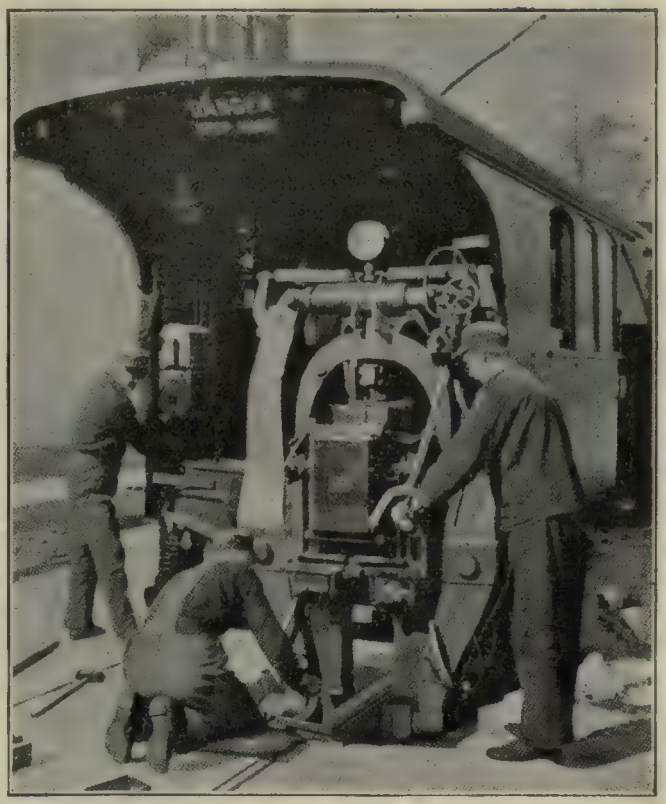


FIG. 429. LORAIN MACHINE FOR SPOT-WELDING ELECTRIC RAIL BONDS

series arrangement of the transformer secondaries, the current from each transformer flowing through both of the spots to be welded.

The bottom electrodes are stationary, and the copper bases which bear them are connected rigidly to the terminals of their transformer, while the bases which carry the top electrodes are connected through flexible leads of laminated copper, to permit of the motion necessary for engaging the work.

Previous tests with an experimental machine had shown that, to successfully weld two spots at the same time in the manner adopted here, it is necessary that the pressures shall be independently applied. Otherwise, due to inequalities in the thickness of the work, or in the wear and tear of the electrodes, the pressure may be much greater on one of the spots than on the other. This results in unequal heating in the two spots. The resistance and its heating effect are less in the spot with the greater pressure. The two top electrodes in this machine were therefore mounted on separate plungers, operated by separate pistons through independent levers.

The pressures obtained in this machine with an air pressure of 100 lb. per square inch, are 30,000 lb. on each spot, giving a total pressure of 60,000 lb. which must be exerted by the frame around the 6-ft. gap. The necessary strength is obtained by constructing the frame of two steel plates, each 2 in. thick, properly spaced and rigidly bolted together.

The use of steel in this case is easily permissible on account of the restricted area of the welding circuit and its relative position, resulting in small tendency for magnetic flux to enter the frame. However, the heads carrying the electrodes, being in close proximity to the welding circuit, were made of gun metal.

The two air cylinders are mounted on a cast-iron bedplate in the back part of the machine. The levers connecting the pistons to the electrode plungers, which are 7 ft. in length, were made of cast steel, in order to obtain the necessary strength.

The maximum welding current for which this machine was designed is 50,000 amp. This current is obtained with 500 volts at 60 cycles applied.

The distance between the electrode bodies for this ma-

Gauge Number	Thickness of Sheets in Fractions of an Inch	Thickness of Sheets in Decimals of an Inch	K. W. Required	H. P. Required	Time in Seconds to Make a Weld	Cost 1000 Welds at one Cent per K. W. Hour
30	1/80	.0125	3.0	4.2	.25	.002
28	1/64	.0156	4.0	5.6	.3	.003
24	1/40	.0250	5.0	7.0	.45	.006
20	3/80	.0375	6.5	9.2	.6	.011
18	1/20	.0500	8.0	11.3	.8	.017
16	1/16	.0626	9.5	13.5	1.0	.026
14	5/64	.0781	10.0	14.2	1.3	.036
12	7/64	.1093	12.0	17.0	1.6	.052
11	1/8	.1250	13.0	18.5	1.7	.061
10	9/64	.1406	14.0	19.9	1.8	.070
9	5/32	.1562	15.0	21.3	1.9	.079
8	11/64	.1715	16.0	22.7	2.0	.088
7	3/16	.1875	17.0	24.1	2.1	.099
6	13/64	.2031	18.0	25.6	2.2	.110
5	7/32	.2187	19.0	27.0	2.4	.124
4	15/64	.2343	20.0	28.4	2.7	.148
3	1/4	.2500	21.0	29.8	3.	.174

As the cost of current varies in different places, we have figured the current at one cent per K. W. hour to give a basis for calculating the cost. Multiply the cost of current given above by the rate per K. W. hour you pay and you will have your cost per 1000 welds for current.

TABLE XXIX. SPOT-WELDING POWER AND COST DATA

chine is fixed at 8 in., center to center, but the distances between the centers of the tips may be easily varied from 6 in. to 10 in. by shifting the tip from the center of the body toward one side or the other.

Provision has been made for shifting the electrodes on their bases to positions 90 deg. from those shown in the pictures, thus spacing the welds in a direction along the axis of the machine instead of traverse to it.

The transformers are insulated and cooled in the same manner as those in the semi-portable machines. The windings are interlaced in order to obtain minimum reactance, the primary being wound in two layers of 14 turns each, one inside and the other outside of the single turn secondary.

With 50,000 amp. in the secondaries of these transformers, the current in the primary is 1,800. The respective current densities are 7,000 and 9,000 amp. per square inch. The kva. entering the transformers on this basis, the two primaries being in series on 500 volts, is 450 for each transformer.

This machine also has been provided with a regulating transformer for applying different voltages to give different values of welding current, and with a panel carrying the necessary selector switches and contactor. The maximum voltage provided by this regulating transformer as at present constructed is 440. If it is found that the current obtained with this voltage is not sufficient for the heaviest work which it is desired to do with this machine, the maximum voltage may be changed to 500.

The kva. entering the transformers at 440 volts will be approximately 350 each, instead of 450.

In order that this machine may be operated from any ordinary power circuit, it will be necessary to use a motor-generator set provided with a suitable flywheel. This will eliminate the bad power-factor, distribute the load equally on the three phases, and over a much larger interval of time for each weld, thus substituting small gradual changes in power for large and sudden changes. On account of the high reactance the welding current will remain practically constant as the speed of the motor-generator set falls away, thus favoring the utilization of the flywheel.

Number of Gauge	Approximate Thickness in Fractions of an Inch	Approximate Thickness in Decimal Parts of an Inch	Weight per Sq. Foot Iron	Number of Gauge	Approximate Thickness in Fractions of an Inch	Approximate Thickness in Decimal Parts of an Inch	Weight per Sq. Foot Iron
30	1–80	.0125	.5	13	3–32	.09375	3.75
29	9–640	.0140625	.5625	12	7–64	.109375	4.375
28	1–64	.015625	.625	11	1–8	.125	5.
27	11–640	.0171875	.6875	10	9–64	.140625	5.625
26	3–160	.01875	.75	9	5–32	.15625	6.25
25	7–320	.021875	.875	8	11–64	.171875	6.875
24	1–40	.025	1.	7	3–16	.1875	7.5
23	9–320	.028125	1.125	6	13–64	.203125	8.125
22	1–32	.03125	1.25	5	7–32	.21875	8.75
21	11–320	.034375	1.375	4	15–64	.234375	9.375
20	3–80	.0375	1.50	3	1–4	.25	10.
19	7–160	.04375	1.75	2	17–64	.265625	10.625
18	1–20	.05	2.	1	9–32	.28125	11.25
17	9–160	.05625	2.25	0	5–16	.3125	12.50
16	1–16	.0625	2.5	00	11–32	.34375	13.75
15	9–128	.0703125	2.8125	000	3–8	.375	15.
14	5–64	.078125	3.125				

TABLE XXX. THICKNESS AND WEIGHT OF SHEET IRON

Decimal Inch	Mill.	Fra In.	B&S	Birm	Decimal Inch	Mill.	Fra In.	B&S	Birm	Decimal Inch	Mill.	Fra In.	B&S	Birm	Decimal Inch	Mill.	Fra In.	B&S	Birm	Decimal Inch	Mill.	Fra In.	B&S Gge	Birm Gge
.00394	.1				.04525				17	.11443			9		.203125		13/64			.296875		19/64			.40157	10.2			
.00787	.2				.046875		3/64			.11811	3.0				.20431			4		.29921	7.6				.40551	10.3			
.010025			30		.04724	1.2				.12				11	.20472	5.2				.3				1	.40625		13/32		
.011257			29		.049				18	.12204	3.1				.20866	5.3				.30314	7.7				.40944	10.4			
.01181	.3				.05082				16	.125		1/8			.21259	5.4				.30708	7.8				.4096			000	
.012				30	.05118	1.3				.12598	3.2				.21653	5.5				.31102	7.9				.41338	10.5			
.012641			28		.05512	1.4				.12849			8		.21875		7/32			.3125		5/16			.41732	10.6			
.013				29	.05706				15	.12992	3.3				.22			5		.31496	8.0				.42125	10.7			
.014				28	.058				17	.13385	3.4				.22047	5.6				.31889	8.1				.421875		27/64		
.014195			27		.05905	1.5				.134				10	.2244	5.7				.32283	8.2				.425				000
.015625		1/64			.0625		1/16			.13779	3.5				.22834	5.8				.32495			0		.42519	10.8			
.01575	.4				.06299	1.6				.140625		9/64			.22942			3		.32677	8.3				.42913	10.9			
.01594			26		.06408				14	.14173	3.6				.23228	5.9				.328125		21/64			.43307	11.0			
.016				27	.065				16	.14428			7		.234375		15/64			.3307	8.4				.437	11.1			
.0179			25		.06692	1.7				.14566	3.7				.23622	6.0				.33464	8.5				.4375		7/16		
.018				26	.07086	1.8				.148				9	.238			4		.33858	8.6				.44094	11.2			
.01968	.5				.07196				13	.14960	3.8				.24015	6.1				.34			0		.44488	11.3			
.02			25		.072				15	.15354	3.9				.24409	6.2				.34251	8.7				.44881	11.4			
.0201			24		.0748	1.9				.15625		5/32			.24803	6.3				.34375		11/32			.45275	11.5			
.022				24	.078125		5/64			.15748	4.0				.25		1/4			.34645	8.8				.453125		29/64		
.022571			23		.07874	2.0				.16141	4.1				.25196	6.4				.35039	8.9				.454				0000
.02362	.6				.080801				12	.16202			6		.2559	6.5				.35433	9.0				.45669	11.6			
.025				23	.08267	2.1				.165				8	.25763			2		.35826	9.1				.46			0000	
.025347			22		.083				14	.16535	4.2				.259				3	.359375		23/64			.46062	11.7			
.02756	.7				.08661	2.2				.16929	4.3				.25984	6.6				.36220	9.2				.46456	11.8			
.028				22	.09055	2.3				.171875		11/64			.26377	6.7				.3648			00		.4685	11.9			
.02846			21		.09074				11	.17322	4.4				.265625		17/64			.36614	9.3				.46875		15/32		
.03125		1/32			.09375		3/32			.17716	4.5				.26771	6.8				.37007	9.4				.47244	12.0			
.03149	.8				.09448	2.4				.180			7		.27165	6.9				.37401	9.5				.47637	12.1			
.03196			20		.095				13	.1811	4.6				.27559	7.0				.375		3/8			.48031	12.2			
.032				21	.09842	2.5				.18194			5		.27952	7.1				.37795	9.6				.48425	12.3			
.035				20	.10189				10	.18503	4.7				.28125		9/32			.38			00		.484375		31/64		
.03543	.9				.10236	2.6				.1875		3/16			.28346	7.2				.38188	9.7				.48818	12.4			
.03589			19		.10629	2.7				.18897	4.8				.284				2	.38582	9.8				.49212	12.5			
.03937	1.0				.109				12	.19291	4.9				.2874	7.3				.38976	9.9				.49606	12.6			
.04030			18		.109375		7/64			.19685	5.0				.2893			1		.390625		25/64			.49999	12.7			
.042				19	.11023	2.8				.20078	5.1				.29133	7.4				.3937	10 0				.5		1/2		
.0433	1.1				.11417	2.9				.203			6		.29527	7.5				.39763	10.1				.50393	12.8			

TABLE XXXI. DECIMAL EQUIVALENT OF AN INCH FOR MILLIMETERS, B. & S. AND BIRMINGHAM WIRE GAGES

The total maximum power drawn from the circuit with this arrangement would be about 100 kilowatts.

The machine shown in Fig. 427, was built in 1918 by the General Electric Co., in order to investigate the possibilities of welding plates from ¼ in. up. Three plates each 1 in. thick have been welded with it. The machine is provided with a 2,000-kva. transformer, having a capacity of 100,000 amp. at 20 volts. Hydraulic pressures up to 36 tons are obtained at the electrodes. Motor-generator sets of 500- and 6,000-kva. capacity were used. From the nature of the service, it was apparent that some form of cooling was needed at the contact points. It was found however, that it was impossible to water-cool the points sufficiently to give a reasonable life to the electrodes if they were kept the same diameter for any distance from the work. In consequence heavy masses of copper were placed as close to the points of contact as practicable. By doing this it was possible to have a very large cooling surface at the top of the electrode and by passing water through this part at the time of welding and between welds, the joints were kept cool enough for all practical purposes.

A portable machine for making mash-welds for splicing or attaching round or square rods cross-wise, is shown in Fig. 428. This was made by the General Electric Co., for ship-yard use.

A big machine for spot-welding electric railway bonds, is shown in Fig. 429. This is made by the Lorain Steel Co., Johnstown, Pa. It will weld two plates 18 in. long and 3 in. wide by 1 in. thick, each plate having three raised "welding bosses." Pressure as high as 35 tons is obtainable and current up to 25,000 amp. may be used.

Spot-Welding Data

It is difficult to give definite costs for spot welding, as much depends on the operator. A careless, or inexperienced operator will waste more current than a good one, and various conditions of the metal being worked on will make a considerable difference at times. However, the information given in Table XXIX, which is furnished by the Winfield Electric Welding Machine Co., will prove of value as a basis for calculations. Tables XXX and XXXI will also be useful to use in connection with the measurement of the thickness of sheets, and in comparing different gages.

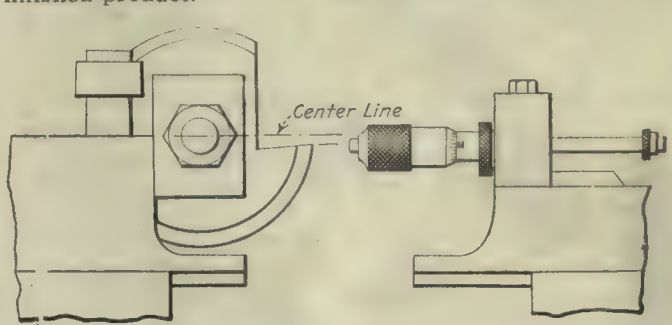
Sizing Forming Tools Without a Formula

By Arthur B. Johnson

It is understood that every automatic screw machine requires that forming tools be cut a certain distance below the center, this distance varying with different machines. To produce accurate work, the relative diameters of the different steps of the tool have to be carefully figured out.

With the method shown by the drawing, you can take the blueprint of the piece to be machined and, with an inside micrometer, set in an adjustable holder the given distance below the center, by working to the surface of the cutter, obtain the same result.

The outside diameter of the forming tool can be of any size convenient, but with the micrometer touching the tool at the required distance below the center, the cutter can be machined until the micrometer registers the same difference in the steps as is desired in the finished product.



SIZING A FORMING TOOL BY MEASUREMENT

WHAT to READ —for the man in a hurry



Suggested by the Managing Editor

STEEL stamps are used for a variety of purposes and their manufacture by hand is probably a familiar feat for most toolmakers. However, as Sheldon remarks in his synopsis of the leading article this week, it is probably not so well known that most steel stamps are made by the same old fashioned process, or a modification thereof. He goes into the details of the manufacture of these articles both on a production and on an emergency order basis. The making of stamps of brass and bronze as well as those of steel is covered and the illustrations show many types of wheel stamps, hand stamps, embossing dies, etc.

What to read was not a difficult matter to decide two hundred years ago when books were few and magazines unheard of. It is far different now when so much reading matter is offered to pass the time pleasantly or profitably as the reader chooses. We are doing our utmost to make the "American Machinist" not only profitable but indispensable as a clearing house of ideas and news of the machinery world. This page is the editors' advertisement of their section of the paper. It gives the high spots.

Fred Colvin is turning his attention for a moment from his beloved automobile shops and on page 795 he tells of some of the ingenious blacksmith tools in use in the Pacific Coast Shops of the Chicago, Milwaukee & St. Paul Railroad at Tacoma, Washington. We cannot but admire the clever makeshifts devised to do the ever varying repair jobs in the old fashioned shops of our moth-eaten railroads. But even so, we feel that it is not only a pity, but almost a national calamity, that the men charged with the maintenance of anything so important as the rolling stock of our railroads should be hampered by the lack of the proper modern tools that would save so much time, money and energy.

On page 798 we begin the first detailed article on cost systems by W. R. Basset. Two weeks ago we gave you the introductory chapter of this second section of "Modern Production Methods," and this week, as we promised, we are getting down to brass tacks. Once again Mr. Basset warns of the dangers of over-doing the red tape end of cost analysis, and shows how the well-designed charge register can simplify matters.

Following the cost article is one that we are reprinting from the *Journal of the Society of Automotive Engineers*, on "Duralumin," the aluminum alloy which has been said to be one of the indispensable factors in the success of the Zeppelin, rigid type airships of Germany. The article was translated from a German treatise by Starr Truscott, of the Bureau of Construction and Repair of the United States Navy. The field opened up by this alloy is astonishingly broad. Consequently we are sure American designers and constructors, draftsmen and mechanics will want to be familiar with its possibilities and behavior under certain conditions.

The final part, No. XXXI, of Viall's welding series begins on page 807 and winds up his series in a blaze of glory. Please do not be dismayed by the length of this installment for although it covers a good many pages a large part of the material consists of illustrations and tables and the "dope" is interesting and worth while. Spot welding machines and their work are described in considerable detail and the fine points of the art of spot welding are covered thoroughly. Those of you who prefer to have this material in handier book form will soon be able to obtain the whole series from the McGraw-Hill Book Co., Inc. This ends Mr. Viall's series but not all we have to say about welding, for we intend to supplement these articles by other individual ones on the developments in the field as they occur. Several are in process at the present time.

This week it is Glenn Quharity who comments in lighter vein on the hard life of the machinist. He takes up once more that much argued question of running the planer table off on the floor. If you don't believe it can be done read his explanation of the "accident" that led to the catastrophe and you will be convinced. Page 828a.

On the next page is a letter from our London correspondent written Oct. 1. He comments on the growth of unemployment in England and the general stagnation of industry which seems to have hit almost every one regardless of locality. The cloud of the impending coal strike which has since burst hangs over everything. An unusually interesting announcement is that of the formation of Atalanta, Ltd., an engineering works, as the British call it, run by women and employing only women operatives. England trained many women in machine operation during the war and apparently some of them like it well enough to keep at it.



Making the Shipper Stay "Put"

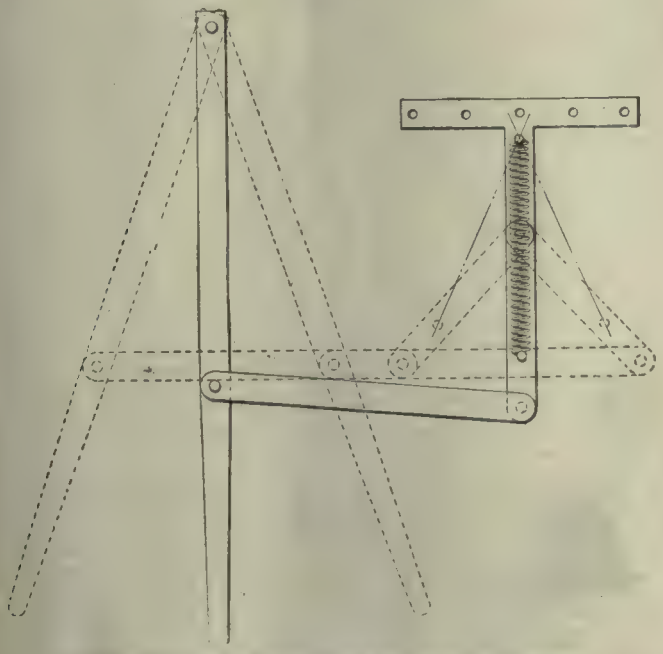
By Lew W. Spaulding

One of our workmen, while operating the bolt cutter, had trouble in making the clutch on the countershaft stay in, and, becoming tired of holding the shipper lever by hand, devised the method described below to make it stay "put." So successful was the device that it has since been applied to several clutch-levers and belt-shippers in our shop that refused to stay "in" or "out."

The device is very simple, consisting of a T-shaped piece made by welding together two pieces of ⅜ x 1¼-in. cold-rolled stock, two other pieces of the same material to act as connecting links, and an ordinary coil spring.

The base of the T is to be screwed to the timbers overhead with the projecting piece extending downward in line with, and a little to one side of, the shipper lever. The short link is pivoted to the lower end of the T, and the longer one connects the short link to the lever. The coil spring is then hooked over the projecting end of the lower pivot stud and over another stud specially placed near the angle of the T piece.

It is obvious that when the shipper lever is midway between its extreme positions the link and spring are parallel and there is no tendency for the link to move in either direction even though the spring is under considerable tension. When the lever is thrown either way from the center, the spring shortens and holds the shipper firmly in its extreme position regardless of which way it is moved.



HOLDING A CLUTCH LEVER "IN" OR "OUT"

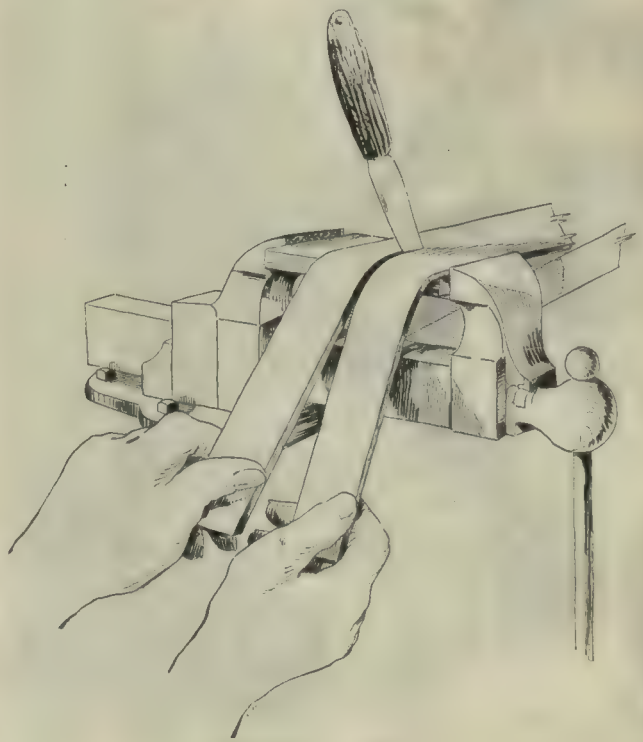
Making a Narrow Belt from a Wider One

By John A. Grill

A good way to reduce the width of a belt when a narrow belt is desired in an emergency is to put a block of wood, wider than the belt to be cut, in the bench vise with the surface of the block a little below the level of the jaws. Measure off from one jaw the width of strip of belt desired and drive the blade of a stout jack-knife into the wood.

Starting the cut with another knife, the belt may be quickly drawn through the vise, one jaw guiding the belt and the knife blade shearing it evenly and smoothly the whole length.

This is much easier than laying the belt on a long board and trimming it with knife and straight edge.



SLITTING A BELT

SHOP EQUIPMENT NEWS

Edited by S. A. HAND

SHOP EQUIPMENT • NEWS •
A weekly review of modern designs and equipment

Descriptions of shop equipment in this section constitute editorial service for which there is no charge. To be eligible for presentation, the article must not have been on the market more than six months and must not have been advertised in this or any previous issue. Owing to the news character of these descriptions it will be impossible to submit them to the manufacturer for approval.

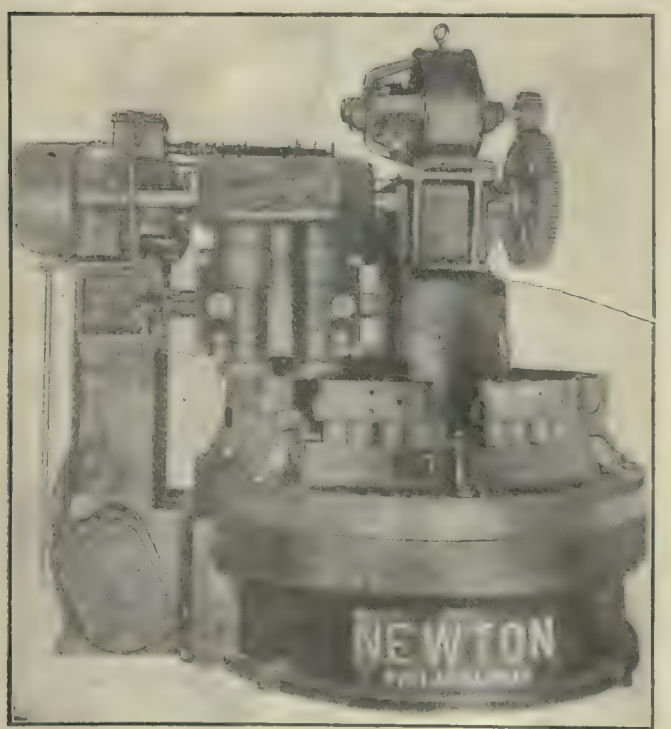
• CONDENSED • CLIPPING INDEX
A continuous record of modern designs and equipment

Newton Ring-Table Continuous Milling Machine

The ring-table type of continuous milling machine shown in the illustration is built by the Newton Machine Tool Works, Inc., 23rd and Vine Sts., Philadelphia, Pa. It is known by its maker as the second-model continuous milling machine.

The base is circular in form and is provided with a tapered column in the center. The table is fitted to the column and in addition is provided with an annular bearing close to its periphery. It is 84 in. in diameter, and the thickness from the annular bearing to the top is 12 in. The least diameter of the taper bearing between the column and the table is 36 in. The table is provided with a finished hub 42 in. in diameter to assist in locating jigs.

The central column is bolted and keyed to the base. The cross-rail and the central upright are made in one piece so as to reduce the number of bolted connections. The outer end of the cross-rail is supported by a column which is bolted and doweled to an extension of the base. The cross-rail is fitted in the front with a saddle carrying two spindles for roughing. On the back of the cross-rail is a similar saddle carrying a single spindle for the finishing cutter. The saddles for both the roughing and finishing spindles can be moved on the cross-rail, so that the spindles can be positioned to suit the work being done.



NEWTON RING-TABLE CONTINUOUS MILLING MACHINE

The drive mechanism is located on the top of the machine, a motor on the central upright being geared to a jackshaft entering the gear box on the outer column. The jackshaft is geared to the horizontal shafts, driving the roughing and finishing spindles through worm gearing. This permits independent variation of the rotative speeds of the spindles when the grade of material or size of the cutter is changed, although the speed is pre-determined and fixed for each job.

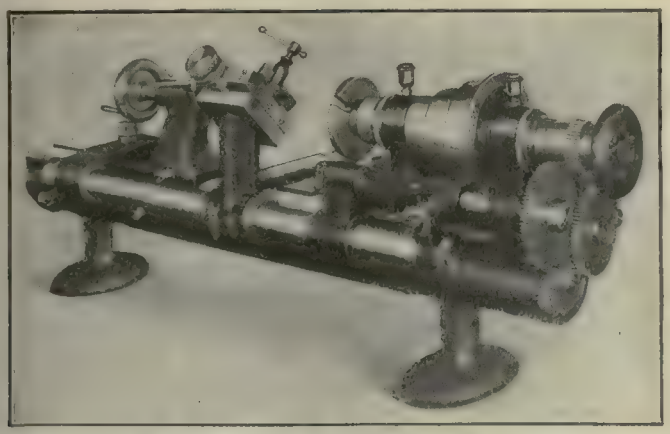
The speed of rotation of the table is also fixed for each job, but provision is supplied by which this rate of feed can be changed to suit any change in the grade of material. The operator cannot increase or decrease the pre-determined production of the machine without attracting attention. A clutch is provided for disengaging the table-driving mechanism. The table itself is rotated by means of a pinion engaging a herringbone gear 81 in. in diameter.

Different saddles providing different center distances between the roughing spindles can be furnished to suit the work. Generally the distance is either 12 or 14 in. The roughing spindles are rotated in opposite directions, the direction being clockwise for the left-hand spindle and counter-clockwise for the right-hand spindle. The distance from the centers of the roughing cutters to the center of the finishing cutter is 42 in., so that the roughing operation can be completed on a casting before the finishing operation commences. Only a very light finishing cut is taken. The spindles are independently adjustable for height. It is claimed that very rapid production is obtainable, because roughing and finishing are done at the same time.

All bearings, except the spindle bearings, are oiled by the cascade method, the oil being pumped from a reservoir in the outer upright to the box on the top of the machine, from which point it is distributed. The bearings are sealed to prevent the escape of lubricating oil and all gears are inclosed and run in oil.

Potter Thread-Chasing Attachment for Bench Lathe

For attachment to its bench lathes, the S. A. Potter Tool and Machine Co., 77 East 130th St., New York, N. Y., has recently placed on the market the thread-chasing fixture shown in the illustration. It is claimed



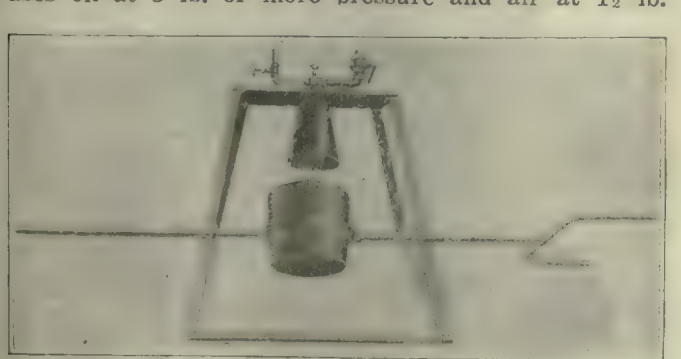
REAR VIEW OF POTTER BENCH LATHE WITH THREAD-CUTTING ATTACHMENT

that the fixture can be readily attached, fitting both the No. 5 and No. 7 lathes. It will cut threads up to 5 in. long with leads from 4 to 84 threads per inch.

The lead screw is mounted on a shaft carried in brackets at the rear of the headstock, and is driven by a train of gears from the spindle. A short section of the screw is fluted to form a hob for cutting the bronze lead-nut when necessary. The toolholder is mounted on a slide which is provided with screw adjustment and a graduated feed dial. The slide swings on a frame mounted on the chasing bar back of the bed. The tool can thus be disengaged from the cut and returned to the starting position without stopping or reversing the work. The nut, which consists of a bronze bar suitably mounted in an arm on the chaser bar, is thus out of contact with the screw when the tool is away from the work. It engages the nut again as the tool is brought into its cutting position. The proper position of the tool frame for cutting is obtained by keeping the handle of it in contact with the hardened plate placed on the bed of the lathe. It is claimed that threads can be chased very rapidly on light work by this method. Hobs and screws for various leads, either English or metric, can be furnished.

Wayne Pouring Ladle Heater

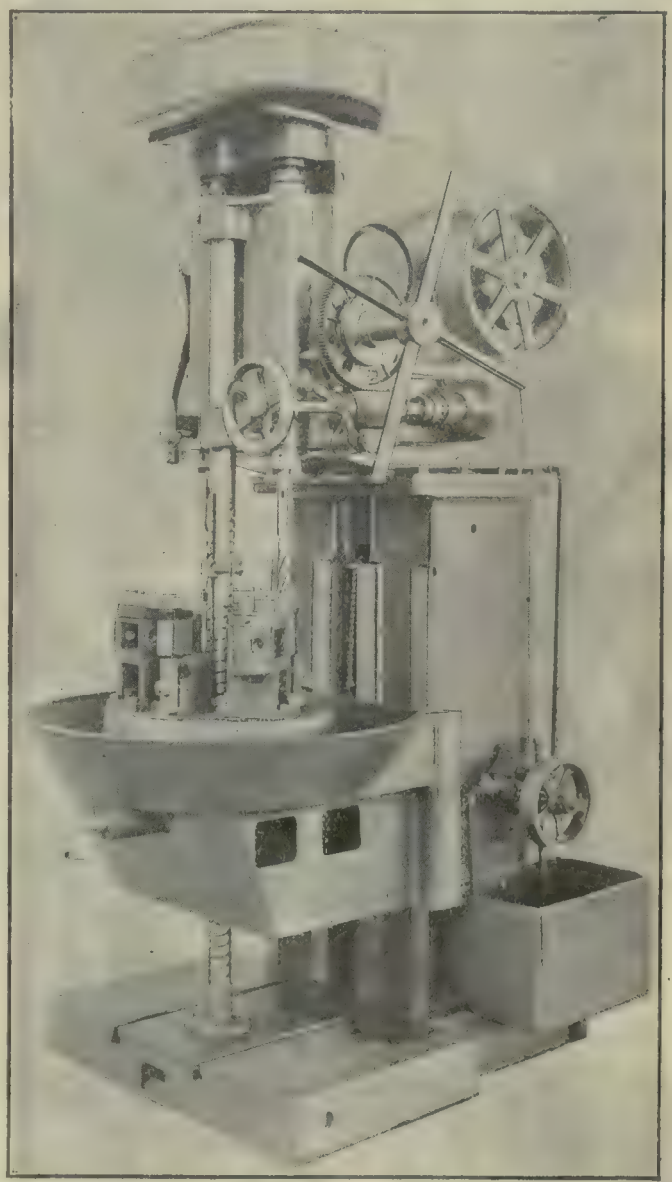
For use in connection with tilting crucible and non-crucible melting furnaces the Wayne Oil Tank and Pump Co., Fort Wayne, Ind., is building the No. 3085 ladle heater shown in the illustration. It consists of a frame upon which the ladle may be supported at various heights. There is mounted, on the top plate of the frame, an inverted burner with a cone-shaped hood to blow the flame into the ladle. The burner is designed for connection to the regular oil or gas supply lines and uses oil at 5 lb. or more pressure and air at 1½ lb.



WAYNE NO. 3085 LADLE HEATER

Baker No. 220 Two-Spindle Drilling Machine

A recent addition to the line of Baker Bros., Toledo, Ohio, is the No. 220 two-spindle drilling machine illustrated. It is built as a single-purpose production tool for successive operations and can be used for drilling, boring, counterboring, reaming, facing, etc. The indexing table affords two work stations and a loading station. The rated capacity of the machine is 2-in. diameter for high-speed drilling. The spindle centers are 10½ in. apart. The length of down feed is 12 in. Changes of spindle speed can be had by changing slip gears in the gear box on the side of the machine. These speed changes are independent for each spindle. The feed-works are the same as on the standard Baker drilling machines. The screw that extends through the center of the table is for aligning the table, raising and lowering it and locating it in the desired position. It also furnishes support to the table. The worktable revolves on ball-thrust bearings, is indexed by hand and is located in position by a hardened steel plug.

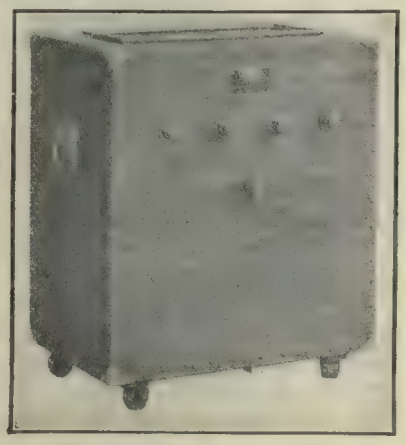


BAKER NO. 220 TWO-SPINDLE DRILLING MACHINE

Specifications: Speeds and feeds built to suit job. Weight, 5,200 lb. Floor space, belt drive, 31 x 42 in.; motor drive, 31 x 66 in. Motor, 10 to 15 hp. Height, 8½ ft.

"Weldrite" A.C. Electric Welding Machine

The Weldrite electric welding machine is built by the Electric Welding Machine Co., 500 E. Larned St., Detroit, Mich. The company recommends this device particularly for electric welding of cast-iron and repair work in machine shops and foundries. It uses a short drawn arc which, it is claimed, eliminates the necessity of pre-heating the work. The device is built without moving parts and, it is claimed, is so designed that the delivery of voltage and amperage to the work remains substantially constant for any given setting, thus maintaining a uniform degree of heat in the arc.

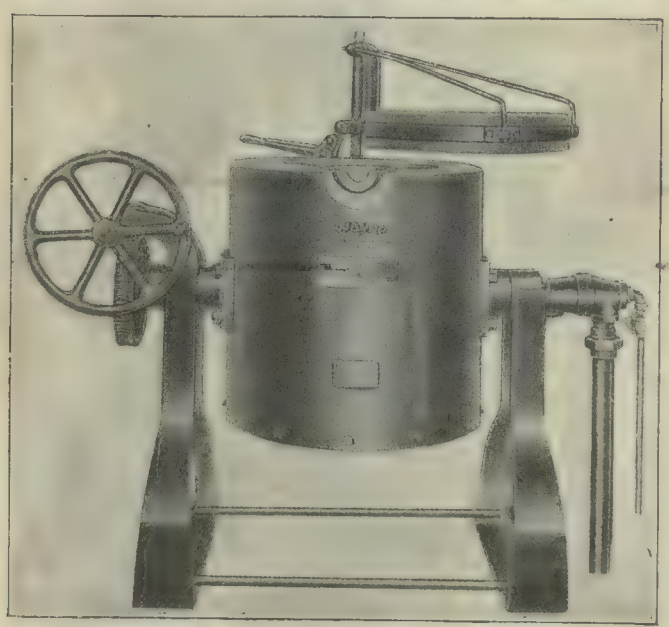


"WELDRITE" A.C. ELECTRIC WELDING MACHINE

The machines are built to be operated on 110, 220 or 440-volt alternating-current, indoors or out, where access can be had to an electric circuit of 75 amp. capacity. They are portable, the largest type weighing about 300 lb. All are mounted on ball-bearing casters.

Wayne Tilting Crucible-Type Oil-Burning Furnace

The Wayne Oil Tank and Pump Co., Fort Wayne, Ind., announces as additions to its line of industrial furnaces, the No. 3015 tilting crucible-type, oil-burning furnace as shown in the illustration. The furnace stands entirely above ground, is self-contained and is ready for connection to the oil and air supply lines. The crucible remains constantly in the furnace with the object of not subjecting it to sudden changes of temperature, nor to rough handling by tongs.



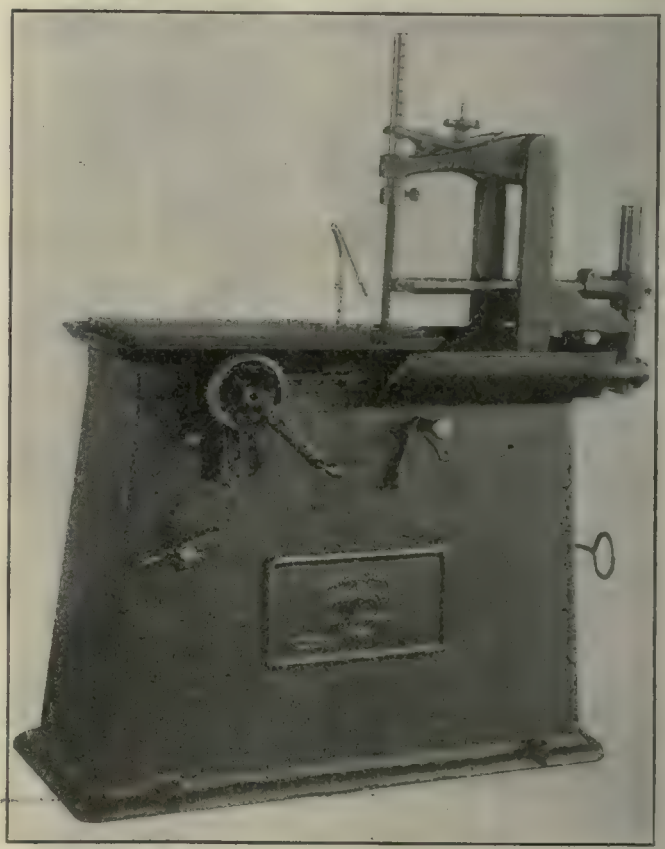
WAYNE NO. 3015 TILTING CRUCIBLE-TYPE OIL-BURNING FURNACE

Specifications—Three sizes, Nos. 3, 6 and 9. Respective capacities, 200, 350 and 750 lb. Average heats per day, 6 to 10, 5 to 9, 3 to 5. Floor space, 36 x 66 in., 39 x 68 in., 42 x 70 in. Height to cover, 3 ft. 8 in., 3 ft. 10 in. and 4 ft. Air pipe connections, 2, 2½ and 3 in. Oil pipe connections, ¾ in. Air volume required, 200, 250 and 400 cu.ft. per minute. Shipping weights, complete, 2,000, 2,500 and 3,000 lb.

The flame from the burner strikes a stool upon which the crucible stands, thus relieving the crucible from the cutting action of the flame. If desired the flame may be continued while pouring. The cover tilts with the furnace. A worm-gear drive is provided for tilting and its action serves to lock the furnace in any position. The burner is designed for air at a pressure of from 1 to 2 lb. and oil at pressure of 5 lb. or more.

Racine No. 25 Slotting Machine

The Racine Tool and Machine Co., Racine, Wis., has redesigned its No. 25 slotting machine. The original machine was described in detail in *American Machinist*, Vol. 49, page 953. The redesigned machine is shown in the illustration.



RACINE NO. 25 SLOTTING MACHINE

Specifications—Table, 12 x 27 in. Strokes per minute, 60. Length of stroke, 7 in. Drive pulleys, 3 x 10 in. Pulley speed, 750 r.p.m. Net weight, 2,000 lb. Floor space, 26½ x 57 in. Height overall, 58 in. Power required, 2 hp.

The base contains the main working parts of the mechanism and the reservoir for the coolant. The table has a slotted hole lengthwise through its center for about one-half its length which permits the table to be fed for that distance into the cutting tool.

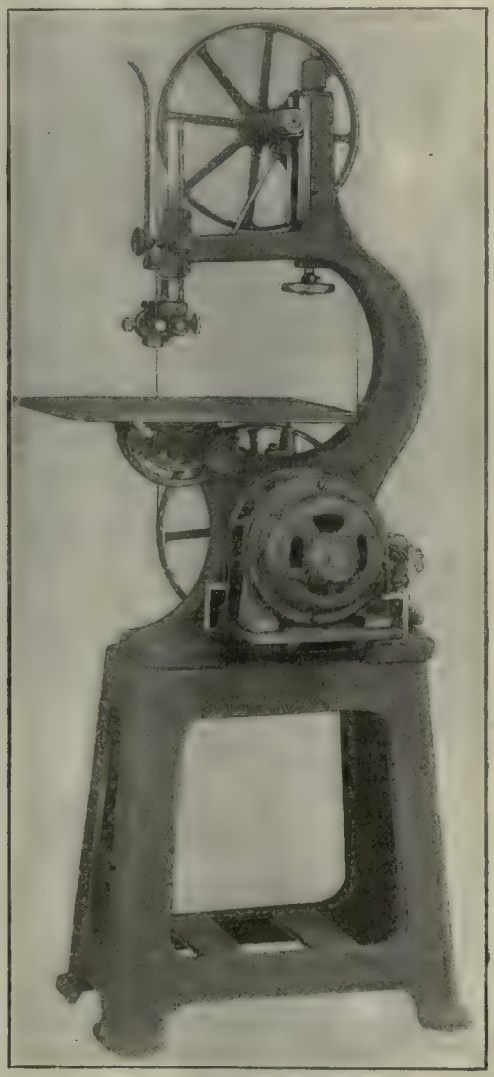
The cutting tool can be supported by an overarm or by a bracket from the rear. Its reciprocating motion is imparted by a crank-disk operating a connecting rod giving a length of stroke of 7 in. The periphery of the crank-disk serves as a cam for actuating the feed and release mechanism of the table. Feeding pres-

sure exists only during the cutting stroke as the tool is relieved from the work on its return stroke. The feed is not positive but is governed by a spring-controlled lever and the pressure of the spring and consequent rate of feed of the table are regulated by a hand lever on the front of the table. The thrust against the cutting tools is counteracted by the support of a bar which carries a small roller that fits in a spline cut in the back of the tool. The cutter coolant is circulated by a small belt-driven pump.

The machine is furnished either with tight and loose pulleys for belt-drive or with a tight pulley only for motor drive.

West Side Junior Bench Bandsaw

The illustration shows the 14-in. bench bandsaw built by the West Side Iron Works, Grand Rapids, Mich. It was designed particularly for the service of pattern shops, furniture factories, manual training schools and jobbing shops and can be used as a portable machine



WEST SIDE 14-IN. BANDSAW

or mounted on a bench when not furnished with the pedestal.

The machine is furnished either for belt or motor drive. The belt drive pulley is 5½ x 1½ in. The frame is a one-piece cored casting, carrying self-oiling bearings for the shafts. The wheels are 14 in. in diameter with 1 in. face and are covered with rubber bands. The shaft of the upper wheel runs in a double yoke-box and has a tilting device for shifting the saw-blade to the desired path. The table is 16½ x 19 in., is finish-planed and can be tilted to any angle up to 45 deg. The over-all height without pedestal is 3 ft. 6 in.

Woodison Mechanical Pouring Device

The illustration herewith shows the relative advantages of the pouring device, brought out by the E. J. Woodison Co., Detroit, Mich., over the old style method.



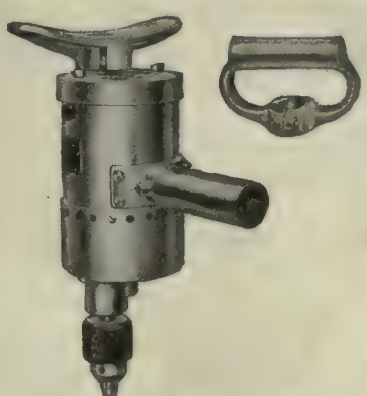
WOODISON MECHANICAL POURING DEVICE

The pouring is said to be more accurate, with fewer spills and accidents. Adjustable levers and a counterweight enable ladle capacities of over 400 lb. to be lifted 18 inches.

Arnold Type "C" Portable Electric Drill

The portable electric drill shown in the illustration has recently been placed on the market by the Arnold Electric Tool Co., Inc., New London, Conn., and 114 Liberty St., New York. The drill, known as type "C," has a ⅛-hp. motor and an idle speed of 480 r.p.m. It is claimed to have a capacity for drilling ½ in. in steel and ¾ in. in wood or brass.

The motor operates on both a.c. and d.c. current of 110 to 120 volts, although machines can be furnished for other voltages. It is claimed that the tool is very simply constructed. Each section can be removed as a unit. By removing the upper housing the commutator can be cleaned while the motor is running. The gear housing can be removed without disturbing the motor. The lower housing can be removed without disturbing the gear housing, thus enabling the armature to be taken out of the motor housing with the gear train intact.

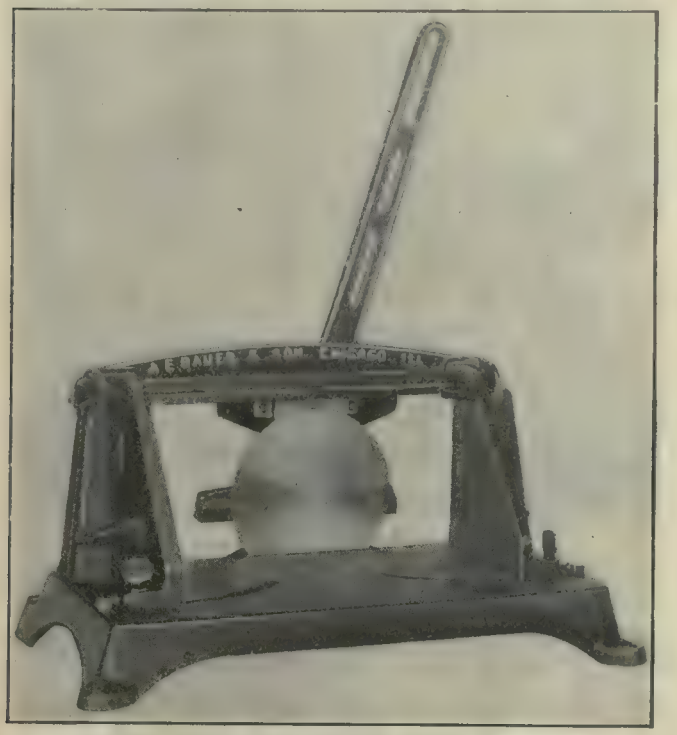


ARNOLD TYPE "C" PORTABLE ELECTRIC DRILL

The housing is made of aluminum. There are five sets of ball bearings holding the rotating parts. The switch is located in the side handle. The breastplate and the spade handle are interchangeable. Screw feed and "old-man" attachments can be furnished, thus enabling the tool to be used as a bench drill. The over-all length of the tool is 16½ in. and the weight 13½ lb.

Bauer Revolving Knife Wood Trimmer

The illustration shows the revolving knife wood trimmer made by A. E. Bauer & Son, 7021 S. Racine Ave., Chicago, Ill. It is claimed that the revolving knife cuts instead of crushes off the wood, making a



BAUER REVOLVING KNIFE WOOD TRIMMER

Specifications: Length overall, 17½ in. Width overall, 11 in. Height (without handle) 9 in. Maximum length of cut, 7½ in. Maximum height of cut, 2½ in. Diameter of knife, 5½ in. Weight, 40 lb.

straight, smooth cut with a polished surface effect on any kind of wood. The total cutting edge of the knife is 16½ in.

The guides at the ends can be set at any angle up to 45 deg. and 45, 60 and 90 deg. angles are marked on the base of the machine. There is an attachment to be used when grinding the knife.

Davis No. 1 Continuous Duplex Four-Spindle Milling Machine

The milling machine illustrated in Fig. 1 is a late product of the Davis & Thompson Co., 251 Reed St., Milwaukee, Wis., and is intended for continuous end milling and milling to length.

In each head are two cutter spindles having an endwise micrometer adjustment of 2 in. and provision for locking them in place after adjustment. The right-hand head is adjustable on the bed, permitting milling various lengths up to the capacity of the machine. The work is held in a revolving fixture as shown and the cutters are so located that the front ones do the roughing and the back ones the finishing.

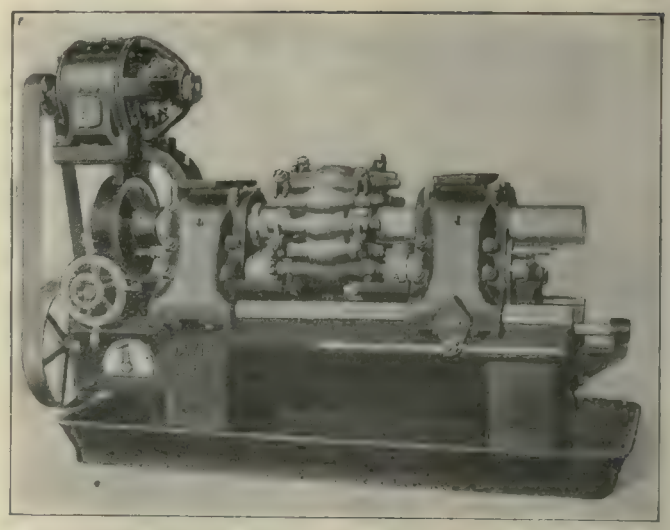


FIG. 1. DAVIS CONTINUOUS DUPLEX MILLING MACHINE

The work mandrel is supported in both heads and is rotated by worm gearing. The various feeds are by change gears at the back of the machine and the feed is engaged by a cone friction clutch. The speed gears are enclosed in an oil-tight compartment filled with transmission oil while the lubrication of gears and spindles is taken care of by oil reservoirs inside the heads.

An attachment for carrying the work without clamping is shown in Fig. 2. The clamping is automatically

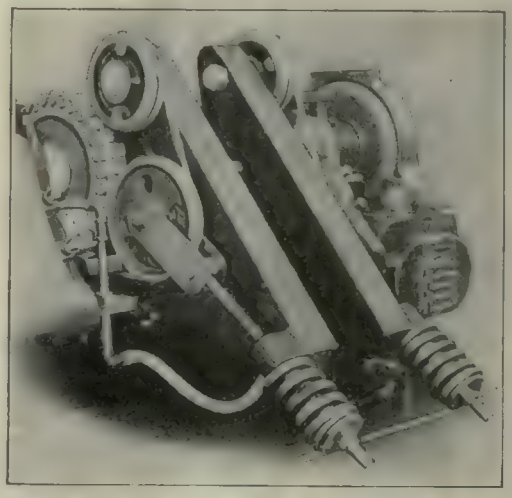


FIG. 2. ATTACHMENT FOR CARRYING WORK WITHOUT CLAMPING

done by endless wire ropes passing over sheaves and being held taut against the work by stiff springs. With this attachment it is only necessary for the operator to put in and take out the pieces at the proper station.

The Fourth Roll Call of the American Red Cross

The Fourth Annual Roll Call of the American Red Cross will be held from Nov. 11 to 25. It is neither a campaign nor a drive; it is simply the time set aside for all members to pay their dues and renew their memberships, and for new members to join. The dues are one dollar. If you are in sympathy with what the Red Cross is doing for public health in this country, for the 26,000 wounded soldiers still in hospitals and for the millions of sick and starving people in Eastern Europe, you will want to join.

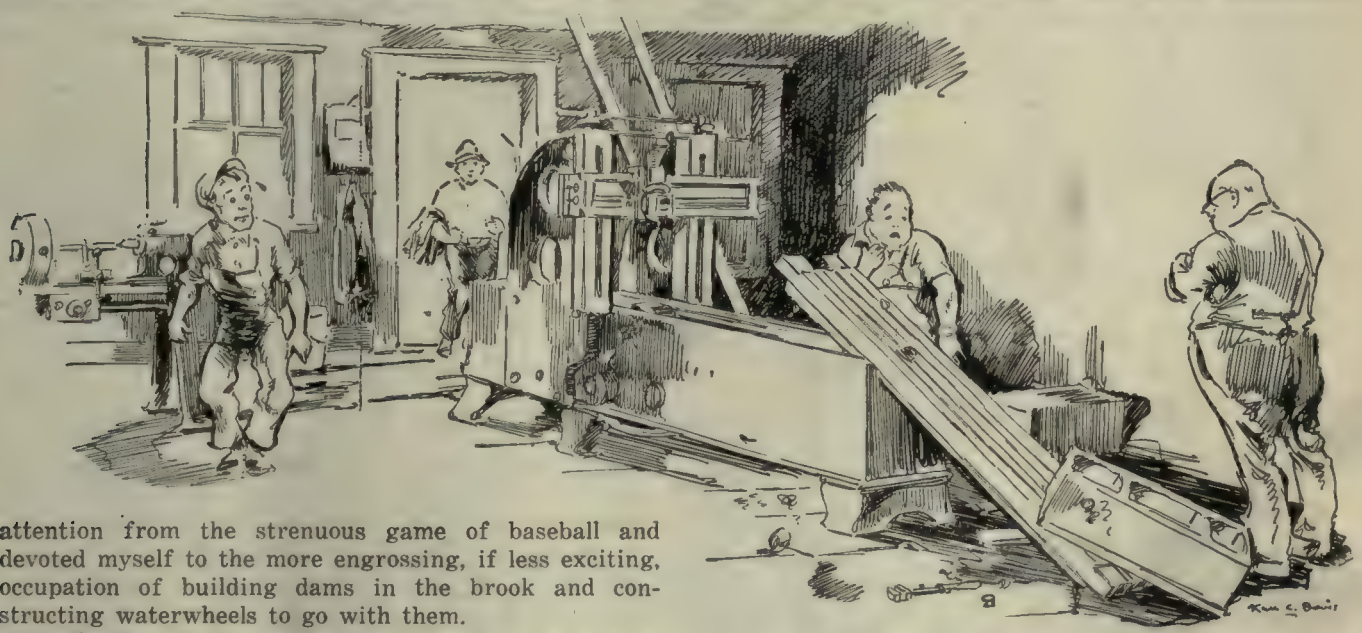
Pipe Dreams of a Tramp Machinist—Boys Will Be Boys

By Glenn Quharity

A contributor to the *American Machinist* said some time ago, I do not remember in what issue, that he did not believe it possible for a planer table, or platen, to run off on the floor. I cannot share his belief for the reason that very early in my career I not only witnessed such a catastrophe, but had a guilty hand in the causes which led up to it.

I haven't the least idea when or by whom the great American institution of baseball was invented but it must have happened long before I did, for one of my earliest recollections is of getting a baseball on the end of my nose while watching the "boys from Brookses" play "three ol' cat" in the field adjoining the Brookdell Shops. It must have been a very "soft" ball, suited to my tender years—and nose—else the latter would now be a dimple.

For a few days after that event I withdrew my attention from the strenuous game of baseball and devoted myself to the more engrossing, if less exciting, occupation of building dams in the brook and constructing waterwheels to go with them.



By the time, however, that I had reached the mature age of 16 years and was serving my time in the machine-room with some of the same men that had helped to bust my nose, I had regained my interest in baseball and during the season used to hurry back from my dinner each noon for a few minutes of ball tossing and whacking before being whistled into the shop by Bill Shailer's relentless hand on the whistle cord.

Given a dozen or more men or boys engrossed in ball playing and summon them to the sterner duties of life, though they respond conscientiously enough, it is too much to expect that their thoughts will be instantly transferred from sport to the work in hand, and so it would not be strange if there were more or less horseplay after dinner before the boys finally settled down to the afternoon's routine.

Especially if two or three boys happened to have "cuts" on lathe, planer, or shaper (and it was wonderful, the facility with which this condition could be arranged for just before noon) so that their immediate duties after one o'clock were satisfactorily discharged by simply throwing the shipper, there would be more or less surreptitious tossing of balls back and forth across the room between the belts, posts and other obstructions; which latter included workmen who did not care for baseball.

One warm afternoon, after reluctantly obeying Bill's clarion call, several of us boys found (much to our surprise) that all we had to do to get to work was to start up our machines and throw in the feed. I had a big bronze bushing in the lathe chuck and was boring it out by my favorite method of turning the tool bottom side up, running the lathe backward, and feeding toward the tailstock. (Did you ever try it? "Charlie" Pratt taught me the trick and it is astonishing how it will quiet a "chattery" lathe on such jobs).

Fortunately, as I thought, the cut had just been started. It had taken a deal of grinding and setting to get that tool in just the right position at twelve o'clock, but I did it, and so this afternoon I had nothing to worry about until the tool had traversed the 14-in. length of a 10-in. diameter bushing. Further, if I didn't happen to notice it at the exact instant that the tool came out of the work, why, it was a long bed lathe, and somebody would probably call my attention to the fact that I was "cutting wind" before the carriage reached the tailstock.

Fatty (*not* Fatty Arbuckle) was running the old planer down in the dark corner of the room. (Fatty was so called because of his avoirdupois; at the age of 17 years he was 5 ft. 4 in. high and weighed 174 lb.) He was a wizard (for a second year boy) on the old planer, and though he didn't like it very well, much preferring the new milling machine up near the boss' desk, he used to be assigned to it quite often; "just out of pure cussedness" he was wont to grumble.

The old planer, which I think was built by the Phoenix Iron Works of Hartford, Conn., had a comparatively short bed, with a table that, though short in itself, was long by comparison. It had four pulleys on the first shaft and only one belt, which drove first the outside pulley and then the inside one as the table travelled back and forth, the belt at each reversal passing across two loose pulleys placed between the tight ones.

Fatty was planing up the edges of a large iron flask which covered nearly the entire surface of planer table. "Just as good a job," says Fatty, "as if it was solid—

it lasts just as long and you don't have to grind the tool so often."

"Bunk" was running the milling machine (Bunk didn't mean the same thing then that it does now, and was not a term of opprobrium). He was cutting a rachet—a job that Fatty had wanted—and had his hands free only at intervals.

The boss not having shown up after dinner, Fatty and I were passing the ball back and forth across the room while Bunk looked on with envy from the opposite corner. Catching the ball at a moment when Bunk had his hands free, I sent it spinning down the long line of lathes, just missing the heads of half a dozen men who had just as soon have soused me in the brook as not, to where Bunk stood with hands up ready to receive it. Making a neat catch, Bunk instantly shot the ball diagonally across the room to Fatty who, somewhat confused by the new direction, muffed it and allowed it to fall into the reversing mechanism of the planer at a most psychological moment.

I say psychological advisedly. The planer table had arrived at the end of its reverse stroke; Tom Jones, the boss, had just blown in at the back door, which was nearest his house; Mr. Brooks, our principal owner and executive, had chosen that exact moment to frame his portly presence in the doorway leading through the shop to the office.

The ball having jammed the levers of the planer, the belt stopped on the loose pulleys, but the table did not stop. Oh No! It kept right on going until the end overbalanced, then it stood up endwise, the holding straps which Fatty had used to fasten down the job were not equal to the strain from the new angle, and the 500-lb. casting toppled over at the feet of Mr. Brooks, ending the rattle and crash of falling tools and bolts with a thud that shook the rafters.

Everybody (except Bunk and I) looked at everybody else, and Fatty with his hair standing on end, looked at all of them. Both Bunk and myself were so completely absorbed in our work that one glance was sufficient to disclose the culprits to Tom and Mr. Brooks.

Inventory was taken of the damage (which was slight) and then, obeying a significant crook of the "old man's" finger three crestfallen lads marched off to the office to listen to a long and solemn admonition against the evils of thoughtlessness, carelessness, and inattention to business; concluding with an estimate of the direful things that *might* have happened had not a wise and beneficient Providence, of which we were entirely undeserving, intervened.

Mr. Brooks did not scold; he was too wise to the ways of boyhood to do that; but he had a masterful way of bringing home to boys a realization of the enormity of their offenses; the fulness of forbearance displayed by their elders, and the wonderful things that were sure to result if they placed Business before Pleasure and made the most of their opportunities.

We three boys went back to our respective jobs with the feeling that our old man was the best old man in the world and that we (with reservations) were the meanest and least deserving of his creatures. I wonder if labor agitators, and other people who live by making trouble for others, would not have a harder row to hoe if there were more employers like our "old man?"

Business Conditions in England

FROM OUR LONDON CORRESPONDENT

LONDON, Oct. 1, 1920.

MOST people are now ready to admit that Great Britain has entered on a period of decreasing employment. For this various reasons are adduced, strikes and fears of labor disputes being prominent. Everybody was relieved when the coal strike was postponed, if only for a week. Most people were confident—wrongly, as it turned out—that in that period a satisfactory working arrangement could be reached as the result of the series of conferences between representatives of coal owners and workmen. The demand for the reduction of 14s. 2d. in the price of household coal is of course withdrawn, but the claim for a 2s. per shift wage advance is persisted in. Agreement will probably depend on whether the miners continue to claim this advance without conditions, or whether they will allow it to be dependent on a really, and not merely camouflaged, increased output.

Decline shows itself clearly in shipbuilding and engineering, in the textile trade, in the shoe industry, and to some extent in drapery and furniture. On the Clyde unemployment is increasing, and about 3,500 shipyard workers and 1,500 engineering workmen are said to be looking for jobs. South Wales is another area of increasing unemployment in the metal trades, and engineering firms in the Openshaw district of Manchester are dividing their forces into halves, each working alternate weeks.

THE MOTOR INDUSTRY

The condition of the motor industry has long been a subject of general and, it may be added, not always instructive conversation. Receiverships and imminent failures generally have been freely asserted. The stoppage of the Sopwith firm, maker of the A.B.C. motorcycles, and the shutting down of the Vulcan branch of the Harper-Bean combination, are about all that at present need be noted. But unemployment in this section of the engineering industry grows, and of all things which can be imagined overproduction has been adduced as the cause. Not long ago the position was that one could not possibly get delivery; now customers are much more likely to forfeit deposits and refuse to accept cars. The coming change in the basis of taxation—from petrol to power of engine—will probably not ease conditions. The decline in the French automobile industry is described as almost catastrophic. In Great Britain several instances of price reduction have been announced, the latest being Vauxhall Motors, Ltd., which reduced the price of its 25-hp. car (now £1,450) by £300, and of its 39- to 98-hp. cars (now £1,675) by £285.

What, it seems, will not be generally recognized is that high prices are the cause of the decline. High prices are largely the result of high costs of production. Taxation, both national and local, has a crippling effect, and the high cost of labor shows itself again in the price of so-called raw materials. Then, too, while the rate of production has sunk, credit and currency have multiplied. How to reduce labor costs is the problem, the solution to which is by no means obvious. Reduction of wages is not usually even hinted at. Instead, higher production is pressed for, if that is the right phrase.

HIGH PRICES HAVE LED TO DECLINE OF DEMAND

High prices have at last led to decline of demand and the only obvious stimulus is their reduction. The whole subject was discussed at a special conference held last week at Olympia, W., during the run of the machine-tool and engineering exhibition. Here G. N. Barnes read a paper on un-

employment, production, etc., under the auspices of the Industrial League and Council, an organization that exists for the purpose of bringing employer and employed together with a view to harmonious working. The conference was attended by about 250 people, a large proportion of whom were delegates—somewhat youthful—from the Amalgamated Engineering Union. The latter almost without exception urged control of the industry by workpeople and it is evident that the Italian example is being watched very carefully.

This does not imply more opposition to industry; the purpose is to reconstruct industry on a new basis.

In the same hall a conference was held the next day on safety first in factories. Here G. Bellhouse, deputy chief inspector of factories, drew attention to the example of America, which, he suggested, by the experience of some twelve years showed that with proper safety organization three-quarters of all accidental injuries could be eliminated. This will not be readily accepted as applying in the same proportion to Great Britain. The Home Office here, through its factory inspection department, has always paid very close attention to the safeguarding of machinery and to anything else likely to prevent accidents in workshops and factories. To take an example, it was only the insistence a few years ago of the factory inspectors that overcame the objection of certain machine-tool manufacturers to the guarding of cutters on milling machines.

The Machine-Tool Exhibition

The machine-tool exhibition as a show of machine tools was undoubtedly a success. Good design and finish were evident in the standard tools which were displayed prominently by British makers. It was clear, too, that, to take a detail, the production of abrasive wheels is extending in England, and a marked feature was the considerable number of gaging and measuring appliances for the engineering workshop as made by firms for whom Alfred Herbert, Ltd., acts as agents, and by others too. Note may be made of the glass surface plates by Leonard & Co., Ltd., Croydon, guaranteed to within 0.000025 in. The thickness of the glass is from ¾ in. to 1¼ in., according to size of plate, the standard sizes at present ranging from 6 in. by 4½ in. to 24 in. by 19 in. The glass, it is asserted, will not mature or distort with passage of time and is immune from effects of temperature changes, at least as common in the workshop.

Among the Swedish tools was one pronounced copy of an American production: but for the most part the machine tools from Scandinavia were of standard form. Exception can be made of the Bergstrom four-cutter semi-automatic machine for grooving and backing-off two-lip twist drills, in sizes up to 1¼ in. in diameter; a $\frac{5}{16}$-in. high-speed steel drill 3 in. long on the flutes, for instance, being grooved and backed-off in two minutes. The American tools shown—milling and grinding machines may be mentioned—certainly prevented any tendency on the part of the British maker to mere self-satisfaction.

Commercial Results of the Exhibition

As to the commercial results of the exhibition, opinions are naturally somewhat conflicting. The writer knows of relatively small and new firms who certainly did well, more particularly during the first week or fortnight. One firm with a fairly large stand sold it four times over the first ten or twelve days and then did practically nothing. Several of the larger firms were not particularly enthusiastic, though of course many inquiries have been received which may bear good results. The promoters certainly did their best to insure that the exhibition should be visited. Apart from advertising, both in Great Britain and on the European continent, they sent out 12,000 invitations all over the world, and engineers attended from France, Belgium, Switzerland, Holland and Scandinavia. Overseas Britain sent many representatives; in fact one exhibitor concluded that the population of Australia is about five millions—all machinery agents.

From today onward rates of wages in Great Britain will be a matter for direct settlement between employers and employed, but with the agreement of both parties an industrial court may arbitrate. Whitley councils are of course trade courts at which such matters are discussed; in fact in some instances the chief work of these councils so far has been the settlement of the exact amount of increase to be made in wages rates. They can if they choose go a good deal further, and enthusiasts have suggested these councils as a means of settling all the problems incidental to employment. They suffer however from a serious defect, being incompletely representative. Apart from other points, consumers are not represented. In short, to take wages only, by agreement these have in many instances been raised, this applying also to prices. In the end, as was suggested at the luncheon held during the course of the conference on unemployment mentioned, something like a general strike has been entered into by the consumers, and a declining demand is leading to lessening employment. As to wages, engineering workpeople have been making claims for another 6d. an hour, with a corresponding increase in piece rates; the matter has yet to be decided. Conferences have been held on overtime working and similar affairs and seem likely to be settled amicably on a national basis.

Women Workers Employed Entirely by a New Firm

The prospectus of Atalanta, Ltd., is shortly to be issued, the company being in the process of formation, with a factory in the Midlands to undertake engineering work. It will be run completely by women, though it would seem that the directors are to include mere males. Machinery is now being ordered and it is expected that work will be started in the course of a few weeks. We have here a Women's Engineering Society, and Miss C. Hazlett, its secretary, has stated that Atalanta, Ltd., has accepted a sub-contract for the machining of parts of a new pump ordered by the French government and that work in connection with hosiery needles will also be undertaken. Apparently a works in Scotland, where women received regular engineering training during some years of the war, is to be drawn on for personnel, with other women workers who have had experience in machining operations in munition factories. All the employees will be shareholders. No one would assert that the women who were so usefully engaged in engineering workshops during the war period have been generously treated. They have been discharged to make room for the returning male worker and where attempts have been made to retain the women legal means have been sought, with success, for removing them. The firm of Atalanta, Ltd., is intended to give women freedom to use such engineering ability and skill as they may possess. The works will commence operation on a small scale, but will be extended as required.

Meanwhile as regards the employment of women in industry, mention may be made of the fact that the factory inspection department of the Home Office is apparently being reorganized and that the twenty-one women inspectors will shortly receive additions to their numbers. Further changes are anticipated in the direction of putting women on an equality with men. Then as regards women in the civil service, the post of director of women's establishments has been instituted and the chief woman inspector to the Board of Education has, in fact, been appointed to the position.

British revenue returns for the first half of the current financial year have been published today and indicate a total revenue during the six months of £619,299,498. The increase as compared with the same period last year is rather more than 160 millions, but the sum of more than 115 millions obtained from the sale of war stores is included. The excise returns, £88,846,000, represent an increase of no less than £37,621,000, but customs receipts are lower by 4 millions, their total being £67,834,000. Property and income tax returns increased by about £16,818,000, but a decline is shown in excess profits duty of £20,487,000. Property and income tax, etc., in fact raised £126,335,000, and excess profits duty £109,400,000. During the past half year the net reduction in the floating debt amounted to £30,297,000, and the net sales of war savings certificates amounted to £3,450,000.

SPARKS FROM THE WOR

Valentine Francis

The Leipzig Technical Fair and the Outlook of the German Machine Industry

Few Deals Were Closed at Fair—Difficulties Encountered in Executing Large Foreign Orders Placed a Year Ago—Outlook Not Favorable

The Leipzig fair is over—and its result may be considered a true reflection of the present trend of business in Germany. No effort was spared by the management to attract both inland and foreign visitors and an extensive and well-organized propaganda campaign was carried to that end. It would be misleading, however, to assume that industrial circles were under a delusion when planning the fair, for it was almost universally realized that in view of the obtaining stagnation of business in Germany, no great volume of business could be expected and it is no exaggeration to state that the recognition of the aforementioned fact determined the whole character of the fair. The unabating stagnation of business and the steadily increasing cancellations of foreign orders rendered a rally of the German industries absolutely imperative. A demonstration of the productive capacity and efficiency of the German machine industry was needed and the Leipzig Technical Fair was considered an ideal medium. From a purely organizing and exhibitive point of view the Fair was a brilliant success; from the business viewpoint it was a pronounced failure.

The outstanding feature of the fair was the marked improvement both in the design and the construction of German machinery products. A return to pre-war standards of efficiency as regards quality of material and workmanship was plainly noticeable and the determination of the German machine industry to regain the lost foreign markets by sheer "quality first" products is strikingly illustrated by the fact that the various substitute metals and materials are fast disappearing. Wherever such substitute materials have proved their serviceableness beyond doubt, they are retained with a view of cheapening production.

As at the last technical fair in the spring of 1920, the collective exhibition of the Association of German Machine Tool Manufacturers formed again the center of attraction, showing a great variety of fine specimens of modern machine tools and revealing many interesting departures in the design of German machine tools. The latter feature was particularly noticeable in grinding-machine construction, there being a distinct tendency to devote increased attention to the design where the operation is finished by the entire width of the wheel without longitudinal shifting of either the piece or the wheel.

Another striking feature of the fair was the progress made in the construction of automatics and semi-automatics as evidenced by the exhibited specimen and it was interesting to note that many types were clever copies of the Gridley. There were also a great variety of exhibits of planers and drilling machines, many of which showed the influence of American trend of design.

It would certainly take up too much space to enumerate all the branches of industry represented; suffice it to say that the fair afforded a splendid opportunity to become acquainted with the standard lines of German machine manufacturers as well as to gain an idea of the novelties and improvements introduced during the year.

There were approximately 3,400 exhibitors at the Fair which was visited by about 34,000 people. As was remarked at the beginning, very few deals were closed, customers adopting a rather reserved attitude on account of high prices, and a tendency to hold back with orders in anticipation of a break of prices in the near future was noticeable.

That this anticipation is not entirely unjustified is clearly shown by the report made by one of the leading personalities in German industrial life, Director Becker, of Cologne, at the annual meeting of the Association of German Machine Manufacturers held at Berlin in the middle of September. In the course of his statement on the economic situation of the German machine industry he emphasized the difficulties with which the industry was confronted in executing the many and large foreign orders placed a year ago. While the cost of labor, raw material, overhead charges, etc., was rapidly advancing, the depreciation of the mark increased to an alarming extent, resulting in serious losses to the industry in general though many works succeeded in weathering the storm by reaching an understanding with their foreign customers. Something like a catastrophe set in when the mark improved and thereby automatically raised the price of German machinery above the world's market level. In spite of a reduction of prices, the German industry was unable to carry that reduction so far as to be able to compete effectively with the industries of foreign machinery-producing countries, with the result that a falling off of orders and cancellations were steadily increasing.

As regards export possibilities, Director Becker stated that outlook was anything but favorable, seeing that most of the former neutral countries were on the whole well supplied with machinery products, while Eastern and Southeastern Europe did not enter into consideration at all. Italy, France and Belgium were fully able to supply their own industries themselves while such goods as had to be imported were chiefly ordered in Great Britain or the United States. According to his opinion, the latter two countries had lost their importance as a purchasing factor for the German machinery export industry; moreover, they had now become formidable competitors in the world's markets wnere their influence—chiefly by reason of financial interests—is being increasingly felt. Continuing, the speaker dwelt upon the far-reaching results of the business stagnation in Germany.

Inland sales being practically nil, many works had to reduce working hours or shut down altogether for an indefinite period and the unemployment would have been even more pronounced but for the fact that many works are still busy on orders contracted last year, or are manufacturing stock. The latter policy, however, could not be carried on indefinitely seeing that there are large stocks of machinery valued at several million marks without there being any reasonable hope of a speedy clearing. The principal reason for the lagging of inland sales, he declared, was to be seen in the enormous extension of machinery-using plants during the war. Orders being few and far between now, many of those plants were selling their entire equipment to foreign firms, thus aggravating the difficulty of the export industry. Director Becker foreshadowed that legislative measures will be taken with a view of putting a stop to that practice. In conclusion he pointed out that a reasonable reduction of prices should be effected quickly and emphasized the fact that no improvement of the general situation could be hoped for unless the machine industry determined upon a reconstruction of its program by devoting all energies to standardization and specialization of manufacture, while a recovery of the foreign markets will be intimately connected with a further reduction of the cost for raw materials, abolishing the export duty, setting a limit to further wage claims and improving the lowered capacity and efficiency of the works.

LD'S INDUSTRIAL FORGE
News Editor

Machine Builders Meeting Changed from November to December

We have just received word that the annual meeting of the National Machine Tool Builders' Association will be held at the Hotel Astor in New York City on Nov. 11 and 12 instead of on Dec. 4 and 5, as previously announced.

Money and Markets

CREDIT SITUATION

The downward revision of prices continues to be the factor dominating the general business outlook. The movement is a natural and inevitable corrective of the unstable condition created in the previous period of rising prices, reckless public buying and widespread speculation. Falling prices are not a recent development. Before the close of 1919 the prices of a number of important commodities had begun to decline. By spring of 1920 a definite downward trend had been established. Since then the movement has been accelerated, until within recent weeks it has forced general recognition that the period of excessive buying at rising prices has definitely ended. Business must now go forward on a lower price level. This readjustment cannot be affected without embarrassment in individual cases. It will be effected, however, without serious general results by reason of the inherent strength of the credit situation and the assured co-operation of the banks with business.

The banks are amply prepared to finance business while it is working out a more normal basis of operation and a stable level of prices. This process will require the employment of a large volume of credit. Inventories cannot be disposed of abruptly. In many lines, owing to general indisposition to buy, their liquidation must be effected very gradually.

Stabilization on a new price basis does not involve a return to the pre-war price level. For nearly two decades prior to the war, prices have been rising steadily. On economic grounds this rise might reasonably have been expected to continue, had there been no war. Moreover, the improvement effected in our credit and banking machinery since the inauguration of the Federal reserve system now enables a given gold reserve to finance a greater volume of business at higher prices than was practicable in the pre-war days. The country's present gold reserve greatly exceeds the pre-war reserves, and will have a sustaining influence on the new price level.—*National Bank of Commerce.*

Judge Gary, Before Iron and Steel Institute, Says Price Reductions Are a Healthy Sign

Believes Former Levels Were Outrageously High — Declares That Business Skies Are Without Clouds and That U. S. Steel Men Should Co-operate With Other Nations

"Recent decreases in the volume of new business and voluntary reductions in selling prices in some departments of the iron and steel industries reflect a decidedly healthful condition," Elbert H. Gary, president of the American Iron and Steel Institute, and chairman of the United States Steel Corporation's directorate, said on Oct. 22 at the semi-annual meeting of the institute in the Hotel Commodore, New York.

Additional F. A. E. S. Members

KANSAS ENGINEERING SOCIETY. The Kansas Engineering Society, by letter ballot, has voted to become a charter member of the Federated American Engineering Societies and has named Lloyd B. Smith as the delegate to represent the society at the first meeting of the American Engineering Council on Nov. 18-19, 1920.

ALABAMA TECHNICAL COUNCIL. The Alabama Technical Council at its regular meeting on Oct. 1, 1920, voted to become a charter member of the F. A. E. S.

Judge Gary counseled that the manufacturers be "reasonable and just," reducing prices "if and when other reductions and costs permit, and then with level heads and honest convictions stand solidly as against panic and lack of confidence in the industrial situation."

"The people have cause for confidence in the business future," Judge Gary emphasized. He analyzed the philosophy behind the post-war price movement by suggesting that as there was a scramble for higher and still higher prices there will be its equivalent in selfishness in the enforced reduction.

Judge Gary said that in his recent tour of Europe he found the steel mills of Belgium and France working day and night. He said France and Belgium need and deserve financial and commercial assistance from the people of the United States, and, he added, this will be accorded. His opinions on the business outlook were as follows:

"Although this is a time for courage, composure and caution, the business skies are practically without clouds. It is up to the business men and women to maintain certain and continuous business activity in satisfactory volume with fair and reasonable profits.

"In certain lines of the iron and steel industry there have of late been some decreases in the volume of new business and also voluntary reductions in selling prices. I consider this decidedly healthful. All, or nearly all, of us have for months been unable to supply the demands of our customers as to quantities or deliveries and our prices, considered as a whole, have resulted in profits. As a matter of course some adjustments will need to be made. The average of the general scale ought to be reduced equitably and relatively. Without referring to individual cases or lines of general business, I believe in many instances prices have been outrageously high. This observation applies more especially to middlemen, so called, and to smaller departments of industry.

"Now a general public, including particularly those who are neither sellers nor buyers to a large extent, will in one way or another bring about a fair and reasonable adjustment of prices. The law of supply and demand will be the principal factor.

"Let us be reasonable and just, reducing our prices if and when other reductions and costs permit, and then with level heads, clear minds and honest convictions, stand solid as against panic or lack of confidence in the industrial situation. Let us strive to be right. If we are right we can be determined and courageous. Let us as individuals consider the interests of all others.

"The people of the United States have reason for confidence in the business future. They need not be discouraged nor impatient. Love of country is the rule. Indeed, it is the habit.

"I think the members of the Iron and Steel Industry of the United States, up to the full limit of propriety, should co-operate with those of other countries.

"The onward march of progress is moving rapidly. We may and will be a part in the procession and, in a measure, assist in guiding the course. I have heretofore publicly said, quoting

from the Bible: 'As no man liveth to himself so no nation liveth to itself.' This is applicable to the present period."

At the banquet in the evening an address by H. Cole Estep was read by John A. Penton on the European iron and steel industry. He said that with the American dollar holding the same relative position in the world's moneys American iron and steel prices were higher than those of any country, but with the exchange rates of the different countries favoring the United States American iron and steel prices were the lowest. He stated that Great Britain is the only country that the United States has to fear in the export trade during the next two years, and that England is the only country in Europe today producing more iron and steel than prior to the war. In speaking of the future possibilities of American exports, Mr. Estep said that America's best chance was to export billets and plates to Great Britain and that there would develop a large increase in our export trade as Europe became able to invest in larger and larger enterprises.

George Otis Smith, director of the United States Geological Survey, said that while the unmined resources of the United States were billions of tons, that at the present rate of consumption there was need of conservation. He indorsed Hoover's recent statement that the bituminous coal industry was the worst functioning industry in existence.

During the morning session, C. P. Perin, a consulting engineer of New York, addressed the institute on the "Industry and developments in the iron and steel industry in India"; A. H. Holliday, manager of exports, Jones & Laughlin Steel Co., Pittsburgh, Pa., spoke on "Foreign Trade," while in the afternoon F. L. Toy, superintendent open hearth department, Homestead Works of the Carnegie Steel Co., read a paper entitled "The Basic Open Hearth Process"; D. M. Buck, of the American Sheet & Tin Plate Co. had one on the "Review of the Development of Copper Steel."

Detroit Twist Drill Co. Opens Canadian Plant

The Detroit Twist Drill Co. has announced the establishment of a manufacturing plant in Walkerville, Ontario, known as the Canadian-Detroit Twist Drill Co. The Detroit company decided several months ago that the growth of Canadian industry warranted the construction of a plant across the border, and the new company was accordingly incorporated. High-speed drills and reamers will be manufactured and a complete stock will be built up as soon as possible. The nucleus of the Walkerville organization was formed from the personnel of the Detroit plant. About thirty men will be employed at the start and the company expects to expand as fast as business conditions warrant.

H. M. Houston Joins Stamets Force

The policy of the William K. Stamets machine tool organization, of Pittsburgh, Pa., is to continually enlarge and strengthen its staff of salesmen, engineers and executives. On October 1 H. M. Houston, who recently resigned from the Houston, Stanwood & Gamble Co., takes up executive duties as an active member of the William K. Stamets organization. As Mr. Houston has been in close touch with the Stamets organization for a term of years, he is with old friends and is not entirely unfamiliar with his new duties.



H. M. HOUSTON

Tentative Annual Meeting Program of the A. S. M. E.

The 1920 annual meeting of the American Society of Mechanical Engineers will be held in the Engineering Societies Building, 29 West 39th St., New York, on Dec. 7 to 10, 1920.

Special attention is called to the Keynote Session to be devoted to the subject of Transportation. Invitations have been issued to authorities in the sub-divisions of Railroads, Waterways, Terminals and Motor Trucks, and an especially strong speaker has been requested to present the broad phases of the entire problem.

Keynote Session on Transportation

The following phases of the Transportation Problem will be discussed by authorities in this field:

Railroads, Feeders, Waterways, Motor Trucks, Terminal Problems in New York City.

Sessions of Professional Sections

Fuels:
Fuel Supply of World—L. P. Breckenridge.
Low Temperature Distillation of Coal—O. P. Hood.
Fuel Conservation versus Money Conservation—D. M. Myers.
Form Value of Energy in Relation to Its Production, Transportation and Application—Chester G. Gilbert, Jos. E. Pogue.

Machine Shop:
Side Cutting of Thread Milling Hobs—Earl Buckingham.

Management:
The Life and Work of the late Henry L. Gantt.
Mr. Gantt's Contribution to Industry—Fred J. Miller, Pres. A. S. M. E.
Mr. Gantt's Contribution to Shipbuilding, Ship Operation, Ordnance and Aircraft—Marshall Evans.
The Culmination of Mr. Gantt's Work—E. A. Lucey.
An Appreciation from France—M. Ch. de Freminville.
An Appreciation from Great Britain—James J. Butterworth.
Mr. Gantt's Industrial Philosophy—W. N. Polakov.

Railroad:
Static Adjustment of Trucks on Curves—R. Eksergian.
Increasing Capacity of Old Locomotives—C. B. Smith.
Modernizing Locomotive Terminals—Geo. W. Rink.

Textile:
Humidity Control in Textile Plants—Author to be announced.
Power Application to Finishing Plants—Leo Loeb.
Textile Fabrication for Mechanical Purposes—J. W. Cox.
Ventilation of Dye Houses—D. W. Andrews.

Power:
Session devoted to Consideration of Future Development of Power.

Special Sessions

Woodworking:
Engineering in Furniture Manufacture—B. A. Parks.
Use of Wood for Freight Cars—H. S. Sackett.
Woodworking Education—F. F. Moon.
Wooden Hollow Ware—John L. Graham.
Wooden Factory Flooring—L. T. Erickson.
Wood Preservation—E. S. Park, J. M. Webber.
Electrically Operated Saw Mills—A. E. Hall.

Research:
Calibration of Nozzles for the Measurements of Air Flowing into a Vacuum—Wm. L. de Baufre.
The Heat Insulating Properties of Cork and Lith Board—A. A. Potter, J. P. Calderwood, A. S. Mack, L. S. Hobbs.
The Flow of Fluids through Pipe Lines and the Effect of Pipe Line Fittings—D. E. Foster.
Steam Formulae—R. C. H. Heck.

Design:
Disastrous Experiences with Large Center-Crank Shafts—Louis Illmer.
Tests of Truck Rear Axle Worm Drive—K. Heindlhofer.
Foundations for Machinery—N. W. Akimoff.

Miscellaneous:
The Constitution and Properties of Boiler Tubes—A. E. White.
Armor Plate and Gun Forging Plant of the U. S. Navy Department at Charleston, W. Va.—Roger W. Freeman.

Railway Association Convention Held Oct. 12 to 14

The American Electric Railway Association held its thirty-ninth annual convention at Atlantic City, N. J., on Oct. 12 to 14. President John Purdee called the meeting to order in the Greek Temple, the title of his address being "Industry on the Road to Better Days." Business of the association followed.

During the three days of the convention many papers were read along lines relating to electric railways. "The Settlement of Labor Disputes," was the title of an address by Governor Henry J. Allen of Kansas. This was a feature of the program. The evening entertainments consisted of the annual reception Monday night, informal dancing Tuesday night, the "Country Fair" Wednesday night and the annual ball on Thursday night.

The selection of Philip H. Gadsden for president for the ensuing year seems a wise choice, as his part in the work of the Federal Electric Railway Commission has given him a vision of the industry as a whole.

Changes in Personnel of Machine-Tool Combine

Charles E. Hildreth, general manager of the National Machine Tool Builders' Association, has resigned as president of the Whitcomb-Blaisdell Machine Tool Co.

Albert E. Newton, president of the National Metal Trades Association and of the National Machine Tool Builders' Association, has resigned as vice president and general manager of the Reed-Prentice Co. Mr. Newton felt that his financial interests other than those connected with the Reed Prentice Co. require his entire time, and his resignation to take effect Jan. 1, 1921, was tendered some time ago. Until 1922, however, he will remain with the Reed-Prentice Co. in an advisory and consulting capacity.

F. O. Hoagland, recently vice president and general manager of the Bilton Machine Tool Co., Bridgeport, Conn., has been made general manager of the Whitcomb-Blaisdell Co. and the Becker Milling Machine Co. and is expected to be elected general manager of the Reed-Prentice Co. soon. The three companies mentioned are to a great extent owned by the same interests and their management is being consolidated to secure greater efficiency. A central executive office was established early in the year at 53 Franklin St., Boston.

Annual Meeting of A. M. E. A.

(Continued from last week.)

At the banquet of the American Manufacturers' Export Association meet held at the Waldorf-Astoria, New York, on Oct. 14, speeches were made by Dr. Charles A. Eaton, of *Leslie's Weekly*, on "The Human Side of Industry"; by Alba B. Johnson, of the Philadelphia Chamber of Commerce, on "Transportation and the Citizen's Responsibility"; and by Alfred Reeves, manager of the National Automobile Chamber of Commerce, on "How America is Motorizing the World."

Dr. L. S. Rowe, director-general of the Pan-American Union, spoke of Latin-American markets. An abstract of his address follows.

While the experience of the last five years has served to impress upon us the importance of Latin America as a market for our manufactured products, it has failed to bring about anything like a corresponding change in the fundamental attitude of the American business community toward these countries. Although willing to fill such orders as may be sent, and, in fact, ready to indulge in a somewhat feverish and spasmodic attempt to secure such orders, we are apparently not prepared to take the steps necessary to secure a permanent foot-hold in these countries. That permanent foot-hold is to be secured through the investment of American capital. In order to attain this end, however, we must bring about a change in the point of view of the American investor; a strengthening of his confidence in the stability and security of investments in Latin American countries. Unfortunately, a few isolated instances of losses sustained by American capitalists have created an entirely false impression as to the security of foreign investment in Latin American countries. The large losses in Mexico during the last ten years have served to color our vision with reference to all of Central and South America. As a matter of fact, the number of losses to foreign capital in Central and South America during the last 25 years, due either to violence or unfair treatment, has been so small as to be almost negligible. As regards taxation, the burden on foreign investments in South America is far less than on similar investments in the United States. While large returns are justified, it is unfair to say that such large returns must be assured because of the extraordinary risks involved. As a matter of fact, risks in most sections of Latin America are no larger than in the United States. The fact remains, however, that the spirit of confidence of the American investor must be strengthened if we are to become permanent factors of importance in Latin American markets.

U. S. Chamber of Commerce on Business Conditions

Somebody has got to pay the piper in the present decline of prices, according to Archer Wall Douglas, chairman of the committee on statistics and standards of the Chamber of Commerce of the United States, in his monthly report on general business conditions.

Pointing out that natural laws are no respecter of persons, Mr. Douglas says that no price understandings, nor withholding of products from the markets ever succeed for more than a comparatively brief space of time in maintaining the price of any commodity.

"Those who predicted continued high prices because of the great volume of money have mostly taken to the woods," he says. "For the amount of currency in circulation today is greater than ever before, and yet prices are on the downward movement.

"Declines in food prices are naturally following the abundant harvest. Corn is selling at about half the high prices of twelve months ago. Nor has much labored propaganda about the great demand for breadstuffs to be expected from Europe sufficed to maintain the price of wheat. Another reason is that our neighbor, Canada, has a great crop. The three prairie provinces alone will produce about two hundred and fifty million bushels of wheat. They can consume only a small portion of it, and their storage facilities are most inadequate. There is nothing left for them but the export trade.

"Unemployment grows slowly. It is most noticeable in industrial life and in localities connected with textiles, leather goods and automobiles. Coincidentally the strike fever is waning, and efficiency is increasing, for there is a fast growing public demand for service, a demand born largely of what we have endured on every hand for the past five years. We are fast coming to the period when the standards will be those of common sense and work honestly done. We shall, in all likelihood not experience any shortage of labor during the coming months.

"The corn crop is made. The mere story of its unprecedented volume brought about the present low prices, especially of the December option. And thereby hangs a tale. Nothing has sufficed to keep up the prices of wheat and cotton. For the laws of supply and demand cannot eventually be denied. Every student of the situation realizes that much of the welfare of the country depends upon the purchasing power of the farmer. And that this in turn hangs upon his receiving reasonably remunerative prices for his products. But how to do this in face of the competition, nation-wide, is yet an unsolved problem.

"Few stories are of greater moment and importance to the nation than that of the recently published history of lumber; of the priceless heritage of the vast forests which once covered so large an area of this country. They are more than half gone, and still we are deaf, dumb and blind to the grim consequences of this fatal lack of foresight. The vital needs of forests and trees in every phase of country life needs no setting forth. In industrial life the need is equally as pressing despite all the substitutes for wood we are daily concocting. Besides there are vast industries whose very existence depends upon the continued production and use of wood. Lumber and things made of wood must daily grow more expensive and difficult to obtain. Yet we have scarcely learned the first elements of reforesting—as it is done, for example in France. Meanwhile a great business, that of lumber, is employed in consuming its capital. And between this and the areas of feasts and famines of demand and prices which mark its history it is wondering what fate has in store for it."

Nashville Corporation Buys "Old Hickory" Powder Plant

The War Department has announced that the Nashville Industrial Corporation has been the successful bidder for the plant and equipment of the "Old Hickory" powder works, located outside the city of Nashville, Tenn.

The plant was built by the government during the late war at an approximate cost of $80,000,000. It has been sold to the Nashville Corporation for $9,000,000.

Cambria Steel Production Decreases

Production at the Cambria Steel Co.'s plant, Johnstown, Pa., has decreased due to failure to obtain materials and the need of repairs, says Vice President L. R. Custer issuing the following bulletin: "Production will be curtailed in the Bessemer works and also in both the Cambria and Franklin open-hearth plants. Only seven of the eleven furnaces are going. This curtailment is due to falling off in orders, as to all except three furnaces. Three are being reconstructed and repaired."

The A. S. M. E. Committee on Plain Limit Gages for General Engineering Work held a meeting on Oct. 14 and 15 at Cleveland. Reports were made and past work was discussed. Subcommittees were selected to obtain data for the establishment of the various classes of fit necessary in interchangeable manufacture; these will make reports at a later meeting.

Westinghouse Co. Enters Wireless Field

The Westinghouse Electric and Manufacturing Co. has announced that it is prepared to enter the wireless field on a large scale. In furtherance of this the company has taken over the International Radio Telegraph Co. and will apply to the manufacture of wireless equipment the benefit of the research and development work undertaken for the Government during the war.

The International Radio Telegraph Co. maintains wireless stations on ships and has shore stations at Newport, New London, Brooklyn and Cape May, as well as others under construction in Maine and Massachusetts. It is stated that the company is perfecting a worldwide service of overseas wireless telegraph communication, as well as being active in the development of wireless telephony. R. A. Fessenden, one of the pioneer investigators in the continuous wave field, founded the company, which controls his patents.

In a statement issued by the Westinghouse Co., it was asserted that the older International Radio Telegraph Co. has been reorganized to form a new company of the same name. This company will have a capital of $1,250,000 in preferred stock and 250,000 shares of common stock of no par value. Guy E. Tripp, chairman of the board of the Westinghouse Co., is chairman of the new International Radio Co. The other officers are E. M. Herr, president; S. M. Kintner, Calvert Townley and H. P. Davis, vice presidents, and J. V. L. Hogan, manager. With the exception of Messrs. Kintner and Hogan, president and manager, respectively, of the older company, all of the officers are Westinghouse officials.

In connection with the new undertaking the Westinghouse Co. has equipped a special factory at East Springfield, Mass., for the manufacture of wireless apparatus. It will not only furnish outfits for the new International Radio Telegraph Co., but will devote its energies as well to supplying the needs of watercraft, railroads, power companies, factories, mills, mines, camps and ranches.

The engineers of the company have directed special attention to the problem of reducing interfering electric disturbances, with the result, it is asserted, that the Westinghouse system is on a par with the best wire and cable telegraphy as regards reliability.

War Veterans Favor M. E. Courses

Of the 1,949 disabled ex-service men who are taking vocational education courses, 447 are pursuing studies in mechanical engineering. This instruction is being given under the auspices of the Federal Board for Vocational Education, at ninety-six schools, of which thirteen are in New England, twenty-seven in the East, eight in the South, thirty-five in the Middle West, and thirteen in the West.

A. C. & F. Co. Spending $3,500,000 in Improvements—Changes in Personnel

Announcement was made by the New York office of the American Car and Foundry Co. that as a part of its plan of extension in the Buffalo district, W. H. Sanford, for many years district manager of its Buffalo plants, had been appointed assistant vice-president and would be placed in charge of sales in this vicinity.

Prior to the formation of the American Car and Foundry Co., Mr. Sanford was employed by the Union Car Co., and when that company was absorbed he was appointed paymaster and cashier at the Depew plant. In 1902 he was appointed local auditor of the Buffalo district followed by promotion to the position of resident representative. Later, in 1912, he was made district manager in charge of the Depew as well as the Buffalo Plants.

Mr. Sanford will be succeeded as district manager by Andrew H. Gairns now occupying a similar position with the company in Chicago. Mr. Gairns will direct the operation of the new plant in Buffalo, the foundries located here, and the plant at Depew. He has had an extended experience in steel car work and locomotive building and is well qualified to take up the duties demanded by the Buffalo district.

Announcement was made at the same time that the company's new plant now under construction in this city will be used for building all-steel cars, with a capacity for turning out 20 to 30 cars per day. It will be equipped with the most modern machinery and labor-saving devices. There will be a number of features introduced which are entirely new and novel to the car-building industry. In addition to the new car-building plant a modern up-to-date office building will be erected on property recently acquired across Babcock St. The soft foundry at the Buffalo plant has been completely re-equipped and is now engaged in quantity production. The Niagara wheel department has also been brought up to a high state of efficiency.

At Depew, during the war, the company was the largest producer of 155-mm. shell. Immediately following the armistice, the entire Depew plant was reconstructed and is now capable of building twenty cars per day. E. G. Englehart is assistant district manager at Depew.

The car company's plans thus briefly outlined above involve a total expenditure of $3,500,000.

A site for the new building in Washington which is to serve as a home for the National Academy of Sciences and the National Research Council has recently been obtained. It comprises the entire block facing the Lincoln Memorial in Potomac Park. The Academy and Council have been enabled to secure this admirable site, costing about $200,000, through the generosity of friends and supporters.

Obituary

TOM HARTLEY, fifty years old, proprietor of the Hartley Machine Works at the Bush Terminal, and widely known as a maker of printing presses, died on Oct. 13 of heart trouble. Mr. Hartley was born in Burnley, Lancashire, England, and was a civil engineer by profession. He was, in his early business career, engineer for a sugar plantation in the British West Indies. His father, the late James Hartley, was a ship builder.

JAMES CLARENCE HARBOURT, of the Westinghouse Air Brake Co., died on Oct. 9, 1920.

JOHN L. JACOBS, for over thirty years with the Brown & Sharpe Manufacturing Co., Providence, R. I., died in New Haven, Conn., Oct. 3, at the age of seventy.

M. B. JOHNSON, chairman of the board of the White Motor Co., died recently in Cleveland.

LOUIS A. COOK, office manager of the Wells Brothers Co. branch of the Greenfield Tap and Die Corporation, of Greenfield, Mass., died Oct. 17 at his home in Greenfield. Mr. Cook was sixty-one years old.

ALVIN A. WINSHIP, superintendent of machinery at the plant of the Bethlehem Shipbuilding Corporation, Sparrows Point, Md., died Oct. 17 from a tumor of the brain. He was 48 years old and had been associated with the Sparrows Point plant since July, 1916.

Personals

S. N. PETERSON, purchasing agent of the S.K.F. Ball Bearing Co., Hartford, Conn., has been appointed purchasing supervisor of the S.K.F. Industries, Inc., with headquarters at New York.

R. G. BARRINGTON, for fifteen years with the Cleveland Twist Drill Co., is now Cleveland sales manager for the Reed-Prentice Co., Becker Milling Machine Co. and Whitcomb-Blaisdell Machine Tool Co. combine.

GEORGE S. BARTON, president and treasurer of the Rice, Barton & Fales Machine and Iron Co., Worcester, Mass. machinery manufacturers, has been elected a director of the Massachusetts Chamber of Commerce.

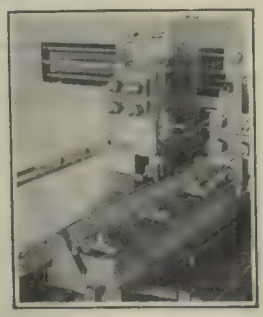
G. J. KELLER, formerly district manager of the Buffalo office of the Knox-Anderson Tool Co., has resigned and accepted a position as sales manager for the Frontier Chuck and Tool Co., Buffalo, N. Y.

JOHN F. STANTON, eastern sales agent of the Crucible Steel Co., 2 Rector St., New York, has resigned his position and is now associated with the John Illingworth Steel Co., of Frankford, Phila., Pa., and 217 Broadway, New York, as general sales manager.

Condensed-Clipping Index of Equipment

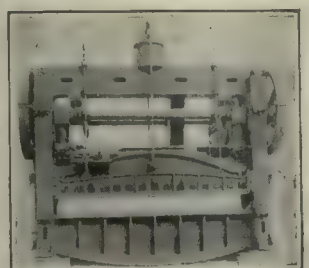
Patented Aug. 20, 1918

Planing Tool, Oil-Groove
Hanson-Whitney Machine Co., Hartford, Conn.
"American Machinist," Sept. 30, 1920



This device is intended for cutting zig-zag oil grooves in slides. It is mounted on the clapper of the planer, and means are provided for locking the clapper. The device itself has a small clapper box carrying the grooving tool and mounted on a cross-slide, its position being adjustable. A bar cam is fitted in the body of the device, one end being attached to an upright strapped to the planer table, so that it moves with the work. The connection is made through both horizontal and vertical slides, so that considerable freedom of movement of the planer head carrying the device is possible. As the planer table travels, the follower in the cam groove is caused to reciprocate, its motion being transmitted to the grooving tool.

Press, Tie-Rod, 500-Ton
Williams, White & Co., Moline, Ill.
"American Machinist," Sept. 30, 1920



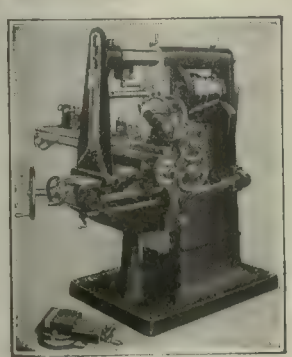
This machine is designed for blanking outside rails for pleasure cars. All gears and operating parts are located overhead so that the work can be placed in and removed from the front, back or either end of the machine. Specifications: Capacity, 500 tons. Distance between housings, 16 ft. Width: table, 30 in.; ram face, 30 in. Die space: Maximum, 23 in.; minimum, 11 in. Stroke, 7 in. Openings in housings, 24 in. Height, 21 ft. Length, 21 ft. 10 in. Width, 10 ft. 6 in. Stroke per min., 12. Motor, 75 hp.

Milling Machine, Continuous
Newton Machine Tool Works, Inc., 23rd and Vine Sts., Philadelphia, Pa.
"American Machinist," Sept. 30, 1920



The column and base of this machine are cast in one piece, in order to eliminate a bolted joint between them. The table is circular in form and adjustable upon the base, in order to provide for the proper positioning of the fixtures. Tables can be furnished either 24, 36 or 48 in. in diameter. A fixed feed controls the rotative movement of the table. The left-hand spindle is used for the roughing operation, and the right-hand spindle for finishing. The distance between the centers of the spindles varies from 13 to 22½ in., depending upon the size of the table used, so that long pieces can be completely machined in the roughing operation before the finishing cutter starts on them. The machine is driven through worm gearing by an individual motor. The head carrying the spindles is adjustable.

Milling Machine, Universal Back-Geared, "No. 1½"
American Milling Machine Co., Cincinnati, Ohio.
"American Machinist," Oct. 7, 1920



Specifications: Same general dimensions as for the plain milling machine. Universal table swivels 54 deg. on each side of center; 11-in. universal dividing head. Net weight, 3,400 lb. Weight crated, 3,650 lb. Weight boxed for export, 4,100 lb. Export case, 118 cu.ft. When desired, a swiveling vertical milling attachment can be furnished, which is secured to the face of the column by four screws and located by the front spindle bearing; it can be set at any angle. The columns of all machines are drilled and tapped for this attachment, the distance from the face of the column to the center of its spindle being 10 in.

Grinding Machine, Wet Tool, Oilstone
Mummert-Dixon Co., Harrison, N. J.
"American Machinist," Sept. 30, 1920



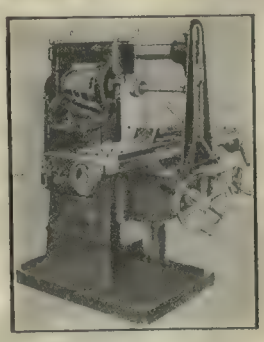
This machine is intended for general tool grinding in both toolrooms and machine shops, and is provided with three wheels of different grades. It is thus possible to rough and finish a tool on the same machine. The machine can be driven either by motor or by belt, a countershaft being furnished in the latter case. Specifications: Size of wheels; coarse, 16 x 2 in.; medium and fine, 10 x 2½ in. Speed; coarse wheel and pulley, 1,350 r.p.m.; medium and fine wheels, 675 r.p.m.; countershaft, 450 r.p.m. Driving pulley, 6 x 4½ in. Countershaft; length, 24 in.; drop, 12 in. Motor, 3 hp., 1,800 r.p.m. Floor space, 33 x 41 in. Net weight, 1,075 lb.; with countershaft, 1,285 lb.

Press, Tie-Rod, 800-Ton
Williams, White & Co., Moline, Ill.
"American Machinist," Sept. 30, 1920



This machine is designed for blanking outside rails for motor trucks. All operating parts are located overhead. The strippers are operated by cams on the crankshaft. The table and ram have T-slots. The crankshaft is driven from both ends, and an automatic knockout is connected and operated by the ram. Specifications: Capacity, 800 tons. Distance bet. housings, 18 ft. Width: table 30 in.; ram face, 30 in. Die space: Maximum, 23 in.; minimum, 11 in. Stroke, 7 in. Openings in housings, 24 in. Height, 24 ft. 7 in. Length, 24 ft. 9 in. Width, 13 ft. 2 in. Strokes per min., 8. Motor, 100 hp.

Milling Machine, Plain Back-Geared, "No. 1½"
American Milling Machine Co., Cincinnati, Ohio.
"American Machinist," Oct. 7, 1920



Specifications: Working surface of table, 46 x 10½ in. Power longitudinal feed, 25 in. Power cross feed, 9 in. Hand vertical feed, 19 in. Face of column to overarm brace, 21⅝ in. Size of taper hole in spindle, No. 10 B. & S. Spindle speeds, 16, ranging from 12 to 382 r.p.m. Distance from overarm to center of arbor, 6½ in. Four-step cone pulley with largest diameter 11 in. and smallest diameter, 7⅝ in. Width of belt, 3 in. Sixteen feeds ranging from 0.005 to 0.212 in. Two-speed countershaft, 107 and 265 r.p.m. Countershaft friction pulleys, 12 x 4 in. Floor space, 85 by 64 in. Net weight, 3,000 lb. Weight crated, 3,250 lb. Weight boxed for export, 3,700 lb. Export case, 118 cu.ft.

Grinding Machine, Full-Automatic
Warren G. Fraser Co., Westboro, Mass.
"American Machinist," Oct. 7, 1920



The machine is intended for grinding rolls and other small work where the length of the surface to be ground does not exceed the width of the grinding wheel. The work is placed in a magazine and fed by gravity to the machine. The automatic control unit consists of a cam-set rotated by worm gearing, and all operations are entirely automatic. Both the wheelhead and headstock rest on three-point bearings. The wheel-spindle is hardened and ground and runs in bronze boxes which are adjustable for wear. The wheel-slide is adjusted by a screw having a graduated hand-wheel.

Clip, paste on 3 x 5-in. cards and file as desired

PAUL E. THOMAS, president of the Kempsmith Manufacturing Co., Milwaukee, Wis., returned on Oct. 23 from an extended business trip through Europe.

F. W. RUGGLES, formerly manager of the Republic Motor Car Co., Alma, Michigan, has been appointed president and general manager of the Ruggles Motor Truck Co., which has just been incorporated for $3,000,000, with head offices at London, Canada.

PAUL MOORE of the Service Motor Truck Co., Wabash, Indiana, has been appointed general manager of the firm's Canadian branch which will be located at London, Ont.

HOWARD C. HOEFLICH has resigned his position as secretary of the Case Crane and Engineering Co., of Columbus, to accept a position as general purchasing agent for the F. G. Austin Machinery Corporation, of Chicago.

A. Z. POLHAMUS has been elected president and general manager of the Visible Pump Co., of Fort Wayne, Ind., manufacturer of gasoline and oil pumps and distributing systems. Mr. Polhamus was formerly general manager of the S. F. Bowser Co., Inc., of Fort Wayne, Ind., for twenty-five years.

EDWARD CASEY has joined the Duff Manufacturing Co. as the sales representative of the forge department in the East, with offices at 50 Church St., New York. Mr. Casey was formerly associated with Kraenter & Co. and the Bethlehem Steel Co.

S. S. SMITH has joined the sales organization of the Jones & Lamson Machine Co., Springfield, Vt. Mr. Smith was formerly with the Windsor Machine Co., now the National Acme Co., of Windsor, Vt. During the war he was a superintendent at the plant of the John-Thomson Press Co., at Long Island City, N. Y., and was also with the General Vehicle Co., of the same place, for a time.

ALEX CROWE, formerly superintendent of the Western Gas Construction Co., Ft. Wayne, Ind., has accepted a position as superintendent of the Aetna Foundry and Machine Co. of Warren, Ohio. Mr. Crowe was formerly with the Youngstown Sheet and Tube Co.

W. W. IRWIN, for many years president of the Canton Sheet Steel Co., has left this concern to head the newly organized Superior Sheet Steel Co., which began operation one month ago at its new plant at Louisville, Ohio.

WILTON BENTLEY, works manager of the Mercury Manufacturing Co., a Chicago trailer and truck manufacturing concern, for the past three years, has resigned in order to accept the managership of the New York office of the K. W. Battery Co., of Chicago, Ill.

F. RODGER IMHOFF, who has been located in Detroit as field engineer for the Precision and Thread Grinder Manufacturing Co., Philadelphia, Pa., has been appointed sales manager of that company.

Business Items

The superintendent of the Virginia Mechanic's Institute, Richmond, would like to get in touch with manufacturers who would be willing to supply the institute with rough castings to be machined by the students.

The new plant of the Kelly Reamer Co., located at 3705 W. 73rd St., Cleveland, Ohio, was officially opened on Oct. 9. This addition to the factory has been completely equipped with the latest improved machinery for producing high-grade tools.

The combine of Reed-Prentice Co. and the Whitcomb-Blaisdell Machine Co., Worcester, Mass., and the Becker Milling Machine Co., Boston. Mass., has announced the opening of permanent offices in the Liberty Building, Room 514, in Philadelphia.

The Dale Machinery Co., 56 Lafayette St., New York, has opened a branch office in Philadelphia in charge of E. K. Wood.

The Yale & Towne Manufacturing Co., Stamford, Conn., announces the removal of its general offices from New York City to the plant in Stamford, Conn., where a new office building has been erected.

The E. J. Manville Machine Co., Waterbury, Conn., manufacturers of sheet-metal and wire-working machinery, is completing a two-story brick and mill manufacturing addition to its plant on East Main St., which when completed will add approximately 20,000 sq.ft. of factory floor space.

The Mutual Motors Co. has recently announced that it has changed its address from Jackson, Mich., to North Tonawanda, N. Y.

Joseph Beal & Co., of 21-23 Purchase St., Boston, Mass., dealer in new and second-hand machinery and tools, announces the establishment of a branch warehouse in Water St., in Springfield, Mass., where the firm will carry a complete stock of both new and used tools and machinery.

Announcement is made of the change in name of the Signalite Manufacturing Co. to Jones, MacNeal and Camp. The company's plant is at Chicago, Ill. The management, organization and finances of the new company is in all respects identical with the old concern.

The Jewell Belting Co., Elmwood, Hartford, Conn., is planning to increase its capital stock from $500,000 to $1,000,000 for increased production. The company manufactures a high-grade factory leather belting, and recently erected a new plant in the Elmwood section of Hartford, having disposed of its old plant in the downtown section.

The Bearings Co. of America, Lancaster, Pa., has moved into its new concrete and steel factory in which all new and modern machinery had been installed. This addition to the company will increase the productive capacity about 50 per cent.

At a recent meeting of the board of directors of Landers, Frary & Clark, New Britain, Conn., it was voted to recommend to the stockholders of the concern that the capital stock of that corporation be increased one million dollars.

The Norton Co., of Worcester, Mass., manufacturer of grinding machinery, announces the opening of a branch office in Pittsburgh, with Paul R. Hawkins in charge. It will be located at 230 Fifth Ave., Room 800. As in the past the Somers, Fitler & Todd Co., of 327 Wall St., Pittsburgh, will continue to distribute the grinding wheels.

France, Belgium and Italy have issued patents to Cornelius T. Myers, consulting engineer, Rahway, N. J., covering the Myers Magazine Oiling System of Chassis Lubrication. This system is used on the Liberty Class "B," Fageol, Diamond T, Ward La France, Service, Bethlehem and several other trucks in the United States.

The Northwood Implement Co., Northwood, Iowa, has been incorporated to manufacture the Olson revolving tooth harrow, the invention of Ole A. Olson, a Northwood man. The organization is capitalized at about $100,000.

The Sanford Riley Stoker Co., Ltd., Worcester, Mass., has recently moved its general offices from 25 Foster St. to 9 Neponset St., Worcester, where all communications should be addressed.

In order to carry out an extensive industrial housing scheme and to considerably expand the size and capacity of its two plants at Attalla, Ala., the National Pipe and Foundry Co. has increased its capital stock from $100,000 to $525,000.

The New Britain Machine Co., New Britain, Conn., is planning the addition of $1,000,000 to its capital stock. This additional capital will make the outstanding capital stock three millions.

Forthcoming Meetings

The National Machine Tool Builders' Association will hold its 19th annual Fall convention at the Hotel Astor, New York City, on Thursday and Friday, Nov. 11 and 12, 1920. C. Wood Walter, care of the association's offices at Worcester, Mass., is secretary.

The National Founders Association will hold its twenty-fourth annual convention at the Hotel Astor on Nov. 17 and 18, 1920. J. M. Taylor, care of the Association, 90 West St., New York, is secretary.

The Federated American Engineering Societies will hold its first meeting at the Hotel New Willard, Washington, D. C., on Nov. 18 to 20 inclusive.

The 1920 annual meeting of the American Society of Mechanical Engineers will be held in the Engineering Societies Building, 29 West 39th Street, New York City, from Dec. 7 to Dec. 10.

The Society of Automotive Engineers will hold its annual meeting on Jan. 11 to 13 inclusive at New York.

November 4, 1920 American Machinist Vol. 53, No. 19

Machining the Connecting Rods of Two Well Known Motors

By FRED H. COLVIN, Editor, *American Machinist*

While the connecting rods for both the Oakland and Studebaker motors are of similar design, there is considerable difference in the methods of machining and the fixtures used. Both methods are of interest to all confronted with problems of large production in this line.

BEGINNING with the manufacture of the connecting rod for the Oakland motor, the main machining operations are outlined in Fig. 1. The methods of holding the work in the fixtures are plainly shown in the halftone illustrations. The rough drilling of the large hole is done under a six-spindle drilling machine, two spindles of which are shown in Fig. 2. The fixtures are of the semi-box or open-side type, the top plate being cut away to allow easy handling and observation. The centering of the large end of the rod is done by a hollow coned center which is threaded on the outside and provided with the handwheel or nut *A*. The small end is centered by a sliding V-block *B*, which resists the tendency to turn under the torsion of the drill used. These same drilling fixtures are used in the next operation and for that reason carry a bushing for the roughing drill for the small end. After the large hole has been rough drilled the fixtures are slid around on the track shown in Fig. 3 to the machine which backs up against the one used for rough drilling. On the way from one machine to the other the fixture lies under the air jet *A* so that all chips can be readily blown out. The second machine, carrying six spindles, drills three connecting rods at once, rough drilling the small ends and finish boring the large ends with the fluted boring tools shown. The rods clamp the piston pins in the small end. This clamping, how-

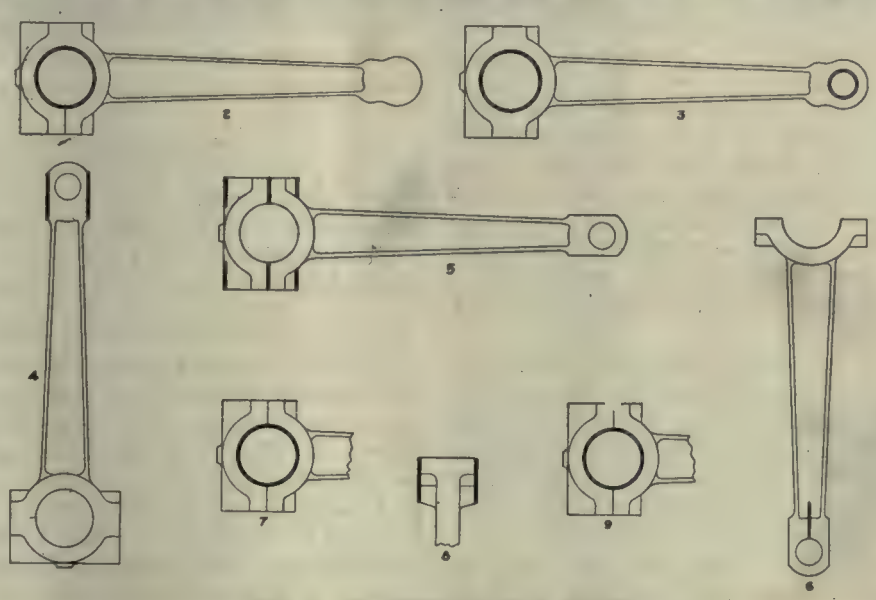


FIG. 1. TRANSFORMATION SHEET

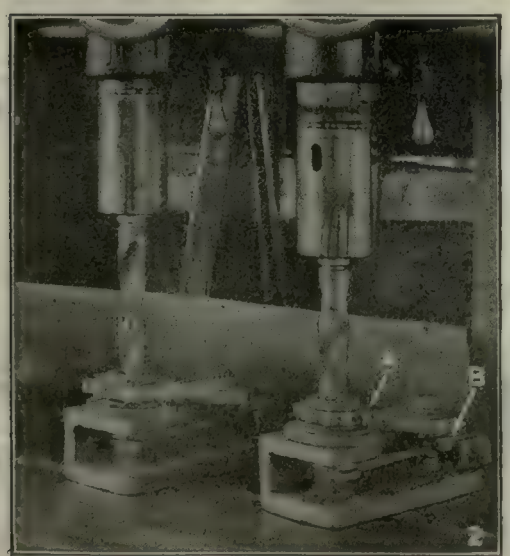


FIG. 2. ROUGH-DRILLING LARGE END

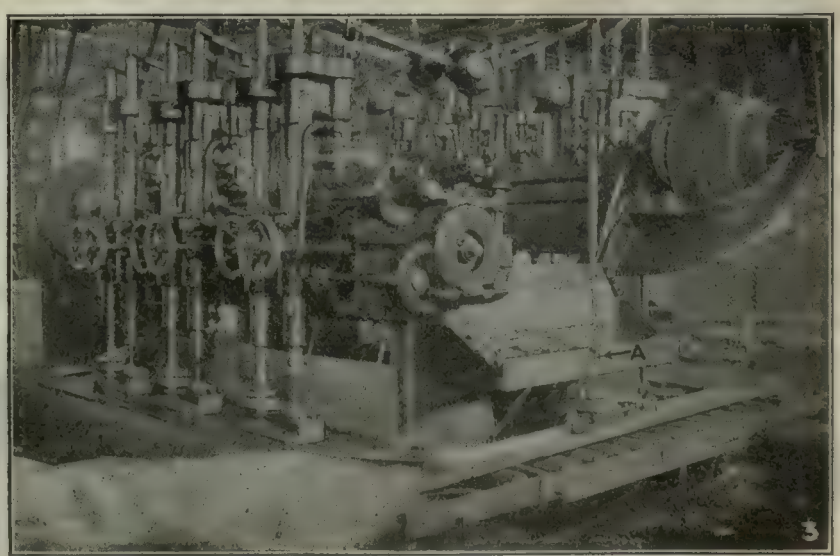


FIG. 3. THE SECOND DRILLING

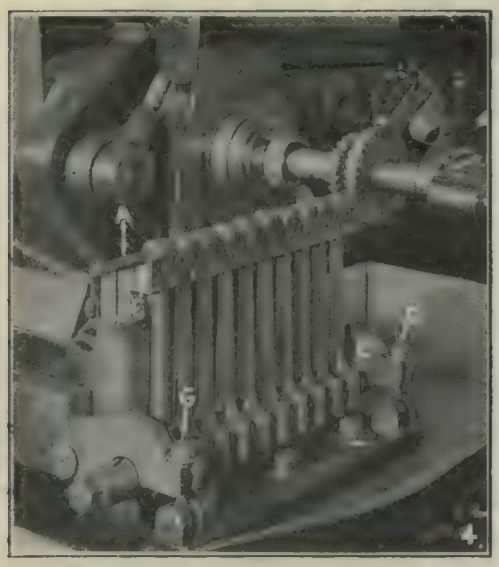


FIG. 4. MILLING SMALL END

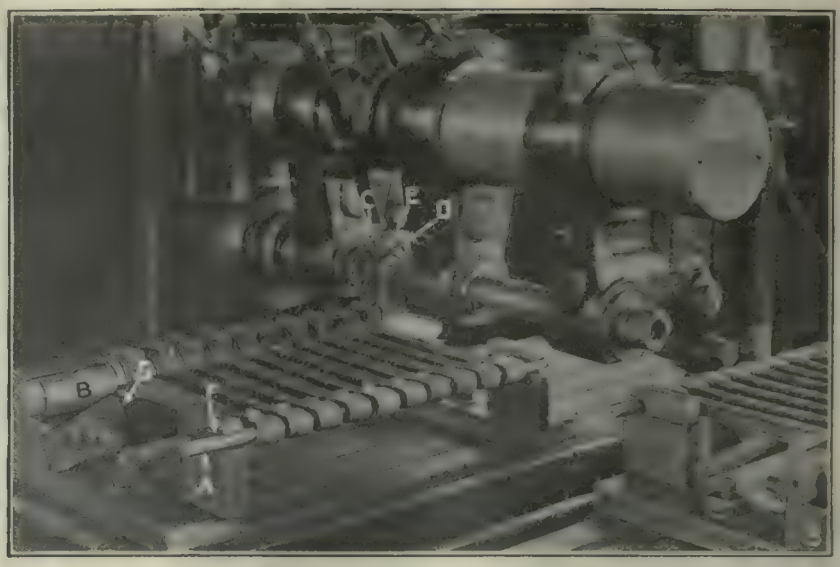


FIG. 5. SAWING OFF THE CAP

ever, is done by splitting the small end of the connecting rod down to the center of the web instead of putting it in at an angle from the side, as is usually the case. In order to flatten the sides of the small end for the clamping screw, a pair of straddle milling cutters are used, as shown in Fig. 4. The rod *A* is slipped through the holes in the small ends, while the bar *B*, having collars on the end, clamps the large ends of the rods firmly together in lots of ten. The ten rods are then placed in the fixture shown so that the rod *A* rests in a V-block, *C*, at each end, while the arms *D* and *E*, hooking over the bar *B*, hold the connecting rods firmly in place for the milling operation. The counterweights *F*, at the back of *D* and *E*, automatically lift the clamping arms out of the way as soon as the bolts *G* are released.

The same batch of ten connecting rods, still held in place on the rod *A* and the bar *B*, are then taken to the manufacturing milling machine, Fig. 5, and held in the fixture shown. This machine carries two milling cutters, *C* and *D*, which face the seats for the bolt heads and nuts and the slitting saw *E*, which at the same time cuts off the cap on one side.

The work tables are then swung 180 deg. so as to bring the other fixture into position, and, while the next ten connecting rods are being milled, the first batch is released and turned over so that the bolt bosses on the other side can be milled, and the separation of the caps completed. It will be noted that, as in the preceding case, the rod *A* fits into a suitable notch *F* and the bar *B* is located and clamped in the proper position by means of the angle block shown and the strap *G* clamps it in place. This is an excellent example of practically continuous milling.

Next comes the splitting of the small end of the rod as shown in Fig. 6, the bolt hole having already been drilled and tapped, as can be seen. This is done in a simple fixture on a hand milling machine, the small end of the rod fitting over a pin at *A*, while the other end of the pin *B* positions the large end.

Babbitting the Bearings

After the connecting rod bolt holes have been drilled and reamed, the rods are ready to be babbitted, this being done on an interesting revolving table, as shown in Fig. 7. This table can accommodate thirty-two connecting rods, each block *A* being screwed to the table and carrying two fixtures, as at *B* and *C*. These fixtures each consist of an arbor of the proper diameter, having a head which fits easily into the slot shown. The arbor has a handle *D*, by which it can be easily put into place and removed. Over it is slipped the base



FIG. 6. SLOTTING THE WEB

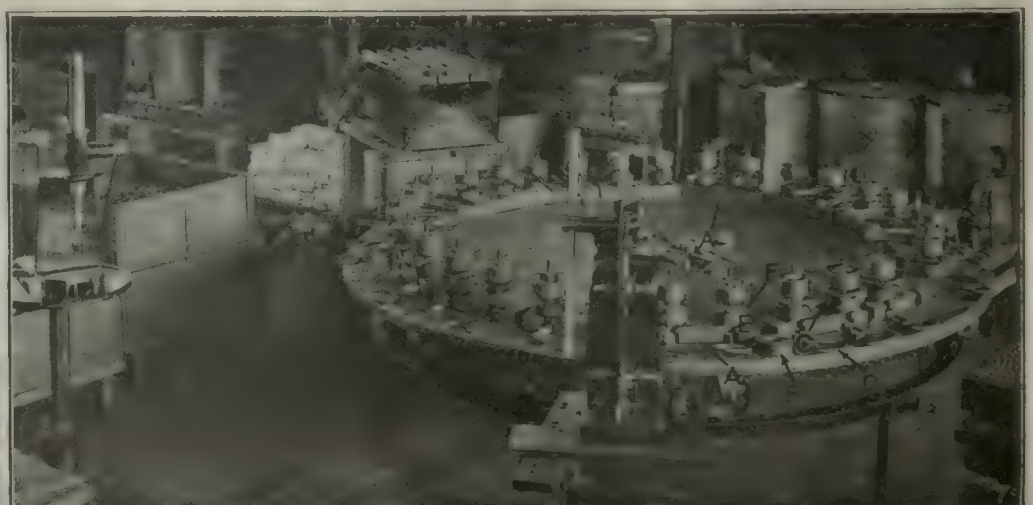


FIG. 7. BABBITTING LARGE END



FIG. 8. TRIMMING SURPLUS BABBITT

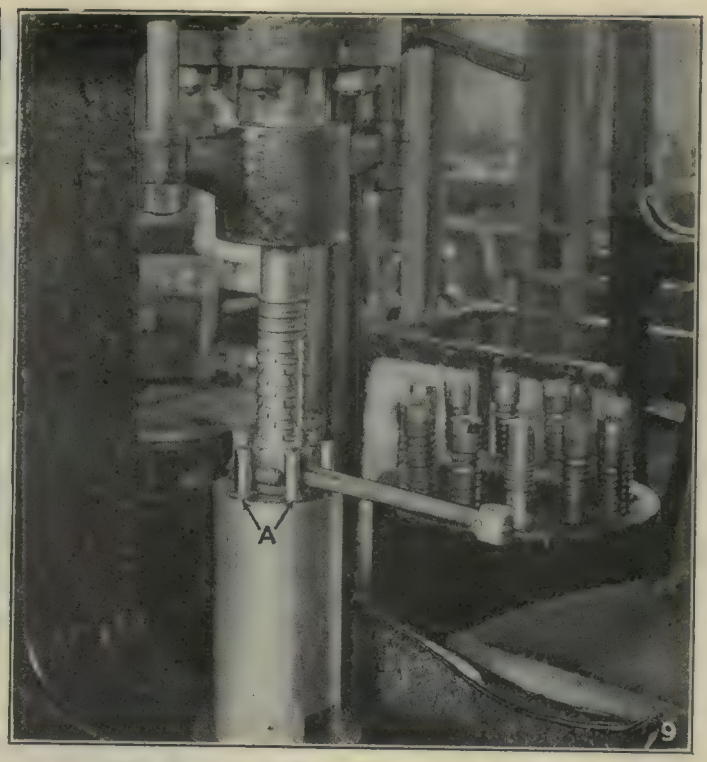


FIG. 9. BROACHING THE LARGE BEARING

ring *E*, which is recessed to guide the large end of the rod from the outside.

Then the rod is put in place over the arbor, a quick acting clamp *F* holding the cap in position, and the top ring put in place. As the table revolves in front of the three babbitt furnaces shown, the bearings are poured and by the time the table is halfway around the metal is set sufficiently for the rod to be removed. The rod and the mold are pulled out of the block by means of the handle, and the arbor forced out in one of the arbor presses shown. This makes a very convenient arrangement and allows the rod to be handled rapidly.

The surplus babbitt is trimmed off on the special device shown in Fig. 8, rigged up on a hand milling machine. The milling machine spindle carries a saw and the rods can be handled very quickly, as it is only necessary to place them in position on two dowel pins which fit into the bolt holes. Before the rods come in contact with the saw they run under the shoe *A*, which is held in position by sufficient spring pressure to prevent their lifting under the action of the saw. After passing under the shoe they fall off the pins by their own weight and drop into a box to be carried to the next department.

The babbitt bearing is finished by broaching and burnishing under an hydraulic broaching press, as shown in Fig. 9. Short push broaches are used, the finishing of the bearing being accomplished by the burnishing rings at the upper end of the broach. Several broaches are used in each set, so as to reduce the cut per tooth to the desired amount. The pins in the top of the column *A* are so located as to hold the large end of the rod firmly in position and at the same time allow it to be easily handled in and out of the fixture. The broaches used are shown standing upright in their holder at the right.

The Studebaker Method

Although the connecting rods dealt with in this article are of almost the same type as the Oakland, both the fixture design and the method vary to some extent.

THE Studebaker connecting rod also clamps the piston pin by means of a split web, although the splitting fixture and the machining of the clamping surfaces are quite different from that in the Oakland plant, as previously shown on page 829. The transformation sheet, Fig. 1, gives an outline of these operations. The first operation is to spot-face the large end of the connecting rod in the fixture shown in Fig. 2. This illustration shows the type of fixture and the facing cutter used. The clamping slide *A* is shown in its outer position. When pushed in, the latch *B* hooks over the pin *C*, after which the block is screwed into place, using the wheel *D*. The same fixture is used in facing both sides.

The large hole is drilled in a somewhat similar fixture shown in Fig. 3. The large hole is located by the piece *A* and held against it by a V-block on the end of the screw *B*. The same forms of sliding block and latch are used as in Fig. 2. The small end of the rod simply fits into the block *C* which aids in resisting the turning movement of the roughing drill.

Drilling Small End of Rod

The small end of the rod is next drilled in the fixture shown in Fig. 4, this being of the same general design as the others. The bored hole of the large end fits over the half round stud *A* and is forced against it by

a suitable V-block operated in the same manner as the previous fixtures shown.

After this the small hole is reamed, the edges of both holes chamfered and the small hole finished by broaching. Then the anchor slots for holding the babbitt bearing metal are broached in the Lapointe machine, clear the outside of the small ends. Two passes are required, the rod being turned over so as to have the slots equal on each side.

The hole is then tapped for the clamping bolt, after which the rods are ready for the conveyor shown in Fig. 7, which carries them to the upper floor for tinning and

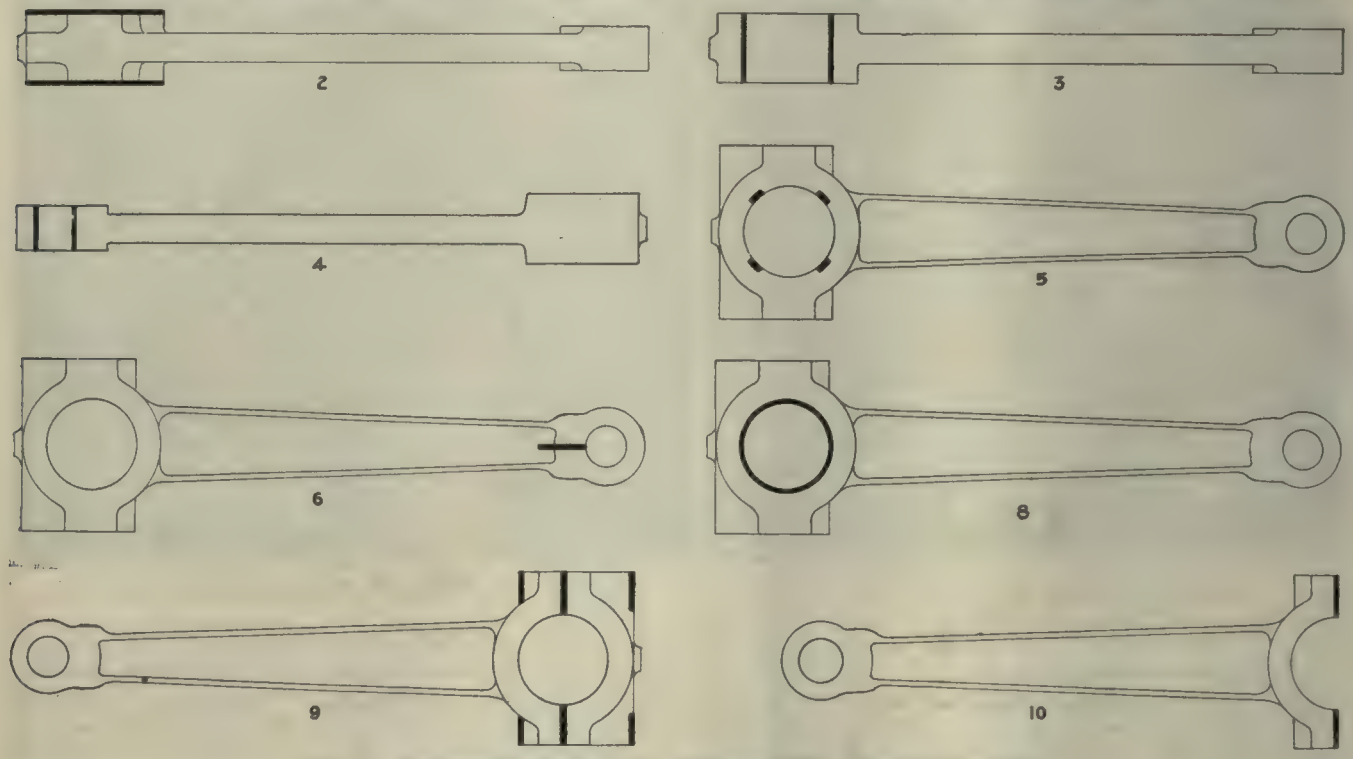


FIG. 1. TRANSFORMATION OF STUDEBAKER CONNECTING ROD

shown in Fig. 5. The rod is positioned on the pin *A* and four anchor slots are cut by the broach *B*. This gives an anchor near each end of the bearing surfaces on both the rod and the cap. The inclined chute or conveyor *C* brings the rod to the broaching machine and shows one of the methods of handling which are quite common in the Studebaker shops.

Both sides of the large end are then chamfered on the outside, and the bolt holes drilled in the two sizes necessary for the small end of the rod. The small end is then spot-faced, after which the web slot is sawed in the small end, as shown in Fig. 6.

The rods are sawed in pairs, being supported on the inclined surface shown, so that the slitting saws will

babbitting. As the rods come from the slitting operation it is only necessary for the operator to remove them from the fixture *A*, Fig. 7, and place them in the chute *B* from which they slide into the conveyor *C* and are automatically carried up to the babbitting department. Incidentally, this same illustration shows the use of inclined chutes for the piston department at *D*.

On reaching the upper floor, the connecting rods are first tinned and then babbitted on the revolving table shown in Fig. 8. The small end of the rod is located by the pin, as at *A*, while the large end is centered by the babbitt mold *B*, which carries a mandrel that governs the inside diameter of the hole. The outer or large end is fastened into position by means of the screw *C*. After

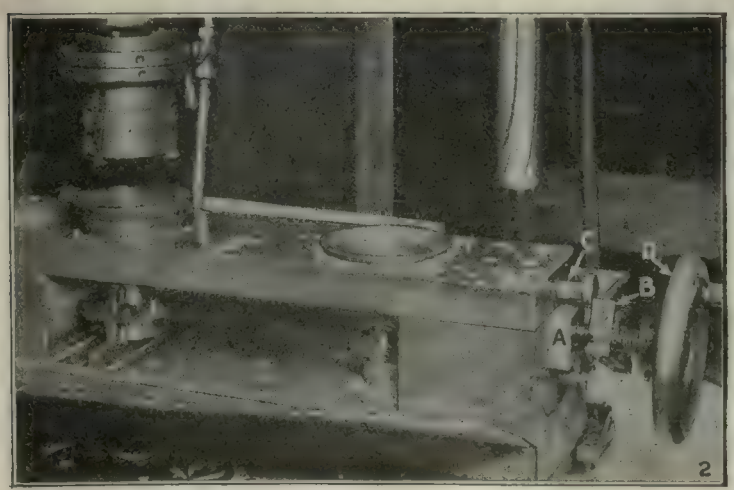


FIG. 2. SPOTFACING THE LARGE END

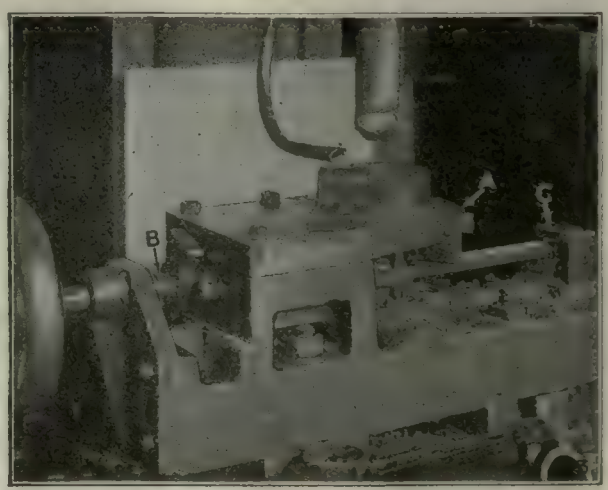


FIG. 3. BORING THE LARGE END

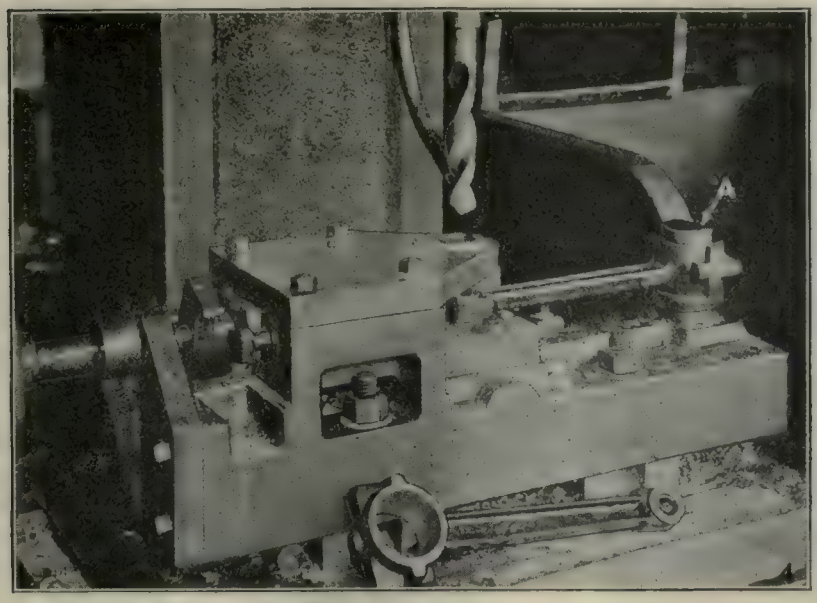


FIG. 4. DRILLING THE HOLE IN THE SMALL END

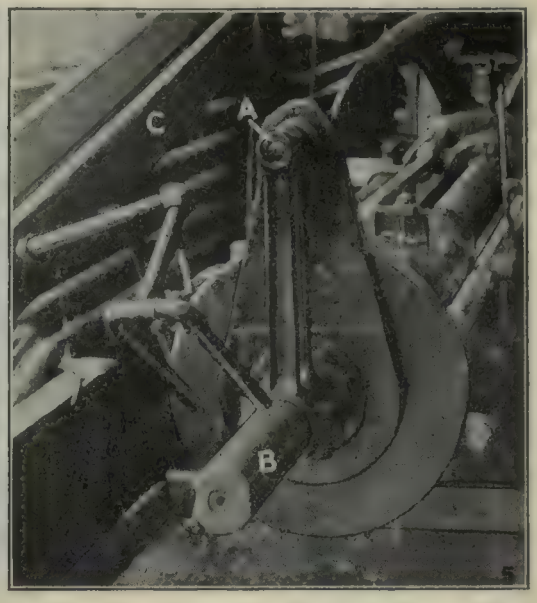


FIG. 5. BROACHING ANCHOR SLOTS FOR BABBITT

babbitting, the rod and mold are removed, the top of the mold being taken off while the mandrel is forced out under the arbor at *D*. The pigs of babbitt metal shown at *E* give some indication of the number of rods handled in this department.

It will also be noted that contrary to most practice, the cap has not as yet been removed from the connecting rod itself. The babbitt is then rough reamed and the end of the babbitt faced. The babbitt bearing is then finished by broaching, a blank end on the broach preventing more than 0.001 in. being removed by the teeth of the broach. The surplus babbitt is then trimmed off and the rods go to the Cincinnati duplex milling machine shown in Fig. 9. Here all four bolt bosses are faced and the cap cut from the rod. The rod is positioned by the flattened stud *A* while the large end is supported on both sides of the slot by a swinging clamp *B*. The post *C* comes through the large end of the rod and the screw *D* locks the fixture together, so that the rod is firmly held during the milling operation.

Another departure from usual practice is the drilling of the connecting rod bolt holes in both the rod and cap, after they have been separated, instead of while they are all one piece. After the bolt holes are reamed, all holes are drilled and countersunk, the bottom of the cap being drilled for the oil splasher and all grooves milled on both rod and cap. The next operation is to first mill the bearing end of the connecting rod in the fixture shown in Fig. 10. This carries four rods at one setting, two being milled at one pass of the milling cutter *A*. The semi-circular block *B*, which is somewhat less than a half cylinder, is fastened solidly to the fixture. The pin *C* is mounted in a slide *D* which is controlled by the screw *E*. After a rod has been placed in position, the screw *E* forces it against the block *B* and not only positions it, but holds it firmly in place. At the same time the semi-circular block *F*, which is also a part of the slide *D*, forces the lower rod against the pin *G*. The indexing table allows the whole fixture to be rotated so as to present both ends to the milling cutter *A*.

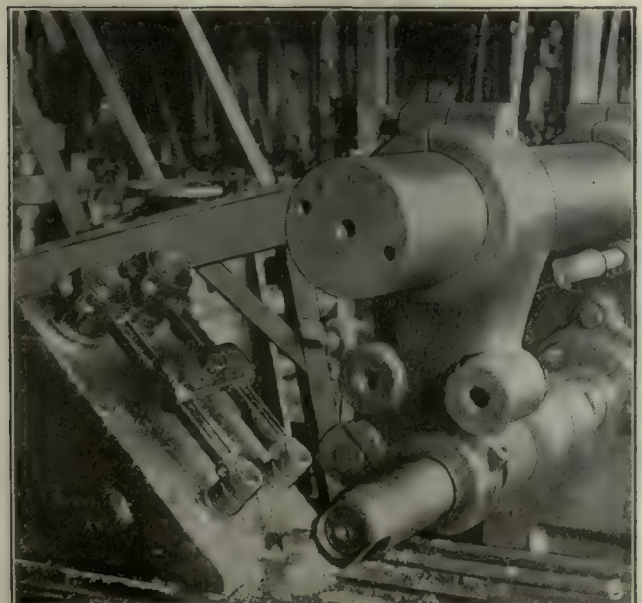


FIG. 6. MILLING SLOT FOR CLAMPING PISTON PIN

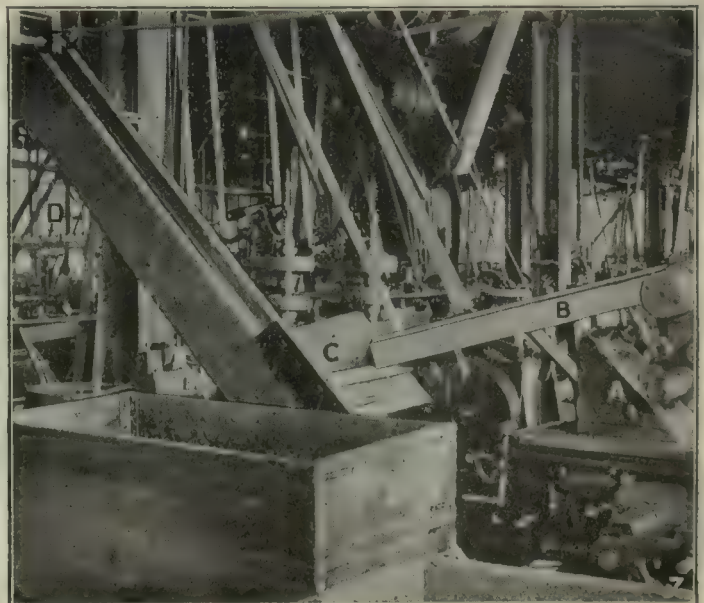


FIG. 7. CONVEYORS HANDLING CONNECTING RODS



FIG. 8. BABBITTING THE LARGE END OF ROD

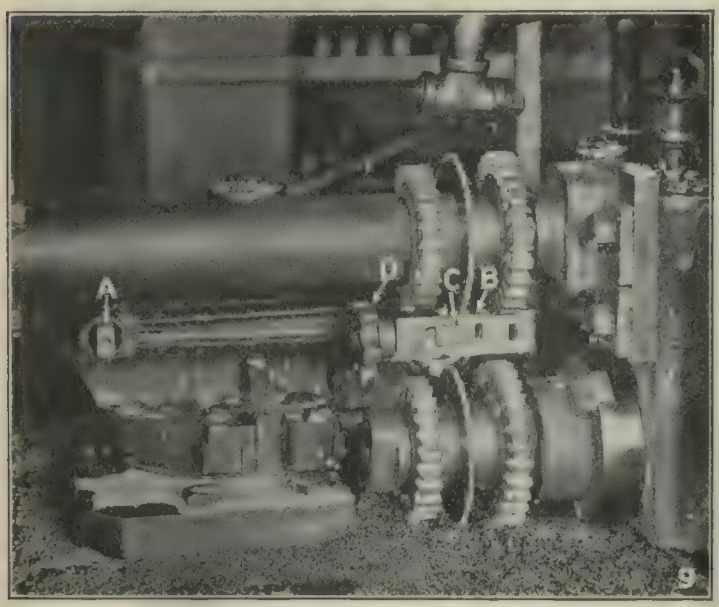


FIG. 9. SEPARATING THE CAP FROM THE ROD

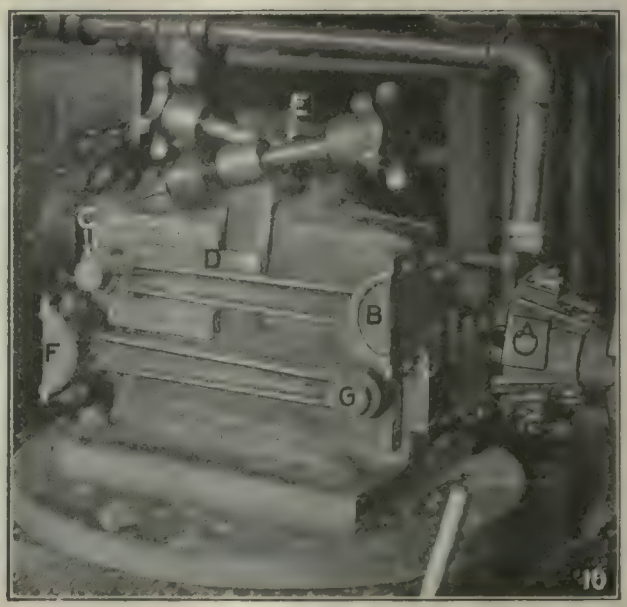


FIG. 10. FACE-MILLING END OF ROD

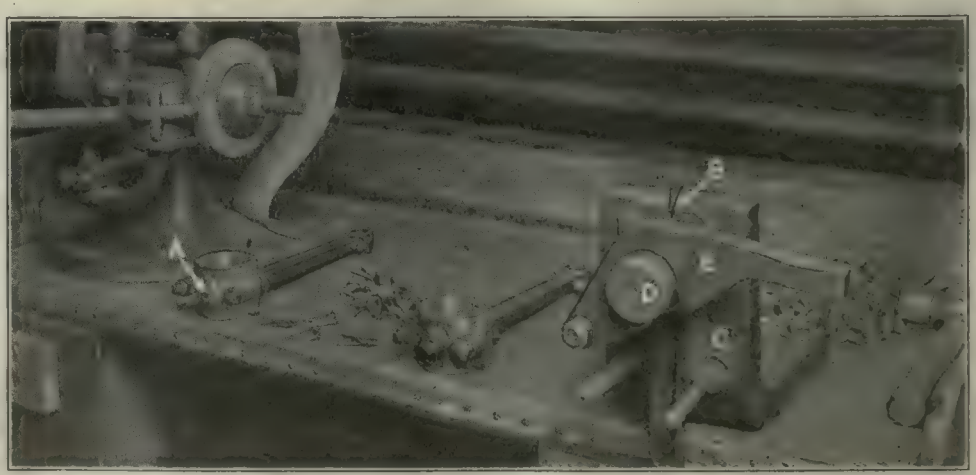
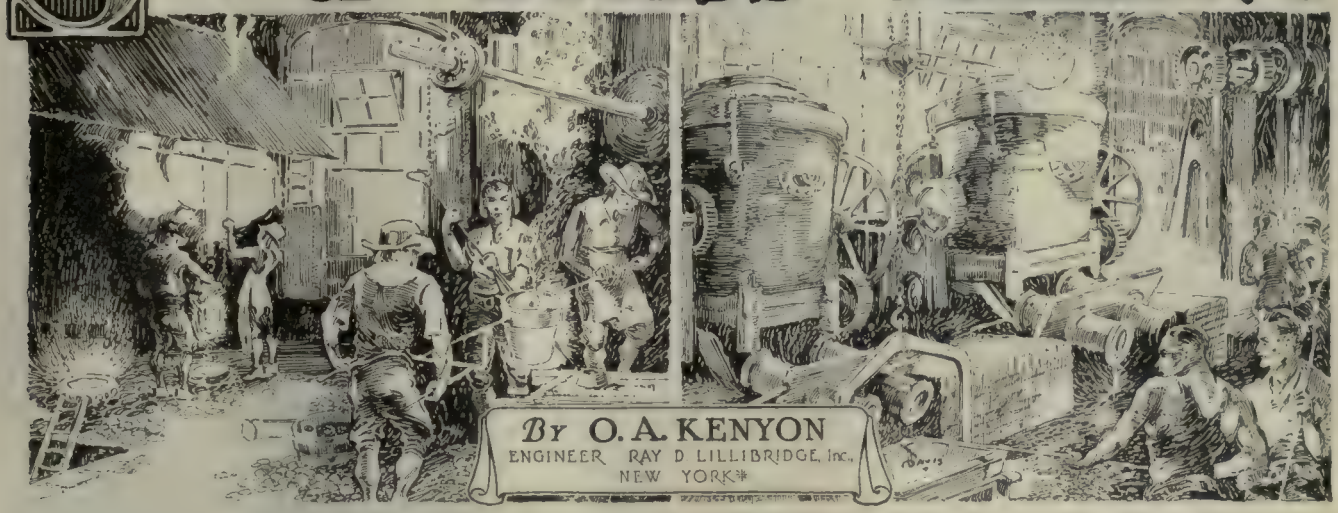


FIG. 11. PUTTING OIL SPLASHER INTO PLACE

The face of the cap is milled in a similar manner, and the rod and cap assembled with shims, bolts and nuts, the nuts being first run on with an air drill provided with a slipping clutch and finally tightened by hand. The crank end is then finish-reamed, filleted and a clearance broached on each side where the rod and cap meet. The splasher is then asesmbled in the cap as at *A* and *B*, Fig. 11, the rod being held in the fixture shown at *C*. The rod simply slips over the stud *D* and is held firmly in position by the latch *E*, while the splasher is being driven into place and the edge of the hole peened around it to prevent its becoming loose at some future time. The edges of the splasher are then trimmed on the grinding wheel shown at *F*. A final reaming, burring and washing makes the rod ready for final inspection before going to the assembling department. The rods are next assembled to pistons and carefully weighed to secure balance in the motor.

SEVEN CENTURIES of BRASS MAKING



By O. A. KENYON
ENGINEER RAY D LILLIBRIDGE, Inc.,
NEW YORK*

APPARENTLY the first attempt to cast brass in the North American colonies was made in 1644 by John Winthrop, Jr. in his iron foundry at Lynn, Mass. It is also known that brass cannon were cast in Philadelphia before the Revolution. Beginning in 1725 and for 50 years thereafter, Casper Wistar, his associate and successors, in Philadelphia, hammered out stills and kettles from brass and copper and cast some brass. (Bishop's History of American Manufacturers.)

In 1802, the Grilleys (Henry, Silas and Samuel), who had established a brass button business at Waterbury, Conn., in 1790, were joined by Abel and Levi Porter from Southington and began making buttons from sheet brass. This was the first known instance in America of brass making by direct fusion of copper and zinc according to the process invented by Adams Emerson in England in 1781. This undertaking also involved the first rolling of brass in this country.

The American brass industry was imported from England in labor, processes, and machinery. Up to 1820 the American brass makers struggled along, engaged principally in making buttons which were sold by traveling peddlers. Competition with the English product was impossible until James Croft, an English brass maker, came to Waterbury, and hired out to the Scovill Manufacturing Co., where he introduced English machinery and processes. (Lathrop's "The Brass Industry in Connecticut.")

In 1830 Waterbury rolled brass became a factor on the American market and from then on the industry grew rapidly. Next came brazed tubing which was used for gas in New York City in 1836. Seamless tubing was the last important process to come from England, where it was invented in 1838. This process was imported by a group of Boston men in 1848, who organized the American Tube Works in 1850.

The first really basic improvement in brass working contributed by America was the invention of the spinning process in 1851 by Hayden. From this time on American brass makers forged ahead rapidly and soon took the lead over their English competitors.

The brass industry perhaps more than any other requires extraordinary skill that can only be obtained by long experience. Therefore, whenever a brass works started it was necessary to obtain one or more men skilled in the art, by taking them away from some works already in existence. The brass industry in America started in Waterbury, Conn., in the Naugatuck Valley. The reason for this is probably due to the fact that the people of Waterbury were largely engaged in the making of pewter buttons, which was an important home industry, and when brass buttons came into vogue these people were threatened with disaster. They were forced to take up the making of brass buttons in order to save themselves. Fortunately the natural conditions of Waterbury, such as water power for driving the machinery, water supply for washing the metal, and wood for annealing purposes, were favorable to brass manufacture, and therefore having started there, it continued to grow.

II. The Crucible Process

The author tells of brass making by the crucible process, with its attendant difficulties. The field covered extends from the melting of the metal to pouring the molds. Also it is explained why the brass industry in America started in the Naugatuck Valley in Connecticut.

(*Part I was published in the Oct. 21 issue.*)

The fact remains that the industry did begin in the Naugatuck Valley and that this valley became famous as the home of the American brass makers. These men evidently liked the place where they were born as no one has ever succeeded in inducing any considerable number of them to go to another part of the country and this is undoubtedly the real reason why Connecticut has so long remained the greatest producer of brass in the United States.

The melting and casting of the metal in a brass mill is the most important step in the whole process of making brass materials, because any failure there cannot be rectified by later manipulation. However, in spite of the vital character of this stage of the process it is the one in which the least advancement has been made.

*Booklet published by the Bridgeport Brass Co., Bridgeport, Conn.

Practically all mills that produce brass for rolling into sheets or rods, or drawing into wire or tubes, employ the crucible in the coal-fired pit furnace, which is, basically, the same method as used in the middle ages. In Fig. 1, which was reproduced from a drawing made in 1672, it was seen that the three main elements of the ancient casting shop (furnace, crucible, and mold) bore a truly remarkable resemblance to the corresponding elements in the casting shop of some of the largest brass mills of today.

During the same period wonderful advances have been made by brass makers in the mechanical working of brass, so that it cannot be said that the practice of casting has remained stationary because brass makers have not tried to improve it. They have tried, and up to very recently it seemed as though it simply could not be done. The process was in the hands of skilled workmen, and each master caster guarded his secrets well.

In order to prove the statements just made with regard to the similarity of the ancient methods of brass casting and the modern ones, the operation of a modern pit furnace plant will now be briefly described.

The casting plant of the modern brass sheet, rod, wire and tube mill consists of the following main elements:

1—Furnaces. 2—Crucibles. 3—Molds.

Furnaces

The furnaces are almost without exception of the square, natural-draft pit type and usually employ anthracite coal for fuel. Fig. 12 shows a typical cross-section of such a furnace.

It should be noted that the principal difference between this furnace and the furnaces used in the middle ages is that the gases of combustion are carried off at the side, and lead to a chimney, while in the ancient furnaces they were allowed to pass up through the top and into the casting room. Then, too, the old furnaces were made large enough to hold a number of crucibles, usually eight (see Fig. 3), while nowadays there is one furnace for each crucible. The modern practice is to use anthracite coal in most instances although coke is also used quite extensively. In ancient times charcoal or wood was the fuel.

Crucibles

The crucibles, which are ordinarily made of clay and graphite, usually have a capacity of from 160 to 300 lb. of metal. They require great care in handling in order to obtain a satisfactory life, and for this reason and others they constitute one of the weakest elements in the casting shop. Ordinarily the life of a crucible is from 25 to 35 heats, depending upon the manner in which it is handled, and some casters, by virtue of special practices, get even longer life out of their crucibles. Comparing modern crucibles with those used in the middle ages, it is difficult to see any appreciable difference except the introduction of graphite, which has greatly increased their durability.

Molds

The modern mold is made of soft, gray iron, hand finished. Metal intended for sheet brass is cast in flat bars of varying widths, while metal for rods and wire is cast in cylindrical billets. Metal for tubes is cast either in solid or hollow cylindrical billets, depending upon the process employed. In ancient times stone was used for molds.

Casting in this type of plant is entirely up to the caster. He, with his one or more assistants, controls the fires, charges the crucibles, stirs and skims the metal, prepares and pours the molds. The whole process from start to finish is up to him, and he is usually paid on the basis of the output of good metal he attains.

The eight to twelve fires under the charge of one boss are all started at one time. The crucibles are warmed carefully before charging with scrap and copper ingot. If the crucibles are not carefully dried out and gradually brought up to heat, they will flake off and crack and their life will be materially shortened.

Charging

The charging of the crucible must also be made with care. For instance, if the crucible doesn't set firmly or evenly on the bottom, it will be subjected to undue strain and is even liable to tip over. Then, too, the charge itself must be so placed in the crucible that it will not become wedged and cause excessive strain against the sides when it expands before melting. All

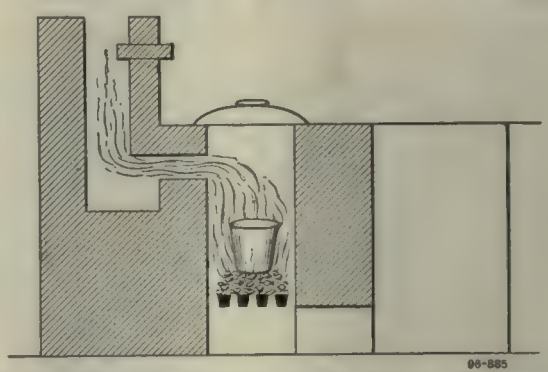


FIG. 12. CROSS-SECTION OF A TYPICAL PIT FURNACE

these points and many more require the constant and keen attention of the caster and his assistants.

As the copper begins to melt, a handful of salt is added and stirred in to remove the copper oxide, and then the surface of the metal is covered with a layer of charcoal to protect it from the action of the furnace gases or the air.

After the charge is completely melted and the temperature raised to the proper point, the zinc, or spelter is added. This temperature may be gaged by the expert caster by the color of the flame.

Adding Spelter

The spelter, being lighter than the copper, will float to the top and finally oxidize and waste away unless it is thoroughly stirred in and the surface protected with a layer of charcoal or some suitable flux. In Fig. 13 is a view of a modern casting shop showing a line of pit furnaces. The casters are stirring in the spelter. In the upper right-hand side of the photograph may be seen the hoisting apparatus that is used for lifting the crucible out of the furnace and manipulating it as will hereafter be described.

After the introduction of the spelter, the crucible must remain in the fire long enough to overcome the chilling effect produced by the introduction of the spelter, before pouring. If the crucible remains too long in the fire the metal will be overheated and an undue loss of zinc produced, while if it is poured too soon, before the temperature has attained its proper value, the casting will not be good.

The caster often judges the pouring temperature through the medium of his stirring rod. His sense of touch is so trained that he can perceive the vibration due to the boiling of the zinc, which signifies that it is time to pour.

Since all the fires are started at the same time, it naturally follows that all the various operations occur at approximately the same time. Consequently it requires extraordinary skill on the part of the caster to manipulate the fires in such a way that each crucible will be poured as nearly as possible at the time it is ready.

Skimming the Crucibles

The metal being considered ready for pouring, the coal is poked away from the crucible with an iron bar and the tongs, with which the crucible is manipulated, inserted and clamped. With a block and tackle, fastened to the light jib crane shown in Fig. 13, the helper hoists



FIG. 13. A LINE OF PIT FURNACES IN A MODERN CASTING SHOP

the crucible out of the furnace and swings it to a position on the cast-iron floor as shown in Fig. 14, where the caster with a skimming iron removes the dross. This photograph is an excellent illustration of the volatilization of the zinc, which is going off in a white cloud because of the removal of the charcoal covering. Incidentally, this picture shows why casters often suffer from "spelter shakes" which is a mild form of poisoning supposed to be caused by the inhalation of zinc oxide fumes. This is one of the working conditions which makes the crucible process difficult.

The tongs, with which the crucible has been lifted from the furnace, are used by the caster to manipulate it during the entire operation of skimming and pouring. To keep the rope from too close contact with the heat and gases from the crucible, a link rod connects the block to the tongs. These tongs should be compared with those shown in Fig. 1, as there is practically no difference in the construction. The helper who manipulates the crane does so with the aid of a rope and a rod. The rope serves to hoist the crucible, while the rod, in



FIG. 14. SKIMMING A CRUCIBLE

addition to offsetting the side pull of the rope, enables the operator to push and pull the trolley and jib to any desired position, thus giving him complete control over the manipulation of the crucible. The caster has simply to tilt the crucible. This method of hoisting has been used for more than fifty years without appreciable change, although various unsuccessful attempts to replace it have been made. Its advantage is quick action.

Pouring the Crucible

As soon as the crucible is skimmed it is hoisted and swung into position for pouring as shown in Fig. 15. The pouring itself requires great skill, as the perfection of the casting depends to a very large extent upon the manner of pouring. As is seen in the illustrations, the caster rests the edge of the crucible on the mouth of the mold, and as he tips the crucible he holds back any dross or charcoal with a skimmer iron, and at the same time often uses the skimmer iron to divide the stream into two parts, in this way greatly improving the



FIG. 15. POURING THE FIRST MOLD IN THE CRUCIBLE PROCESS

chances for a perfect casting, especially where wide bars are concerned. Attention is called to the great similarity between the molds here shown and the one shown in Fig. 2. It will be seen, that the method of clamping the parts together is practically the same in both cases.

Preparing the Molds

Previous to using, the molds are coated with a high-grade lard oil which serves a two-fold purpose, namely: it prevents the metal from acting upon the iron, and in burning at the mouth of the mold it envelops the stream in a reducing atmosphere which decreases the possibility of oxidation.

The molds are slightly inclined so as to make it easier for the caster to pour the metal, thus preventing it from striking against the sides of the mold. If the metal strikes continuously in one spot the casting will be porous on that side.

No attempt has been made here to cover the almost infinite number of fine points involved in the art of brass casting as practiced by the best men in the industry. In fact, the subject has never been reduced to an exact science and for the purpose of this article a more detailed description would be of little service.

Difficulties in Brass Making

The foregoing brief description of the routine operations in melting and casting brass, makes it perfectly plain that the human element enters into every step and detail of the process.

To keep ten fires right and take care of ten crucibles, putting in the spelter at the right moment, stirring and pouring at the right moment, is a full size job for the caster. There is a tendency among brass casters to use time as a guide in the execution of the various operations. However, this procedure cannot be relied upon for satisfactory results because of variations in the fuel, in the draft, in the weather, in the condition of the flue and in many other factors that may act to render any timing scheme for the various operations entirely unreliable.

In the last analysis it must be admitted that there is no positive way of determining just the right moment for carrying out the various important operations in the melting and casting of brass. It is simply a matter of experience, and even with experience as a guide, if the man hasn't the will and the power, he may not even do as well as he knows how. In other words, the character, disposition and moods of the men as well as their experience, enter into the making of brass by the crucible process.

The second undesirable feature of the crucible process is due to the extremely disagreeable working conditions imposed upon the men. Even with the best ventilation they are subjected to noxious fumes and extreme heat, and the more conscientiously they execute their tasks the worse the conditions they must endure. In Fig. 14 is shown a caster skimming a crucible with his head entirely enveloped in fumes. If he attempted to dodge the fumes, he would not be able to skim the metal as quickly and perhaps not as well, the result of which would be an inferior casting. To stand over the fires and stir the metal is an extremely hot and disagreeable job and yet the quality of the metal is dependent upon the thoroughness with which it is stirred. These are only instances which illustrate that the caster in the execution of his work must practically disregard the conditions under which it is done.

Composition Discrepancies

The crucible itself is often the cause of discrepancies in the quality of the metal, due to the fact that a slight leak has permitted a portion of the mixture to disappear into the furnace so that when spelter is added the ingredients of the brass will not be in the proportions expected. The proportions are also modified by various conditions which affect the volatilization of the zinc, so that, in spite of the most expert attention, the composition of brass made by the crucible process will vary and does vary more than most brass makers are willing to admit.

The composition is also affected by the furnace gases to which molten brass in a crucible is always exposed to a greater or less degree. In general, the action of these combustion gases is to change the chemical composition of the metal by oxidizing its ingredients and thus introducing impurities, as well as by removing a certain portion of the metal. The extent of the damage done by flue gases depends upon such factors as the temperature of the metal, the temperature of the gases, the composition of the gases, the velocity of the gases, the pressure of the air, and the perfection of the coating on the surface of the metal. Evidently, the combined result of these various factors is beyond human power to determine, except under test conditions such as may be obtained in a well-equipped laboratory.

Crucible Process Not Satisfactory

To sum up the crucible process of brass melting, it is sufficient to say that it is not susceptible to scientific control and therefore cannot be admitted as a satisfactory manufacturing process for the production of a uniform, high-grade product. Its possibilities are dependent entirely upon the individuals that operate it and the product can be controlled only by thorough inspection and conscientious scrapping of all metal that is below the standard.



Common Sense in Engineering*

By J. E. ALDRED
Founder of the J. E. Aldred Lectures on Engineering Practice

Common sense as a term is as old as the hills; nor is the definition of common sense obscure. The application of common sense, however, is always new to many. Each man who really grows, if he does not have knowledge of common sense thrust upon him, discovers it for himself. Let those who read benefit by the "thrust" here presented so that there will be less necessity to learn by experience.

ALLOW me to say at the outset that this article is not intended so much for students of pure science as for the average man who, having taken an engineering course, goes out to make good and earn a living. To that man I would say: "Try at the outset to get onto the firing line, that is, into the constructive work, whatever form it may take. Do not waste time around a city office, but get out onto the frontier, or into the shop, where you will learn to develop a practical turn of mind."

I am to say something about common sense in engineering. When we say "Common Sense," we mean the application of those fundamental elements of judgment which have, through usage, come under the homely term "Common Sense." It is more difficult to define than to illustrate. As applied to engineering, it may have no relation to engineering as such, but may be of great importance in the application of engineering to a problem. It is an element which is of importance in the training of students of engineering because, if kept constantly before them, it will, in the process of time, become instinctive in the practice of their profession. It is difficult to overestimate its importance, because it is something which may be passed on through an organization, and it may have a strong influence on the personnel of that organization. Later on I will give an illustration of this.

Accounts of Personal Experiences as Illustrations

It is my thought that I might best present to you what is in my mind if I attempted to take you with me through some of the personal experiences I have had in connection with engineering matters, beginning about twenty years ago, when I took up the first large project which brought me in close contact with engineers and engineering problems. This took the form of a development carried out by the Shawinigan Water & Power Co. in Canada. When I found that I was to take up this enterprise, I thought it well to see what work of this character was being carried out at Niagara Falls and elsewhere.

When I went to Niagara Falls and looked over the two large plants there—one having been built by the Niagara Power Co. and the other by a company under the name of The Niagara Falls Hydraulic Power & Manufacturing Co.—I was at once impressed by the difference between these two enterprises.

The plant of the Niagara Power Co. had been carried out by the engineers and designers with the design of making this a show plant; the beautiful power house was designed by no less celebrated architects than McKim, Mead & White. The grounds about the station looked almost like a park, and in the center of the plot, facing the power station, was a beautiful bronze flagstaff. The development indicated that an expensive upkeep would be necessary. The water was brought in from the river in a canal of comparatively small capacity, conveyed to the waterwheels which stood at the bottoms of deep pits which had been cut through the solid rock. The water, discharging from these wheels at something like 150 ft. below the surface of the earth, was carried under the city of Niagara Falls in a subterranean tunnel which served as a tailrace, and by means of which the water was discharged into the Niagara River below the Falls. Everything about this enterprise indicated a lavish expenditure and a disregard of economy.

The plant of the Niagara Falls Hydraulic Power & Manufacturing Co. showed, in every respect, the opposite inclination. The water was carried in a canal on the surface of the earth to the edge of a cliff, where it was taken from a collecting basin by means of penstocks over the side of the cliff and down to the bank of the river, where power houses were built. Here were installed the waterwheels and generators, and the water, after passing through the wheels, simply spilled into the river at the lower level.

Simplifying Problems

The impression made upon me as the result of examining these plants was that the engineer who had carried out the latter development had shown great economy and common sense in the general way in which he had met the requirements. I inquired as to who was responsible for the plant, and met Mr. Wallace Johnson, who had carried out the plans. The result of my visit was that when we were ready to go on with our work at Shawinigan Falls I called Mr. Johnson from Niagara Falls to take up the work in Canada; and that decision I never regretted. In all of the work carried out by Mr. Johnson there was constantly in evidence the desire to simplify problems and to apply sound reasoning and sense to the carrying out of every part of the work.

Now, to show how important this is—what a far-reaching influence a man may have on his associates. With Mr. Johnson there came to Canada from Niagara Falls two young men who quickly attracted my attention by reason of the fact that they, too, showed in their work an appreciation of the desirability of simplifying problems and applying to those problems calm and sane reasoning. It is enough to say that one of those men is now the head of the Engineering Department of the Pennsylvania Water & Power Co. and the other is the General Manager of the Shawinigan Water & Power Co. in Canada.

Mind you, I do not for a moment mean to convey the impression that these qualities which we designate

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as "Common Sense" and "Reason" will stand alone. They must necessarily be accompanied by technical training and the brain and ability, without which no man may rise to a dominating position in his profession. But the value of association of those men with that first man who was picked out among engineers as a man who more nearly answered the description of a safe and sane man, of sound judgment and common sense, has been of inestimable value to the men I have mentioned.

In speaking of the early work at Shawinigan, I cannot resist the temptation to recall an interesting incident which I associate, in my mind, with a man who accomplished wonderful things, involving pioneer work and engineering, and I attribute his remarkable success largely to the simplicity of his make-up and his great power of reducing complicated problems to their simpler elements. I refer to the late Lord Strathcona, who, in the early days of his work in Canada, was known under the name of Donald Smith.

Lord Strathcona—Donald Smith

When I had the work at Shawinigan Falls under way it was necessary to do some financing and sell some securities, and for this purpose I went to London. I was proposing a certain underwriting of securities and their offering on the English market, and among the men to whom I had letters was Lord Strathcona. He was then occupying the position of Lord High Commissioner for Canada to the Court of St. James, and was considered the foremost living Canadian. He was much interested in my story of what we were attempting to do by the development of power at Shawinigan Falls and its transmission through the Province of Quebec. After I had explained to him the general layout of the canal, penstocks and power houses, he said: "Mr. Aldred, tell me just where the first great penstock is to be carried down the hill?" I pointed out its exact position on the map and he said: "Is that not where the old portage was?" I answered: "Yes, and that was the only path we found at Shawinigan Falls when we first went there. We were in the forest." He looked up and said to me: "Mr. Aldred, many times have I traveled up over that portage with my tow-strap over my head, my canoe and pack on my back, on the way to the Hudson Bay Post at Kickindish, in the headwaters of the St. Maurice River."

Donald Smith, as he was then known, was the factor at a frontier post of the Hudson Bay Co., situated at the headwaters of the St. Maurice River. He spent ten years of his life there. Later on he spent twenty years of his life at a similar post in Labrador. This man came back to civilization from those frontier posts after having spent over forty years of his life on the outskirts of the Canadian settlements. And so strong was his faith and purpose that he was eventually the principal factor in the building of the Canadian Pacific Railway across the continent. His simplicity and sound common sense never failed him, and he accomplished perhaps as much in the way of engineering development as any man ever accomplished on this continent.

The development of the power at Shawinigan and its transmission to Montreal at high voltage represented one of the earliest works of this character. We had expected that by the time we completed our line a certain railroad bridge across the Ottawa River at the foot of the city of Montreal would have been completed, over which we had planned to carry our line. This project was delayed and it was necessary for us to find other means of crossing the river. Plans were made for high towers on either side of the river, and by the use of steel cables we were to jump over the intervening space, something like 5,000 feet. The most difficult element in the problem was to furnish strain insulators which would hold these cables at the point where we were required to take the current off for the transmission to Montreal. The carrying out of this work was of vital importance to the success of our enterprise. You will understand our feelings when, after successive tryouts of the strain insulators, we had to admit that they were a failure. It was put up to me that we would require to have new strain insulators, that it would take a considerable time to make them, to say nothing of the great expense. In fact, our whole enterprise was seriously affected by the failure. After giving the matter some consideration and throwing up my hands, I said: "Well, it will be necessary to find other ways of doing this. Why not support the crossarms on the cables, put pins and insulators on the crossarms and string ordinary transmission wires on these inulators and use the cables to carry the lines?" The engineer in charge of this particular work, a highly technical man, explained that the lines would not stand the wind strain and that they would not do this and they would not do that. I did not know exactly what a wind strain was, so he went on and told me all about a wind strain, and he also explained that for some six or seven other reasons this was an impossibility. In fact, he left me no conclusion except that I had better figure on a failure. However, we went on, and we did this crude thing, and the result was that we carried through the winter. We established our service in Montreal, and that crude method of getting over the difficulty was the thing that saved the day, and probably saved our company at that time. I only cite this case, not as a criterion, but as an instance of what happens sometimes when you have got to forget the extremely technical conception of things and do something to "get there."

Cedar Rapids Development

The next large development out in Canada with which I was associated was the development of Cedar Rapids, in the St. Lawrence River, and this furnishes a good example of how common sense and reason applies to a large undertaking. The Cedar Rapids development consisted of turning one section of the river bank into a huge canal which, skirting the rapids at this point in the river, gives at the lower end of the canal, under a head of about thirty feet, a large volume of water. When we came to the construction of this project we found it difficult to get contractors to make a reasonable bid for the work by reason of the fact that a good deal of the ground they would require to operate on was under water. After calling in some of the principal concerns in the country we decided that it would be advisable to carry out this work ourselves. We laid out the plans and plant, and uncovered the area, exposing the bed of the river, and after we had put the thing in shape so that everything was visible to the naked eye, we brought in a contracting firm in whom we had confidence to do the work.

It is enough to tell you that this method of carrying out this work resulted in a saving of over a million

dollars, as against the best price we had from any contracting concern. After we had worked on the Cedar Rapids for a year and a half, we saw signs of distress on the part of the contractors. They were working on the basis of so much a yard for earth, rock and concrete. They were good men and competent, and we went to them and asked them how they were getting on. And they finally confessed that it looked as if they would have two years' work for nothing. This was not a desirable situation. We had a year's work ahead of us to finish this plant and to put it in operation to meet the requirements of the city of Montreal. I said: "We will put an auditor on your books, and if your statement is correct we will make a new arrangement with you." We very quickly ascertained that they had told us the truth, so I worked out a proposition whereby they would be assured a profit of $150,000. We then said: "Now, go ahead with the work; keep the prices that you have been working under and see what you can do in the end. If you make any saving over and above the $150,000 that we are giving you as a profit we will divide it with you."

They worked up to such a degree of speed and efficiency—and they were employing between two and three thousand men—that during the next year it was perfectly wonderful to see the work go on. The net result was they not only saved the $150,000 that we agreed to give them as a profit, but they saved $75,000 additional, which we divided with them. In other words, the common-sense policy applied to this undertaking cost us not one cent, but it resulted in a saving to us and the contractors' making $187,500.

Development of Power on the Susquehanna River

I well remember when I first heard of the work which was to be carried on in the development of power on the Susquehanna River. A friend of mine told me of a visit he had made to the work and described the manner in which it was being carried on. He was familiar with the economical system we employed in our work in Canada, and he was setting up this Susquehanna River work as a sample of the opposite kind of management. After he had described the undertaking and the character of its plans for the carrying out of the work, I said: "Well, we may have an opportunity of taking it over some day." I little realized at the time the seriousness of that statement, but three years later I was appointed receiver for the company. I brought down and put in charge of completion of this work—the plant was about 50 per cent completed—one of the young men I previously referred to as having come to Canada with Mr. Johnson, and he carried out this huge undertaking—in sole charge of the engineering work—with the net result that the completed plant was at least 25 per cent better than it would have been in accordance with the original plans, and at a cost of something over a million dollars less than the amount which we had provided for him to do the work.

To illustrate how foolish engineers can be, I will tell you of one detail in connection with this plant on the Susquehanna River. We found, according to the original plans, that provision was made that the transformer house should stand on a bridge and that the cooling coils for the transformers should be submerged in the tail-race (this was a water saving device), under the arches of this bridge. Well, as you know, these cooling coils have hundreds of joints, anyone of which is liable to leak, and the only way to get at these cooling coils to make a repair was by putting on a diver's suit and going down under the bridge. The absurdity of such a scheme must be evident to anyone, yet this was a scheme devised by one of the well-known engineers in this country.

Now, a word as to the penalty for not applying reason and sense to engineering undertakings. In considering this, please keep in mind that a substantial percentage of the great engineering works undertaken are initial failures. I suppose you hardly realize that, but I know it to be true from a survey made of the principal engineering undertakings in this country and outside, and if it were necessary—but I think it would be inadvisable—I could give you a list of hundreds of huge engineering undertakings in this country that have been substantial failures.

Personally I have seen hundreds of reports on water power projects, but I have never yet seen an unfavorable report. To consider the seriousness of this, I will give you a specific instance of a company (which shall be nameless) which carried out a large water power development on this continent on the strength of a report by one of the three or four best-known engineering concerns in America. That enterprise involved an initial expenditure of over seven million dollars. The report set forth that the company could develop an initial 100,000 hp. capacity, and eventually could develop as much as 400,000 hp. capacity. The company has been in operation for ten years now and it has never, in any one year, developed 20,000 hp. capacity. What about it? Here is a report of a reputable (supposedly) well-known, engineering concern, on the strength of which report people made an investment of millions of dollars. Lost! And any man with sound common sense and any knowledge of the business could have said right at the start that it would be lost. What does it mean? It means that a lot of lads sitting in a drafting room down here in New York designed, subject to a report which they had from some of their superiors, I suppose, a plan to generate electricity by means of water power under conditions with which they were unfamiliar. They had only surface knowledge, but they wanted to do a job. Engineers always want to do a job of work. They never turn down a job; but what is the net result? The loss of millions of dollars in the course of a work that would do an indefinite amount of harm to other similar enterprises that may be suggested for years to come.

Profession of Engineering the Finest There Is

That illustrates the seriousness of engineering and practice without regard to sound reason and sense. I could duplicate the above case a number of times both in Canada and in the United States, but—what's the use? It does, however, bring home to you men this: That it is a very serious profession you are proposing to follow. I urge the necessity of bringing to bear upon the student of engineering the influences that will tend to make him more practical and constantly have in mind that an engineering project must check up, not only from the standpoint of the technical, but from the standpoint of the reasonable and the desirable, and that the student must cultivate this habit of considering his work from the standpoint of "Common Sense." Personally, I think the profession of engineering

is head and shoulders above every other profession. I am not an engineer; I wish I had been, it would have been the pride of my life. I think it is the finest profession there is. It gives a man a chance to get out onto the frontier, to get into the constructive side of things, and there is somthing about engineering that makes men. A man who follows the profession of engineering after a time gets into the habit of looking at the big things as of comparatively small importance, but big things to be overcome, and he goes to them and he overcomes the tremendous difficulties that are involved in all these great enterprises. It may be building a tunnel through the Rocky Mountains, in Canada or the United States. It may be some great reclamation project. What you like. But the carrying out of these enterprises and the training that a man gets makes, on the whole, by and large, a class of men that, to my mind, stand above any other class.

You men ought to be proud of your profession. You have before you, if you go through with this course, a chance to go out in the world and do your part. You have a living that should appeal to any man who has red blood in his veins. You can perform a useful function in society; you can do a work that will bear fruit after you have passed on.

Think of the work here at hand. Why, right here in the State of Pennsylvania the cost, by reason of the flood conditions of three great rivers in Pennsylvania, over a period of forty years, averages over $2,000,000 a year, and yet nothing has been done to curb these torrents. There's a job for some man—some one of you, perhaps. When he is doing it he not only saves the $2,000,000, but he will conserve for useful purposes the water resources of those rivers, and, by so doing, make it possible to produce hundreds of thousands of horsepower by the utilization of the Susquehanna, the Allegheny and the Monongahela Rivers. What better work could you have than that, and this is only a sample of the great things that are waiting for you men to do.

All I have to say in conclusion is: Go, see and do these things, and do them in a "Common Sense" way.

The Industrial Development of Australia

BY ERNEST L. LITTLE

THE remarkable industrial development of Australia is the result of accident rather than natural conditions. That country, with its enormous expanses of land suitable for farming, would doubtless have profited more if its population had become more largely engaged in the industries of the soil instead of engaging in manufacturing. The discovery of gold, however, attracted a population essentially industrial in character, and, coming in too great numbers, at the beginning of the second half of the last century, it failed in many cases to find employment or opportunity in connection with the development of milling. This surplus of labor showing a disinclination to offer itself for agricultural work, and remaining unemployed in the cities, created an acute problem for the government. With a view of remedying the situation, Victoria, and to a less extent, New South Wales, finally determined upon a policy of industrial encouragement and protection. By means of the tariff, bonuses, and bounties a great impetus was given to the local manufacturer of many articles that had previously been extensively imported.

Furthermore, the European war stimulated the development of Australian industries and everywhere there is evidence of increased industrial growth. Numerous factories and workshops are producing what has hitherto been imported. Some indication of the large scale on which certain industries are being established is given by the following figures published by the Commonwealth Treasury regarding issues of capital recently organized:

Nature of Industry	Capital Authorized
Extension of Steel Works	$7,917,795
Manufacture of paints, white lead	1,459,950
Manufacture of woolen yarn	681,310
Cement works	851,637
Manufacture of zinc	486,650
Manufacture of hosiery	437,985
Wool scouring	364,987
Manufacture of steel products	344,978

The general growth and the effect of the war on Australian industries is clearly indicated by the following figures, estimated in pounds, which show the direction of the industrial trend during the last ten years:

	1909	1918	Increase
	£	£	£
No. of establishments	13,229	15,421	2,192
Hands employed	266,661	328,049	61,388
Salaries and wages paid	21,111,656	38,379,268	17,267,612
Value of machinery, land and buildings	54,629,357	96,588,009	41,958,652
Value of materials used	64,028,881	146,181,866	82,152,985
Value added by manufacture	41,929,447	79,571,745	37,642,298
Value of output	105,958,328	225,753,611	119,795,283

Progress in Iron and Steel Products

During the last few years considerable progress has been made in the production of iron and steel products. Several large plants have been established and negotiations are proceeding, or in some cases completed, for the erection of works for producing galvanized iron, sheets, tin plates, fencing wire, wire ropes, and steel pipes. The State of Queensland possesses vast deposits of iron ore and coal, and the Government is considering the development of these deposits and the erection of a steel works, which will probably be located at Gladstone.

In the State of New South Wales are also found valuable resources for the extension of the iron and steel industry. A fine quality of coal is very abundant in the Blue Mountains, about one hundred miles from Sydney, and iron ore of about 58 per cent quality, together with limestone, can also be obtained in this district.

There has been considerable expansion in the manufacture of machinery of all kinds and while Australia cannot possibly compete in price with countries manufacturing machines on quantity production lines, the local demand will greatly aid the future development of Australian industries.

Manufacturing Industries—Value Added By Processes of Manufacture

	1915 £	1918 £
Treating raw materials, product of agricultural and pastoral, etc., pursuits	2,256,225	3,867,253
Treating oils and fats	795,721	1,366,219
Processes in stone, clay, glass, etc.	2,870,186	2,892,919
Working in wood	4,504,536	4,961,380
Metal works, machinery, etc.	15,067,974	17,090,920
Connected with food and drink, etc.	14,877,081	18,396,327
Clothing and textile fabrics, etc.	8,744,907	10,671,416
Books, paper, printing and engraving	4,790,263	5,740,863
Musical instruments, etc.	95,864	157,017
Arms and explosives	310,070	464,857
Vehicles and fittings, saddlery, harness, etc.	1,870,653	2,112,032
Ship and boat building and repairing	1,038,423	818,057
Furniture, bedding and upholstery	1,378,311	1,627,932
Drugs, chemicals and byproducts	1,416,617	1,958,153
Surgical and other scientific instruments	49,500	84,625
Jewelry, timepieces and plated ware	347,846	407,897
Heat, light and power	5,050,934	5,849,668
Leatherware, n.e.i.	231,207	293,230
Minor wares, n.e.i.	614,300	810,980
	66,310,618	79,571,745

Plants have been successfully established for the manufacture of brass and copper wire, tubes and sheets and also for the manufacture of brass and iron fittings of various kinds. The treatment and smelting of nonferrous ores of various kinds has developed rapidly and greater expansion is expected in this industry.

Despite the handicap imposed through inability to secure necessary machinery from England and the United States during the war, the woolen industry has made considerable headway. Several new wool spinning mills have been erected and others are in contemplation.

American hardware products are considered to be superior to those of British manufacture since the American packages are more adaptable for shelf display. These packages are said to be more clever in design and cheaper. Owing to the fact that it is possible to show the goods in suitable glass cases, thus enabling the customers to examine quickly a large array of articles, there is a greater demand for the American product. The customer is usually ignorant of the latest devices and the American method of display has especially appealed to the hardware trade.

While the population of Australia is very small in proportion to the enormous area of the country, the per capita purchasing power of the people is undoubtedly considerably above the average of most countries of the world. While the number of persons of great wealth in Australia is not large, the average means of most of the population is sufficient to allow purchase of the necessities of life, and also of a reasonable amount of luxuries. About a quarter of the population of the Commonwealth live in the two great cities of Sydney and Melbourne. The rural population is widely scattered. In many instances their holdings of land are very large, and probably the most prosperous people in the country are the "squatters," or holders of large estates, which are devoted chiefly to the pastoral industry, the returns from wool during the last few years having brought large profits to this class.

In a general way the articles required for the people of Australia are similar to those required in the United States, so that Australia naturally furnishes a suitable market for most of the products of the United States with the exception of agricultural products, most of which Australia produces quite sufficiently for her own needs.

In most classes of manufactured goods there is opportunity for extension of American trade if American manufacturers would give serious attention to this market and pursue the same enterprising business methods that they do at home. The American manufacturers who have established branches and have their own salesmen, have been doing a successful business despite the disadvantages of the high protective tariff.

For the sale of American machinery and hardware there should usually be a distributing agency or headquarters in the metropolis of each state, with a general headquarters at Melbourne or Sydney. As the population of Tasmania is small, and the island is reached over night by steamer from Melbourne, that territory may, in some instances, be easily covered from Melbourne.

The establishment of branch factories in Australia has been found a means of overcoming the protective tariff. Providing that unnecessary competition is not introduced, it may be said that branch factories of American manufacturers are welcome. Land is easily obtainable, but construction is costly, while skilled and unskilled labor is scare. Both classes of labor are inclined to be restive and to strike on the least provocation, but it should be noted that where welfare movements have been established comparatively few labor disputes have taken place.

When making shipments to Australia the details in regard to the usual size and weight of the packages containing any particular articles should be ascertained from the importer and these instructions should be carefully followed. The primary consideration of the American exporter must be safety of carriage. As all import duties are *ad valorem* and not levied on gross weight as is frequently the case in Latin-American countries, there is no reason for the manufacturer using too fragile a container for his goods in order to save weight and reduce the duties.

Care should be taken to make the packages as compact as possible as freight is generally charged on cubic measurement. A neglect of this precaution may lead to loss of business. As an illustration of this point, one of the reasons given why English enameled-iron bathtubs have enjoyed a greater sale than the American is that they are packed in crates containing four or five tubs, while the American crates contain only three. Thus, five tubs from England pay no more freight than three from the United States. In order to obtain this closer nesting the English tubs are made with sloping sides.

Special packing for animal-back transportation is not necessary in the case of goods shipped to Australia. The merchandise is discharged directly from the steamers to the docks and then taken to the warehouses by motor or horse-drawn trucks. If the goods have to be shipped back into the country, the transportation is by rail and breakage can only be avoided by the use of well made, strong cases, carefully secured. By taking these factors into consideration and following Australian methods of merchandising the American exporter can be assured of a constant growing market for his products in Australia.

Medical Aid Under the Compensation Acts

By CHESLA C. SHERLOCK

The attitude of the law toward the subject of medical aid for industrial workers is, in general, quite well defined. Who has the right to choose the physician to attend an injured man, the company or the employee himself? The subject of operations arising from industrial accidents is another point often misunderstood; the author covers such matters fully.

THE liability of the employer to furnish medical aid to injured workmen is absolutely fixed by the Workmen's Compensation Acts. There is no escape from it. This liability attaches even before the liability to pay compensation does.

It attaches even when there is no liability under the law for the payment of compensation, for many workmen are injured sufficiently to require medical treatment, but are not incapacitated from earning wages, within the meaning of the law. People receiving injuries of this class are not entitled to cash compensation from the employer, but they are, nevertheless, entitled to medical aid at his expense.

The liability for the payment of compensation and the liability for furnishing medical aid, while springing from the same root of liability in the law, are not in any sense to be considered as dependent on each other. Many employers feel, and rightly so, that unless they are liable for the payment of compensation arising out of an injury, they are not liable for medical treatment beyond first aid; but the converse of this is not likewise true, as many would suppose, that, unless they were liable for medical aid, they could not be held for compensation payments.

Medical Aid Must Be Provided

These things are not true, for the law provides, as the very first relief which the employer shall furnish an injured workman, medical aid. If the workman recovers rapidly and is back to work before the time fixed by statute for compensation begins, then such return to work relieves the employer of the necessity of paying compensation, but he is not relieved of the amount spent on medical aid furnished. On the other hand, the law feels that the workman has received sufficient compensation for the injuries received, if he gets back to work before the statutory "waiting period" has run, in the form of the medical treatment furnished by the employer; and it strikes a balance and calls the account square.

While it is not specifically provided in the various acts, it has come to be a part of the law by judicial interpretation, that the employer is liable for medical treatment, including first aid, at least, of all workmen injured in his employ, whether the workmen were injured under compensable circumstances or not. The employer cannot afford to take a chance and resort to snap judgment as to whether or not the workman was injured under compensable circumstances. He must assume that the workman was, for purposes of fulfilling the medical aid provision, and furnish first aid treatment, at least, without a question on his lips. Then, if investigation reveals the fact that the workman received his injury while outside the scope of his employment or through any of the means not recognized by the compensation acts, the employer, if he wishes to deny liability, may notify the workman and withdraw his medical aid.

The employer should ever keep in mind the fact that the injunction in the acts to furnish medical aid is not arbitrary, but in reality is a distinct advantage to him.

Competent Medical Aid Reduces Number of Serious Cases

Competent and adequate medical attention at the right time reduces the number of serious cases to a minimum and often prevents more serious complications that might impose a real liability upon the employer. I need only to mention a common fruitful source of industrial loss which springs from apparently trivial injuries, and, usually, from a lack of proper medical attention at the right time. I refer to blood poisoning. I have witnessed many severe cases of blood poisoning among workmen, and in practically every instance, the trouble came from a slight scratch or cut which the workman considered as inconsequential and which he did not have properly dressed by the company physician.

The liability to furnish medical treatment imposed by the compensation acts is placed upon the employer, not as an additional burden to be borne by him, or as an act of charity to the injured workman, but because it is legitmately a part of the cost of production, just as is compensation, and for the further reason that it is to the interest of the employer and of society to restore the workman to his normal usefulness at the earliest possible moment. This can be done only through the furnishing of proper medical aid promptly and without delay.

Choice of Physician Belongs to Employer

Naturally disputes arise as to the manner in which the medical aid shall be furnished. The law is not explicit; it does not go into detail. The employer provides a company physician and sends him when a workman is injured. The workman, on the other hand, is oftentimes suspicious of the company physician, thinks that he is working in the interest of the employer and does not trust him. He wants to call his own physician, in whom he probably has more confidence, and then he wants the employer to pay the bill.

Right here one can put his finger on the most fruitful source of trouble between employers and injured workmen under this section of the compensation acts. If the workman could be trusted to exercise that quality of judgment which the employer usually exercises (under state influence), then the courts might be more disposed to listen to the workman in his plea. Experience, however, has demonstrated that the workman cannot be trusted to secure the most competent medical aid when he is entrusted with that privilege. He is an easy prey to quacks and quackery. Too often he falls into the hands of a disreputable physician who has no desire to hasten his recovery as much as possible, but,

in order to fatten off the employer, merely cares to keep the patient on the road to slow recovery Then again, he may fall into the hands of some of the various faddists and cults who would experiment on him at the employer's expense.

The courts were at first undecided on this question, but they finally came to see that the only solution was to uphold rigidly the right of the employer to select the physician who was to treat the injured workman and to deny such right to the workman. The employer is the one who pays the bill. He is usually a man of affairs, and it is to his interests to get the workman back to his normal usefulness as soon as possible. Who, then, is more competent to select the physician? Because of these considerations, he is more likely to engage competent medical skill to treat the injured workman than the workman himself would be likely to do.

The employer, however, must post a list of the physicians he has designated to be called in case of emergency, and he must also give adequate instructions as to what must be done when it is necessary to make such a call. These instructions and this list must be posted in the place of work where the employees can have a chance to see them. In fact, the supreme court of Massachusetts has held that the mere posting of a list of physicians' names without instructions is not a compliance with the duty to furnish medical aid, and that an employee may call his own physician in such a case and bind his employer therefor.

Employer's Liability Limited

The law usually puts a time limit upon the employer's liability for medical aid, also a monetary limit. If the need for medical aid extends beyond these limitations, the employer is, of course, relieved of further liability and the injured workman must bear the additional expense necessary. Employers, however, do not hasten to absolve themselves of this medical liability, as a rule, if the workman is still in need of close attention. They realize that the better care he has the quicker he will recover from his disability and the sooner the payment of compensation will cease. Often the expenditure of a few dollars more for medical aid than that required by the statute will save many weeks' compensation payment by shortening the period of disability.

The payment of money for medical aid has nothing whatever to do with the payment of compensation. It is additional to such compensation payments as may be required, and cannot be deducted in whole or in part from the compensation due. Likewise, it is due whether compensation is due or not.

The Law Regarding Operations

When an operation is necessary to restore a workman to his earning power or former efficiency, it is the duty of the workman to submit, if such operation is of a nature not ordinarily dangerous to life. Refusal of the workman to submit to an operation may have a great effect upon the employer's liability under the acts.

If the operation or treatment which the workman refuses to submit to is a simple one, and such refusal greatly aggravates his condition and causes him to suffer a greater incapacity than he would have had he submitted at once, then the employer is justified in stopping compensation payment immediately.

The supreme court of Wisconsin tried just such a case and it ruled that the subsequent disability "is not proximately caused by the accident, but is the direct result of such unreasonable refusal." The court added that to prolong or increase the disability by such refusal, "and thereby place the burden of his wrongful act upon society in general, is not only repugnant to all principles of law, but abhorrent to that sense of justice common to all mankind."

This situation, however, is vastly different if the operation is a serious one and threatens the workman's life.

Law Does Not Require Any Man to Submit to Serious Operation

The law does not require any man to submit to an operation endangering his life, but he may do so of his own accord. If the workman refuses to have such an operation performed it is generally permissible to reduce his compensation payments to such amount as he would have received had the operation been performed and had it been successful. However, his payments cannot be cut off entirely unless all subsequent developments are clearly the result of his refusal and in no way the result of the original accident. If his life would have been saved beyond a reasonable doubt by a prompt decision to accept the operation, there is room for debate.

In Michigan such a case arose. The workman was urged to accept an operation immediately. He refused, but gave his consent the following day. The injury was to the intestines, but complications had set in and pneumonia resulted. As a result, the man died, and the employer claimed that he was not liable for the death, inasmuch as it had been caused by the refusal to submit to the operation when first offered. The court, however, took into consideration the fact that the workman was a foreigner and probably could not understand clearly what was meant, and held that it could not be said as a matter of law that his conduct was so unreasonable as to defeat the right of his dependents to compensation.

Rights of the Workman in Choosing a Physician

We have been assuming thus far in the discussion that the employer has promptly offered medical aid to the injured workman. But, where the employer fails to provide medical aid within a reasonable time after the injury a different situation arises. The workman then has the right to summon his own physician and he may bind the employer for the services so rendered, regardless of the fact that the employer did not select such physician.

The time during which the workman may bind his employer for medical services rendered by his own physician is from the time of the injury, or a reasonable time thereafter, until such further reasonable time in which the employer might have furnished his own physician. If the employer supplies medical aid within any period of his disability, the workman must ordinarily dismiss his own physician and accept the employer's, except in a case where a capital operation is necessary, in which instance the original physician will be retained throughout the case, unless it be shown that he is incompetent.

It is generally held, in the case of an emergency, that if a physician other than the employer's designated physician is called, whether by request of the injured

workman or by his fellows, the employer will be bound for the services rendered by such physician. It is generally held that the physician most quickly obtainable must be summoned whether or not he be known to the employer or workman, and the employer can later turn the case over to the company physician, if he was not summoned in the first instance.

The employer must furnish the medical aid immediately and he must offer it whether the injured workman requests it or not. Employers are not relieved from the obligation by saying that the workman went home and did not ask for medical aid. The notice of injury of a workman to the employer is also notice to such employer to furnish such workman with competent medical aid. If the employer does not furnish it, within a reasonable time after the injury, and has said nothing about it, the workman has a right to call his own physician and charge the bill to the employer.

Competence of Employer's Physician

It will be noticed that the employer must furnish "competent" medical aid, and when he fails to do this he has, in the ruling of the courts, furnished no aid at all and the workman will be justified in procuring his own physician. In Connecticut it has been held that the employer did not furnish competent medical aid when he furnished a chiropractor. Said the commissioner:

"The notion of competency, when embodied in a legislative act, connotes conformity to some prevailing standard. . . . There are numerous schools and cults enjoying limited patronage and making divers claims of ability to alleviate pain and cure disease, whose merits it is not necessary for me to consider. . . . When the employer, operating under this statute, undertakes to provide an exponent of any such school or cult as 'competent,' and the question of competency has to be passed upon by the commissioner, the measure of competency then becomes the prevailing standard of society, not the judgments or convictions of the employer, however sincerely or disinterestedly exercised. . . . While it is not without the limits of possibility that some person or persons, either by reasoning on theoretical grounds or by experimentation, or even accident, might discover a new and better method than that generally practiced and taught, such a contingency is highly improbable and the employer who under this act provides a practitioner of any such unusual method, contrary to the prevailing standards of society and the consent of the injured employee, fails to conform to the provisions of . . . the act."

Changing of Physicians

It seems well settled that the time for the employer to bring his own physician into the case, where he was not summoned in the first instance for the emergency treatment, due to a failure to provide or an inability to procure, is at the end of the emergency treatment immediately following the injury. Employers must take into consideration the ethics of the profession as well as the rights of the injured workman. They cannot unnecessarily embarrass him or his chances of recovery by changing physicians in the middle of a necessary treatment or period of treatment, especially when the need for any such change at all rests upon their original failure to provide.

If the employer fails to furnish a physician within a reasonable time, he cannot compel the injured workman to discharge his physician and accept the treatment of the employer's physician whenever the employer gets ready to furnish such treatment. The employer's right to designate the physician does not extend this far by any means. In a California case it was said that the employer must take the initiative and that he must act promptly, else he will lose his rights and cannot thereafter require the workman to change his physician.

Amount of Expense for Medical Aid

The employer is liable for the reasonable value of all necessary medical services which grew out of the accidental injury. This has been held to include hospital treatment, first aid, dental work, and the further necessary treatments during the time limit specified in the statute, but within the maximum money amount allowed. It does not, however, include treatments rendered by unrecognized cults or schools, such as chiropractors or Christian Science healers.

In Connecticut it was held: "The amount to be charged by the physician is not to be determined by what the insurance company or the industrial corporation is able to pay. It is not to be determined by the physician's estimation of the disposition and social qualities of the insurance adjuster or attorney. It is not to be determined by what the particular physician, whose bill is being considered, has been in the habit of charging and collecting in like cases. A physician who is treating a compensation case is supposed to charge and collect from the employer or the employer's insurer as much, and only as much, as the profession in general in his locality would ordinarily charge and collect from a workman of like standard of living if he was injured at home and had to pay his own doctor's bill."

How to Appeal When a Physician Overcharges

If the employer feels that the physician has charged him too much for the service rendered, he has a right to appeal to the Industrial Commissioner or Commission for an audit of the bill. Usually all that is necessary is to forward the bill to the authorities with a statement of the nature of the treatment rendered.

The bill must be itemized. The employer is not liable for the maximum statutory charge allowed in each case, but merely for the reasonable value of the services rendered, not exceeding said amount.

The Iowa Industrial Commissioner has said: "When submitted for judgment, it is the statutory duty of the Industrial Commissioner to pass upon bills for legal services and medical and surgical relief afforded claimants. . . . Physicians should submit bills no larger than in case the same were to be charged against the workman himself. The idea, where it may obtain, that low fees are simply a benefit to a rich insurer should be abandoned, since he is able in the long run to take care of himself by an advance in rates and the excessive charge is simply a tax on consumption and society in general."

In closing the discussion, it is necessary only to call attention to the fact that if nursing is necessary it may be considered a proper charge to list under "medical aid." This will be determined upon the same test for reasonableness as other medical charges are. The employee or members of his family, however, are not entitled to recover the value of their services while attending the injured workman at home, nor to charge the same to nursing expense when no hospital care or attention is necessary.

Programs of Apprenticeship and Special Training In Representative Corporations

By J. V. L. Morris



THE Westinghouse Co. is one of the great manufacturing concerns of the world. In the East Pittsburgh works alone eighteen to twenty thousand people are employed. Under the heading "Some Westinghouse Products," published by the company, are mentioned such articles as automobile starting and lighting systems, circuit breakers, condensers, fuses, gas engines, generators, heating devices, lightning arresters, electric lamps, locomotives, meters, ranges, rectifiers, rotary converters, transformers, and steam turbines. While this is only a partial list, a glance will show that not alone skill but an immense amount of initiative and experimentation is necessary for developing and improving not only the products but also their means of production. An organization consisting of designing and organizing engineers with a supply of labor of specialized efficiency is not alone sufficient. To these two important groups there needs to be added the third type of workman, not with the highly technical training requisite in the engineer, but equipped with the practical all-around shop knowledge that will enable the attacking of problems of machine operation and control with some probability of obtaining a solution. This third type, the mechanic, must be given recognition in the company's organization.

An examination of the educational department of the Westinghouse Co. shows that these three primary differentiations of productive skill and intelligence are recognized by the management. Special training and various devices of expert employment management are practiced to produce optimum efficiency among the partially skilled and specialist labor groups. Carefully supervised apprenticeship and a flourishing technical night school provide the training and industrial education for the skilled or mechanics group. Finally, being one of the leaders among manufacturing concerns and requiring a large technical staff, some three hundred or more graduates of the leading engineering schools are each year taken in under conditions approximating apprenticeship in order to recruit the engineering and administrative force of the company.

IV. The Westinghouse Electric and Manufacturing Co., East Pittsburgh, Pa.

In this article the methods employed for training apprentices and machine men in the electrical industry are again taken up. The various factors, such as selection, education, grading and promotion, which enter into the conducting of an apprenticeship program are all considered, as well as Americanization and the training of graduate engineers.

(*Part III was published on Oct.* 21)

Special Training

Considering these various programs more in detail we find that to efficiently handle the unskilled and partially skilled labor employed, an elaborate system of employment management is utilized. To facilitate this job-analysis cards have been prepared enumerating in detail the duties of each separate occupation in the plant, and a number is affixed to each occupation by which foremen can make requisitions on the employment department for additional workers. Standard methods are used to reduce labor turnover, one of them being transfer, which is employed when work slackens in one department and increases in another or when dissatisfaction develops between a foreman and one of his workmen. Before any employee is discharged or withdrawn of his own accord the department endeavors to arrange an interview to discover the real reason and, if possible, to adjust the matter amicably.

At the present time an intensive training course is being conducted for stenographers. The students are already either experienced or fresh from the commercial schools, and they are given this special training primarily to acquaint them with company forms and practices, as well as to give them acquaintance with technical terms peculiar to the industry. The course lasts from a period of a few days up to several weeks, according to the ability of the pupils enrolled and the demands made for stenographic help in the various departments.

Similarly, recruits to the clerical force are provided with special training by the educational department upon requisition from the department by which they are employed. This may take the form of four hours per

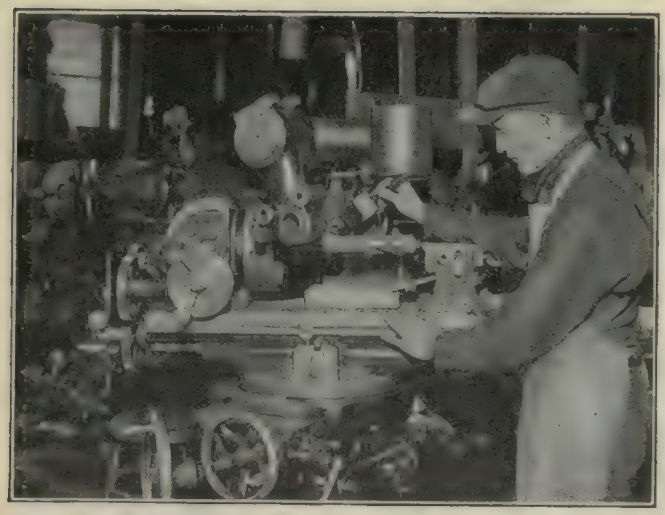


FIG. 16. APPRENTICE OPERATING A MILLING MACHINE IN THE TOOLROOM

week of instruction in matters directly related to the work, and is provided for both sexes.

Of greater interest from a mechanical standpoint is the special training department or "vestibule school" for operator-specialists on the various machines. A boy or young man wholly inexperienced may in a few days to several weeks be taught to operate a boring mill, lathe, or milling machine, and thus in a very short time reach the standard production-capacity when he is transferred to regular production work. A small department, segregated from the usual production floors and containing standard equipment, is provided for this purpose. None of the work is, however, of an exercise sort, but of a kind suited to beginners chosen from regular production jobs. A similar training department is provided in winding and taping for female employees.

Apprenticeships

Concerning the organized apprenticeship and evening instruction provided for the mechanics or skilled craftsmen, we shall consider first apprenticeship, which has not waned in popularity either with the more capable boys, or with the plant's administration, despite the existence of the intensive machine-training just described. This is due to the facts that a broader training is provided and steadier qualities are proved by the willingness to forego standard production wages during a long period of training. A group of superior workmen is developed, who are assured of steady employment and later of preferment in the choice of foremen, superintendents and ultimately even of executives. There is no break in the ladder of advancement to the boys who will take the all-around training.

We find at the present time 198 four-year apprentices employed in the East Pittsburgh works. These are divided as follows: 142, or 72 per cent, are in the machinists' and toolmakers' trades; seventeen, or 9 per cent, in the patternmakers' and thirty-nine, or 19 per cent, in the electricians' trade. There is, in addition, an opportunity offered for apprenticeship in pattern-making and foundry work in the Cleveland plant of the company, where ten apprentices are enrolled.

An effort was made to discover the ratio of apprentices to skilled men in the various trades, but without success, owing to the lack of a definition as to what constitutes a skilled man. For instance, thirty-nine electrical apprentices would, of course, be a very insignificant number compared with the very large number of people employed on electrical work in the plant, and the same applies, though perhaps in less degree, to the other trades. One must recognize that in this plant, as in most large manufacturing concerns, much of the training, if provided at all, is in limited special fields and does not conform to regular apprenticeship. "The latter is designed to produce a man with far broader knowledge than is generally required on the majority of production jobs."

Instruction of Apprentices

Approximately one-third of the 4-year course is spent in a special training section by the machinists and toolmakers and the remaining two-thirds in various sections of the works which provide facilities for broad experience. Fig. 16 shows an apprentice operating a milling machine on a job requiring considerable skill. There are, however, no special training sections for patternmakers or electricians, as in those trades it is believed advisable for the apprentices to learn their trades by working with journeymen in the respective shops. Fig. 17 shows an apprentice at work on a pattern, while in Fig. 18 another can be seen wiring a switchboard. Definite schedules for transferring apprentices from one kind of work to another are administered by the educational department, in order to insure that each apprentice receives an all-around and balanced training during his course.

For all apprentices four hours per week during the entire course is given up to classroom instruction. Classes meet from 7 to 9 a.m. in the educational department for the study of mechanical drawing and practical shop problems. The textbooks for these courses have been compiled by the instructing staff, all problems used being those actually met in the shops.

The instruction in mechanical drawing includes blueprint reading, sketching, layout problems, developments and tool design, Fig. 19 showing apprentices at work in the drawing room. In the course in shop problems instruction is given by means of problems in English, mechanics, shop system, costs, and the application of the principles of arithmetic, algebra, geometry, and trigonometry to shop work. Fig. 20 shows apprentices at work in the shop problem class.

Two hours' home work is required each week in addition to class work. Instructors in the apprentice



FIG. 17. APPRENTICE MAKING A PATTERN



FIG. 18. ELECTRICIAN APPRENTICE WIRING A SWITCHBOARD

school are selected from the engineering, drafting, and shop departments of the company. Because of their close contact with the shop conditions encountered in this particular industry these men are obviously particularly well qualified to develop in each apprentice a correct understanding of the work involved and an appreciation of the relation between the various trades and the industry as a whole.

As the method of training is similar, mention should here be made of the opportunities offered to those who wish to become draftsmen. They start as tracers in the drafting department, and are given a 2-year supplementary course for six hours each week by the educational department. This instruction covers design problems involving various applications of mathematics, physics, mechanics, materials, shop methods, estimating and cost calculating in tool design. It also includes such special subjects as lubrication and bearings, heat transfer and ventilation and electrical machinery. The pay is somewhat better than for trade apprentices.

Wages of Apprentices

The pay of apprentices as in other progressive corporations, has shown considerable appreciation, both during and since the conclusion of the late war. On Jan. 1, 1920, the schedule stood as follows:



FIG. 19. APPRENTICES IN A MECHANICAL DRAWING CLASS



FIG. 20. CLASS OF APPRENTICES STUDYING SHOP PROBLEMS

22c.	per hour for the first	1,218 hours
24c.	per hour for the second	1,218 hours
26c.	per hour for the third	1,218 hours
28c.	per hour for the fourth	1,218 hours
31c.	per hour for the fifth	1,218 hours
35c.	per hour for the sixth	1,218 hours
39c.	per hour for the seventh	1,218 hours
44c.	per hour for the eighth	1,218 hours

This pay is based on a 48-hour week, or an average month of 203 hours. A period of six months is thus 1,218 hours.

The Selection of Apprentices

The company takes much care in the selection of apprentices. For admission to the trade courses the applicant is required to be between sixteen and nineteen years of age and possess the knowledge of English and arithmetic to be expected of a grammar school

WEIGHT CHART FOR SELECTION OF TRADES APPRENTICES

		WEIGHT		
MENTAL				
(a)	Two-year high school at 16	5	( )	
(b)	Observation	5	( )	
(c)	General knowledge	5	( )	
(d)	Attitude	5	( )	
(e)	Self reliance	5	( )	
	Total	25		( )
MORAL				
(a)	Manners and habits	5	( )	
(b)	Character	10	( )	
	Total	15		( )
PHYSICAL				
(a)	Appearance	5	( )	
(b)	Activity	5	( )	
(c)	Health	10	( )	
	Total	20		( )
GENERAL IMPRESSION				
(a)	Tact	5	( )	
(b)	Common sense	10	( )	
(c)	Mechanical aptitude	5	( )	
(d)	Future ambitions	5	( )	
	Total	25		( )
MATHEMATICS		10	( )	
REFERENCE		5	( )	
	Total	15		( )
	GRAND TOTAL	100%		( )

APPLICANT..... DATE.....
COURSE..... INTERVIEWER.....
ACCEPTED..... 1. COMM. CHECK.....
REPORTED..... 2. COMM. CHECK.....
3. COMM. CHECK.....
AGREEMENT SIGNED.....

FIG. 21. THE WEIGHT CHART USED BY THE COMMITTEE

graduate. For the electrician's course, in addition, the applicant must have two years of high school training or its equivalent. Complete high-school training is ordinarily required for entrance to the drafting course.

Every applicant is interviewed by two or more members of the company's trades apprentice committee, usually the director of trades apprentice instruction and one of the foremen being included. In case of doubt or disagreement as to the suitability of a candidate he is turned over to one or two additional interviewers, whose judgment is final as to acceptance or rejection.

Fig. 21 shows the chart used by the interviewers while judging the important characteristics of the applicant. Re-ratings by the committee are made at the end of each of the first three months of probation period, the entry being made in the space at the lower right hand corner of the form. If at this time an applicant is rejected for apprenticeship, the practice is to find other work for him in the plant for which he is more suited. The educational department is equally painstaking in its records of the boy's progress in both his studies and shopwork, entering the amount of time spent in each of the distinct units which together form the complete course.

An interesting method has been developed for rewarding extra proficiency. "Once a week the committee comes together, and at each meeting the records of all apprentices who have finished eleven months of the apprentice year are brought to the attention of the members. The committee examines the records and grades the apprentices into four classes, A, B, C, and D. If an apprentice is placed in Class A, one month is taken from his apprentice course, or in other words, he is permitted to begin immediately on his next year. If an apprentice should be graded as a Class A man at the end of each eleven months during the 4-year apprenticeship, he would save one month each year and would finish his apprentice course four months ahead of schedule. If he finishes his course as a Class A man he will also be accorded a higher rate as journeyman than he would if he finishes as a Class B or Class C man. At the present time, the rate per hour for Class A men is 3 cents higher than the rate for Class B men, and the rate for Class C men, 3 cents lower than the rate for Class B men. If the apprentice is placed in Class B, he will be required to serve his normal time. This class includes the majority of the apprentices. If he is placed in Class C, he is notified that he must show an improvement, and if he should be so deficient that he is placed in Class D, he is either discharged or sent to the employment department for suitable work." During 1919 thirty-seven were given Grade A rating among the trades apprentices and student draftsmen.

The Technical Night School

The night school, which has been previously mentioned, operated under the name of the "Casino Technical Night School." It is independent of the company in its corporate organization, though something over one-third of its revenue is provided by the company. Nearly half of its income, however, comes from fees of the students. The course in fundamental engineering principles costs $16.50 for each of the two terms per year, the same fee being charged in the preparatory department, while in the foreign department the charge is $7.50 per term, and in the women's department $12.50 per term. The imposition of so considerable a fee naturally limits the attendance to the more serious students. Consequently, the classes show a much better record for remaining through the course than is the experience of most night schools, the curve shown in Fig. 22 giving the results of a recent term.

The enrollment is ordinarily less during the second term than in the first; but on March 1, 1920, it was as follows:

Engineering department	372
Women's department	169
Peparatory department	61
Foreign department	25
Total	627

The school, as its attractive announcement states, was founded in 1902. It is located in the several public schools maintained by the communities in the neighborhood of the Westinghouse industries, where the population is of course largely employed. However, admission is extended to all, regardless of occupation, previous education, or present place of employment. Only those who have completed their elementary education are

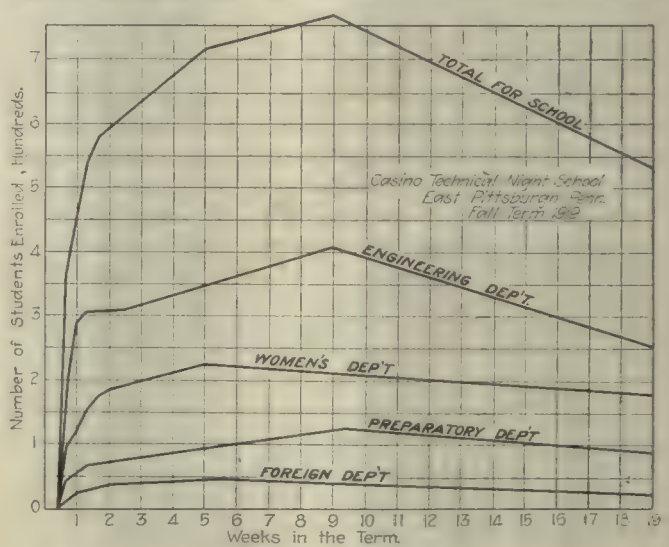


FIG. 22. CURVE SHOWING ATTENDANCE AT HIGH SCHOOL CLASSES

allowed to enter the engineering course. All others must enter either the preparatory or foreign departments. An interesting feature worth considering for our public schools is that, in addition to grading on regular courses, all students receive ratings on the personal characteristics of judgment, thoroughness, personality, reliability, initiative, and health. These ratings are not shown on the report cards which are sent to the students, but are retained on the permanent record card in the school office, where they may be consulted by the students and may be utilized in considering promotions. A faculty of approximately sixty-five, mostly technical graduates drawn from the staffs of the company, together with the able administration, assures a high quality of instruction.

The standard weekly schedule of the engineering course, from which no variation is ordinarily permitted, is shown in Fig. 23. Inspection trips to a dozen nearby industrial plants form a useful supplement to the regular instruction, and an hour assembly is held every other week. At these assemblies talks are given by members of the board of directors, by some of the older engineers, or by prominent men. It may also be mentioned that graduates are permitted to make application and to

enter, if accepted, the one-year course for technical engineering graduates. Several are at the present time availing themselves of this privilege.

That the school has been successful is shown by the positions held at present by the graduates of the course up to and including the class of 1919. A summary of the positions follow:

Administrative	27	Commercial	38
Managers	8	Business	2
Superintendents	5	Oil field development	2
General foremen	2	Salesmen	24
Foremen	12	Clerks	8
Engineering	72	Advertising writer	1
Operating and service engineers	24	Buyer	1
Design and research engineers	18	Manufacturing trades	16
Consulting engineers	1	Machinists	7
Supervisor	1	Skilled workmen	9
Draftsmen	10	Miscellaneous	7
Tool designers	3	Farmers	3
Teachers	2	Students	3
Inspectors	7	Lawyer	1
Testers	6	United States Army and Navy	29
		Deceased	6
		Unknown	2
		Total	197

This is a particularly satisfactory record when it is considered that the average period since graduation is only approximately six years. It should also be borne in mind that the school has been of benefit to industry in general, since one-half of its graduates are now in the employ of companies other than the Westinghouse.

ENGINEERING DEPARTMENT

STANDARD WEEKLY SCHEDULE

Days per week	MONDAY			WEDNESDAY			FRIDAY		
Hours when classes begin	5.45 p.m.	6.45 p.m.	7.45 p.m.	5.45 p.m.	6.45 p.m.	7.45 p.m.	5.45 p.m.	6.45 p.m.	7.45 p.m.
FRESHMAN YEAR									
1st Term	Shop Problems	Foundry		Shop Problems	Pattern Shop		Shop Problems	Mechanical Dwing	
2nd Term	Algebra	Mechanical Drawing		Algebra	Mechanical Drawing		Algebra	Mechanical Drawing	
SOPHOMORE YEAR									
1st Term	Algebra	Machine Shop		Algebra	Machine Shop		Algebra	Machine Shop	
2nd Term	Physics		Geometry and Trigonometry	Physics		Geometry and Trigonometry	Physics		Geometry and Trigonometry
JUNIOR YEAR									
1st Term	Physics			Electricity	Mechanics	Business English	Electricity	Mechanics	Business English
2nd Term	Electrical Laboratory			Chemistry	Electricity	Mechanics	Chemistry	Electricity	Mechanics
SENIOR YEAR									
1st Term	Steam	Engineering Problems	Electricity	Electrical Laboratory			Engineering Problems	Steam	Electricity
2nd Term	Engineering Problems	Steam Laboratory		Engineering Problems	Metallurgy		Electrical Laboratory		

Students will be notified of assembly in auditorium.
This schedule is subject to change at the discretion of the faculty.

FIG. 23. SCHEDULE OF CLASSES AT THE NIGHT HIGH SCHOOL

AMERICANIZATION

The company under consideration is one of the few among those investigated which had already awakened to the desirability of Americanizing its alien labor before the dis-affection and unrest attendant upon the late war aroused the country to action. From the very beginning of the technical night school a course in English and civic education for the immigrant employees has been in operation. Many have been taught English and encouraged to become citizens. There are twenty-five enrolled in this course at present, receiving instruction for three hours per night on three evenings per week. There are also provided free evening classes twice a week in sections of the plant employing a considerable number of foreign laborers. In these classes 110 are enrolled and seven paid teachers are provided. While the more extensive course in the night school provides an opportunity for the ambitious young men, these latter classes appeal more particularly to the older men and between the two methods practically all non-English-speaking employees are reached.

The aims of the classes might form a suitable program in any plant:

1. Learn to speak, read and write English.
2. Learn about the United States Government and how to become a citizen.
3. Learn how to figure your pay by the different methods used in the works.
4. Learn how a big company like this is built up; where the money comes from to build it and pay wages.
5. Learn how to help yourself by being of service to other people and working well with them.

The success of the program may be gaged by the fact that during the past year 114 men were assisted in obtaining first papers and 153 their second papers. The secretary of the Americanization committee aids the men in every way and pays for the time of witnesses.

GRADUATE ENGINEERS' APPRENTICESHIP

To recruit the engineering and administrative staffs graduates of the leading engineering schools are taken into the works for a year of training on a basis similar to that of internship for medical students. The number varies somewhat with the needs of the plant from year to year, but three hundred seems to be about the average number received. These students spend several months in the shop acquiring experience and information regarding the company's products, personnel, and policy; and they are then segregated into the specific branches which they expect to follow as their respective vocations. There are three fundamental lines of employment open to them, namely, design engineering, works management and sales. Approximately 40 per cent go into engineering, 40 per cent to sales, and 20 per cent to works management. Special schools are provided for the design engineers and sales students. These schools run for twelve weeks usually, during which time the student receives his pay but does no productive work. At the present time the pay is $90 per month for the first six months and $95 for the second six months.

THE ORGANIZATION FOR EDUCATION

Every one recognizes that the primary purpose of a manufacturing corporation is to get production. It is a newer conception that there may be an important secondary purpose in education, which may, moreover, minister profitably to the main object of producing goods. The staff used to effect this secondary aim needs to be as efficiently organized as for production. In the case of the company considered, the educational department has at its head a manager with a considerable staff. For the graduate students and for the trades apprentices there is in each case a director, and for the two departments, a foreman in charge of schedules. Competent individuals from each field are detailed to handle tracing and drafting instruction and clerical and stenographic training, while the director of trades apprentice instruction supervises the English and

Americanization work. The Casino Technical Night School has as president the manager of the educational department and as manager a man devoting his whole attention to it and to the somewhat closely related welfare work of providing noon lectures and directing the Valley Garden Association, which provides an opportunity for employees who wish to raise vegetables.

To provide the necessary co-operation with the production and employment departments, suitable interdepartmental committees have been created; and the interest and support of the employees are fostered likewise by committees, made up usually of those who have already benefited by the educational opportunities. Thus, there are enthusiastic committees of the alumni of the night school who solicit new students, and of naturalized immigrant employees who urge their countrymen to join the English and Americanization classes.

The whole program seems to be conceived not as philanthropy or charitable paternalism, but as essential functions of a well-organized productive corporation.

The Essentials of a Plant Safety Organization*

By W. E. WORTH
Assistant Manager, Industrial Relations, International Harvester Co.

WEBSTER defines essential as "constituting or making that which is most important in a thing." Our question therefore is—what are the most important things in a safety organization? To the speaker, there appeal seven prime essentials, and they are given in the order of their importance, namely:

1. A sincere desire on the part of the management to reduce accidents.
2. A willingness by the management to intelligently spend sufficient money to achieve results.
3. A realization by the management that constant and intelligent effort is necessary.
4. A man supervising the work who truly believes a safer operation is possible.
5. An organized group of superintendents, foremen and workmen, all working to a common end.
6. A definite policy and procedure adopted by management and men, and that policy and procedure adhered to.
7. Unflagging enthusiasm.

If these seven prime essentials are accepted as a basis for your conduct the mechanics of organizations can readily be determined. Briefly, these are:

Committees of foremen and workmen, organized for the sole purpose of assisting in carrying on the safety propaganda. These committees should meet at stated intervals to discuss accidents and ways and means of prevention. Considerable discussion in the past has not settled the question of whether there should be joint committees of foremen and workmen, or independent committees. Either will produce results.

Plant inspection by committees. The committees should be given the privilege of making inspection (either jointly or independently) for the purpose of determining the possibilities of improvement in the methods of operation. Many valuable suggestions are received through the medium of these committees.

The work of the safety organization should be based on standards. Have a proper standard for men, methods and machinery. From lack of proper standards arise accidents.

There is a cause for every accident. Find it. If men, educate them; if methods, correct them; if machinery, surround with proper safeguards. It is very important that you devote considerable time to these three factors. Regardless of the enthusiasm you may arouse for safety work, if the three above mentioned factors are not controlled, definite results cannot be had.

Educate the foremen as well as the workmen. The foreman is your mainstay in accident prevention.

In the process of education of the workmen, particular attention should be given to the new man. He should be given a thorough schooling in safe practices by the foreman or one of the older employees in his department. Too much attention cannot be given to this work.

An analysis of the personal injuries and damages to machinery will show (at least it has been my experience) that a very large percentage of the cost is the result of failure to instruct and introduce the new employee.

Safety committees should have as members men who understand the various languages spoken in the plant, thereby conveying what you are trying to accomplish by spoken word to all the employees. Creating enthusiasm for safety work among those employees who do not speak the English language is of very great importance. When once they are convinced that here is a service which will benefit them personally, it is surprising the results that can be obtained and the suggestions which they will make. For that reason, it is, as before stated, very important that you have competent men speaking foreign languages on safety committees.

Bulletins should be interesting and easily understood. In addition to the bulletins which you receive from the National Safety Council, you can well afford to give considerable thought and time to devising bulletins of local and plant interest. Make these bulletins dignified and illustrate them in a way that is effective.

Safety signs should be liberally used. Make the wording brief and give it a "punch." The argument may be advanced that these signs are not read. The fact remains, however, that the secret of advertising is repetition. A multiplicity of signs results in a continuous affirmation of the importance of playing safe. Affirmation and repetition result in contagion. It is therefore important to use as many signs as consistent.

Every practical suggestion should be put into effect. If a suggestion is not used, it will pay to spend sufficient time to properly explain the reason. If it is not convenient to personally explain to the employee, then an acknowledgement of the suggestion and an explanation should be made by letter. However, it is much more satisfactory to personally discuss the matter with the man. An employee will very soon discontinue making suggestions if he is not acquainted with the fact that his suggestion has been considered. On the other hand, if the suggestion is acknowledged even though not used, it will be an inspiration to make suggestions in the hope that some day he will make one that is practical.

*Delivered before the A B C Session of the Ninth Annual Safety Congress of the National Safety Council, Sept. 28, 1920.

Comparative statements of injuries can be used to great advantage in creating departmental or works competition. There has been considerable discussion in the past as to the basis for computing these statements. That, however, is a matter which should be worked out to the best advantage in your particular industry and condition. If it produces the desired result, the method of computing the statistics is immaterial.

Investigate All Accidents

Every accident, particularly those of a serious nature, should be thoroughly investigated and the cause determined. Accidents which are the result of the failure of men, material, or methods, should be brought to the attention of those concerned, and wherever possible bulletins should be issued telling the cause and how the accident might have been prevented.

Solicit the assistance of the folks at home, the principals, teachers, and children in the school and of the community as a whole. The work within the plant is materially affected by the conditions existing outside the plant. You can well afford to give a reasonable amount of time to the education of the citizens in your community. This will be reflected in the conduct of the men in the plant.

Continually bring to the attention of your employees that it is not necessary and is very foolish to take a chance. The chronic chance taker should not be allowed to associate with men and women who are making a conscientious effort for a safer operation.

Diversify your methods of appeal. If it is true that "variety is the spice of life," so also is it true that variety contains enthusiasm in this work. At no time can the organization charged with the responsibility of a safer operation consider that it has reduced accidents to a minimum. You must keep everlastingly at the work.

Behind the mechanics of a safety organization there lies the spirit of the movement. Your manager is primarily interested in producing a profit out of the business and is a busy man. It is your duty, therefore, to keep him advised by means of proper statistics and reports of the benefits arising from this organized effort to make your plant a safe place to work. Keep him advised of the human side of the work. The benefits therein are numerous and unending. You must ever maintain in him a sincere desire to reduce accidents. Show him the importance of spending money to safeguard dangerous places and correct improper practices.

Eternal Vigilance Is the Price of Safety

Demonstrate to the management the need of constant effort—"Eternal vigilance is the price of safety." You must absolutely believe in the work, and maintain personal enthusiasm as well as the enthusiasm of your co-workers. Keep your supervisory group working for a given result. Running around in a circle may be good exercise, but we get nowhere. It is therefore necessary to give them a definite goal for achievement. If the goal is reached, you can always set a new mark.

The men who are making the goods that pay the wages and produce a profit necessarily give first thought to production. By making constructive suggestions as to safe practices, you can build a safety organization that will produce the desired result—namely, a minimum of accidents by a safer operation without interference to production.

Properties of a Non-Magnetic, Flame, Acid, and Rust Resisting Steel*

By C. M. Johnson
Director of Research Department, Crucible Steel Co. of America, Pittsburgh, Pa.

The steels here described were studied by the author for a period of a year or more with a view to producing a steel that could be forged, rolled or sheared in thicknesses of 0.01 to 1 in. or more, and that offered the maximum resistance to the attack of the oxyacetylene flame. It was also demanded that the steel be machinable and that holes could be drilled in it. As the results now stand, a steel has been produced that has certain unusual properties which are briefly described as follows:

Non-Magnetic Properties.—As to the non-magnetic features, a permanent horse-shoe magnet that is capable of suspending in the air a 500-gram weight, will attract only the finest particles. Or, if a piece of the steel be shaped into a compass needle supported on a needle-point bearing, it is attracted but slowly if a magnet of the size mentioned be brought to within a distance of about one-half inch of the end of the needle.

The following report was received on these steels: "Neither the Esterile nor the Leibling apparatus showed any indication that either grade No. 1 or No. 3 could be magnetized in the natural bar or after quenching in oil or water from 1,900 deg. F.

"The permeability with respect to air is 1.04, and after oil treating 1.05 (H. Max. 300). The residual magnetism after charging did not exceed 4 lines per square centimeter. Both of these samples in all three conditions can be considered non-magnetic."

It has been noted that prolonged heat will cause an increase in its attraction by a magnet. The cumulative effect of many hours heating at the most favorable temperature is being studied further.

Rust Resistance.—These steels will remain for many days immersed in ordinary drinking water without developing any rust stains. In making such tests all roll or hammer scale must be removed as the action of water on scale causes rust stains. They show the highest resistance to all fruit acids and staining in general.

Table I shows the resistance to acids of the non-magnetic, acids, flame and rust resisting steel compared to some other metals and steels. The metals were in sheet form and immersed for 24 hours at room temperature in acids. The loss in weight is given in milligrams per square inch of exposed surface. These tests were made in samples from which all scale was removed.

TABLE I. LOSS OF WEIGHT WHEN IMMERSED IN ACIDS

Non-Magnetic, Flame, Acid and Rust Resisting Steel

Grade	Glacial Acetic	20% H_2SO_4	10% H_2SO_4	32% HNO_3	HCl 19%
No. 2-2 oil 2000° F.	0.15	85.9	50.8	0.93	67.1
No. 2-2	0.26	86.1	68.3	0.26	99.2

Other Metals and Steels

Grade	Glacial Acetic	20% H_2SO_4	10% H_2SO_4	32% HNO_3	HCl 19%
High Cr Ni steel	7.93	1045.0	111.3	0.27	462.8
High Cr Si steel	0.00	2180.0	.....	0.50	.....
25 per cent Ni steel	7.81	9.0	11.0	1683.00	22.3
38 per cent Si steel	13.80	4.1	4.1	3459.00	19.0
Wrought iron	19.30	11.22	490.0	1715.00	261.5
Copper steel	12.20	96.3	73.4	2126.00	201.2
Monel metal	0.70	1.2	1.3	2157.00	13.1
High Cr steel	0.67	2062.0	1262.0	0.10	437.3

*From a paper read at the convention of the American Society for Steel Treating, Sept. 15, 1920.

It is an interesting fact that in some of these grades, the scale is dissolved by glacial acetic acid, discoloring the acid, whereas the steel from which the scale has been thoroughly ground off will show no loss of weight and will not discolor the acid.

TENSILE STRENGTH—Table II gives values for the tensile properties of the steel.

TABLE II. TENSILE VALUES OF THE RESISTANT STEEL

Grade	Elastic Limit	Ultimate Strength	Per Cent Elongation	Per Cent Reduction	Brinell	Treatment
No. 2-1	107,270	146,870	25.5	40.1	302	Nat. condition

This class of steel has an extraordinarily high reduction and elongation at temperatures that would burn anything but high-speed steels.

Grade 2 attracts attention in this respect, that even at 2,450 deg. F. the reduction is 69.3 per cent, the elongation 65 per cent in 2 in. and the tensile strength 103,090 lb. Grade No. 3 at 2,200 deg. had a reduction of 64.3 per cent, an elongation of 50.5 per cent and a tensile strength of 111,170 lb. per square inch.

RESISTANCE TO FLAME.—The steel when attacked by the oxyacetylene flame requires twenty times as long to melt a hole through it as it does to melt a hole through ordinary steel.

High chromium steel after 30 minutes exposure to oxidizing flame in a gas furnace at a temperature of 2,000 deg. F. loses 520.5 milligrams per square inch of exposed surface. The flame-resisting steel suffers only a slight staining and a slight gain in weight per square inch after many hours heating at 1,900 to 2,000 deg. F.

Table III shows resistance to scaling of the nonmagnetic, acids, flame and rust resisting steel compared with some other metals and steels. The specimens were ground smooth, weighed and measured, then heated to 1,150 deg. C. for one-half hour in a gas furnace, cooled in air, weighed again and the loss or gain in weight calculated to milligrams per square inch.

TABLE III. SCALING ACTION DUE TO HEAT

Non-Magnetic, Flame, Acids and Rust Resisting Steels		
Grade	Loss	Gain
No. 2-2	None	4.8 mg
No. 3-2	None	4.6 mg
No. 4-5	0.3 mg	None
No. 5-1	None	None
Other Metals and Steels		
Grade	Loss	Gain
Monel metal	33 mg	Adherent scale
96% Nickel	158 mg	No gain
High Cr-Ni Steel	57.1 mg	.....
Grade A Steel	No loss	1.2 mg
High Cr Steel	52	.....
Copper Steel	967.4	.....

Building Airplanes for Local Use

BY I. B. RICH

Evidence of the increasing interest in airplane work can usually be found in most sections of the country if we look in the right places. Two small shops in Venice, Cal., a suburb of Los Angeles, are now building special ships for local work. Figs. 1 to 4 show a six passenger biplane with about 50 ft. wings in the shop of the Pacific Aero and Supply Co.

This is twin motored plane, two of the old reliable Curtiss OX-5 motors developing about 100 hp. each, being installed as shown. The motors are mounted between the wings, on each side of the control fuselage. Figs. 2 and 3 are side views showing the fuselage top-

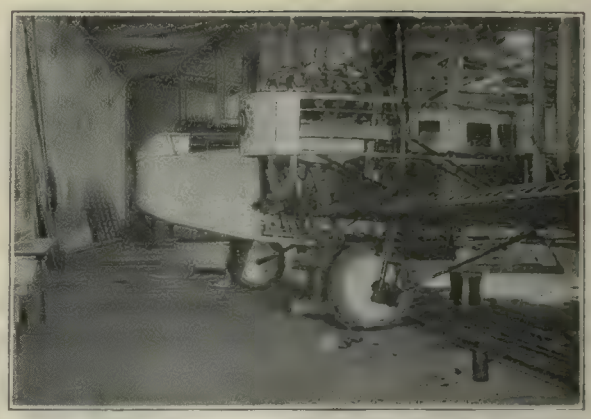


FIG. 1. FRONT END OF 6-PASSENGER SHIP



FIG. 2. A SIDE VIEW

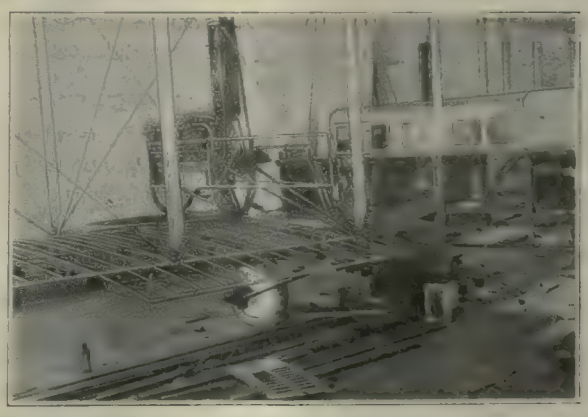


FIG. 3. THE MOTOR AND COCKPIT



FIG. 4. THE INSTRUMENT EQUIPMENT

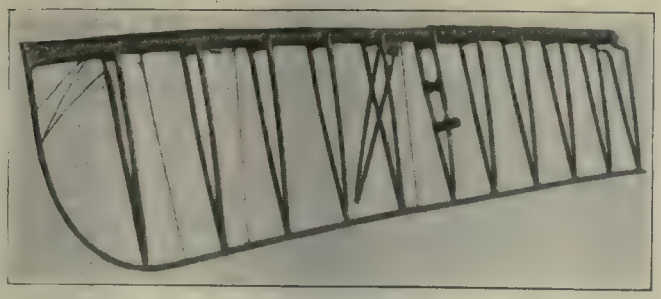
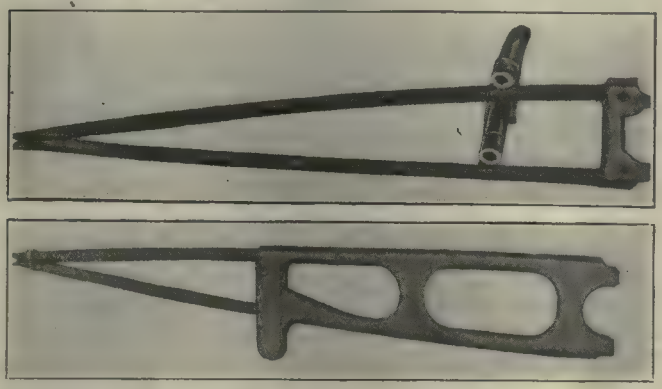


FIG. 5. STEEL AILERON FRAME



FIGS. 6 AND 7. PLANE AND CENTER BRACES

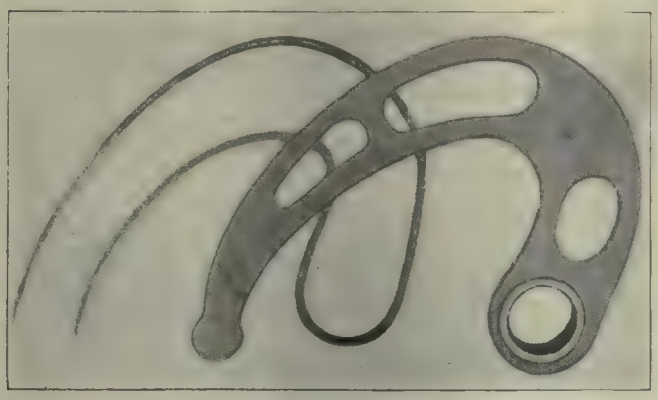


FIG. 8. AILERON CONTROL ARM

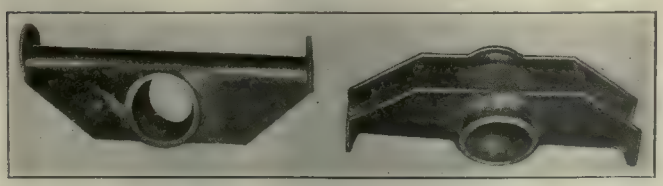


FIG. 9. HINGE FITTINGS

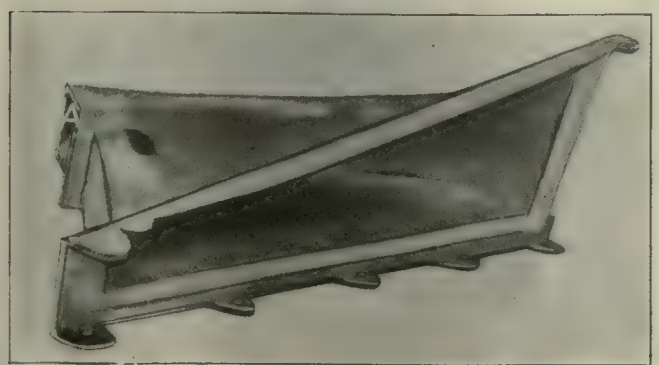


FIG. 10. TAIL SKID FITTING

cover in place. These views also show the windows in the body or passenger compartment, though the wicker seats are not very distinct. The mounting for the motor is also shown very clearly as well as the radiator and the landing wheel and strut.

The interior of the pilot compartment, with a view of the instruments, is shown in Fig. 4. The board includes a tachometer, a Navy type compass and a banking indicator, while on the center post of the sash is an air-speed indicator. The instruments, with the exception of the tachometer, are all special designs of the Pioneer Instrument Co., of New York.

Nearby is the shop of W. D. Waterman, who was an experienced flyer and instructor during the war. He was building a modified LaPere plane for local use at the time of my visit. This has now been completed and is a beautiful example of aircraft building. One of the modifications in this plane is the steel-framed aileron shown in Fig. 5. This view shows how the aileron is built up and the part which oxy-acetylene or arc welding plays in modern construction of all kinds. It will be noted that the braces each side of the center are plain, while the center one is reinforced, these parts being shown in detail in Figs. 6 and 7.

The remaining views show special fittings, sheared, punched and drawn from flat stock and welded. Fig. 8 is a curved arm for operating the aileron and consists of two flat sides and a center distance and stiffening piece which is shown at the left and illustrates a simple way of building up a very stiff and substantial fitting.

Another fitting, for hinging the aileron to the wing proper, is shown in two positions in Fig. 9. It is also built up and welded around the tube which forms the bearing.

The last fitting, Fig. 10, is a very substantial tail-skid frame which is an excellent piece of sheet metal work. The long, tapering side fits up against the lower side of the fusilage frame, while the tail skid itself fits in the opening at *A* and is supported by the whole length of the lower floor of the fitting. This fitting is a particularly good job of sheet metal work where parts are shaped by hand because of the small production required.

How Is the Light in the Drafting Room?

By William H. Kellogg

In your recent editorial referring to what the real meaning of the term "production man" is, you mentioned the benefits and advantages that are gained by beautifying the surroundings of the factory with flowers and the like. There can be no doubt that such things have a tendency toward increased production and the writer believes that they should be encouraged by all means. There is, however, a suspicion that among some of those so-called production engineers the tendency is to follow that idea too literally.

This suspicion is suggested by the fact that at the plant of a certain large manufacturing concern there is a beautiful array of grass, flowers and fountains over its grounds as well as many other things that show the good-will of the employers in their effort to make the workers comfortable and happy, while on the other hand many obvious points of efficiency are overlooked.

For instance, in the drafting room, which covers a vast area of floor space, the tables, inadequately small,

are crowded together, the majority of them placed in the middle span furthest removed from the daylight, while a larger number of files and storage cases are located near the windows. Then to add to the bad condition there is a lack of sufficient attention to keeping the light circuits in order with the result that the draftsmen sometimes go for days without enough light.

It is a matter of general observation with the writer that this question of proper lighting is a thing sadly neglected in a large number of drafting rooms. Can it be that the average employer supposes that it is well enough to wait until a draftsman calls for light before it is supplied to him? If such is the case, the employer is the loser, for the work of a draftsman cannot be easily measured, and he will, naturally and sometimes unconsciously lag with his work when he finds it difficult to see plainly.

The basis upon which efficiency methods rest, according to Mr. Taylor and perhaps many other modern engineers, is in relieving the worker of the necessity of providing those conditions which are needed for the best results. For this reason such matters as light and space should be as carefully and freely provided as oil is provided for a machine.

I suggest that all who are concerned with the management of drafting rooms make a few observations and see if the writer is not justified in calling attention to these small but important points in drafting-room economy.

Tools for Boring a Seat for a Ball Joint

By Frank A. Stanley

The ram, or slide, of the heavy punch presses made by the Gilro Machine Co., Oakland, Cal., is operated by ball-ended connections from the crankshaft fitting in spherical seats formed half in the top of the slide and half in caps attached thereto. The slide and cap construction is shown in Fig. 1, the caps being lifted from their places to allow the interior of the spherical seats to be seen.

These spherical seats are bored in a drill press with the aid of a pair of special cutter bars, Figs. 2 and 3. The roughing bar is fitted with a pivoted cutter head which is operated by a scroll ended plug engaging with teeth on the cutter head.



FIG. 2. THE BORING TOOL AND REAMER USED IN MAKING THE BALL SEATS

Both roughing and finishing bars are operated in a bushed jig, shown in the background of Fig. 1 and in place for operation in Fig. 4. It is bolted by eight screws to the top of the slide in exactly the same way that the caps are afterwards attached for service. The roughing tool bores the seats practically to completion in one or more cuts; the second cutter being really more in the nature of a flat, spherical formed reamer. The first boring bar is fitted with a flexible or floating holder for the driving shank so that alignment of the bar is always secured when once it is slipped through the guide bushing.

The cutter is a single pointed tool secured by a set-screw in the swiveling head. The latter is pivoted to revolve about its axis when the scroll spindle is turned. With the cutter adjusted around toward the midway position the entire head slips easily into the bushing. The action of the scroll member on the cutter head teeth is practically the same as that of an ordinary chuck scroll upon the teeth at the back of the chuck jaws.

The finishing tool, or flat reamer, is $\frac{3}{8}$ in. thick and offset across the center as seen in Fig. 2 so that the cutting edge around the circle is always in the central plane of the cutter bar, thus assuring the correct form to the finished seat.

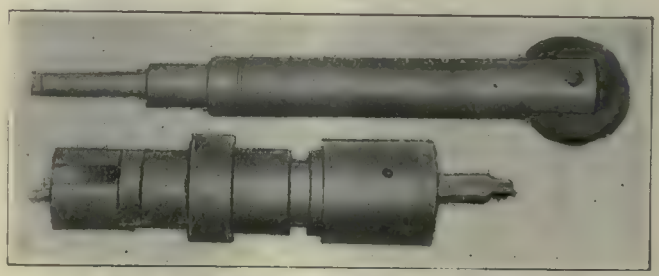


FIG. 3. ANOTHER VIEW OF THE TOOLS



FIG. 1. THE SLIDE, SHOWING THE SEAT FOR THE BALL ENDS OF THE ARMS, AND THE CAPS



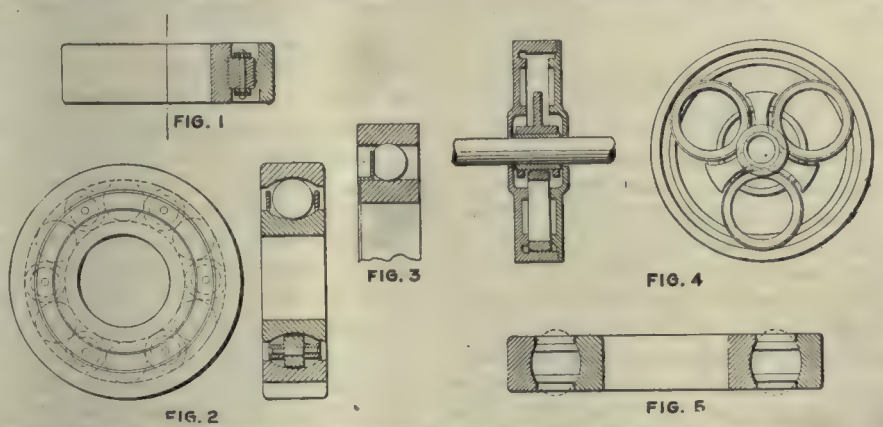
FIG. 4. THE BORING TOOL IN OPERATION, SHOWING HOW THE JIG IS USED

What Is the Difference Between Roller and Ball Bearings?

BY A. DANIELSON

Bearings characterized by rolling rather than sliding action are usually classed as either "ball" or "roller" bearings with attendant confusion due to the many varieties of both types. The author offers suggestions for a definite classification of these two types.

IN BEARINGS where sliding friction has been superseded by a rolling friction, i.e., in "anti-friction bearings," there are to be found rolling elements of widely varying shape. The early types of anti-friction bearings were either ball bearings or roller bearings. Some of the reasons for employing balls in bearings were, no doubt, that balls can be manufactured comparatively easily and cheaply and that the ball need not be guided in the bearing but may be allowed to roll on any of its peripheries, which simplifies the construction of the bearing. Roller bearings have from the start been competitors of ball bearings in carrying heavy loads. In the early roller bearings cylindrical rollers were employed, mainly for the sake of ease of manufacture. A supposed distinction between ball and roller bearings which has often been mentioned, is that balls have a point contact on the raceway, whereas rollers have a line contact. This distinction will not hold in all cases, however, as there are now existing types of bearings which unquestionably must be classified as roller bearings, but which have a point contact, as for example the bearing shown in Fig 1. As a matter of fact, the two kinds of bearings, while originally distinctly different are today not so easily recognized or classified on account of the existence of several types intermediary between the two. For several reasons it is highly desirable that a clear definition be recognized for the classification of an anti-friction bearing.



FIGS. 1 to 5. SEVERAL VARIETIES OF ANTI-FRICTION BEARINGS

Fig. 1. Roller bearing with point contact. Fig. 2. Bearing with both balls and rolling elements. Fig. 3. Axis of rotation unalterable. Fig. 4. Rolling elements with spherical working surfaces. Fig. 5. Rolling elements not having spherical form

This classification can be accomplished in three different ways; namely, (1) so that only bearings having whole balls rotating freely around any axis are called ball bearings and all others roller bearings, (2) only those having cylindrical rollers are called roller bearings and all others ball bearings, (3) all intermediary types are classified each on its own merits. Still another way out would be to introduce a new name for the class of debatable types, which, however, should not be done unless all other ways fail. Examples of types intermediary between ball bearings and roller bearings are shown in Figs. 2 to 5. These have all been obtained from various letters patent and have been selected not with a view to their suitability for bearing purposes or any other practical points, but solely on account of the interest which may be attached to their attempted classification.

An examination of Figs. 2 and 3 raises a doubt as to their proper classification. In these bearings the rolling elements can not rotate freely, inasmuch as their axis of rotation is predetermined and unalterable. The bearing in Fig. 2 may always have to be considered an intermediary type, as it has, alternately, ordinary balls and other shapes of rolling elements which may be considered as either balls or rollers.

The design shown in Fig. 4 can hardly be classified as a ball bearing, unless ball bearings are defined as anti-friction bearings, the rolling elements of which have spherical working surfaces. Fig. 5, unquestionably, must be classified as a roller bearing, as in this design the rolling elements do not have a spherical form. If consideration should now be given to the question of the proper place for a line to be drawn between ball bearings and roller bearings, without violating either the established language or the laws for logic reasoning, it would be found that if the second of the above-mentioned ways of classification were adopted, and only bearings having cylindrical rollers were to be called roller bearings, a number of absurdities would follow. There are many types of bearings with conical rollers, or rollers having a concave contour which cannot possibly be called ball bearings, but whose rolling elements cannot be simply or unquestionably defined.

Now, should the other extreme be resorted to, and ball bearings be considered to include only those anti-friction bearings where the rolling elements have a spherical form and can rotate freely on any axis, all others being called roller bearings, then no absurdities are encountered. Thus it would not be absurd to term the type in Fig. 3 a roller bearing. For this reason then, it can be stated that it is easier to logically define the ball bearing than the roller bearing.

The question now remaining is: Would it be well to extend the definition of the ball bearing so as to comprise in it all anti-friction bearings having rolling

elements with spherical working surfaces? In that case there would be encountered the difficulty of determining whether a surface be spherical or only nearly spherical. Cases could be conceived where it would be necessary to take apart a bearing and to resort to instruments of high precision in order to establish its classification. The line between ball bearings and roller bearings would then be determined not by the constructive features of the bearings but by the dimensioning of the rolling elements. The same difficulty, only to an even greater extent, would have to be met, if the definition of the ball bearings should be still further extended to include those bearings having rolling elements with a nearly spherical surface. It seems, therefore, that it would be most closely adhering to the original meaning of the expression ball bearing, as well as being most logical, to define the ball bearing as an anti-friction bearing having its rolling and carrying elements of a spherical form and free to rotate around any axis. All other bearings having, for rolling and carrying elements, bodies of rotation, should then be classified as roller bearings.

Applying this definition, then, the types shown in the five illustrations should all be classified as roller bearings.

What Is a First-Class Machinist?

By R. McHenry

There has been much discussion in recent numbers of the *American Machinist* as to "what constitutes a high-grade machine" and as to just "what is a machine tool," and the subjects have been very ably handled. A kindred problem that seems to be puzzling many employers and employees at present is, "What is a first-class machinist?"

One shop manager used to say to prospective help, "No, I don't want a first-class machinist, I want a *good man.*" It is evident that the term "first-class machinist" meant little to him. In another case a workman stated that he was a machinist and rated first-class. On being asked about his recent work, etc., he said he was a first-class turret man. As the shop in question had no turret lathes or prospect of acquiring any, this "first-class man" could not interest the foreman.

In this age of specialization it seems hard to place a man without first obtaining his life history. For instance: men employed in machine shops are usually spoken of as machinists. Many of these, however, have served no time at the trade; but as operators of certain machines they are much more valuable than some journeymen who have spent a lifetime in various branches.

Because a man is efficient only in the cutting of gears, he can hardly be classed with the "all-round" mechanic, and yet, the "all-round" man, while considered good on a large variety of work, very likely would be unable to figure out and cut a simple pinion.

During the war, a workman became connected with a shop which was having the usual difficulties with inexperienced help. After the settlement of their contracts this machinist sought work at another local plant doing a high class of work. He was reluctantly hired and given more or less rough repair work, etc. The foreman later remarked with surprise that the new man seemed to carry through every job he was given in some way or other. He was then told that the man in question could claim an experience nearly as general as himself and had worked for years in factories building various kinds of machinery.

Some shopmen have all their work laid out by draftsmen and detailers, even to the finish of machined surfaces. Others are expected to build entire machines from a mere pencil sketch and a survey of the castings. All seem to the lay public to be in the same category.

A marine mechanic often finds difficulty in a shop on land. Also many men employed by steel mills, shipyards, railroads, etc., and rated high as machinists, make a much different impression on manufacturers of typewriters, firearms, and electrical apparatus.

Advertisements for "first-class machinists" are numerous and men claiming the title are legion; but just what is a "first-class machinist?"

Efficient Pattern Making

By M. E. Duggan

The other day while at the foundry, my attention was called to a pattern that for artistic finish had most other patterns wiped off the map, but there was a doubt lurking in the mind of the molder as to whether or not the pattern could be molded. Upon my return to the rolling mill I picked up the *American Machinist*, issue of Sept. 9, 1920, and read upon page 516 the very interesting and instructive article entitled "Efficient Pattern Making," by E. A. Dixie.

Mr. Dixie describes, with the aid of illustrations, how the foreman pattern maker made, in one day, a pattern from which a satisfactory casting was produced. Ordinarily this pattern would have required from six to seven days to make in the regular way.

In the first instance the pattern maker is an artist; the foreman pattern maker referred to by Mr. Dixie is a "mechanic." He knows foundry and molding practice. If he did not know molding practice and how far he could go in making a cheaply constructed pattern with the material at hand, he would have made the pattern in the regular way and by so doing, held up the job six or seven days. Let's have some more of this, Mr. Dixie, it's good stuff.

Speaking about "service" in the pattern shop, the following might be of interest: A spur gear 6 ft. 6 in. in diameter, 5 in. face, 6 arms, and bored for a 5½-in. shaft, broke. The machine must be kept going and producing. What was to be done? Make a new pattern, or section of a pattern; or send out of town to have a new gear made?

A knowledge of molding practice helped to solve the question. What was done is worth knowing in a "pinch." A search of the pattern loft in a nearby machine shop resurrected an old discarded pulley-arm core box, 6 ft. long, or about 3 ft. longer than the arm for this gear job. For the hub an old piston pattern was picked up in the foundry; this was 1¼ in. longer and 1 in. larger in diameter than the hub on the broken casting, a very good fault in a pinch. A rough pattern for one sixth section of the rim was made.

From the side of the hub to the inside of the segment was the length of the cores for the arms. This length was marked off on the core box and the cores for the six arms made and baked in the night oven. The casting was poured fourteen hours after the break occurred. To do a job like this you must *know* molding methods.

How the $5,000,000,000 Slump in the Price of Farm Products Will Affect Industry

The answer to the above title is that it is in the hands of labor itself. This article, reprinted from the Oct. 15 issue of "Industry," gives a pessimistic though forceful outline of the facts in general.

WHAT would it mean to the country should $600 a year be cut from the income of half the families in the United States? This is a simple question, but the facts underlying it are of the most stupendous character; of such a nature, in fact, that sooner or later they must engage the attention not only of every economist but of every man, woman and youth who works for wages. When it is added that this cut is falling not upon the wealthy but on the class whose cash incomes, taken as a whole, are smaller than almost any other, another angle of the proposition is presented which gets down very close to the individual.

The recent slump in the price of farm staples means nothing more or less than that approximately 49 per cent of the people of the United States must suffer a material reduction of annual income amounting in the aggregate to the terrific sum of $5,000,000,000; the people affected represent 40 per cent of the purchasing power of the American people. Let us first get at the facts before attempting to draw conclusions as to what effect this enormous loss will mean not only to the farmers but to all workingmen and women.

Corn, with a 3,000,000,000-bushel crop in sight, has slumped from $1.80½ on June 28 to $0.84½ on Oct. 6.

Wheat, with a 800,000,000-bushel crop, or larger, has slumped from $2.80 on June 28 to $1.90 on Oct. 6.

Potatoes, with a crop in excess of 400,000,000 bushels, have slumped from $2.50 to $3.00 early in the season to $1.50 or less at the present time.

Cotton, with a 12,000,000-bale crop, has slumped approximately 20 cents a pound or $100 a bale.

These four items alone aggregate a total slump in prices, measured in values based on the total crop, of a little more than $5,000,000,000. The decline in corn is more than 50 per cent, in wheat about 30 per cent, in potatoes 40 per cent and in cotton 50 per cent. Oats have declined from $1.18 to about 84 cents. With few exceptions, notably dairy products and eggs, declines ranging from 25 to 50 per cent are indicated for every important farm commodity; and the prices for butter and eggs cannot remain at their present levels indefinitely, if for no other reason than that the great decrease in purchasing power suggested by these shrinkages in time will be reflected in the cities and towns from which the farmer must draw all his supplies except his food. Here, in fact, the gist of the whole situation as it affects the workingman is suggested, although we have not yet reached that stage of the discussion. We pause here only to explain that the farmers cannot cut $5,000,000,000 from their town purchases without either closing many factories or reducing wages or both; and when wages stop prices fall—whether of butter, eggs or phonographs.

The workingman in industry will be affected in still another way. A price decline of this magnitude would force bankruptcy in any industry other than agriculture (it would in that if agriculture were composed of great instead of small units). It will gravely affect agriculture, accentuating the dissatisfaction already existing on the farms and accelerating the exodus from the farms to the cities, thus leading to a labor surplus in industry which in turn will produce an inevitable reduction of wages that cannot be stemmed, for men and women will refuse to starve in the cities merely to maintain the present high level of compensation in industry. Adjustments of this nature are not forced by the employers but are the natural result of conditions which manufacturers would be only too glad to prevent if they could. Indeed, it is a statement easily susceptible of proof that employers would raise no objection to a continuation of the present wage level if (1) their markets would hold up and (2) the employee would return a full measure of work for the money he is paid. The more the situation is studied, however, the more clearly it becomes apparent that within a twelvemonth the secondary reaction herein described threatens to make conditions in the cities worse than on the farms, where at least food is plentiful. It is to forestall such a situation, if it be humanly possible, that all concerned will need to study and realize the facts, and not be misled by labor agitators who would add fuel to devouring flames by shouting that they will spend the last drop of their blood to prevent any reduction in wages.

The drop in values of farm commodities will affect the farmers quickest in their purchasing capacity. As already stated, the people on the farms include approximately 49 per cent of the people of the United States and constitute fairly 40 per cent of the purchasing power of the country. Lopping $5,000,000,000 of receipts from the income of 8,000,000 families means cutting more than $600 from the potential spending power of each family; money which cannot be spent on city products because it is not in hand. This enforced economy is to be measured in automobiles, pianos, talking machines, men's suits, dresses and dress goods, furs, shoes, harness, wagons, furniture, electrical appliances, rugs, carpets, confectionery and a thousand other things. In all these lines sales will fall off in a tremendous proportion of goods which doubtless would be made and sold were the conditions of the last two or three years to continue. The railroads will suffer from lack of patronage, both freight and passenger, and the demand for the products of the mines will be materially reduced. No class of wage-workers in the country can be mentioned that will not experience the direct effects of this stupendous cessation of country purchasing. One of the most common expressions of the times has been: "The farmers never had so much money in their lives. They are having as much and living as well as the people in the cities." Unfortunately this prosperity cannot continue with the prices of farm products cut in half. All this, we may remark parenthetically, is merely another way of saying forcefully and illustrating graphically that American industry cannot be permanently or temporarily prosperous unless American agriculture is prosperous.

The time has arrived when the American business man and the wage-workers must take account of facts which cannot be blinked at. By the same token that the city cannot prosper unless the country makes money, the city profiteer must go when the country profiteer goes, be he capitalist or laborer. Obviously the cost of farm labor must be reduced if a large proportion of the employing farmers' income is to be swept away; and with the country market whittled down, the spending money shut off, the prices of manufactured goods and the labor that produces them must come down. It is not that anyone wants the present "golden era" to end, but that the end is in sight already, and capital and labor alike must adjust themselves to the change.

Strikes No Longer Succeed

It is stating only a solemn fact, not an argument, to say that further increases in wages in the industrial centers have become impossible. It has been an outstanding fact for months that strikes no longer succeed; that fewer are attempted, because most of the wage-workers are sensible people and are not fools enough to risk a long period of idleness in a falling market. But the mere refusal of employers to increase wages is not enough to meet the situation. It may be for a brief period, or until every individual has been able to note for himself the disastrous results of the disappearance of prosperity on the farms; but when the reaction has fully set in and the farmer, by staying at home and hanging onto what money he has, supplies unmistakable evidence that hard times have come, wage reductions cannot be avoided.

In the city of Washington at the present moment 85 per cent of the building industry is tied up by a strike of carpenters for higher wages. Anyone familiar with agricultural conditions as they have been set forth here must know that this strike will fail. So will every other strike of the kind from now on; nor is building likely to be resumed on any large scale until actual wage reductions have taken place. The striker of today is flying directly in the face of industrial providence, and if he cannot read the lesson in advance, if he cannot understand, for example, what so simple but impressive an object lesson as the falling prices of agricultural products teaches, he must lose his time and his money in a vain effort to get what the employer knows he cannot grant.

The important question is whether the workingman and the labor union which represents him in industry will regard and appreciate the situation as it is or will make a bad matter worse by failing to recognize the facts. It has been an axiom of the day that prices will not come down in the cities until unemployment has become more or less general and it has been suggested that manufacturers would shut down their plants for no other purpose than to force a reduction of wages. The absurdity of this idea is apparent on its face, if one will use a little gray matter in considering it; for no business man that is making money while paying high wages ever stops making it merely to cut down the pay of his employees. On the contrary he is glad to pay liberally as long as business holds up.

But the new condition which has arisen in consequence of the serious let down in the price of farm products will relieve the manufacturer of any suspicion that he is conniving at wage reductions; for he, along with his employee, necessarily becomes the sufferer from the loss of trade which the shrinkage of incomes on the farms will entail. Neither will the farming class, with their own business falling and their incomes dropping, listen with patience to the plea of the industrial worker that high wages must continue. Nor will general reductions in wages and prices materially alter the existing situation greatly, if common sense prevails, for the net effect of the adjustments, if they are undertaken fairly and scientifically, will be to add to the purchasing power of the dollar, leaving the general situation relatively where it was before. That is the big fact. Every class will participate in the readjustment and, with reason and not rant at the guide, no one will be hurt.

Use of Cross-Section Paper in Making Charts

By Chester E. Josselyn

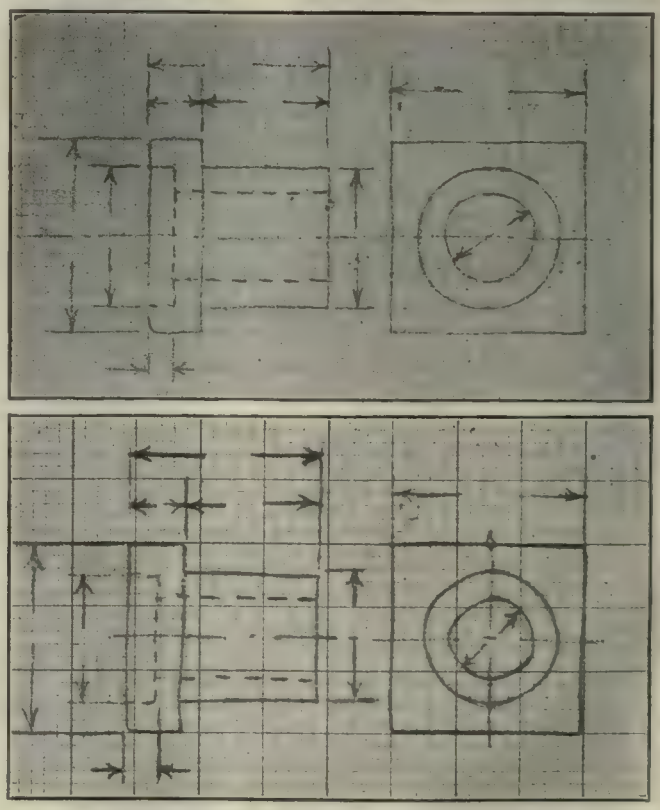
The use of cross-section paper, mentioned on page 16 of the *American Machinist*, was appreciated. Had I used this method in times past much time could have been saved when arranging tabulations.

It suggested for publication a use I sometimes make of section paper which I have never heard of being so used by others.

Just reverse the usual practice of sketching on the ruled side and use the blank side instead.

An impression of the section lines usually shows through on the back which permits using them as guides but they are not so prominent as to confuse reading as when the sketch is on the ruled side.

If prints are to be made it, of course, makes no difference which side the sketch is on, although the objection could be overcome by using the cross-section paper specifically, as Mr. Barr says, underneath the sketch paper.



SKETCH ON BLANK AND RULED SIDES OF CROSS-SECTION PAPER



Some Notes on Tapping

By E. A. Dixie

Someone once said: "The truths of today are the lies of tomorrow" or words to that effect and by the same token the wise things of yesterday may be the foolish things of today, depending on the conditions under which they are done.

Some time ago, while going through a manufacturing plant, I was attracted by an extremely unusual method of machine tapping.

Someone had drilled a large number of holes in some castings. When it came time for these holes to be tapped it was found that they were so small that when the usual method of machine tapping was pursued the taps broke. The holes could be hand tapped by the common method of backing the tap out every turn or two but the tap could not be driven straight ahead without breaking. The drill press on which the attempt to tap the castings was made is equipped with a valve-grinding attachment which makes the spindle rotate almost a complete revolution and then back a small part of one. Someone, wiser than most of us, conceived the idea of securing the tap in the chuck of the spindle and hooking up the valve-grinding attachment and thus simulate hand tapping. The method worked out to the entire satisfaction of everyone; all the holes were tapped and not a tap was broken. It was a wise idea.

The other day I went through the same factory and found the valve-grinding attachment was still on the job tapping holes.

When inquiry was made as to why they used this slow method of tapping they told me that it was the only method by which they could get a full thread. That was where they were foolish.

Remember, they were tapping cast iron and knew or ought to have known that they could not tap a full thread in cast iron and still have a full thread. That last sounds rather Irish but it is a well-known fact that when tapping a full thread in cast iron, the tops of the threads are crowded off by the wedging action of the tap. Besides, even if it were possible to tap full threads, of what use are they? In the case cited the tapped holes in the castings acted as nuts to take the threaded ends of screws which were to attach other pieces. Almost everyone knows that a nut need not have a full thread in order to be as strong as the bolt which fits it, and everyone knows that few commercial nuts have full threads—there is no reason why they should and many reasons why they should not.

Several years ago one of the big electrical manufacturing companies in this country became somewhat concerned over the excessive breakage of taps. The figures have slipped my memory but the tap bills amounted to many thousands of dollars per year. So a committee was appointed to investigate the reason which was not far to seek. The drawings demanded tapped holes to be tapped *full thread*. The next job of the committee was to discover a remedy. A great number of experiments were made in tapping-machine steel, tool steel and cast iron, using various sizes of tap drills with a view to producing a nut which would

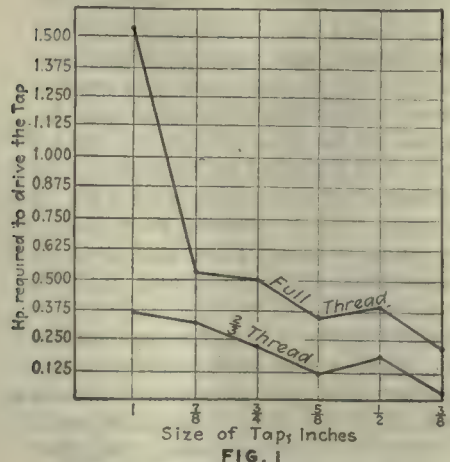


FIG. 1

CHART OF POWER CONSUMED IN TAPPING TOOL STEEL

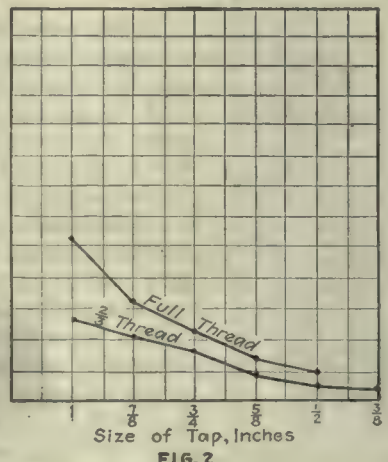


FIG. 2

CHART OF POWER CONSUMED IN TAPPING MACHINE STEEL

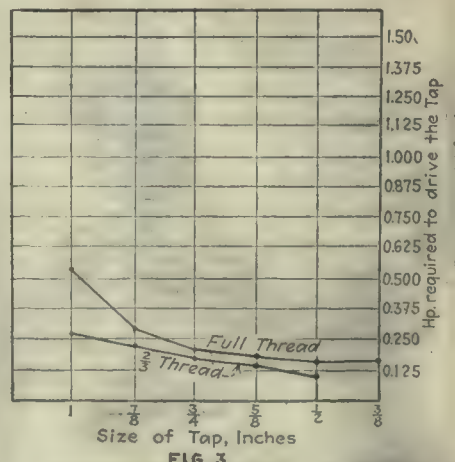


FIG. 3

CHART OF POWER CONSUMED IN TAPPING CAST IRON

be stronger than the bolt and still be easy on the taps. A number of bolts from ¼ in. to ⅜ in. diameter were pulled in two with nuts which had threads only ⅔ of full depth.

Orders were then issued to tap all threads about ⅔ full, with the result that tap breakage was practically eliminated, over 90 per cent of the taps *wore* out in service, and there was a material reduction in the amount of power consumed in machine tapping operations. The accompanying charts were constructed from the average performance of a number of taps, from ⅜ to 1 in. diameter.

Fig. 1 is a chart showing the power consumed in tapping full and two-thirds depth threads in tool steel. The hump in the curve at the ½-in. tap was probably due to poorly made taps. It will be noted in all three of the charts that the power curves of full and two-thirds thread depths nearly parallel each other till ⅞ in. diameter is reached. From this point the rise in the two-thirds thread-power curve is about normal in all three of the charts but that of the full thread shows an extreme rise for tool steel and a pronounced rise in the chart, Fig. 2, which shows the power consumed in tapping machine steel and also in the chart, Fig. 3, which shows the power consumed in tapping cast iron.

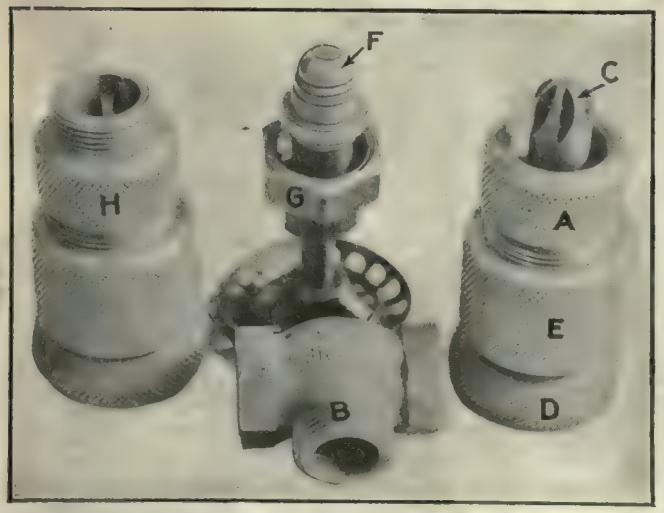
Summed up, the average power necessary to tap a full thread is about twice that necessary to tap a two-thirds thread and a two-thirds thread is stronger than the average bolt. The objection to a two-thirds thread is that it does not "look good," but when a tapped hole has a bolt in it not much of the thread is visible.

Hand Tools for Reclaiming Globe Valves

By J. H. Vincent

The hand tools shown in the illustration were shown at the convention of the Railway Tool Foremen's Association by W. H. Casson, who had made them for reclaiming globe valves brought into his shop for repairs. Both the seat and the disk of the valves usually require refinishing because of having been scored by the action of steam or water passing through them; this scoring usually being caused by carelessness in closing the valve and thus permitting a slight seepage of water under high pressure.

The tool at the right serves to refinish the worn seats. To use it the internally threaded sleeve *A* is screwed onto the valve body at *B*, bringing the formed cutter *C* into position to resurface the valve seat. The cutter is turned by means of the knurled disk *D*, keyed to its outer end. After inserting the tool so that the cutter rests on the valve seat, the threaded sleeve *E* is turned back on the body *A* of the tool until it contacts with the under side of the disk *D*, and thus prevents the cutter from taking too much metal off the valve seat. The amount removed is gaged by turning *E* forward until the valve seat appears smooth.



HAND TOOLS USED FOR RESURFACING WORN VALVES

The tool at the left of the illustration is used for refinishing the disk *F* and works in the same manner, the shape of the cutter being made to conform to the work. The tool is held in position by screwing the gland *G* onto the body of the tool at *H*.

Have You the "Use of Yourself?"

By L. L. Thwing

Some one in enumerating his few blessings once said: "I am thankful that I have always had the use of myself." Among the palliatives, improvements and cures which are offered for our problems of employment is this desire of a man to use himself always considered?

We are told that every man should have a vocation and an avocation—a trade or profession—and also a hobby; something to interest him after working hours.

Machinists are an adaptable lot, and turn their hands to many different kinds of work. I knew one who built himself a fireplace and chimney for his house; I am intimately acquainted with one whose cabinetmaking is my secret envy and despair.

The desire to make something is born in all natural mechanics. To the man with a hobby—be it garden, workshop, motor boat, or even collecting postage stamps—to have time to follow it is to have the use of himself for his own purposes. Few men enjoy work for its own sake, particularly when the character, methods, and time have been selected by someone else.

I have had little official connection with the problems of the employment office, but at one time in 1917 when machinists were hard to get, the stereotyped advertisement offering "steady employment, good wages, and excellent working conditions" did not seem to produce results; so I was allowed to try my hand at it. In substance my advertisement read as follows:

"MACHINISTS WANTED—Hours 7:30 to 4:30; 11 o'clock on Saturday."

These were unusual hours in our section but not unusually short; nevertheless the superintendent was able to hire all the men he needed from the replies. And let us not assume too readily that this was because the hours seemed to be shorter and to involve less work; after a man had travelled on the street car for half an hour or more, had his supper and a bit of a smoke over the evening paper, it would be 8 o'clock for those whose shop hours ended at 5:30, and in those days back yard gardens were very popular and daylight was needed for their cultivation.

This is not an argument for a 6-hour day but an attempt to controvert the idea that still persists in the minds of some employers that the only thing a man does with his time outside of working hours is to waste it; forgetting that some of it may be used, and that the men who make good use of their own time are the ones he likes to have in his shop.

WHAT to READ —for the man in a hurry



Suggested by the Managing Editor

MACHINING the Connecting Rods of Two Well Known Motors, the lead-off article by Fred H. Colvin is another of the instructive automotive series. The methods used in the Oakland and Studebaker shops are detailed. They will be found to be of interest to those engaged in large production in the same or similar lines.

What to read was not a difficult matter to decide two hundred years ago when books were few and magazines unheard of. It is far different now when so much reading matter is offered to pass the time pleasantly or profitably as the reader chooses. We are doing our utmost to make the "American Machinist" not only profitable but indispensable as a clearing house of ideas and news of the machinery world. This page is the editors' advertisement of their section of the paper. It gives the high spots

The second part of the six-part series "Seven Centuries of Brass Making" begins on page 835. It deals with the crucible process, which, says the author, is basically the same method as used in the middle ages. The current story is to some extent historical in that it tells of the first attempt to cast brass in the North American colonies and explains the relation of Connecticut to the development of brassmaking in the United States.

In these days, when engineering is coming to receive its proper recognition as a profession and the engineer is perceiving the relation that his profession bears to the welfare of the public and the world in general, it is fitting that such a talk as that by J. E. Aldred, page 839, should be brought to the attention of engineer readers. Mr. Aldred's talk was delivered to student engineers but it is so thoroughly general in scope and in the selection of topics that practicing engineers as well will be glad to read it and will feel that they have learned from it. The same is true of executives and those aiming to become executives. "Common Sense in Engineering" is the title.

Ernest L. Little in his story "The Industrial Development of Australia" emphasizes what the *American Machinist* has persistently told its readers, that for export shipment packing is all important. He says, "The primary consideration of the American exporter must be safety of carrying." The subject of packing accounts for only a small part of the article on Australia. Figures are given to show the general growth and the effect of the war on Australia's industries and conclusions are advanced relative to Australia as a market for American exporters.

Not so long ago we ran the last of the Sherlock articles on "Know Your Insurance Policy" which proved of interest and value to many who had to do therewith. An article similar in a general way, in that it takes up an industrial subject of interest to all factors, is the one in this issue, "Medical Aid Under The Compensation Acts." Vital points of the acts are explained and the questions which have arisen on many sides are answered.

This week's installment of the J. V. L. Morris series on "Programs of Apprenticeship" deals with the methods employed at the Westinghouse Electric and Manufacturing Company's East Pittsburgh Plant. Apprenticeship and special training have meant much to the Westinghouse Co. on account of its great number of employees, of whom there are from eighteen to twenty thousand at the East Pittsburgh Plant alone. They have, of course, been given scientific attention with the result that the system used is positive and efficient. Morris's comprehensive report on it is worth careful perusal. Page 847.

The *American Machinist* has always advocated "Safety" and has published a great many constructive articles on the subject. Another of the same type is "The Essentials of a Plant Safety Organization," page 852, by W. E. Worth, Assistant Manager Industrial Relations, International Harvester Co.

There are some plain facts in the article beginning on page 859, entitled "How the $5,000,000,000 Slump in the Price of Farm Products Will Affect Industry." It is stated that those directly affected represent 40 per cent of the purchasing power of the American people. It is easy to conjecture what such curtailment means to industry. There is a lesson for the industrial worker who is inoculated with the high wage germ and who cannot see that there must come a readjustment involving lower wages before the purchasing power of the dollar can be materially increased.

Among the shorter articles are "Properties of a Non-Magnetic, Flame, Acid and Rust Resisting Steel," page 853; "Building Airplanes for Local Use," 854; Tools for Boring a Seat for a Ball Joint," 856; "What Is the Difference Between Roller and Ball Bearings?" 857; and Some Notes on Tapping, page 861.

Machine Tool Prices—Are They Too High?

AUTOMOBILE costs have not decreased, yet prices have dropped all along the line. The farmers are facing a loss of income of fifty per cent, in round numbers five billions of dollars. Cut has followed cut in the textile and leather industries and the end is not yet. In the face of this evidence why should not machine-tool prices follow the same downward course?

There are several reasons. Perhaps the best way to bring them out is to go back a short distance into the history of the machine-tool business. Most of the leading concerns of the present day started business on a shoe string in Civil War days or even more recently. The firm names Brown & Sharpe, Pratt & Whitney, Potter & Johnston and many more show the partnership of ambitious and skillful mechanics to have been the usual form of organization, if the early shops can be said to have had organization. These men had simple standards of living and were content with profits on their products that were disproportionately small. They were mechanics and not business men and they ignored many cost factors that would be considered elementary now. The tradition of small profits has clung to the industry and joined with keen competition to keep prices below the intrinsic worth of the great majority of American machine tools.

The World War made great changes in the machine-tool business and boosted prices to a point that enabled struggling companies to show returns which left something to put into new buildings and other much-needed improvements. This was undoubtedly overdone in some cases, but it shows that the profiteering fever attacked but few victims in our field. Many would have been better off now had they taken more profits to establish reserves and put less back into the plant.

Another factor affecting present prices must not be overlooked. It is sales expense. We know of one big producer who has not sent out a salesman since 1914 except by special request. As a result his selling expense has been practically negligible. If this pleasant state of affairs could continue it might be feasible to do a little marking down, but when a selling charge of twenty per cent is added to present production costs the conservative builder feels more like raising than lowering his prices.

And then there is the matter of service charges. It is common knowledge that manufacturers' service facilities for repairs and adjustments have been and still are abused. Right or wrong, service costs cannot be ignored.

If machine tools could be built on a basis comparable to the mass production of automobiles where hundreds or thousands of a model are put through in a series, there might be some chance of a reduction in price through production savings. But where big machines are built one at a time as ordered and smaller ones in lots of from ten to fifty this is out of the question.

There is a widespread impression that because some makers of automobiles have cut their prices, machine-tool builders should do the same. Just why this impression has gained so much credence is hard to understand. About the only points of similarity between automobiles and machine tools are that both are made largely of iron and steel and that both are mechanical contrivances.

Admitting its obvious value as a time-saver to salesmen, doctors and inspectors and its commercial value in transporting passengers for hire, the automobile is still in the luxury class. We venture to say that only a small percentage of the motor cars of this country are actually making money for their owners, and also that five years is a long time for a car to be in the hands of one owner. A machine tool, on the other hand, is purchased to increase the productive output of human labor and must earn its salt or be relegated to the junk pile. It may last ten years or it may last fifty, but during that time it is always a producer. New models come along just as they do in the automobile field but in the shop they are more apt to represent an addition to equipment than a replacement.

A bargain sale of luxuries will often stimulate a sluggish market but when it comes down to a machine tool, a man either needs it or he doesn't need it. If he has no immediate use for an openside planer, a cut of twenty per cent in the price of the planer will not induce him to buy it. If he does want it he can take delivery at once at the current price and make enough out of it to more than balance any probable price cut before it occurs.

Several accounts have appeared lately of New England mill employees who have voluntarily taken lower wages to keep the mills running. It would be most unfortunate to have to resort to such an expedient in the machine-tool business for the simple reason that the wages of skilled mechanics are not high, relatively speaking. We have been guilty at times of printing laments from some of our older readers on the passing of the old "all-round" machinist. If one considers the war-made machine tender who calls himself a machinist and expects a machinist's pay the feeling expressed seems justified, but in view of the training the *real* machinist has gone through and of the work he must be capable of doing, he is not overpaid. Every other possible economy must be effected before wages are reduced to bring down manufacturing costs.

We have mentioned declines in textiles, leather goods and farm products that have gone far deeper than any in the motor field. To compare this condition with that in the machine-tool field seems rather footless, for the speculative nature of raw materials markets sets them far away from one generally so non-speculative as the machinery market.

Another reason why a comparison with raw materials and staples like textiles and leather goods is futile, lies in the advances made in design and construction of modern machine tools over those built in 1914. The potato of this autumn is quite like the potato that flourished before the war, and the cotton sheets on the storekeeper's shelves that arrived last week are indistinguishable from those made six years ago. A good shoe today is no different from a good shoe made in pre-war times but the lathes, planers, shapers and grinding machines of 1914 have been replaced by models with improvements worth far more to the purchaser than the increase in price which may have accompanied their introduction.

Wages are high, materials are up, sales expense is sure to be higher than it has been in recent years, service costs are not diminishing, quality is better than ever. And prices? There is only one answer—they are fair and should be maintained.

Action of Engineering Societies Concerning the F.A.E.S.

THE Board of Directors of the American Institute of Electrical Engineers, at its meeting on Oct. 8, 1920, appointed the following representatives of the Institute on American Engineering Council. The asterisk indicates that the appointment is subject to ratification at the annual meeting in February, 1921: *Comfort A. Adams, Cambridge, Mass.; A. W. Berresford, Milwaukee, Wis.; *H. W. Buck, New York, N. Y.; F. L. Hutchinson, New York, N. Y.; W. A. Layman, St. Louis, Mo.; William McClellan, Philadelphia, Pa.; L. F. Morehouse, New York, N. Y.; L. T. Robinson, Schenectady, N. Y.; *Charles S. Ruffner, New York, N. Y.; L. B. Stillwell, New York, N. Y.; **Calvert Townley, New York, N. Y., *members of Engineering Council of Founder Societies.

The Florida Engineering Society has appointed L. R. McLain as its representative at the first meeting of American Engineering Council, Nov. 18 and 19, 1920.

Additional Members

The following societies have joined the F. A. E. S., bringing the total membership to fourteen: American Society of Agricultural Engineers, Ames, Iowa; Detroit Engineering Society, Detroit, Mich.; Engineering Society of Buffalo, Buffalo, N. Y.; Florida Engineering Society, Gainesville, Fla. (subject to ratification at the annual meeting in February, 1921).

The aggregate membership of the fourteen organizations is 37,233 and they are entitled to 43 representatives on American Engineering Council.

Programs of Other Societies

The following societies to whom has been extended an invitation to become charter members of the Federated American Engineering Societies will consider the question during October and November: American Institute of Architects; American Society of Civil Engineers; Albany Society of Civil Engineers; Associated Engineering Societies of St. Louis; Brooklyn Engineers' Club; Engineers and Architects' Club of Louisville; Engineers' Club of Cincinnati; Engineers' Club of Columbus; Engineers' Club of Philadelphia; Engineers' Club of St. Louis; Engineering Society of Wisconsin; Engineering Society of Western Pennsylvania; Grand Rapids Engineering Society; Iowa Engineering Society; Louisiana Engineering Society; Mohawk Valley Engineers' Club; National Fire Protection Association; Washington Society of Engineers.

The following societies have referred the matter to a special committee for report at an early date: Associated Engineers of Spokane; Boston Society of Civil Engineers; Colorado Society of Engineers; Illinois Society of Engineers; Illuminating Engineering Society (by its Council); Oregon Technical Council; Rochester Engineering Society; Society of Automotive Engineers; Western Society of Engineers.

Unnecessary Finish on Tools

By George H. Henrietta

Many firms engaged in manufacturing a uniform product place a large part of their tool work in jobbing shops and pay for this work on a time and material basis, the usual arrangement being that a certain rate is agreed upon for each hour of time, while patterns, castings, and material are billed at cost, plus 10 per cent to cover expense of handling. The hourly rate varies according to locality, class of work, etc.

This work is mainly jigs, fixtures and similar special single-purpose tools, intended for purely utilitarian purposes, and these tools do not actually require finishing except on such surfaces as function either in their operation or construction. Careful supervision of this feature may result in large savings, for the jobbing shops and the individual workmen therein cannot be held entirely to blame for wanting their product to have a good appearance unless they receive positive instructions covering the case.

The following "Instructions to Toolmakers" are very much to the point. They are appended to tool drawings placed in jobbing shops by an important firm of automobile manufacturers:

INSTRUCTIONS TO TOOLMAKERS

(1) The purpose of this jig or fixture is to produce accurate and interchangeable work and it should be made so that it will do so.

(2) It is not necessary to polish it and files or emery cloth should not be used in its production, except that a file may be used to remove burrs or sharp corners which are likely to damage the hands of the user.

(3) The parts should be machined only where it is necessary for the proper functioning of the jig. The remainder of the jig should show either mill scale on the steel, or casting skin if made from a casting.

(4) The appearance of the jig is of no importance whatever, and any time spent on work which is merely to improve the appearance, is money wasted.

A Question in Factory Management

By A. W. Forbes

On page 375 of *American Machinist* W. Burr Bennett asks a question that has repeatedly come up with us. What shall we do when there is not enough work in one department to keep one man busy? He suggests a nickel-plating department.

Our snagging work is an example of this sort. We have about enough snagging to keep a man busy one hour a day, while anyone familiar with the class of snagging that is done at foundries will recognize that a large part of the snagging must be done where the casting is used. We employ a "Tech" student for this work, and find the method very satisfactory.

In winding electric motors the problem is somewhat different. One man could easily handle all our winding, but what if he should be sick or quit? You cannot teach a winder in a day, and it is impossible to find an experienced winder in our vicinity who is familiar with our class of winding, or if one should be found, it would be necessary to offer special inducements to get him to leave his other job, with problematical results.

We therefore have five persons trained for this work; one machinist and five students. You do not get the speed by this method that would be obtained with a single man at the work, but the additional cost, which is not much, should be considered as insurance.

I would like to call attention to the advantages of technical school students for this class of work. In general it is possible to obtain a greater amount of intelligence with less experience from the students. The result is that they do better work on small, unusual jobs where extreme accuracy is not required, but do not have either the refinements of speed or accuracy that can come only from long training. They also have a characteristic of irregularity which is common to youth; that is they will be doing fine work for several weeks, and then make a mistake so evident that it seems impossible. For about half of our work, I consider students the best solution.

SHOP EQUIPMENT NEWS

-Edited By-
S. A. HAND

SHOP EQUIPMENT • NEWS •
A weekly review of modern designs and equipment

Descriptions of shop equipment in this section constitute editorial service for which there is no charge. To be eligible for presentation, the article must not have been on the market more than six months and must not have been advertised in this or any previous issue. Owing to the news character of these descriptions it will be impossible to submit them to the manufacturer for approval.

• CONDENSED • CLIPPING INDEX
A continuous record of modern designs and equipment

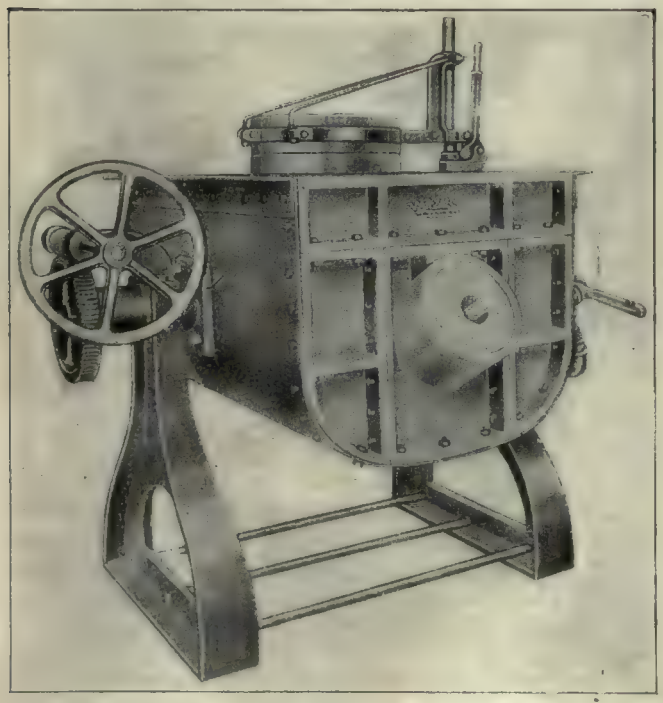
Wayne Tilting Non-Crucible Type Oil-Burning Furnace

The Wayne Oil Tank and Pump Co., Fort Wayne., Ind., builds a line of tilting non-crucible type oil-burning furnaces as shown in the illustration, for melting brass, copper, aluminum and other non-ferrous metals. They were designed with the object of obtaining rapid melting and holding the volatilization losses to a low percentage.

The metal is melted directly on the hearth or bottom of the furnace which is almost flat, a design intended to give a thin layer of metal which will rapidly absorb the heat. Two oil burners are used, both mounted on the same side of the surface. The burners tilt with the furnace so that the flame may be continued while pouring. Air at a pressure of about 1½ lb. and oil at 5 lb. or more pressure is supplied to the burners through piping with swivel joints.

The furnace is charged through a 10-in. hole in the center of the top, which is fitted with a fire-clay cover that can be locked in position or swung to either side for charging. The furnace is tilted by a worm-gear arrangement to insure its being held in any position.

The shell of the furnace is of ¼-in. steel plate with reinforcements of angle iron. The front and back are ribbed gray-iron castings, made in small sections and bolted together. The worm gear for tilting is of cast iron and the worm is machined from steel. The fire-brick lining is 7 in. thick with a layer of insulating material between it and the furnace shell.



WAYNE NO. 3035 TILTING NON-CRUCIBLE TYPE OIL-BURNING FURNACE

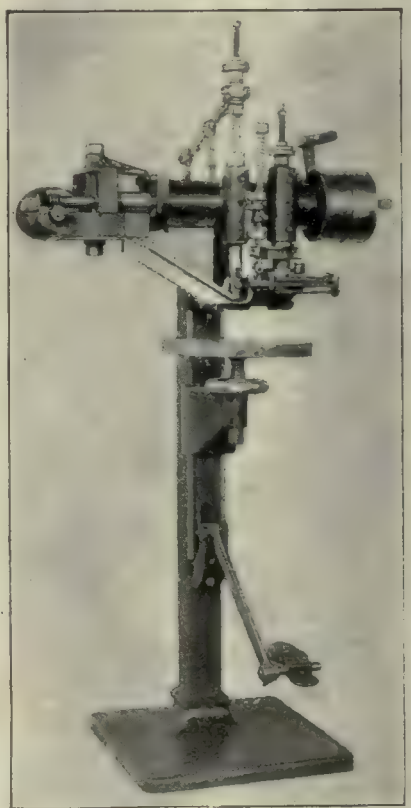
Specifications—Built in two sizes, Nos. 3 and 6. Respective capacities, 350 to 550 and 550 to 800 lb. Average heats per day, 6 to 10 and 5 to 9. Floor space, 56 x 80 in., 66 x 80 in. Height to cover, 51 in. Pipe connections, air, 3 in.; oil, ¼ in. Air volume, 400 and 500 cu.ft. per minute at 1½-lb. pressure. Oil pressure, 5 lb. or more. Shipping weights complete, 5,500 lb. and 6,500 lb.

Reynolds Automatic Magazine-Feed Screw-Driving Machine

The Reynolds Machine Co., Massillon, Ohio, has added to its line the automatic screw-driving machine shown in the illustration herewith. The feature claimed for this machine is that it will not only drive screws of ordinary length, but will also drive very short screws, even those having a length shorter than the diameter of the head.

In operation screws are dumped at random into the magazine where they are automatically arranged in a single row with heads upward and delivered to an inclined track. At the lower end of the track a finger receives a screw and holds it in line with the spindle.

The spindle, carrying a screw-driver bit, is brought down by a treadle, the bit engaging with the slot in the screw head, and both finger and screw are carried downward until the screw engages the work. The finger is then automatically withdrawn allowing the screw to be driven home. The spindle friction can be adjusted so that it will slip when the screw is driven as tight as desired.



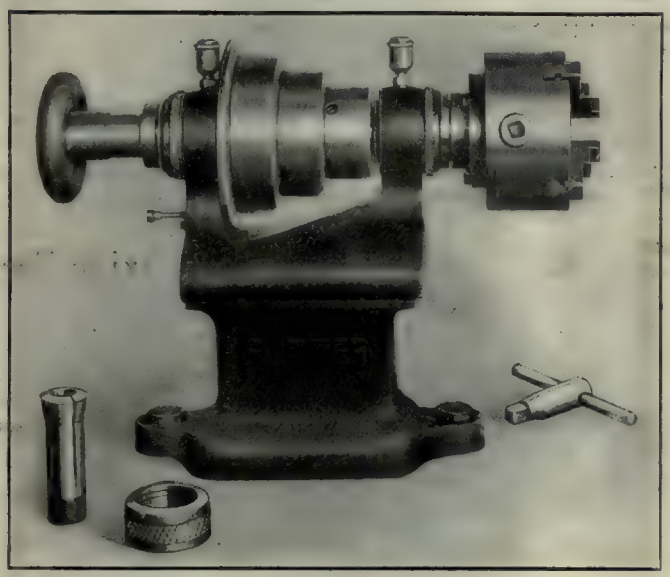
REYNOLDS AUTOMATIC SCREW-DRIVING MACHINE

The table is 12 in. in diameter and can be adjusted on the column to take work up to 15 in. in height and is provided with screw for close adjustment. The treadle is adjustable both for position and resistance to suit the operator. The machine can be belt or motor driven.

Potter Mounted Headstock

The S. A. Potter Tool and Machine Works, 77 East 130th St., New York, N. Y., has placed on the market a headstock mounted for bench use, as shown in the illustration. The device can be employed for filing, polishing and lapping, being adapted to performing speed-lathe work where no tailstock is required.

The headstock is essentially the same as that used on the bench lathes made by the concern. It can be fitted



POTTER MOUNTED HEADSTOCK

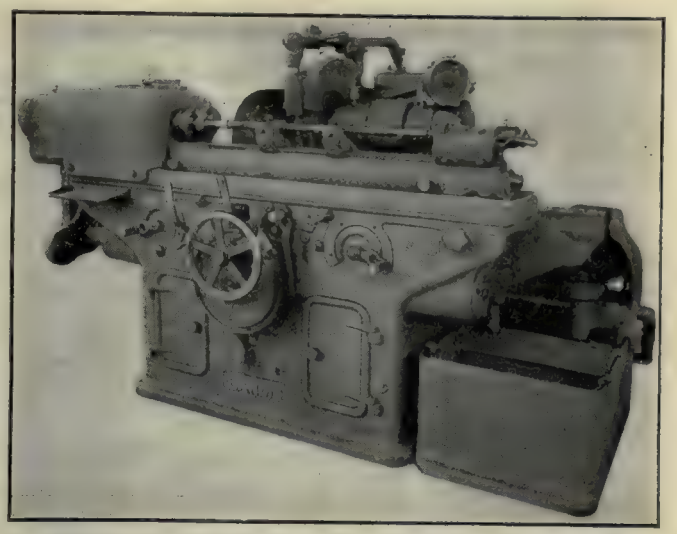
with jaw chucks, spring chucks and lever chuck-openers. The device is driven by belt and fastened to the bench by means of two bolts.

Landis Cam-Grinding Attachment

The illustration shows a cam-grinding attachment mounted on a Landis plain grinding machine. This attachment is a recent product of the Landis Tool Co., Waynesboro, Pa., and is intended for grinding cams for internal-combustion engines.

The master cams are mounted directly on the work spindle inside the headstock. A roller which is stationary in the direction of the cam movement can be selectively brought into engagement with any one of the cams by a lever on top of the headstock, a pointer indicating which one of the cams it is in engagement with. The main body of the attachment carries both the headstock and the tailstock and when one of the cams is in engagement with the stationary roller the whole attachment must move. As the attachment is pivoted to the machine bed the movement must be oscillatory and in unison with the particular cam engaged. The cam and roller are kept in contact by compression springs.

It is claimed that in generating master cams from models, the roller used is of the same diameter as the grinding wheel to be used for reproduction and that with this method together with the pivotal position of

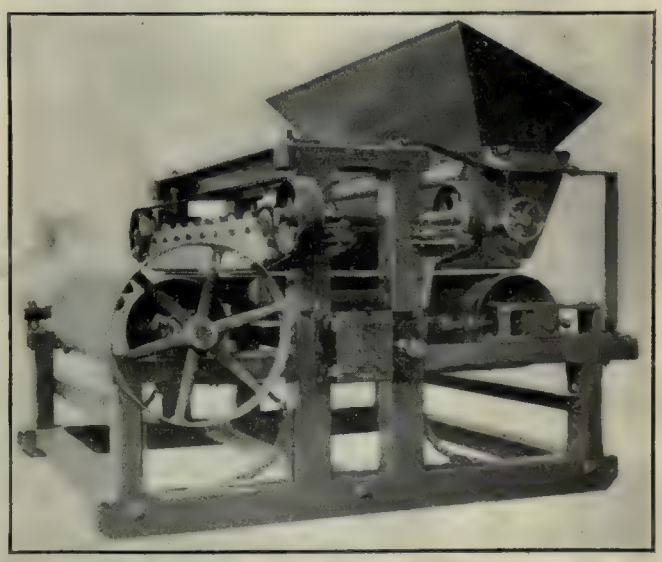


LANDIS CAM-GRINDING ATTACHMENT MOUNTED ON GRINDING MACHINE

the attachment, cams in duplicate of the models can be reproduced with the minimum of error. The live spindle is worm driven. The attachment can be furnished in the following sizes: 5½ x 26½ in., 5½ x 36 in. and 5½ x 52 inches.

Dings Type "B" Magnetic Separator

The Dings Magnetic Separator Co., Milwaukee, Wis., has brought out a Type "B" magnetic separator for granular materials. It is intended for extracting iron from brass and aluminum borings and turnings, and from abrasive materials, rubber buffings and other materials of this nature. The machine has an electro-magnet with poles above two cross-belts which travel above a wide belt containing the materials to be separated. The materials are placed in the hopper from



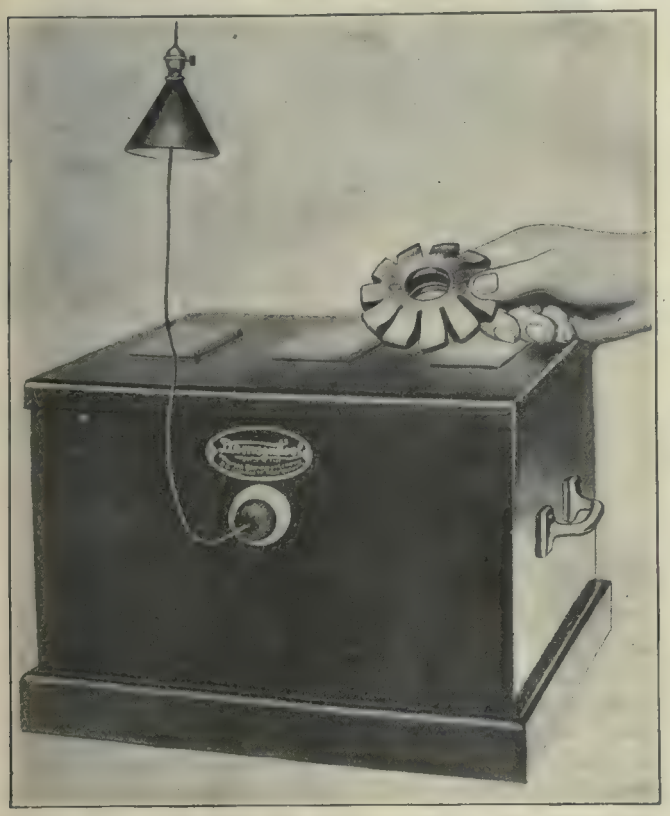
DINGS TYPE "B" MAGNETIC SEPARATOR

which they are distributed evenly on the wide belt. The cross-belts carry the particles which are raised by the magnetic poles to the side of the machine from which they drop into receptacles. These machines are built in five sizes, with conveyor belts from 18 to 60 in. in width. The machine shown in the illustration is the No. 5 size. It is said that the power consumed is very low and that no skilled labor is required.

Brewster "Demagnetool"

The William Brewster Co., 30 Church St., New York City, has recently placed on the market the demagnetizer illustrated herewith under the trade name of "Demagnetool."

It is claimed that this device will demagnetize tools



BREWSTER "DEMAGNETOOL"

to zero instantly and that it is not necessary to rub the tools back and forth on the demagnetizer but only to put them on and take them off.

Warner & Swasey Geared-Head Turret Lathe

The Warner & Swasey Co., Cleveland, Ohio, is placing on the market its Nos. 4 and 6 geared-head turret lathes, designed for machining alloy-steel gear blanks, long drilling operations in the solid, and heavy facing and forming cuts. The No. 6 machine is shown in Fig. 1.

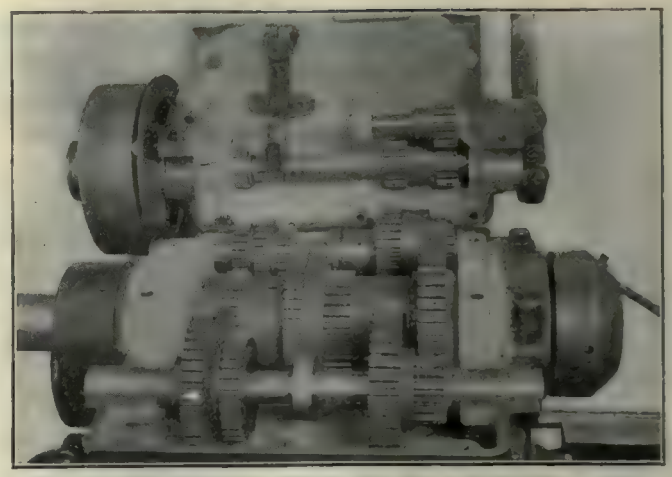


FIG. 2. GEARING IN HEAD OF NO. 6 TURRET LATHE

The geared head is shown in Fig. 2. The gears are of steel, have coarse pitch and wide face and run in an oil bath that also lubricates the bearings. Twelve spindle speeds and reverse are obtainable through two gear sets mounted on the front shaft and one set and the reverse friction clutch mounted on the rear shaft. The No. 4 turret lathe is being equipped with the standard No. 4 cut-off. The No. 6 machine can be equipped with the regular cut-off shown in Fig. 1 or with the "heavy-duty" carriage shown in Fig. 3. A square turret to carry four tools may be substituted for the front toolpost. There are six power cross-feeds obtained through steel change gears which run in oil. The apron gears are also of steel. The turrets are the same as those of the company's standard No. 6 turret lathes and can be equipped with power feed having four changes. The geared-head construction is adaptable to various types of motor drive.

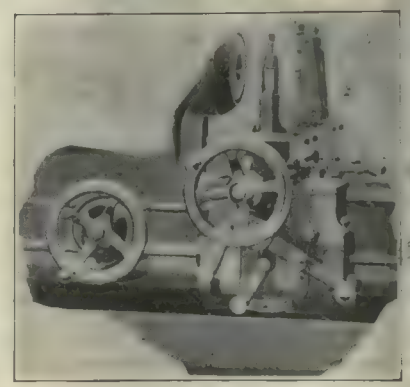


FIG. 3. HEAVY-DUTY CARRIAGE OF NO. 6 TURRET LATHE

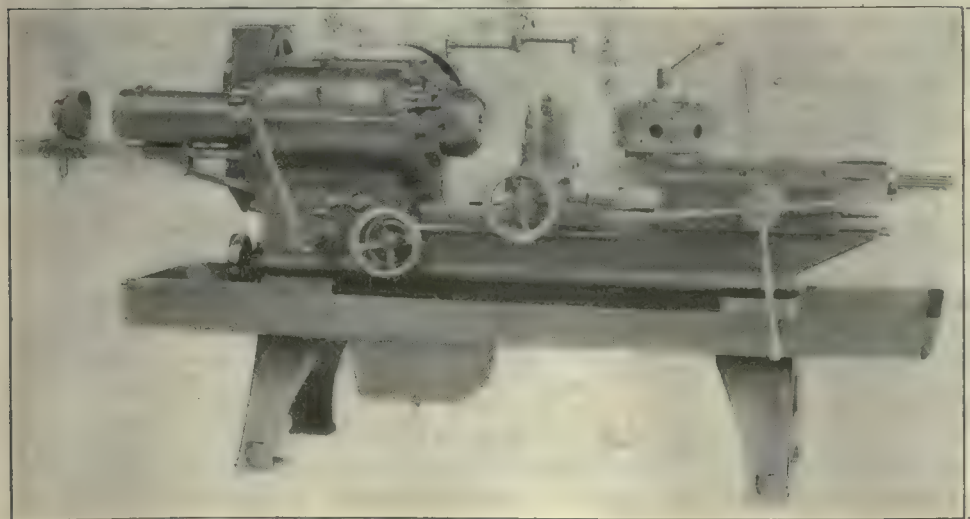


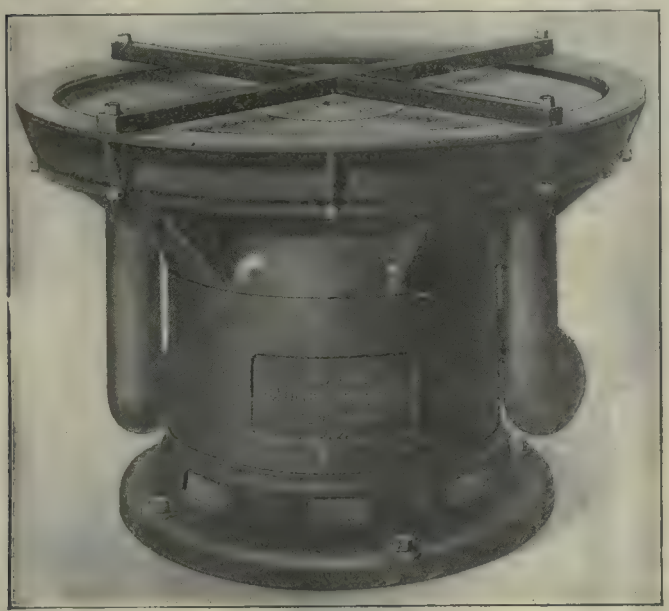
FIG. 1. WARNER & SWASEY NO. 6 GEARED-HEAD TURRET LATHE WITH STANDARD CUT-OFF

Specifications—No. 4, maximum capacities: Round bar stock, diameter, 1½ in. Length turned, 10 in. Swing over bed, 16 in. Swing over cross-slide, 7 in. No. 6, maximum capacities: Round bar stock, diameter, 2¼ in. Length turned, 12 in. Swing over bed, 20⅝ in. Swing over cross-slide, 9¼ in.

Badger No. 142 Vertical-Spindle Disk-Grinding Machine

The Badger Tool Co., Beloit, Wis., has lately brought out the disk-grinding machine shown in the accompanying illustration.

This machine is of the vertical spindle type, the disk travelling in a horizontal plane. The work to be ground is placed on top of the disk and suitable crossbars or



BADGER VERTICAL-SPINDLE DISK-GRINDING MACHINE

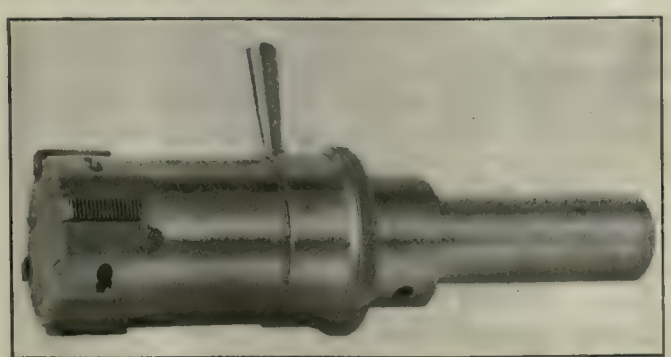
Specifications: Disk, 42 in. diameter. Motor, 15 hp. Speed, 600 r.p.m. Complete equipment includes: Steel disk wheel, press for attaching abrasive disks, oil compensator, extra assortment of abrasive disks and an assortment of supplies. Weight 3,000 lb.

stops prevent it from revolving. Pressure against the disk may be provided either by the weight of the work itself or by adding auxiliary weights to the work. A dust channel, accessible by removing the top guard-ring, completely surrounds the outside of the disk. The vertical motor has forced ventilation and means are provided for effective lubrication and exhaustion of dust. The spindle is mounted in radial and thrust ball-bearings, the thrust bearing being adjacent to the disk collar. The machine is built in motor-driven type only.

Rickert-Shafer Collapsible Tap

The Rickert-Shafer Co., Erie, Pa., has recently brought out the collapsing tap illustrated herewith and known as Model P.

The claims made for this tap are: that the action of withdrawing or collapsing the chasers is positive with no liability to stick; that in tapping to a predetermined depth or close to the bottom of a hole, full reliance may be placed on its action as the chasers will collapse at the proper point; that adjustment for size can be made to fractional thousandths of an inch; that the tap will hold to size within the most exacting limits and that the use of sizing hand-taps can be dispensed with. Taps of this type are made in sizes from one to ten inches.

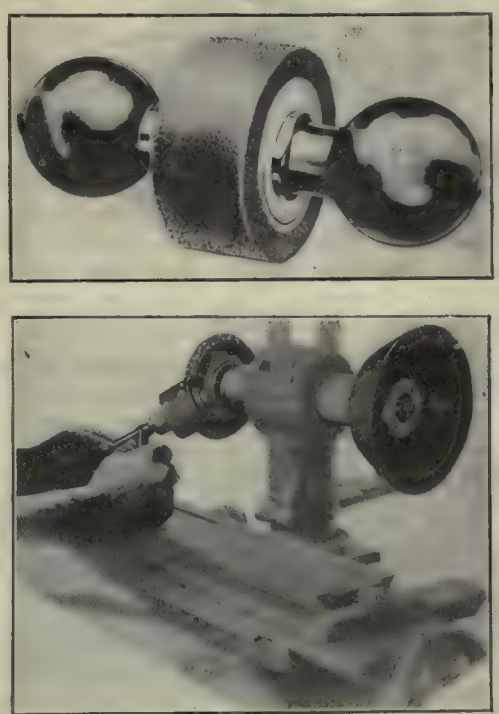


RICKERT-SHAFER MODEL P COLLAPSING TAP

Metcalf Grinding Wheel Dresser

The Oliver Machinery Co., Grand Rapids, Mich., has added to its line the Metcalf grinding wheel dressers illustrated. There are three types, "A," "B" and "C." Types "A" and "C," for hand dressing, are shown by the illustrations. Type "B" is for use with a tool-post.

The dresser consists of a 4 x 1½-in. abrasive wheel revolving freely on its axis. Type "A" (upper) is recommended for truing square, round, bevel or V-edges on wheels 1 in. or less in thickness; type "B" for use with

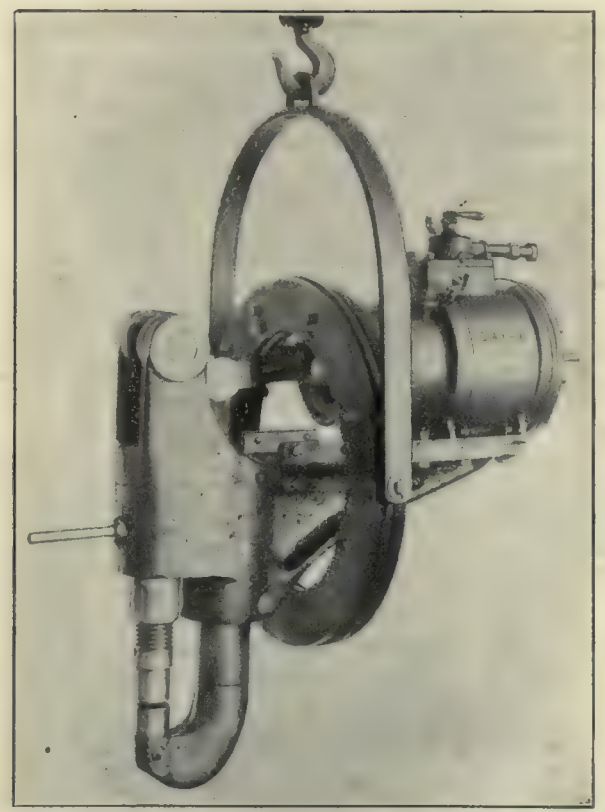


METCALF GRINDING WHEEL DRESSER

cylindrical grinding machines; and type "C" for working in close quarters to true square, round, bevel or V-edges on wheels 1 in. or less in thickness, and the sides on straight or dished wheels. For using type "C" in extremely close quarters smaller sized dressing wheels can be provided.

Baird Stake Riveter for Marine Boiler Flanges

The Baird Pneumatic Tool Co., Kansas City, Mo., has added to its line the riveter illustrated herewith. This riveter is intended for driving rivets between the flanges of either two or three-furnace Scotch marine-boilers but can readily be used in the fabrication of any boiler or tube work where the requirements call for operating equipment having the possibility of adjustment necessary in any of the difficulties met with in such construction. The adjusting screw is of the buttress type and the air cylinders are of the tandem-unit type, both pistons being on the same rod. The delivery of power is

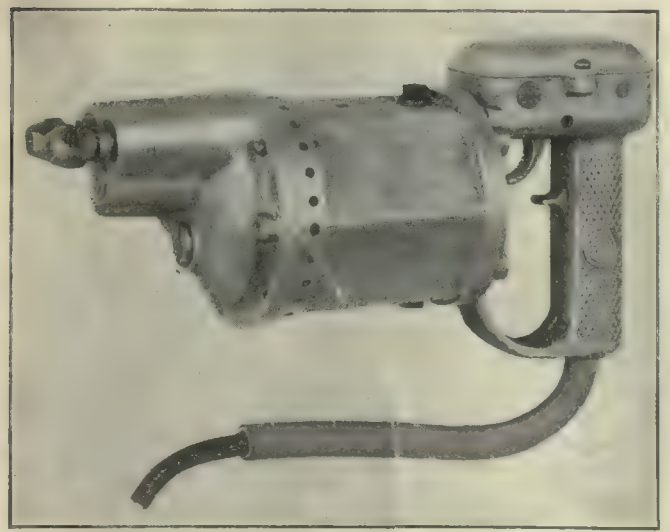


BAIRD STAKE RIVETER FOR MARINE BOILER FLANGES
Specifications: Reach, 5 in. Gap, 12 in. Die adjustment, 3 in. Will drive 1-in. rivets. Air consumption, 4 cu.ft. per drive. Length, 33 in. Height, 40 in. Weight, 750 lb.

at a right angle to the set of the rivet and the toggles are of simple design. The riveter is hung so as to be in balance, and is equipped with a circular frame fastened to the stake. Around this frame and riding on ball bearings is a band fastened to the suspension bail, thus providing for both circular and swinging movements.

Black & Decker Two-Spindle Electric Drill

The two-spindle drill illustrated herewith is a recent production of the Black & Decker Manufacturing Co., Towson Heights, Baltimore, Md., and is intended for drilling the holes for automobile curtain fasteners. The handle of the device is like that of an automatic pistol



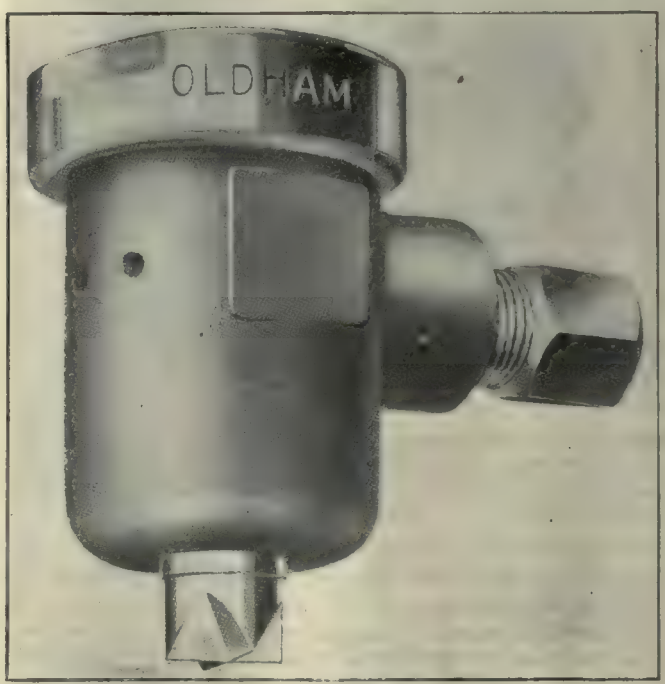
BLACK & DECKER TWO-SPINDLE ELECTRIC DRILL

and a pull on the trigger sets both spindles in motion, while a second pull stops them. The motor and the driving gears are said to be simple yet rugged, the gears being made of heat-treated steel. The two spindles, which are only $\frac{7}{8}$ in. from center to center, have special chucks for holding $\frac{1}{8}$-in. drills.

Oldham Valveless Scaling Tool

The scaling tool shown in the illustration has been brought out by the George Oldham Son & Co., Baltimore, Md. This tool is intended for removing scale from boiler tubes and crown sheets, as well as paint and rust from all metal surfaces.

It is claimed that it gives a light rapid blow that removes scale without injury to the surface. It can be



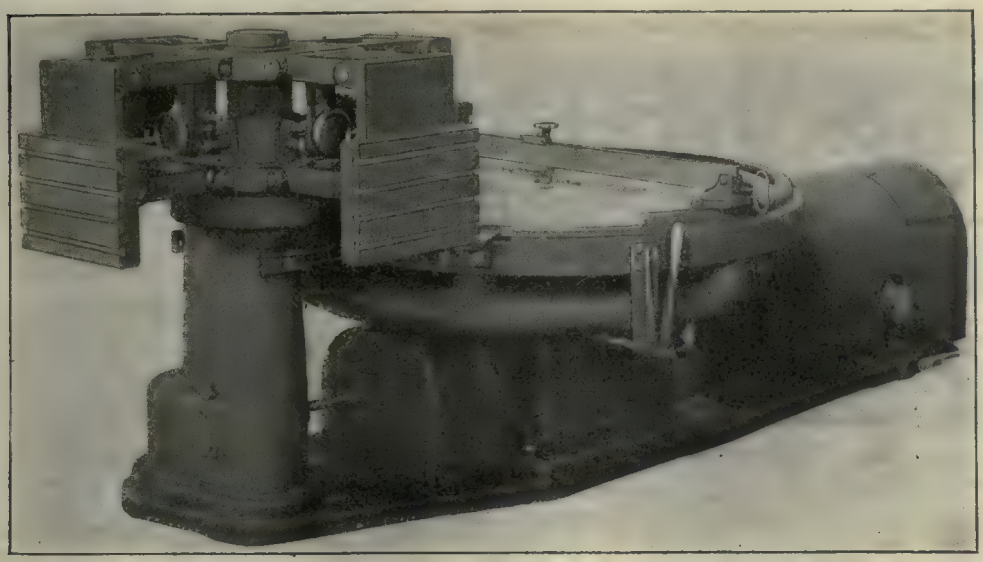
OLDHAM VALVELESS SCALING TOOL

fitted with a pipe extension that enables it to reach places which could not be reached otherwise. It measures only $3\frac{1}{2}$ in. overall, weighs $2\frac{1}{2}$ lb., and will operate on any standard air pressure.

Gardner No. 24 Continuous Feed Disk-Grinding Machine

The continuous-feed disk-grinding machine shown in the illustration has been brought out by the Gardner Machine Co., Beloit, Wis. Its purpose is to reduce the amount of labor usually required for the operation of this class of machine and to eliminate the human factor so far as it affects the work done on a disk-grinding machine. It is also intended to obtain great production on account of its constant feed and the employment of the operator's time solely for loading.

The machine consists of a horizontal grinding disk, 53 in. in diameter, and four work-tables rotated by a power-driven vertical shaft. Special fixtures for holding the pieces to be ground may be attached to the tables. The vertical shaft revolves constantly, carrying the work across the grinding disk. The work-table is automatically lowered by a cam until the work rests on the disk. The pressure of the work on the disk



GARDNER CONTINUOUS FEED DISK-GRINDING MACHINE

may be regulated by means of a compression spring, or by regulating the amount of weight in the work fixture. A micrometer screw stop permits grinding to fixed limits. Upon completion of the grinding the work-table is automatically raised before it travels over the edge of the disk to be emptied and loaded.

The feeding mechanism can be arranged so that a work-table will make a complete revolution in 1, 2 or 4 minutes. It is controlled by a friction clutch which enables the operator to stop the feed without stopping the disk. The stand which carries the work-tables can be adjusted over a distance of 6 in. The weight crated is 7,600 lb.

Roberts Multiple-Spindle Fixed-Center Drill Heads

The Roberts Manufacturing Co., 152-6 Brewery St., New Haven, Conn., manufactures a line of multiple-spindle drill heads of the fixed-center type. The illustration shows one of these heads intended for light work. For heavy duty, the case of the head is clamped to the quill of the drilling machine to prevent rotation.

The case is made of cast iron, although it can be made of aluminum, if desired for use on very sensitive machines. Each drill spindle with its driving gear is made of one piece of chrome-nickel steel, the gear having stub teeth. The spindles run in bronze bearings, ball bearings being used to take the end thrust. It is claimed that the drills will break before any damage can occur to the head, since it is amply strong. By using a friction chuck with the head, multiple tapping and stud-setting can be done.

The head can be furnished with any desired number of spindles to hold drills up to 1 in. in diameter.



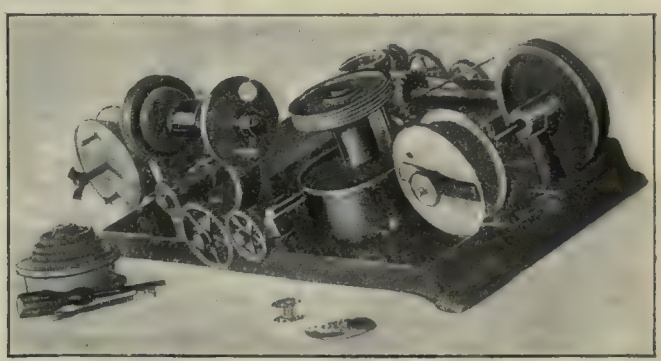
ROBERTS MULTIPLE-SPINDLE FIXED-CENTER DRILL HEAD

"Nemo" Rust Remover

A compound for removing rust and known under the above title is being marketed by Peter A. Frasse & Co., Inc., 417 Canal St., New York. Rusty articles can either be painted with the compound or suspended in a tank containing the compound diluted with water. It is claimed that it will loosen and dissolve rust, grease, oil, dirt, carbon, paint or any other foreign substance irrespective of its age or hardness and that the metal surface will not only not be injured in any way but will be protected from corrosion for a long time after the application. It is also claimed that the compound is safe to use as it will neither burn nor explode.

Eisler Coil-Winding Machine

Charles Eisler, 159 Clifton Ave., Newark, N. J., has brought out the winding machine shown in the accompanying illustration. The machine is intended for winding the filament coils for gas-filled incandescent lamps and it is claimed that it is capable of winding coils from 25 to 900 turns per inch for lamps of 15 to 1,000 watts. The mandrels used are from 0.003 to 0.035 in. in diameter and can be dissolved in acid after completion of the coil. Coils can be wound close or with any desired spacing. The speed of the machine is from 500 to 3,000 r.p.m. according to the size of the filament to be wound.



EISLER COIL-WINDING MACHINE

It is claimed that coils of 5,000 ft. in one length can be wound and that the filament can be electrically heated to a cherry red during the winding.

Iron Production in Southeast

Companies operating furnaces in the Birmingham district report that cancellations have virtually ceased, and that orders still retained will warrant steady operation of the furnaces during the remainder of the present year, and into the early part of 1921. The market continues to experience a lull so far as buying is concerned, but operators feel certain business will experience considerable stimulus immediately after election. October pig iron production wil lexceed that of September.



Progress on the Safety Code Program

Considerable progress has been made on the comprehensive program of safety codes being undertaken by a large number of organizations under the auspices and rules of procedure of the American Engineering Standards Committee. Following this regular procedure, each code is being formulated by a sectional committee, broadly representative of the interests concerned, and composed primarily of representatives designated by the various bodies interested in the particular code. The sectional committee is organized by one or more bodies designated for the purpose by the American Engineering Standards Committee and known as sponsors.

Sponsorships for the additional safety codes have been arranged as follows:

Construction Work—National Safety Council

Electrical Fire Code — National Fire Protection Association

Electrical Safety Code — Bureau of Standards

Floor Openings, Railways and Toe Boards — National Association of Mutual Casualty Companies

Lighting Code — Illuminating Engineering Society

Lightning Protection—American Institute of Electrical Engineers and the Bureau of Standards

Machine Tools — National Machine Tool Builders' Association and the National Workmen's Compensation Service Bureau

Mechanical Transmission of Power—National Workmen's Compensation Service Bureau, the International Association of Industrial Accident Boards and Commissions, and the American Society of Mechanical Engineers

Sanitation Code, Industrial — U. S. Public Health Service

Stairways, Fire Escapes and Other Exits — National Fire Protection Association

Textiles — National Safety Council and the National Association of Mutual Casualty Companies

The following sponsorships have previously been announced:

Abrasive Wheels — The Grinding Wheel Manufacturers of the United States and Canada, and the International Association of Industrial Accident Boards and Commissions

Foundries—American Foundrymen's Association and the National Founders' Association

Gas Safety Code—Bureau of Standards and the American Gas Association

Head and Eye Protection—Bureau of Standards

Paper and Pulp Mills—National Safety Council

Power Presses — National Safety Council

Pressure Vessels, Non-fired—American Society of Mechanical Engineers

Refrigeration, Mechanical — American Society of Refrigerating Engineers

Woodworking Machinery — International Association of Industrial Accident Boards and Commissions and the National Workmen's Compensation Service Bureau

The *Head and Eye Protection Code* has been completed, and the sponsor, the Bureau of Standards, has submitted the code to the main committee for approval.

The Warner & Swasey Observatory

On Columbus Day, Oct. 12, there was dedicated in Cleveland the observatory presented to the Case School of Applied Science by Messrs. Warner & Swasey, well known to both machine-tool users and to scientists the world over. The new observatory stands on a high spot believed to be the former shore line of Lake Erie, and is provided with the latest and most improved equipment.

Mr. Swasey in a presentation address, recalled to the audience the prominent astronomers with whom his work had brought him in contact, not forgetting the famed makers of objectives, the Clarks, father and sons—and our old friend John Brashear, recently deceased. This recital showed the growth of the observatory as an aid to civilization and the prominent part which the Warner & Swasey Co. has played in its development. Mr. Warner, in a few well chosen remarks, presented the keys of the observatory, which were appropriately received by the president, Charles S. Howe.

This was followed by an extremely interesting address by Dr. W. W. Campbell, director of the Lick Observatory, who showed some of the practical assistance which astronomy rendered to mankind. Professor D. T. Wilson, the astronomer of the Case School, then told of the aims of the observatory and made several practical suggestions as to ways in which it might be made of greater value to the community and to its citizens.

This observatory is but another evidence of the part played by builders of machine tools, as without them, we should have no astronomical equipment.

September Exports $28,000,000 Over August

With increased exports and decreased imports, the balance of trade in favor of the United States for the month of September was nearly four times as great as August.

The August figures, showing a slump in exports and a marked increased in imports, resulting in a balance of trade favorable to the United States of only $65,000,000, caused alarm among protectionists, who feared an influx of cheap foreign goods under existing tariff schedules and consequent injury to American industries.

Statistics for the month of September, however, which were made public Oct. 25 by the Bureau of Foreign and Domestic Commerce, show that in September the favorable balance of trade jumped to $243,000,000. Exports increased $28,000,000 over August, while imports decreased $150,000,000.

While showing an increase over the low mark of August, exports in September were still considerably below the totals of most months of the past year and a half. With the single exception of August, the exports were at a lower ebb in September than in any month since September, 1919. Imports were lower than in any month since August, 1919.

Exports in September, 1920, were valued at $606,000,000, as against $578,000,000 in August and $651,000,000 in July. Exports in September, 1919, when the total was less, with two exceptions, than any month of either 1919 or 1920, amounted to $595,000,000.

Youngstown Pressed Steel Co. Moves to Warren, Ohio

The main office of the Youngstown Pressed Steel Co. is now established in Warren, Ohio, having been moved from Youngstown during the last week of September. It is located in the new factory building which cost approximately one million dollars and covers six acres of floor space. This building embodies the last word in modern design and shows careful attention to those details designed to make it "a place where work is a pleasure," a slogan adopted by the company.

Among the changes in organization are the following: C. A. Morrow, appointed sales manager of pressed steel department, formerly assistant manager, Chicago office of the Sharon Steel Hoop Co.; A. C. Snyder, appointed assistant to C. W. Dickinson, sales manager of fireproofing department, formerly in the Eastern sales department of the Universal Portland Cement Co.

LD'S INDUSTRIAL FORGE

News Editor

Estimated Demand for Spark Plugs in 1920

The number of spark plugs required for new equipment and replacement on cars, trucks, tractors, etc., has been calculated with considerable care by the research department of the Class Journal Co. Individual specification sheets of various manufacturers were used to ascertain the number of cylinders in each case. These figures, used in connection with production figures for the past six years and estimated figures for 1920, make it possible to calculate the quantity of spark plugs required with a fair degree of accuracy.

New equipment, spares and replacements required for 1920 production:

Cars and trucks	23,625,000
Motorcycles, tractors, farm light systems, stationary, engines, motor boats and airplanes	3,610,000
	27,235,000

Replacements required for apparatus produced prior to 1920 and now in use:

Cars, trucks, tractors, etc. (See above list)	109,583,928
Exports (including Canada) for replacements	4,808,000
Required to replenish merchandise stocks here and abroad	30,000,000
Total spark plugs required for 1920	171,626,928

—*Automotive Industries.*

A. S. M. E. Organizes Aëronautic Section

In the field of aviation a good deal of co-operative engineering work has been done, standards have been established, details of construction perfected, interchangeability secured. Nevertheless there still exists the real opportunity for promoting in a large way the broad engineering development having to do with the future of aerial navigation regarded as an essentially international science, art and business.

To this end the members of the American Society of Mechanical Engineers interested in aeronautics have organized themselves into a professional section on this subject.

Side by side with the development of the engineering features of aviation, which are obvious to all, a few minds have for some years been looking beyond the details of construction into the realm of international aircraft problems, and have in fact secured for America a reputation for breadth of vision regarding the future of air navigation throughout the world.

Howard E. Coffin, Jesse G. Vincent, Orville Wright, C. F. Kettering, Elmer A. Sperry, James Hartness, John R. Cautley, Lionel S. Marks, Miller R. Hutchison, Charles E. Lucke and Joseph A. Steinmetz, all prominen' in the aeronautic field in the war, are among those who have registered in the section.

Railroad Electrification Night at the Engineering Societies Building

The first joint meeting of the Metropolitan Section of the American Society of Mechanical Engineers and the New York Section of the American Institute of Electrical Engineers was held in the main auditorium of the Engineering Societies Building on West 39th St., Oct. 22. The big hall was jammed by members and guests who came to hear the relative merits of steam and electric locomotives. The feeling on both sides was strong and the remarks naturally showed a somewhat partisan tinge. The speakers were well chosen and the result of the debate seemed to be that each side was more convinced that it was right than before.

Four other joint meetings of the two sections have been arranged as follows: On Dec. 3, the "American Power Problem" will be the topic, Frederick Darlington in charge; Jan. 28, 1921, "Marine Electrical Engineering," Alfred E. Waller in charge; March 25, "Industrial Relations," Prof. Walter Rautenstrauch in charge, and April 22, "Engineering Education," Prof. Comfort A. Adams in charge.

Betts-Ingle Hallowe'en Party

Owing to the fact that no picnic of employees was held this summer, the Hallowe'en party and dance given on Oct. 30 was of considerable importance to the employees of the Betts Machine Co. and of the Ingle Machine Co., Rochester, N. Y. (the former concern is the selling organization for the latter, which is a manufacturing one). The party is an annual affair, this being the second one held. The shop organ, "The Tool Post," said with reference to the stunt: "It's gonna be an old-fashioned Hallowe'en affair, with cider, doughnuts, dancing, music and everything. Old Man Dull Care won't have a look-in that evening."

The dining hall of the plant was appropriately decorated with lanterns and pumpkins, the tables being removed to permit of dancing. Masquerade costumes were worn, prizes being awarded for the best. The party was given by the management for the employees in order to promote acquaintance and friendship between the members of the various departments of the plant.

The Situation of the German Machine-Building Industry

A very pessimistic picture of the near future of the German machine-building industry was drawn at the recent annual meeting of the German Machine-Building Association. "The industry has to eliminate all waste of energy, labor and time," said Mr. Becker, general manager of the Breuer, Schumacher & Co. machine-tool works at Koeln-Kalk. "It is impossible," he continued, "to continue working on the lines of pre-war time when labor and material were cheap and the whole world open to German products. The German works cannot keep up, in the future, their present extensive manufacturing program. The future belongs to specialization and standardization."

This is the first time that the German machine builders have been asked to look upon the situation in this light. At all former occasions, the increase of cost of labor and material has been stated to be responsible for the predicaments of the industry. It is evidently recognized now that no improvement can be expected in that direction and this may be responsible for the change of front.

Although there has lately taken place a slight reduction of iron and steel prices, this is merely due to the present business stagnation. As long as the cost of material and labor, expressed in foreign money, is so far below that of foreign countries, the argument that on this account the German industry cannot compete with foreign rivals is not upheld. The German machine-building industry has not made such huge profits during the last export boom as was commonly believed; it is in a bad way now since the business stagnation has set in. It is, however, not commonly recognized that the failure of making profits was chiefly due to the fact that the shops have neglected economy and that the present dull times are to a large degree due to the fact that the works have forgotten how to sell.

The machine builders united at the annual meeting all agreed that the home demand was at present practically nil. A great number of works during the war have built and installed extensions to their shops for which there is no use at present. Under such conditions there is little inclination to buy new equipment.

The export business on which the German industry is now mostly dependent has greatly decreased. New orders are coming in very sparsely. The business in hand mostly dates from contracts made before the depression set in.

Numerous shops have not received a single order since several months. Working hours have been cut down to 32 and 24 hours per week. The shops are compelled to manufacture for stock and those financially unable to do so, have no option but to close down entirely. The number of unemployed workmen is increasing rapidly, making the situation so serious that the government will shortly be compelled to take matters in hand.

Society of Industrial Engineers To Convene in Pittsburgh

The national convention of the S. I. E. will be held at Pittsburgh, Pa., on Nov. 10, 11 and 12. The meetings will be held in Carnegie Music Hall, which has a seating capacity of 2,000. A cordial invitation is extended by the society to every one interested.

The following is a partial list of the topics on the program:

The Need for Industrial Education;
Training Industrial Engineers Within the Organization;
Methods for Training Time Study Men;
College Training for Industrial Engineers;
Educational Training for Business Men;
Analyzing Industrial Educational Requirements;
Training Shop Employees;
Training Foremen;
Training Personnel Administrators as a Solution of the Labor Problem; Illustrated;
The Value of Morale in Industry and Means of Developing It; Illustrated;
Training the Office Force;
Training Managers to Apply Business Principles;
The Part of Psychology and Psychiatry in Industry;
Some New Factors in Industrial Education;
European Industrial Conditions, etc.

During the convention there will be a series of special group luncheons and dinners at the Hotel Schenley for educators, industrial engineers, personnel directors, production managers, cost accountants, etc. Programs may be obtained from the S. I. E. business office, 327 South LaSalle St., Chicago.

New Ships for Southeast Steel Mill Products

The Chickasaw Shipbuilding and Car Co. will launch early in November the sixth 10,000-ton ocean steel freighter built in the company's yards at Mobile, Ala. Fourteen of these ships are to be built for overseas trade. It is probable that all of them will carry on their initial cargo Birmingham steel-mill products. Two of the first five ships built carried steel products from the Birmingham district to Rotterdam, and two others carried similar cargoes to China and Japan. The Montgomery City, the fifth of the ships launched, is now being equipped for its maiden voyage.

Cutting a 44-Inch Riser

Heavy cutting with the oxy-acetylene flame has become so common that today nothing short of a super cut attracts particular notice. A real super cut was made recently in the plant of the National Car Coupler Company at Attica, Ind., when a cutter operating an Oxweld blowpipe tackled a 44-in. (square) steel riser. The cut was rendered more difficult because of the upright position of the riser, which necessitated a horizontal cut. If the riser had been horizontal and the cut vertical the operation would have been much simplified. To offset this difficulty the operator resorted to first cutting the corners of the riser so as to reduce



CUTTING THE 44-INCH RISER

the uncut cross section to a smaller square. This operation was repeated until the remaining stem could be easily cut through. The equipment consisted of the Oxweld cutting blowpipe, Linde oxygen and Prest-O-Lite dissolved acetylene.

In this manner it would appear that there is no limit to the thickness of steel that can be cut with the oxy-acetylene torch, as the operation of slicing off angles can be carried to any desired extent so long as access to the metal with the cutting flame is provided. With the injector type of blowpipe the "reach" of the flame enabled the operator in this instance to carry out the work by simply directing the jet through the initial kerf.

Meeting of the Industrial Cost Association

The Industrial Cost Association (formerly the Industrial Cost Accountants Association) held a meeting in the office of the Westinghouse Air Brake Co. in New York, recently. The following men were elected members of the board of directors: Spencer M. Duty, president, National Paving Brick Manufacturers Association and president, Medal Paving Brick Co., Cleveland, Ohio; W. E. Hundley, auditor, Mesta Machine Co., West Homestead, Pa.; W. H. Moore, secretary, Gulf States Steel Co., Birmingham, Ala.; G. K. Wilson, assistant secretary, Sullivan Machinery Co., Chicago, Ill.

Walter Rautenstrauch, professor mechanical engineering, Columbia University, and director, Brunswick Refrigerator Co., had been elected a member of the board on Aug. 24. The other members are the four officers of the association, M. F. Simmons, president, General Electric Co., Schenectady, N. Y.; C. H. Smith, first vice president, Westinghouse Air Brake Co., Wilmerding, Pa.; Roland H. Zinn, second vice president, Tanner's Council, New York City; A. A. Alles, Jr., secretary-treasurer.

It was decided that the association should immediately organize local sections, giving first attention to those cities and towns in which its present members were located.

The objects of the Association and the requirements for membership are explained by the following extracts from its constitution and by-laws:

(a) To encourage the interest of manufacturers everywhere in accurately determined costs. (b) To standardize accounting and cost terminology; to so far as practicable simplify cost accounting: and to adopt standard governing principles. (c) To educate the members in the complex economic problem of industry; and to develop, improve and extend the use of charts and other forms of statistics that graphically portray cost data of vital importance to management. (d) To assist standardization committees of trade associations in establishing uniform accounting and cost practices, and to encourage the interchange of average cost experiences among manufacturers who are members of trade associations, thereby making possible the elimination of unintelligent competition. (e) To provide by general meetings, and through local sections for the discussion of cost problems and the interchange of ideas; and (f) To act as a clearing house in distributing to all members the development in cost practices to the end that uniformity once established may be maintained

Section 1. Membership in the association shall be limited to executives of industrial corporations, firms, and trade associations; those executives who use cost data, or encourage others in its use; and those who control, or are permanently and actively engaged in the executive supervision of costs accounting of corporations, firms, or trade associations.

Hewes-Phillips Plant Sold at Auction

The entire plant of the Hewes & Phillips Iron Works, manufacturer of machine tools and Corliss type steam engines, was sold at public auction on Oct. 11 and 12, at the factory, Ogden and Orange Sts., Newark, N. J.

Included in the sale with the machine tools and machine-shop equipment was 100 tons of bolts and nuts and all the small tools and attachments carried in stock. Jessops tool steel was sold at 15 cents a pound. Round iron stock brought 70 cents a hundred pounds and square and angle iron, one dollar a hundred pounds. One Bullard engine lathe, 16 x 8 in., brought $85 and other lathes were sold for $175 and upward.

A Farrel Foundry 15-ton air crane went for $550 and an electric crane with the same capacity brought $400.

Reamers, milling cutters, chucks and other milling attachments sold for one-third of current prices.

Fall Meeting of the American Gear Manufacturers' Association

Opinions differ among the members of the American Gear Manufacturers' Association as to the suitability of the Lake Mononk Mountain House for fall conventions. They met at the beautiful Ulster County resort on Oct. 27, 28 and 29. Some were enthusiastic about the magnificient mountain scenery and the gorgeous autumn foliage but there seemed to be more whose pleasure was spoiled by the local prohibition laws against dancing, cigarettes, cards and the demon rum. Conditions for a successful business meeting could hardly have been improved upon as nothing was seen of the sun, and rain kept the members indoors most of the time with nothing to do but attend the sessions.

Papers were read by P. G. Agnew of the American Engineering Standards Committee and Calvin W. Rice of the A. S. M. E. on "Standardization"; by C. L. Collins, II, a past president of the Electric Power Club, on "Industry Organization," and by Christopher Haigh of the General Electric Co. on "Machine Rate Methods of Distributing Expense." They were well received and aroused much instructive discussion. The rest of the business sessions were devoted to reading and discussion of the reports of the various committees and sub-committees.

An informal banquet was served by the hotel staff on Thursday evening and was to have been featured by an address by Chas. W. Woodward, vice president in charge of personnel of the Hydraulic Pressed Steel Co. Mr. Woodward was unable to be present but his absence was more than made up for by the program of informal stunts directed by G. L. Markland, Jr., of the Philadelphia Gear Works.

The next meeting of the association is to be held in Cincinnati. For the benefit of all the members and particularly those who failed to attend this session it was decided to have the secretary issue a bulletin telling of the occurrences at the meeting. The first bulletin is to be followed by others as the occasion warrants.

Taking into consideration the present unsettled business conditions, and the relative inaccessibility of the Mohonk Lake the meeting was well attended. Nearly two-score ladies were also in evidence.

Reports of the following committees were presented: Reports of the Secretary—F. D. Hamlin; Report of the Treasurer—F. D. Hamlin; Report of the Membership Committee—G. L. Markland; Report of Public Policy Committee—H. E. Eberhardt, chairman; Report of Entertainment Committee—C. F. Goedke, chariman; Report of Publicity Committee—J. C. McQuiston, chairman; Report of Legal Committee—J. E. Gleason, chairman; Report of Library Committee, E. W. Baxter, chairman; Report of Labor Committee—J. B. Foote, chairman; Report of A. G. M. A. Sectional Committee of the American Engineering Standards Committee—B. F. Waterman, chairman; Report of the General Standardization Committee—B. F. Waterman, chairman; Spur Gear Commiteee—F. E. Eberhardt, chairman; Bevel and Spiral Bevel Committee—A. C. Gleason, chairman; Committee on Worm Gears and Spirals, J. C. O'Brien, chairman; Inspection Committee—E. J. Frost, chairman; Sprocket Committee—C. R. Weiss, chairman; Hardening and Heat Treating Committees—R. L. Dodge, chairman; Composition Gearing Committee—John Christensen, chairman; Herringbone Gear Committee—A. F. Cooke, chairman; Committee on Gears and Pinions—Electric Railways and Mine—W. H. Phillips, chairman; Keyway Committee—H. J. Eberhardt; Report of Committee on Uniform Cost Accounting—J. H. Dunn, chairman; Report of Commercial Standardization Committee—C. E. Crofoot, chairman.

Situation in German Steel Market

The stagnation of business has considerably eased the situation in the German iron and steel market and has lately resulted in an all-round reduction of iron and steel prices for raw and semi-finished products. Scrap, which was at its highest point in March at 2,100 Marks, is now freely offered at 500 Marks and still the supply overlaps demand.

The prices for semi-finished products, which were at their highest point in May, have now returned to the level of February.

As Germany is now mostly dependent on foreign countries for the supply of iron ore, the prices will naturally move in accordance with the fluctuations of the exchange. The only stabilizing factor in this respect is the scrap which still forms a large part of the furnace supplies. The supply of scrap is by no means exhausted and is considerably helped now by the scrapping of war material which is now taken in hand vigorously. Lately over 500 airship sheds and aero-dromes estimated to contain over 300,000 tons of steel have been designated to be scrapped. There are still huge stores of ammunition, rifles and ordnance in the country which the Reparation Commission will soon put on the scrap market. Consequently the German industry can to some extent draw raw material still from home resources.

The new Ryan-Bohn Foundry at Lansing, Mich., has been completed and was placed in operation on Sept. 27. The president of the company is Edward Ver Linden, who is also president and general manager of the Olds Motor Works. D. J. Ryan is vice president and general manager. Mr. Ryan is also president and general manager of the Allyne-Ryan Foundry Co., Cleveland, and of the D. J. Ryan Foundry Co., Detroit. E. C. Shields, a Lansing attorney, is secretary, and A. P. Vreeland, formerly with the Mitchell Motors, is general superintendent.

Indiana to Start an Industrial Extension School

The first step toward the start of extension work in Indiana industries, similar to that done for the farmers of the state by Purdue University, was taken recently by representatives of Indianapolis manufacturers and university men at a dinner and meeting at the Chamber of Commerce.

W. E. Stone, president of Purdue; Dr. A. A. Potter, dean of the school of engineering, and George H. Shepard, head of the industrial engineering and management department and the instructor of the course to be given here, spoke on the needs of extension work and the ways in which the university could co-operate with the manufacturers. Arrangements were made for the first course, a training school for foremen, which will be established here.

Dr. Stone spoke of the ways in which agriculture in the state has been aided by the combination of teaching, research and extension work, and he stated that all that has been accomplished for agriculture is possible for the other industries of the state. The engineering schools have been brought to a high standard of instruction, Dr. Stone asserted; scientific research was inaugurated by the establishment of the engineering experiment station three years ago, and now Purdue plans to complete the program by establishing extension schools for manufacturers.

The course will cover thirty-one periods, and will be divided under the following heads: "Setting Shop Standards," "The Relation of Product to Plant Efficiency," "Plant Layout," "Shop Planning and Dispatching, or the Routing of Work," "Cost Systems," "Organization," "Fair Deal," "Development of Morale," "Handling Men," "Improvement of Methods," "Incentive System of Wage Payments."

Stanley Zweibel, of the Nordyke & Marmon Co., read letters concerning the work in Wisconsin and Pennsylvania. A discussion followed. W. D. Oakes was in charge of the meeting.

Mack Co. Increases Capital to Expand Factory

At the annual stockholders' meeting of the Mack Manufacturing Co., Ltd., of Houston, Tex., the capital stock was raised from $500,000 to $2,000,000. The extra capital is to be used to build additions and install more equipment in the modern re-enforced concrete plant at Houston, which consists of a large foundry, both steel and gray iron, a well appointed forge shop and a machine shop, where a most up-to-date line of oil field supplies is manufactured. A branch factory, modern in every respect, is also to be built in either northern Texas or Oklahoma, probably in Dallas, Tex., for the manufacture of cable tool equipment. J. O. Mack is president and general manager; H. L. Sadler, secretary; Charles R. Edwards, plant superintendent.

Business Items

The Colburn Machine Tool Co. announces the removal of its entire business from Franklin. Pa., to its new plant, 1038 Ivanhoe Road, Cleveland, Ohio.

The National Ship Supply and Machinery Co., New York, has purchased the plant of the Maryland Shipbuilding Corporation, Sollers Point, Md., from the Emergency Fleet Corporation, which took over the plant shortly after the signing of the armistice. The property includes 51 acres with 2,600 ft. waterfront and four shipways.

The Williams Machine Co., Poultney, Vt., is the name of a new company organized to manufacture special machinery, dies, jigs, etc. The organizers, Robert H., and Russell I. Williams, have had much experience; the former spent 40 years in this line of work, and the latter has been with the Ruggles Machine Co., Poultney, Vt., for 16 years.

The Rutenber Motor Co. which some time ago sold its plant in Marion, Ohio, to the Velie Motor Co., Moline, Ill., announced recently that it had bought the big plant of the American Chain Co. in West Marion and expected to begin operation Oct. 15. The company will manufacture automobile parts and motors. A large force will be employed.

The Latrobe Electric Steel Co., Latrobe, Pa., has opened a warehouse at 1280 Ontario St., Cleveland, Ohio, where a complete stock of Uranium high-speed steel, Mangano non-shrinkable die steel, and carbon and alloy tool steels will be carried.

The National Pressed Steel Co., Massillon, Ohio, has opened offices in the Andrews Building, Dallas, Tex. Its business for the Southwestern district, including Texas, Louisiana, Arkansas, Mississippi and part of Tennessee, will be handled from this branch.

The United Iron Works, Inc., Kansas City, has opened offices in Dallas, Tex., and will move its district branch from Fort Worth to there. O. C. White, district sales manager, will have charge of this branch. This company specializes in structural steel and heavy machinery.

The Walworth Manufacturing Co., South Boston, Mass., has leased the six-story building at Nos. 88-94 Pearl St., Boston, and will remove part of the main office into this building shortly.

Hubbard & Harris, Inc., machinery engineers, with plant at 1047 Broad St., Bridgeport, Conn., have announced a change in name to take effect immediately. The business will now be known as the Hubbard, Harris & Rowell, Inc.

The Buffalo Steam Pump Co., 490 Broadway, Buffalo, N. Y., announces a change in its organization. The newly elected officers are: H. W. Wendt, president; Edgar Wendt, treasurer; H. W. Wendt, Jr., secretary; A. G. Peterson, sales manager, and Robert G. Nye, factory manager.

The Meldrum-Semon-Greiner Co., Inc., and the Lowery & Canice Tool Co., both of Syracuse, N. Y., have been consolidated to form the Meldrum-Semon-Greiner-Lowery Co., or the M-S-G-L Co., Inc., Syracuse, N. Y. The officers are as follows: Mr. Meldrum, president; Mr. Greiner, vice president; Mr. Semon, treasurer, and Mr. Lowery, secretary.

Obituary

Daniel M. Wright

DANIEL M. WRIGHT, president of the Henry & Wright Manufacturing Co., Hartford, Conn., died Oct. 27. He was born in Philadelphia, June 5, 1870.

Mr. Wright was one of the best-known machine-tool men in the country and his gigantic figure was a familiar



DANIEL M. WRIGHT

sight at almost every convention having to do with the welfare of the machine-tool industry. He was at various times first vice president of the National Machine Tool Builders' Association, president of the Hartford Board of Trade, vice president of the Hartford Chamber of Commerce, president of the Russo-American Mercantile Co., director of the Hartford Morris Plow Co., and president of the Hartford branch of the National Metal Trades Association.

THOMAS W. MEACHEM, prominent in the machinery manufacturing world, died at his home in Syracuse, N. Y., recently. Mr. Meachem was the organizer of the New Process Rawhide Co., and later of the Meachem Gear Corporation. [This obituary is reprinted from our Oct. 21 issue, when the name was erroneously given as Homer W. Meachem.]

Personals

J. H. DRURY, treasurer of the Union Twist Drill Co., Athol, Mass., returned Oct. 23 from a six weeks business trip to Europe.

E. E. SAUNIER, 350 Broadway, New York, is the New York representative of the Steel Car Equipment Co., of Delaware.

C. WILLIAM BAYNE, industrial engineer, formerly with the Ford Motor Co., and Timkin Axle Co., of Detroit, Mich.; is now production manager of the F. C. Austin Machinery Corporation, Muskegon, Mich.

H. A. GUTENKUNST, general manager of the Canadian Malleable Iron Co., of Owen Sound, Ont., is leaving shortly for Milwaukee where he will go into business for himself. He will be succeeded by H. H. Todd who has been general superintendent of the Hamilton Stove and Heater Co., at Hamilton, Ont.

A. ARMSTRONG has been appointed manager of the Northern Bolt, Screw and Wire Co., Owen Sound, Ont., Canada.

JOHN E. MCCREHAN, JR., has resigned his position as assistant manager of the production department of the Walworth Manufacturing Co., South Boston, Mass. He plans to enter business for himself in New York City.

R. J. S. PIGGOTT, who has been industrial engineer of the Bridgeport, Conn., Chamber of Commerce for the past few years, has severed his connection with it to accept a position as works manager of the Crosby Steam Guage and Valve Co., Boston, Mass. Mr. Piggott was also consulting engineer for various Bridgeport manufacturing plants while with the Chamber of Commerce and will still continue in this capacity.

ALBERT B. FRITTS, advertising manager of the Norton Co., Worcester, Mass., was elected vice-president of the Industrial Editors' Association of New England, at the annual meeting and dinner held recently in Boston at Young's Hotel.

JOSEPH P. SESSIONS, treasurer of the Sessions Foundry Co., Bristol, Conn., has been elected president of the Bristol, Conn., Trust Co.

ARTHUR W. YEATES has been appointed production manager of the Eastern Works of the Walworth Manufacturing Co., South Boston, Mass. Mr. Yeates was formerly manager of the sales order department in the same plant.

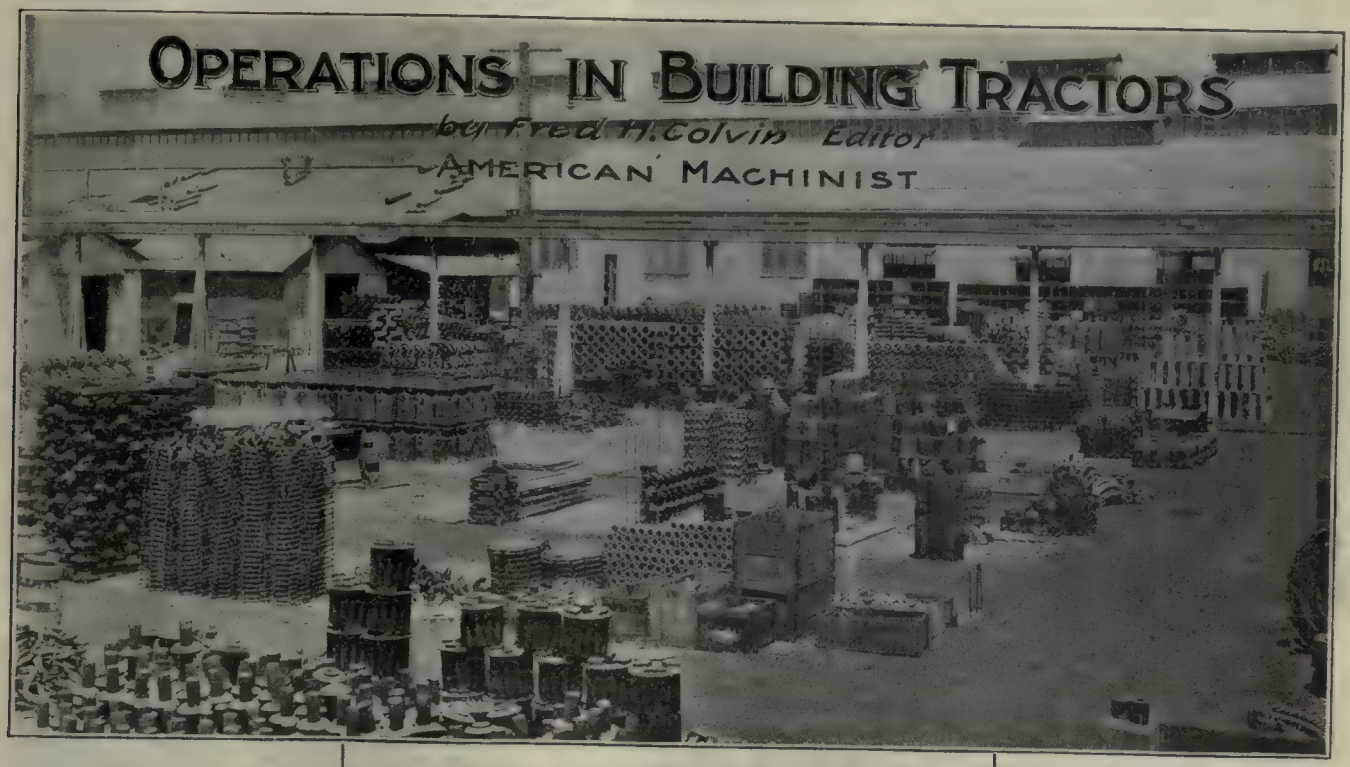
I. R. GREEN, who has just returned from the Far East, where he has been located for the past four years, has taken up his new duties as assistant manager of the export department of the Yale & Towne Manufacturing Co., Stamford, Conn.

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Operations in Building Tractors

by Fred H. Colvin Editor
American Machinist



Some idea of the increases of manufacturing on the Pacific Coast can be had by a visit to the plant of the C. L. Best Gas Traction Co. at San Leandro, California. A number of the machining operations are of unusual interest while the material storage yard shown in the headpiece gives an excellent idea, both of the varied parts of the products and the orderly arrangement, which is not only pleasing to the eye, but makes it easy to find exactly the piece wanted.

THE orderly arrangement of the yard indicates the type of mind which pervades the management. Such a yard has its effect on the personnel of the whole shop and can hardly help being reflected in the products. This company builds large track-laying tractors which are in ever-increasing demand. The rear-axle housing is one of the very important units in heavy tractor work. The housing is a large steel casting and can be seen in various stages of construction in Figs. 1 to 8. One of the first operations is the planing of the top and sides on the Cincinnati planer shown in Fig. 1, which shows the type of fixtures used, the method applied in centering the opening for the axle, the locating screws and the method of strapping the casting to the fixture itself.

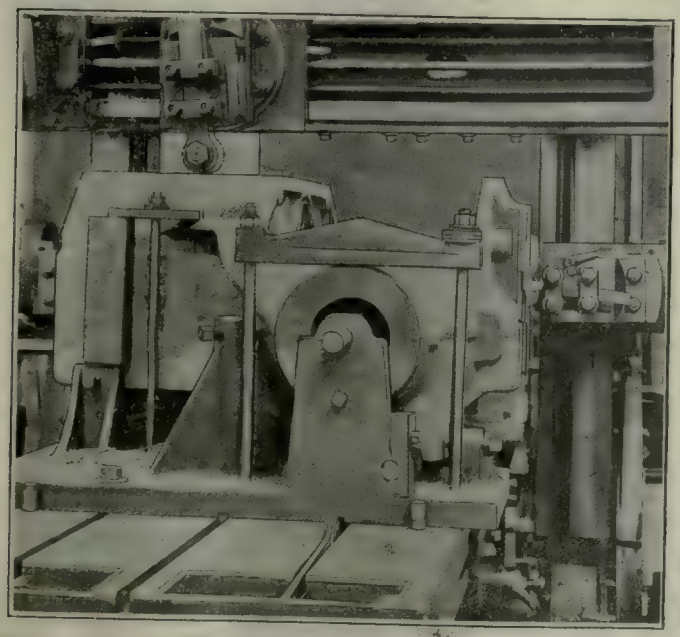


FIG. 1. PLANING THREE SIDES OF REAR-AXLE HOUSING

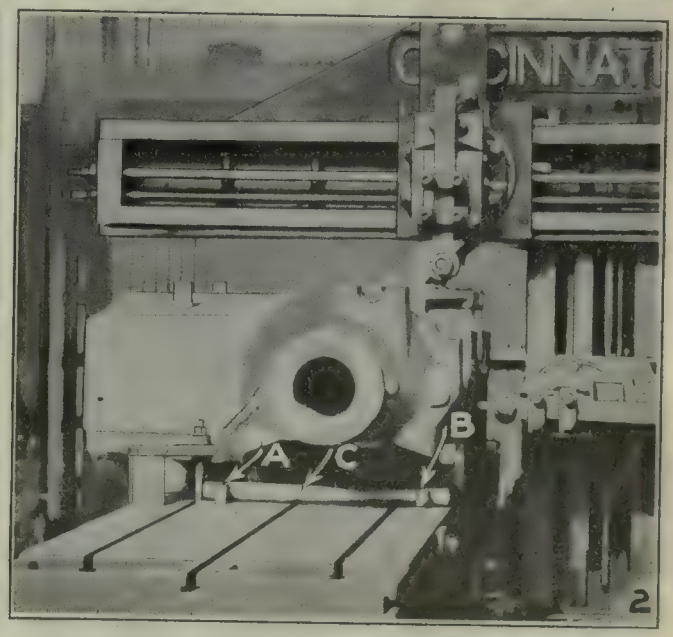


FIG. 2. ANOTHER PLANER OPERATION ON HOUSINGS

AUTOMOTIVE CONSTRUCTION

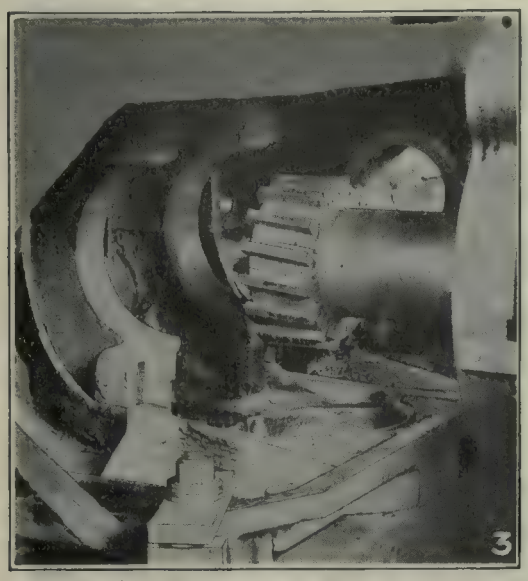


FIG. 3. MILLING THE FACES OF BEARING SEATS

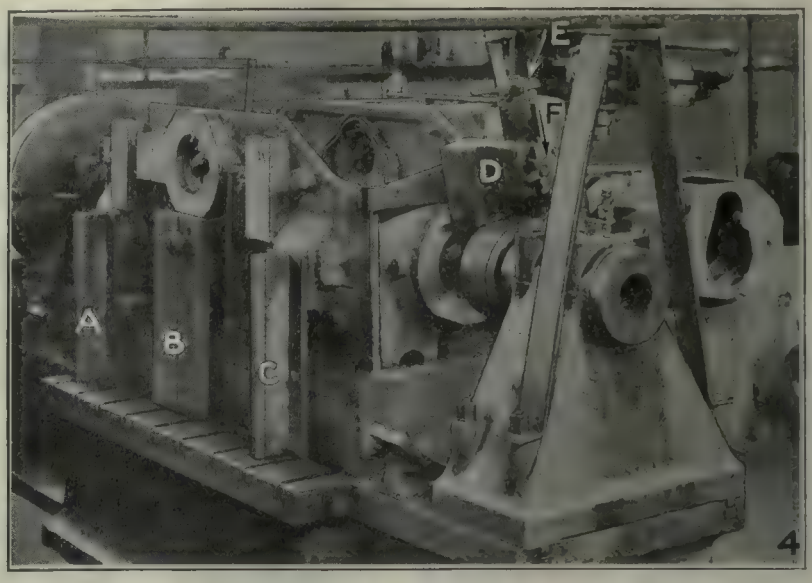


FIG. 4. BORING AXLE HOUSINGS FOR REAR AXLES

Three of the four heads on the planer are being used. Another planing operation, this time on an open-side planer, is shown in Fig. 2. This operation is not unusual, but the use of the stops *A* and *B* and the bar *C* as a means of locating the inclined edge of the casting, is of interest.

An operation, originally one of planing, is now being done by milling on a Beaman & Smith machine by extending the spindle so as to reach the spaces of the bearing supports, as shown in Fig. 3. This method has been found more satisfactory than planing for this job.

Boring the Housing

The boring of the main hole through the rear housing is done in the Barrett horizontal boring machine shown in Fig. 4. A substantial base is provided for mounting the casting, containing the uprights *A*, *B* and *C*, which serve to position the casting so that the alignment of the bore will match the previously planed surfaces. The outer ends are also faced at the same setting, one of the facing heads being shown at *D*. The usual star feed is provided for the facing feed at *E*, a second star-wheel *F* feeding the cross-slide for counterboring when this is necessary.

A second boring operation, that of finishing the cross-holes for the driving shaft which comes from the motor, is shown in Fig. 5. This operation is a comparatively simple one in which the casting is supported for the most part on a fixture that goes on the bed of the machine beside the regular table. The baseplate has uprights as at *A* for positioning the casting with reference to the planed surfaces. The overhanging part of the housing, which contains the transmission units, is supported by the regular table of the Giddings & Lewis boring machine on which the work is done.

Still another boring operation on the housing is shown in Fig. 6, and is being done on the same type of machine as the first milling operation shown. Here the

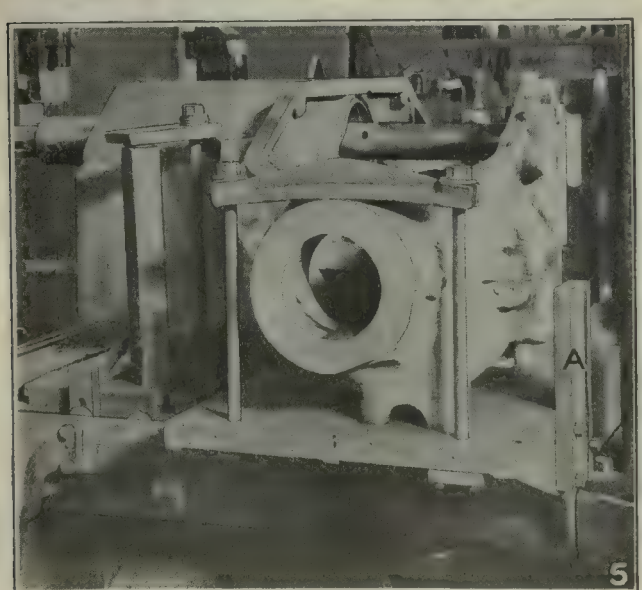


FIG. 5. BORING THE CROSS-HOLES

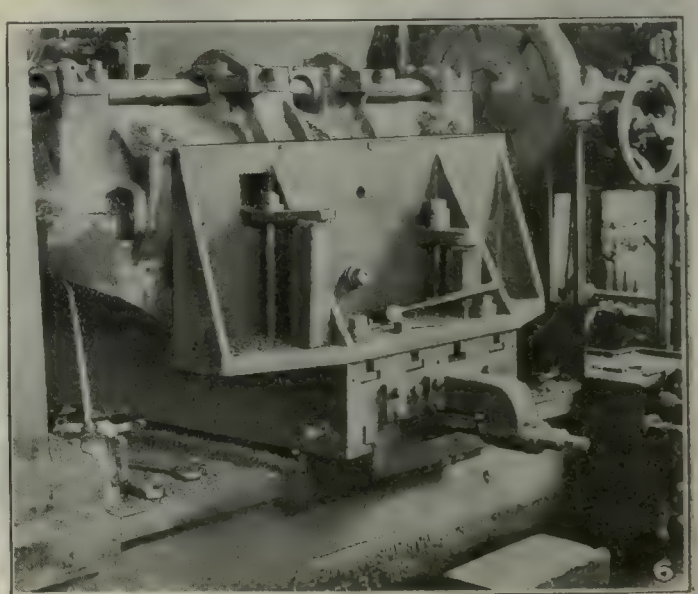


FIG. 6. ANOTHER BORING OPERATION

AUTOMOTIVE CONSTRUCTION

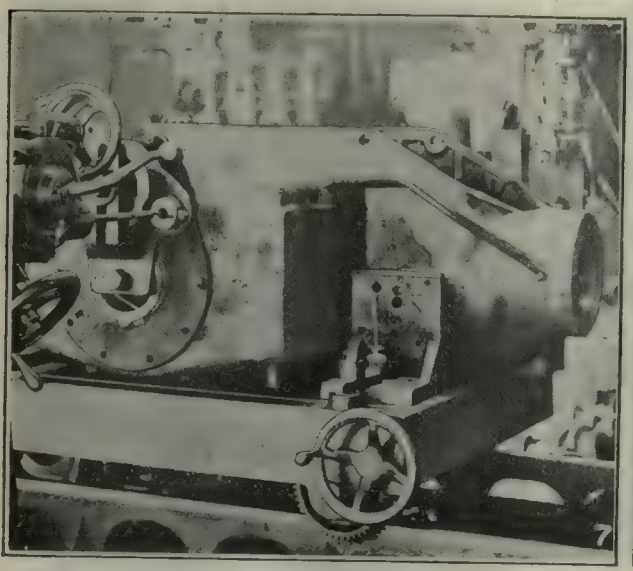


FIG. 7. DRILLING THE SIDES OF THE HOUSINGS

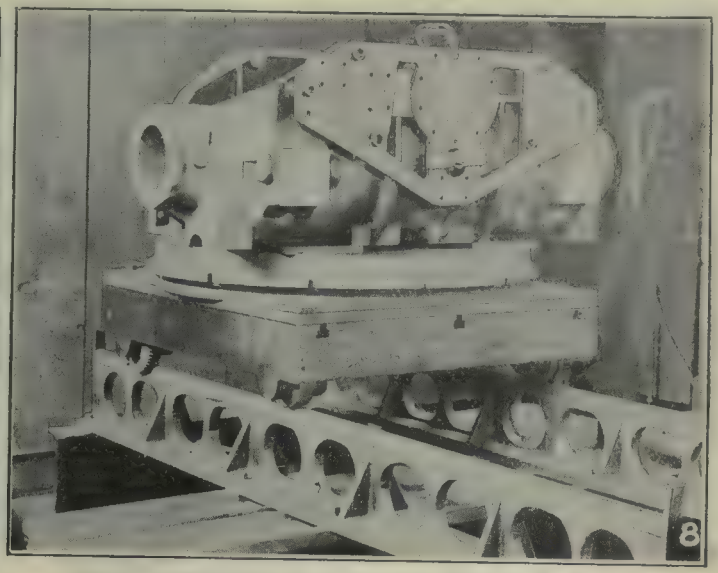


FIG. 8. DRILLING TABLE AND INDEXING FIXTURE

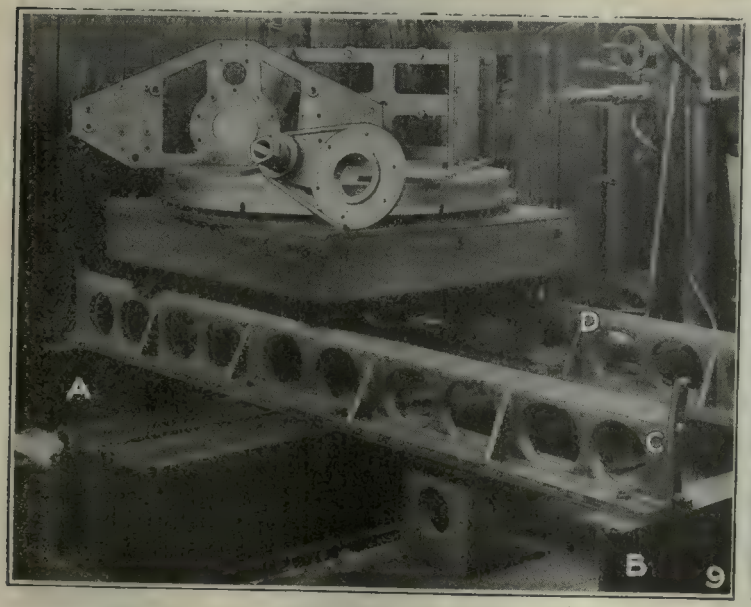


FIG. 9. THE TABLE AND FIXTURE IN DETAIL

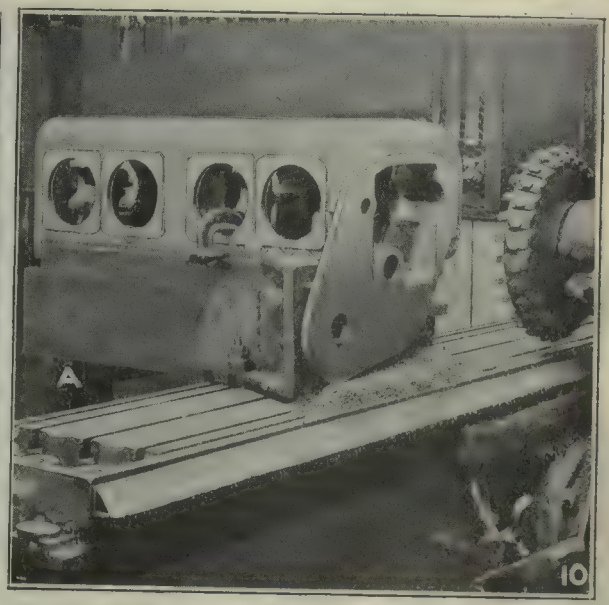


FIG. 10. MILLING END OF ENGINE BASE

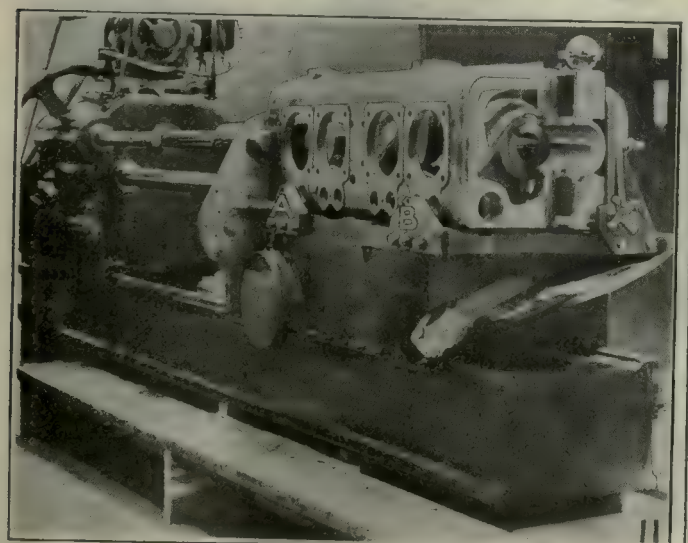


FIG. 11. BORING CRANK AND CAMSHAFT HOLES

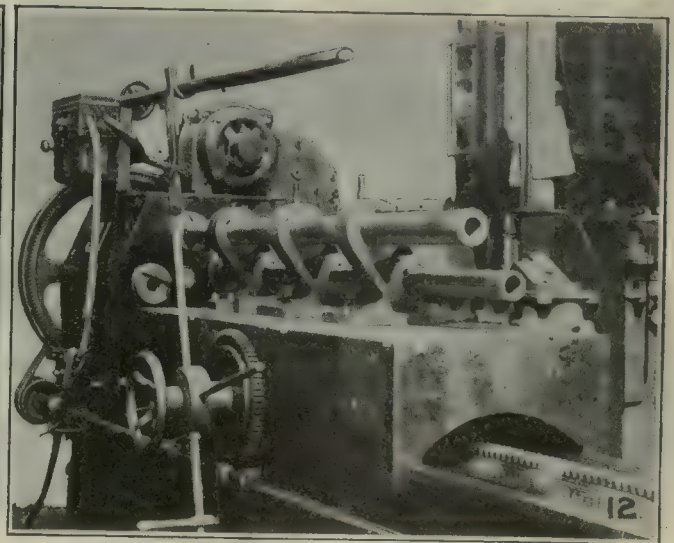


FIG. 12. DETAILS OF THE BORING FIXTURE

AUTOMOTIVE CONSTRUCTION



FIG. 13. BORING THE CYLINDER CASTINGS



FIG. 14. DRILLING CYLINDER FLANGE HOLES

casting is mounted directly on the boring-machine table, but special angle plates, with suitable openings cut out for holding the casting by the use of straps, are used for locating the piece from the original planed surfaces.

Special Table for Drilling

Some of the drilling operations are shown in Figs. 7 and 8. These illustrations show the types of drilling fixtures used and also the carriage on which the work is mounted while being drilled. Fig. 7 shows the drilling of some of the end holes, and also shows the handwheel and reduction gear used in giving easy and positive control to the movement of the carriage on the track. This handwheel and gear are shown much more clearly in Figs. 8 and 9.

The kind of drilling fixture for locating the many small holes, so as to insure assembling without special fitting in the erecting department, is shown in Fig. 8. This view also shows the track on which the carriage is mounted, the wheels on the outer rail having a flat tread while those on the rails nearest the column are provided with coned flanges so as to insure centering and prevent derailment. It also shows very clearly that the gear is connected to the axle beside the supporting wheel, and from this view, as well as from Fig. 7, it can be seen that both wheels on that end of the carriage act as drivers. Fig. 8 also shows the turntable with the indexing notches which enable all the holes in the horizontal plane to be drilled at the one setting.

In Fig. 9 is shown the construction of the drilling machine itself, the supports *A* and *B* being for the ends of the heavy cast-iron rails *C* and *D*. These supports are I-beams of sufficient section to carry the load. The table contains a number of the drilling fixtures used, two of which have been shown in the preceding illustrations.

Motor Building Operations

Coming to the motor, Fig. 10 shows one of the interesting milling operations on an Ingersoll milling machine. The outer end of the casting is supported by a suitable rail *A* on which the fixture slides as the table carries it past the milling cutter. This fixture is simple in construction and enables the cylinder bases to be handled easily and rapidly.

The boring of the crankcase for the crankshaft bear-

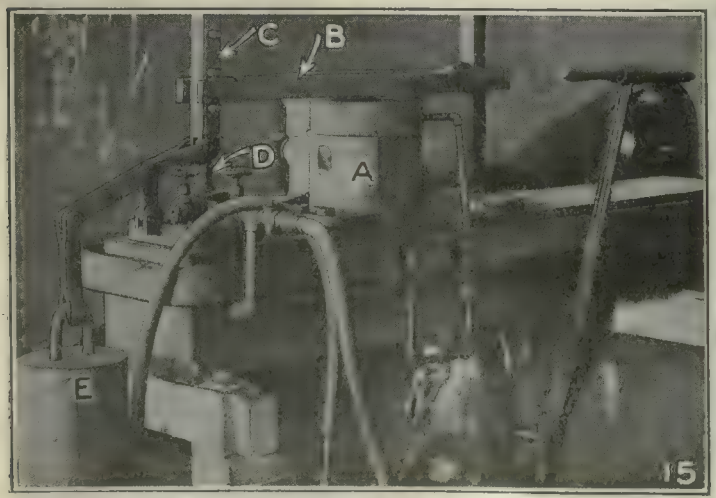


FIG. 15. TESTING CYLINDER HEADS

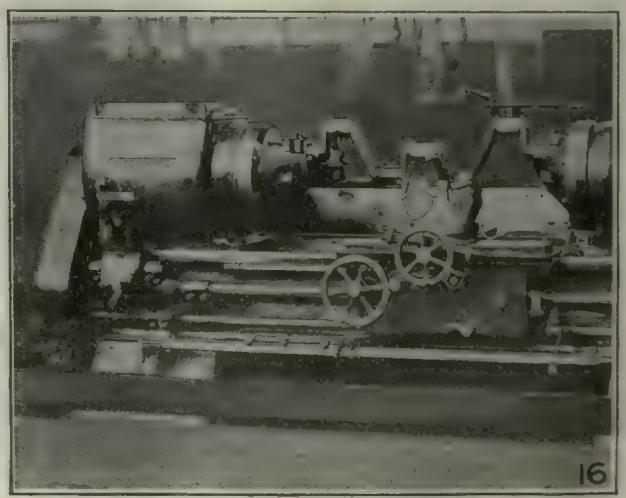


FIG. 16. DOUBLE-HEAD CRANKSHAFT LATHES

AUTOMOTIVE CONSTRUCTION

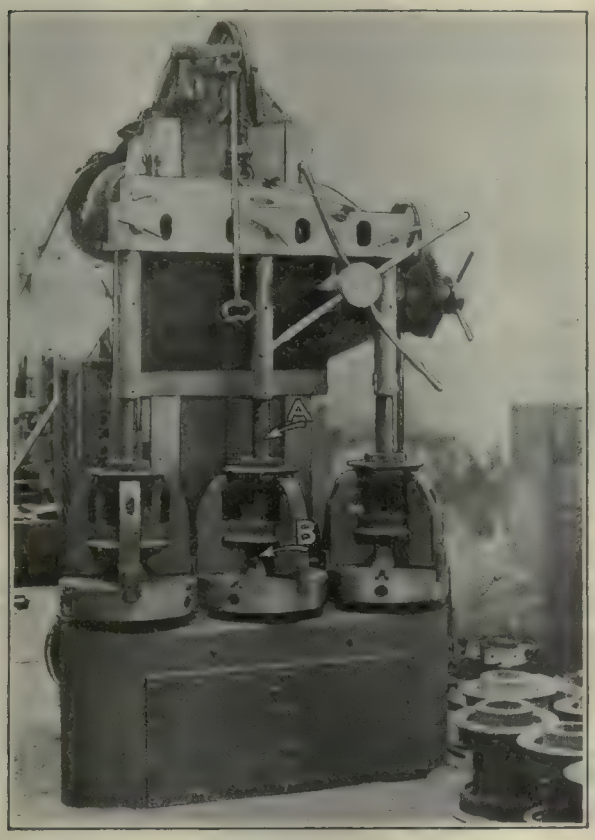


FIG. 17. SPECIAL TRIPLE BORING MILL

ings is shown in Fig. 11, the machine being a special one. The type of fixture used can be readily seen, and consists principally of a baseplate with side projections *A* and *B* for locating the work from the previously planed surfaces for the bases of the cylinder flanges and the valve rod guides. The appearance of the fixture, minus the side arms which locate the casting, is shown in Fig. 12. This view shows the method of supporting the boring bars in substantial bearings inside the crankcase so as to avoid springing and to insure alignment.

The boring of the cylinder itself is shown on a Steinle lathe in Fig. 13. The form of chuck used can be clearly

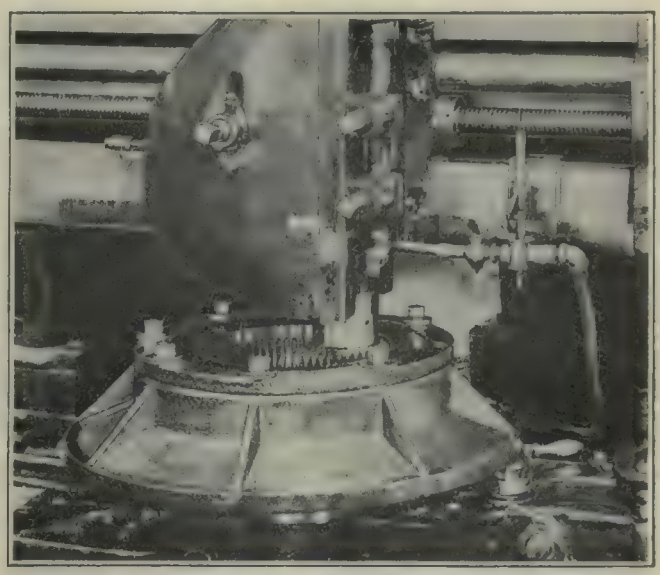


FIG. 20. CUTTING TEETH ON CLUTCH DISKS

seen, it being a large bell-shaped casting which completely encircles the cylinder and makes it almost a part of the lathe spindle itself. The type of boring bar is also shown, as well as the tools used in the cross-slide to face the cylinder flange and turn the projection or spigot, which fits into the cylinder space.

The drilling of the bolt holes in the cylinder flange, using four spindles of a multiple-spindle drilling machine for this purpose, is shown in Fig. 14. This illustration shows the method of locating the drilling fixture by means of one of the outlets at *A*, and the clamping of the fixture to the cylinder flange by means of hand nuts and clamps.

In Fig. 15 is shown an unusual method of water-testing the cylinder heads. The head *A* is placed in position on the table resting on a suitable gasket, the lever *B* is dropped in the horizontal position shown and the arm *C* swung up into the vertical position so that the horizontal lever comes between two of the pins as shown. Pressure is then applied to a piston in a cylinder at *D*, which holds arm *C* down and holds

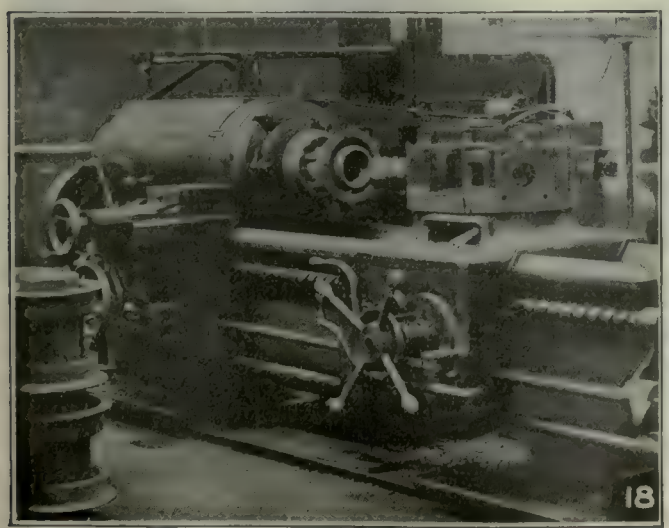


FIG. 18. FINISH-BORING TRACK ROLLERS



FIG. 19. MACHINING REAR SPROCKET

AUTOMOTIVE CONSTRUCTION

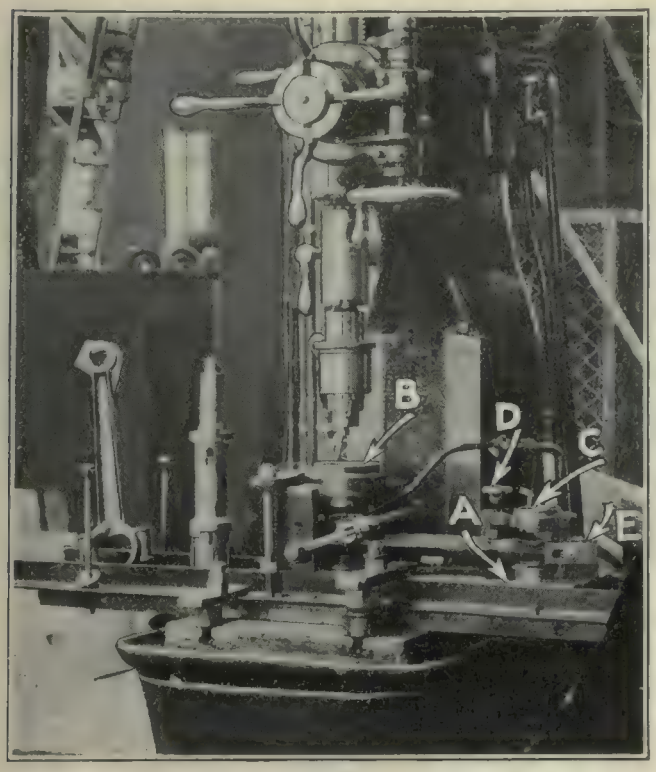


FIG. 21. FIXTURE FOR BORING CONNECTING RODS

the cylinder head firmly in place while being water-tested by means of the hand pump shown. On releasing the pressure from the top of the piston, the weight *E* lifts the arm *C*, releases the lever *B*, and the arm *C* can then be swung down to the left, the lever being raised and the cylinder head removed.

The turning of the crankshaft which is driven from both ends to avoid torsion and which indicates very clearly the general character of the equipment of the shop, is shown in Fig. 16.

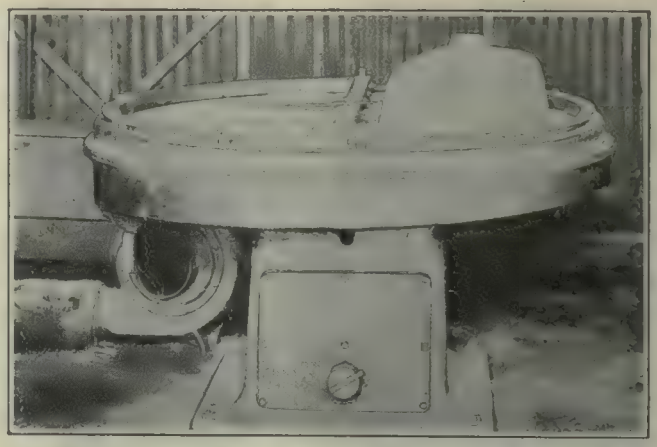


FIG. 23. HORIZONTAL SURFACE GRINDING MACHINE

Two interesting operations are shown in Figs. 17 and 18, the first being the boring of the rollers or spools on which the tractor rolls, in a special triple-head boring machine. The work spindles revolve simultaneously and the three boring bars are all connected in the same head so that they feed through at the same time. The boring bars have a pilot *A* which fits into the guide bushing at *B* in the center of the chuck, and insures a fairly accurate hole through the casting. The special chuck jaws clamp the work at both ends and hold it firmly during the boring operation.

FINISH-BORING TRACK ROLLERS

In Fig. 18 is shown the finish-boring of the track rollers on a Steinle lathe. The work is held on a special plate bolted against the chuck body, the three jaws having been removed for this purpose.

The method of boring and facing the large sprocket wheel is shown in Fig. 19, a Bullard vertical turret lathe being used for this purpose. The cutting of the teeth for the clutch disks on a Fellows gear shaper is

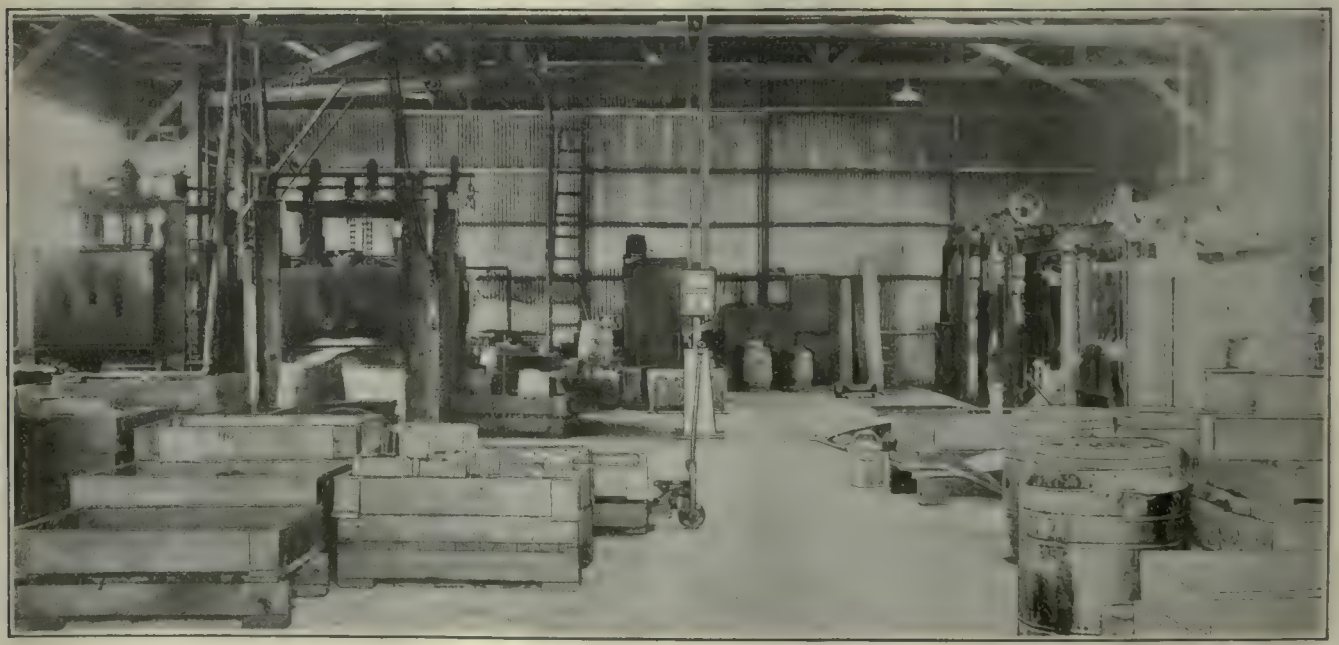


FIG. 22. THE HEAT-TREATING DEPARTMENT

AUTOMOTIVE CONSTRUCTION

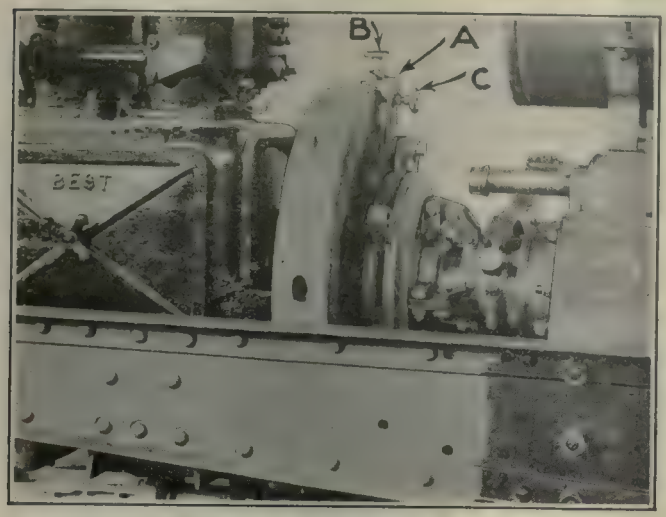


FIG. 24. ALIGNING ENGINE AND TRANSMISSION

shown in Fig. 20. A number of the clutch rings are clamped in the substantial fixture shown, and are then cut in the usual manner.

The Connecting-Rod Boring Fixture

The fixture for boring the connecting rods is shown in Fig. 21, the boring tool for the large hole being seen in the spindle. The fixture is mounted on the track *A* and moved from one hole to the other, being indexed in the two positions. The large bushing *B* is permanently positioned on the fixture, but the small bushing *C* swings into place and is held by the hand nut *D*. The clamp *E* centers and holds the small end of the rod.

Some idea of the extent of the heat-treating carried on in this work may be had from the size and equipment of the heat-treating room shown in Fig. 22. The furnaces are oil-fired and the department is well equipped in every way for handling a large variety of work, some of it being of considerable size as can be seen from the spur pinions in the box in the foreground. This illustration incidentally shows the method of transporting work from one department to another, platforms and tote boxes together with elevating trucks being used for this purpose.

The use of the Gardner horizontal disk-grinding machine for surfacing castings of various sizes is shown in Fig. 23. Here the weight of the casting aids materially in producing the desired feed, this being especially true in the case of such castings as the engine base shown at the right. It is only necessary to press down on the work which is prevented from revolving with the disk by the cross member shown.

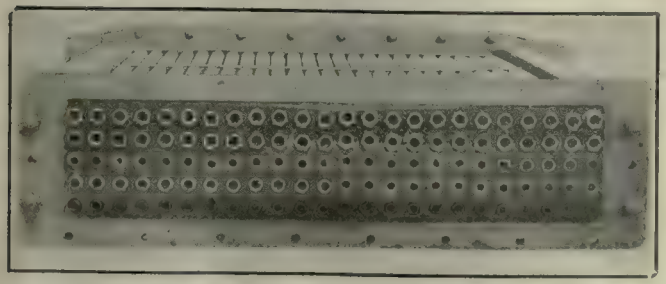


FIG. 25. DETAILS OF THE RADIATOR

When it comes to assembling the motor and the transmission in the chassis, great care is given to securing proper alignment. Fig. 24 shows the gage used for this purpose at *A*. The gage is clamped to one of the gears on the clutch drum shown, the two screws *B* and *C* adjusted with reference to the face and outside rim of the flywheel, and the transmission revolved. The gage shows instantly whether the units are in alignment or not, and also indicates in which direction adjustments, if any, are to be made.

Those who are accustomed to automobile radiators will hardly recognize the construction shown in Fig. 25. The radiator tubes all carry cooling fins on the outside, and the ends project through the plate as shown in the lower row of tubes. The annular space between the tubes and the casting is a recess for the tube packing, which is shown in place in the next two rows. A tight joint is secured by means of the packing nuts or glands shown in place in the two upper rows, these nuts compressing the packing between themselves and the bottom of the recess, and forcing it laterally against both the tube and the circular recess in the header.

A Branch Public Library at the Plant

By Frank H. Williams

Why not establish a branch public library at the plant?

A big percentage of employees either like to read books or would gain considerably in knowledge and ability through a greater use of books.

This is the plan that has been adopted by the Fort Wayne Edison Lamp Works at Fort Wayne, Indiana, and which has been found to be very successful. A regular circulating library has been installed under the direction of the city's main public library and operating under the same rules and regulations.

At this branch a certain number of fiction and other books are carried together with the library's complete catalog. When an employee desires a certain book, the name of the book is given to the branch librarian and the book is secured for the applicant in the shortest possible length of time. The employees appreciate the plan immensely and many of them avail themselves of the scheme.

The branch library was installed at the Fort Wayne Edison Lamp Works by the effort of E. D. Moeller, who is in charge of welfare work at the institution.

Perhaps there is a suggestion in this for the welfare managers of other large plants.

Know Why You Do Things

By L. S. Watson

On page 612 of *American Machinist* I read Mr. Forbes' article about "Knowing Why You Do Things."

I always supposed that it was proper to place the tool on center for certain jobs and above center for other jobs, but have never heard of putting a tool below center. I have read Mr. Forbes' previous articles with interest and hope soon to learn his reasons for placing a tool below center.

Precision Gages

By M. E. KANEK

Methods of accurate measurement, as well as precision gages themselves, are comprehensively treated in this article. Regarding gages, the shape, size and material are all given consideration. The use and scope of the measuring machine and the method of comparison by light interference are discussed.

WHEN America entered the war there was at once thrown upon American metal workers a far heavier burden than is realized even now by the non-mechanical public and by a large portion of the mechanics of the country.

Many of the products demanded were extremely complicated, and in order that they function properly it was imperative that each component be accurate to exceptionally close limits. In many cases it was impracticable to manufacture complete mechanisms in a single plant, and occasionally units from three or four plants were collected at an assembly station to be assembled for shipment as a completed product. Obviously these units must be "interchangeable" in the most perfect sense of the word. Even though the drawings from which the products were made "checked" perfectly it was possible, for instance, for a hole made 0.5005 in. in one shop to be too small for a pin made 0.500 in. in another shop. The micrometers in one place may be adjusted to one standard while those in another shop may be noticeably different, being adjusted to another standard.

This possibility became apparent several years ago to a Swedish inventor, who developed a combination of different sizes of solid gages which were finished to a hitherto unapproached accuracy. With a set of precision gages which could be depended upon for accuracy and which were known to be identical with those in other plants, there could be little possibility of trouble in assembling parts which were made to correspond to the precision gages.

Gage Block Sets

The first sets of precision gage blocks to come to America were made up of the now familiar eighty-one sizes. There are really four sets in one. The first set of four gages, in 1-in. units, gives any even inch from 1 to 10 in. The second set of nineteen gages, in 0.05 in. units between 0.05 and 0.95 in., gives any even multiple of 0.05 in. between 0.05 and 10 in. when used in connection with the even-inch series. The third set of forty-nine gages, in 0.001 in. units between 0.1 and 0.149 in., can be used with the other two to get any even thousandth within the range. And the fourth set, composed of nine gages varying by 0.0001 in., may be assembled with the others to get any ten-thousandth in. between 0.2 and approximately 10 in. The large number of gages in the third set (49) is, of course, due to the dimension of the smallest gage in the set, which is 0.05 in. In order to secure the intermediate sizes there must be individual gages as there are none which are thin enough to be built up to form them.

For some reason not apparent American manufacturers have adopted these same sizes and prepared the same 81-block sets. Obviously the cost and the selling price must be dependent upon the amount of time required in making. If the number of gages could be halved and the range unchanged or increased the price could be halved and the market enlarged. Production could be greatly increased with the same equipment.

Let us suppose a set of 30 gages instead of the 81 These might be in the following sizes:

1.-2.-3.-4		
0.1-0.2-0.4-0.8		
0.01-0.02-0.04-0.08		
0.011	0.012	0.013
0.014	0.015	0.016
0.017	0.018	0.019
0.0101	0.0102	0.0103
0.0104	0.0105	0.0106
0.0107	0.0108	0.0109

With these thirty sizes any ten-thousandth between 0.02 and 10 in., or more, can be built up. This set can be made for half the cost of the 81-block set, and has a range of several hundred more sizes. It provides ten-thousandths between 0.2 and 0.02, which the 81-block set will not do, with nine exceptions. The writer has heard more than one toolmaker express wonder that our gage makers have not developed a much smaller set than is available. Who will be the first? It is a safe wager that the firm which starts the reduction in numbers will have the entire field following at its heels.

Types of Precision Gages

There are several types or shapes of precision gages on the market today, but only three are used to any extent. These are the sphere, as exemplified by the steel ball; the cylinder, as seen in the plug gage; and the two planes, parallel and accurately separated, as exemplified in the solid "size blocks."

The ball is of little value because of its limited possibility of application. It is also practically impossible to manufacture a sphere to the degree of precision desired, and, still further, there is the extremely short life of the ball. The area of contact between a sphere and a plane surface is, of course, so small as to concentrate the wear and to tend to produce a flat surface on the ball each time it is used. In a short time the accuracy of the ball, and hence its value as a reference standard, is gone.

In the case of the plug, or cylinder, the objections are not as well founded as with the ball, because the contact is a line instead of a point. There is the same difficulty of manufacture, only in a lesser degree. It seems that plug gages will serve their greatest purpose in the inspection of holes instead of as masters.

The blocks having two parallel planes, as used in 90 per cent of the shops which have master reference sets, present one of the prettiest problems which has been put up to the gage maker. It is a simple matter to make one surface flat, but when there is required another plane surface not only parallel to the first but a pre-determined distance from the first there arises a real problem. It can only be done between two laps which are, in turn, held parallel and the desired distance apart. And,

if the laps are in a horizontal position and the weight of the top lap is appreciable, it will probably be found that the surface characteristics include a "running" off at the edges. The writer has made some experiments along this line and has found that the flatness of the surface can be improved by light rubbing on a very slightly convex hand lap after the gage comes from the machine.

The flat surface, then, may be accepted as offering the greatest value. Such gages are made with various sections. Some are round, some oblong, some a full square and still others a hollow square.

Effect of Size on Accuracy

All have their peculiarities, and curiously enough the peculiarities and inaccuracies seem to be governed by size rather than by shape. For instance, take the familiar oblong gage. The writer measured many of them, and in nearly all cases the gages marked a certain dimension have been found to show the same error, although of different shapes or from different makers. Three-inch gages run long. Some of them are as much as 0.00009 oversize, and 80 per cent of them are from 0.00005 to 0.00007 long. Two- and four-inch gages usually show about 0.000015 and 0.00004 oversize respectively. One-inch gages run nearly correct, but those just under this size seem to run long. This is true of all makes in so far as they have at present been investigated.

It would appear from the above that there is still room for development in the case of the longer sizes. The square gage with a hole at the intersection of the two diagonals seems to have one or two good points not possessed by the others. The hole permits more free circulation of the quenching medium in heat treatment, which may tend toward more uniform structure. The hole also permits facile clamping into stacks. It does not insure however, the absolute alignment which is imperative when the gages are used in connection with the "half-plug" attachments which are provided for measuring holes. If the axes of these two plugs, which are at opposite ends of the stack, are not parallel the accuracy of the stack is destroyed and the setting is of little value. Some shops have made a channel which just permits the gages to enter, for use in assembling stacks with attachments. With this trough, or channel, a very satisfactory setting may be made.

Material for Gages

In making up stacks for use the maker's marking is perforce depended upon for the size of the stack. If any one gage has become worn from use the stack may be small. If the gages have "grown" as a result of incomplete "aging" the stack will be large. And so the selection of material is important for several reasons. First, it must have high wear-resisting qualities; second, it must be susceptible to accelerated seasoning or aging processes; third, it must in its hardened state have high rust-resisting qualities. In view of the fact that all makers of gages in the "precision" category have settled upon an alloy having 1.35 per cent chromium and 1.0 per cent carbon it seems probable that this material offers the nearest ideal raw material. The treatment varies greatly, however. Gages may be found which show only 80 on a scleroscope, while others show 97. The writer has seen gages considerably large, although they had at one time been correct, with a scleroscope reading of 82; and he has seen one gage which showed 96 scleroscope and which had not changed in size over a period of fifteen months. From this it would appear that the aging process seems to affect hard gages more permanently than the softer ones.

The alloy of 1.25 to 1.50 per cent chromium with about 1.00 per cent carbon gives excellent results as to hardness, wear-resisting qualities and rust resistance. It also shows permanence of size and shape when properly normalized and hardened, provided the strains are relieved after hardening by a series of "draws" at varying temperatures. Some makers use a low carbon steel for gages and harden after carbonizing to shallow depths. Results are often satisfactory when the gages are symmetrical in shape.

In a cube or sphere or cylinder there will be little change in shape when properly treated, while with thin flat gages there will be found after a very few days a noticeable convexity on the sides of largest area.

Assembling Gage Blocks

The assembly of sets or combinations is far too little understood. They are usually "wrung" together, and it is commonly supposed that gages which will wring are perfectly flat, and their accuracy is frequently taken for granted. As a matter of fact a lapped surface of the commonest size in use (9 x 30 mm.) may be as much as 0.000015 in. concave or convex and still wring to another one 0.00001 in. in error in the same form, i.e., both convex or both concave. The mere fact that two surfaces may be made to wring together does not prove that they are flat.

Gages which are to be built up into a combination for checking other gages should be carefully cleaned. The hand, or cloth, or waste, should not be used. They should be washed on the lapped surfaces by lightly drawing them across a piece of paper toweling on which has been poured a few drops of naphtha, benzol or grain alcohol, and then at once drawn for an inch or so over a clean, dry piece of the same material. Newspaper and cotton batting are usable substitutes but are not as good as toweling fresh from the carton or roll.

After the gages have been washed a warm breath should be blown on the two surfaces to be wrung together, and a slight sliding motion given them. As the motion alternately covers and exposes the surfaces the thin film of moisture evaporates and the gages will suddenly "seize," just as though stuck together. They are now "wrung" and may be depended upon to be within 0.000003 in. of actual contact. In many cases they will be much closer, but if more than that they will not seize when properly cleaned. Alcohol instead of the breath will also cause them to wring closely, but is not recommended because of a tendency to cause a discoloration much like rust.

Handling Gages in "Stack"

After a number of gages have been wrung together to form a "stack" they should be left on a surface plate or other iron or steel plate for at least ten minutes in order to allow the temperature to return to normal, or approximately so. They will grow larger while handling, about 0.000006 in. per in. per degree rise in temperature, and if three or four are wrung the change will often be several degrees. In some shops all precision gages are handled only with gloves.

The manufacture of gages of this kind is not entirely a manufacturing problem. One of equal interest is the

measuring in such minute quantities as 0.00001 and less. There are, briefly, only two methods of measurement. The most common is that of direct reading from a scale, screw, rack, lever, or wedge. The other, by comparison of work with a reference gage of known size. In speaking of them they will be called "direct" or "original" and "comparative" methods.

Accuracy of Instruments and Skill of Operator

The success or reliability of the direct method depends upon two elements—the accuracy of the measuring engine and the skill of the operator. With some of the better known types of measuring machine it is possible for an expert operator to determine a dimension with as small an error as 0.00001, or, in other words, he can repeat his observation within 0.00002.

When a measuring machine is being used continuously there are many changes taking place. The body temperature of the operator, who necessarily stands in close proximity to the machine, has a more or less marked effect on the machine itself. The temperature changes in the machine are greater on the side near the operator, and of course the elongation of that side due to the higher temperature throws the headstock or measuring head out of alignment with the footstock. Most of these machines depend upon a "drop plug" held between two flat faces for a telltale device. Unless the plug is perfectly cylindrical and the two retaining faces plane and parallel, conditions are not identical through a series of measurements. Obviously the results will not be reliable. The contacting anvils must be plane and parallel, a condition rather difficult to obtain when temperature changes are disturbing alignment; the screw error must be constant throughout its length if the compensator is to correct it properly; and all oil films in the operating portion of the machine must be of constant thickness. The graduations on the dial or scale must be correct and the observer must be highly skilled.

The "Comparative" Method

There remains the "comparative" method of measuring. All of the makers of precision gages are using some method of comparison for their final calibrations. This is proved by the uniform error in gages of the same ostensible size. Among the most common devices of mechanical nature are the dial indicator, the fluid gage, and the various indicators which employ the lever, either simple or compound. Any of these will show a half thousandth, and at least one is graduated to show ten-thousandths, or less by estimation. In none of them is there the rigidity needed for measurements to 0.00001 in. or less.

Still another plan, and perhaps the most accurate of all, employs a phenomenon discovered by Newton in the seventeenth century, the "Newton Rings." These rings are alternate bands of different spectral colors which become apparent to the eye when a transparent surface is brought within 0.0002 in. (approximately) of another surface of the same shape. These bands are due to the interference of light waves and when the two surfaces are plane the bands are uniformly straight and parallel. If one of the surfaces is plane the bands will indicate with precision the shape of the other surface.

In employing this method the only equipment necessary is a plane surface to which the reference gage and the work may be wrung, and a transparent plane. The two gages are placed side by side on the plane, and the rings or bands are produced by the transparent plane. Any difference in size becomes at once apparent by the irregularity of the bands across the two surfaces of the gages.

The fact that two gages are exactly the same size may be determined in a very short time by this method, but the accuracy of a quantitative measurement of the difference between two which are not alike may perhaps be questioned, unless a light from a source which has a known wave length is employed. Inasmuch as scientists do not agree on the wave-length measurements of various lights there is much research to be made before the optical or interference-fringe method will be of great value, except for actually identical gages. A peculiar sidelight on the above comes from the fact that purely monochromatic light is a rara avis. And, when two or more colors are combined in a light ray there are varying wave lengths in the same ray.

The objections to this method of measuring are: The difficulty of securing contact between the gages and the base plane; the practice necessary to enable the proper interpretation of the fringes or bands; the difficulty of securing transparent planes; and the inaccurate knowledge of the wave length of the light ray used. The writer has made many comparisons by this method and, while it is possible to repeat a measurement within 0.000005 in. (half a hundred thousandth), it is safe to say that figures purporting to be closer than that are largely guess work.

For ordinary work the measuring machine may be relied upon for original measurements to 0.00003. For accuracy from 0.00002 to 0.00003 in. the amplifying gage or indicator may be used. For measurements to 0.000005 in. the optical or interference-fringe plan seems to offer the only solution.

France Rapidly Developing "White Coal" Resources

Development of her water power under plans now being carried out will make France third among the nations who lead in this respect.

The report of the Commission des Forces Hydraulique shows that in round figures the water power (colloquially known as "white coal") in France may be reckened theoretically at about 9,000,000 horsepower. Of this amount 1,165,000 hp. is in use and about 500,000 hp. additional is being equipped.

In about fifteen years 6,000,000 hp. more should be realized. The rest remains available for eventual development. The 1,165,000 hp. now installed is capable of 850.000 kilowatts. In 1919 it furnished effectively 700,000 hp. (570,000 kw.). The plants in course of construction provide an additional 550,000 hp. (365,000 kw.).

The region of the southeast of France is the best developed thus far, with 750,000 hp. already installed, and with 290,000 hp. in the course of installation. The southwest has 210,000 hp. and will have 75,000 more in a short time. The central section has 140,000 hp. and is making plans for an additional 125,000 hp. The eastern district expects to increase its 25,000 to 35,000.

Existing plans are to provide the 3,000,000 hp. additional of the program inside the fifteen years. Of this total 1,200,000 hp. will be in the southeast, 500,000 in the southwest, 40,000 in the center and 62,000 in the east.

The Design of Square and Acme Thread Taps of Steep Lead

By E. A. DIXIE

The quicker the lead of a thread, the greater is the necessity for fluting the tap so that the cutting faces will be at an angle of 90 deg. to the helix angle of the thread. Otherwise one side of the cutting face will present an obtuse angle.

IN FIG. 1 is shown a set of four taps $\frac{1}{3}$ in. pitch and 1 in. lead by 1 in. outside diameter, that were intended to tap a thread in the machine steel piece *A*, which in the illustration is shown cut in half after No. 1 tap stuck in it so tight that the square was twisted off the shank. This tap broke when it had been entered about one inch.

A glance at the illustration will show what was the matter. One side of the thread had a sharp cutting edge at an acute angle while the other side was at an angle of about 110 to 115 deg. and tore instead of cut the metal. With this class of tap the flutes should always be helical so that both edges of the thread have the same cutting clearance. Even with helical flutes it is difficult to cut clean threads with the acme or square shape of thread unless one makes the leading tap start with some variation of the V-thread and gradually change to the form desired, be it acme or square.

In Fig. 2 is shown what is meant. At *A* the tap is started with a V or U.S.S. thread, narrow in width and shallow in depth but gradually deepening and widening till the predetermined point *B* is reached. The square thread can begin at *B* either as a shallow thread which gradually deepens toward *C* or if the V-thread has been cut to full depth it can start as a narrow thread of full depth at *B* and gradually widen as it approaches *C* or it can start as a narrow and shallow thread at *B* and gradually both widen and deepen as it approaches *C*. I have seen satisfactory taps made in all three ways.

There are at least two ways in which the lathe can be set up for cutting the thread on this kind of a tap. Change gears in some cases may be available to produce

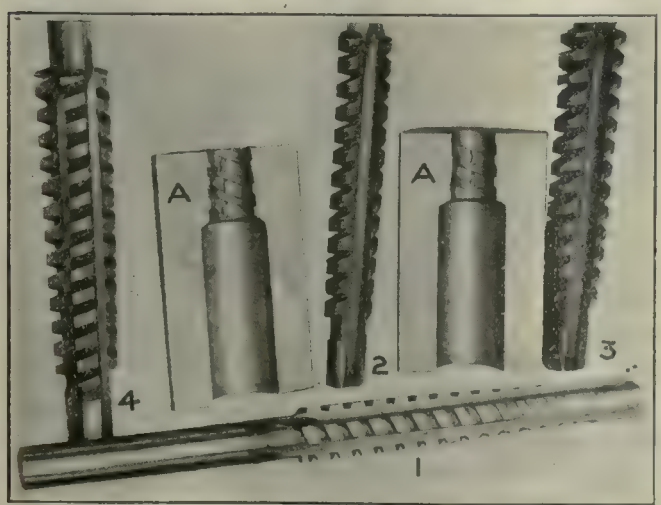


FIG. 1. SET OF IMPROPERLY MADE ACME THREAD TAPS AND THE WORK

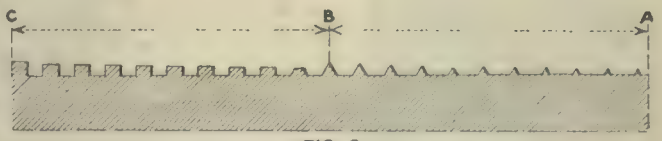


FIG. 2
Square Thread Tap with V Thread Leader

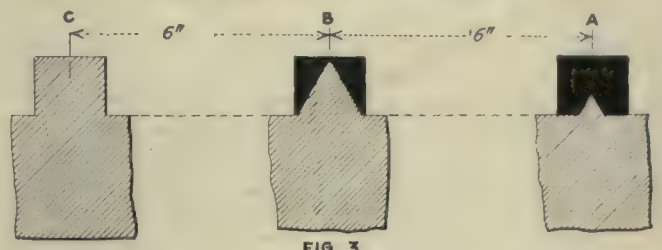


FIG. 3

FIG. 2. DIAGRAM OF SQUARE THREAD TAP WITH V-THREAD LEADER. FIG. 3. DIAGRAM SHOWING CHANGE OF FORM AND STOCK REMOVED

the gradual change in the width of the base of the V-thread or a combination of the taper attachment and the set over on the tailstock used to produce the same result. The change in shape on the square or acme shape of thread can be best obtained with either the taper attachment alone for the acme shape of thread or a combination of the taper attachment and the tailstock set over for the square thread.

When making taps of this type the writer has been accustomed to thread them at the start just as though they were ordinary square or acme taps. Where they were in sets, as those shown in Fig. 1, all the taps of the set were first made with either the square or acme form of thread from end to end. It was then decided just what length V or U.S.S. thread should be required for the leader. Let us assume that there are a certain even number of threads in a certain length, as for instance 12 in. as shown between *A* and *C* in Fig. 3, and that we have decided to make the V-threaded leader 6 in. long from its start as a very small thread at *A* till it reaches full size as shown at *B*. The black portions at *A* and *B* show the amount of metal that has to be removed from the original square threaded No. 1 tap. Obviously if we left the setting of the work parallel with the ways of the lathe and used the same change gearing we would cut the same shape and size of thread on *B* as we start to cut on *A*. But we want a wider and deeper thread at *B* than we want at *A* and the only way to obtain it is by changing the lead which the lathe is to cut so that we may be able to start a cut in the middle of thread *A* and gradually recede toward the right way from the center of the thread which has already been cut until when we reach the thread *B* we have receded so much from the center of the thread that one-half of a large V-thread occupies the space between the threading tool and the center thread *B*. This change in lead can be readily obtained either by correct change gears, if we have them, or by setting over both the tailstock and the taper attachment or by a combination of both. This phase of thread cutting has been covered so often in the pages of the *American*

Machinist and is so well understood that it is not necessary to repeat.

The diagram, Fig. 4, shows the gradually decreasing cut of the tool *X* as it advances from the starting thread *A* and approaches the thread *B* which is the termination

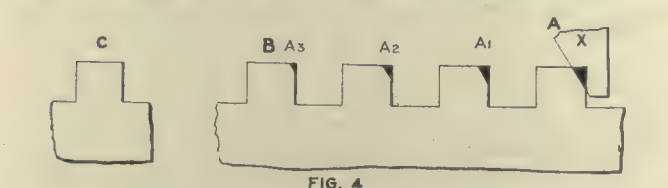


FIG. 4



FIG. 5



FIG. 6

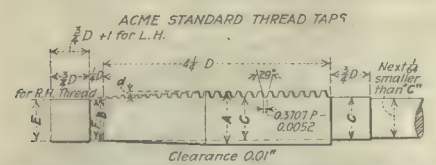
FIG. 4. SHOWING METHOD OF REMOVING STOCK FROM THE SQUARE THREAD TO TRANSFORM IT INTO A V-THREAD. FIGS. 5 AND 6. TRANSFORMATIONS FROM V-FORM OF THREAD TO SQUARE FORM OF THE FINAL TAP

of the V-threaded portion of the tap. After both sides of the square thread from *A* to *B* have been turned to the desired V, that part of the tap can be considered finished as far as threading is concerned.

The square or acme portion of the thread can then be formed beginning at the next thread beyond *B* either to the shape shown in Fig. 5, where the same method and tool is used as in Fig. 3 with the results that the V-shape of thread at *B*, Fig. 3, is gradually widened until it becomes either a perfect square or acme thread; or a square-nosed tool can be used as in Fig. 6 and the taper attachment used so that the square or acme shape of thread starts at the thread beyond *B*, Fig. 3, as a very shallow thread and gradually grows deeper from thread to thread until the full depth is reached a few threads before the end of the last thread on the final tap is reached.

It is a matter of individual taste which of these methods is preferable; to the writer's mind one is just as good as the other. In either case the full depth and width of thread left by the V-portion of the tap when run into the work will afford considerable chip space over and above that provided for by the flutes of the tap.

In Fig. 7 are given the details for making Acme standard taps. It will be noted that a variation of the method just described is used for forming the leaders of these taps. For single thread taps this method is all right but for multiple threads the other is better.



Tang, of Angle of Lead = $\frac{LEAD}{(D-\frac{P}{2})\times 3.14}$
D = Diam. of Screw
P = Pitch = $\frac{1}{\text{No. of Threads per Inch}}$
H = Diam. of Tap Drill = D - P

Nick teeth of first tap as shown, making nicks .005" deep and approximately 0.25 pitch wide disappearing on last tooth of taper. Use for nicking U. S. Standard Thread Tool.

	A	B	C	Tangent a Use same taper from diam F to diameter C	E	F
1st Tap	D-($\frac{1}{8}$P-0.0075)	D-(P+0.005) or H-0.005	D-(P+0.04)	$\frac{P+0.0333}{20\,D}$ or $\frac{A_1-B_1}{75\,D}$	D-(P+0.002)	D-(P+0.04)
2nd Tap	D-($\frac{2}{8}$P-0.0125)	D-($\frac{2}{8}$P-0.0025) or A_1-0.005	" "	" "	" "	" "
3rd Tap	D-($\frac{3}{8}$P-0.0175)	D-($\frac{3}{8}$P-0.0075) or A_2-0.005	" "	" "	" "	" "
4th Tap	D+0.02	D-($\frac{4}{8}$P-0.0125) or A_3-0.005	D-(P+0.02)	" "	" "	" "

FIG. 7. TABLE OF DIMENSIONS OF ACME STANDARD TAPS

A Comparative Test for High-Speed Steels

By Frank A. Hurst,
Works Manager, Samuel Osborn & Co., Sheffield, England

I have read with considerable interest the four articles under the above title by H. J. Langhammer which appeared in Vol. 52, pages 979, 1140, 1227 and 1292 of the *American Machinst.* There are, however, a few points which, from one connected with a firm that has been testing tungsten tool steels for the last 50 years, may be of interest to your readers.

I quite appreciate the fact that for tests, as carried out by Mr. Langhammer, there must be standard conditions, but experience has shown the manufacturer of high-speed steel that in his testing there must be one very large variable, namely the material upon which the steel is tested. All Mr. Langhammer's tests were carried out on the same kind of material, whereas, in manufacturing tool steel for the general trade it is necessary to select, not the particular composition that will give the best results on one material only, but one that will give the best all around results on the various materials used in every machine shop.

My experience at the works with which I am connected (maker of Mushet tool steel) is that in order to produce a steel that will give the greatest general satisfaction, it is necessary in deciding on the formula for the mixture, to make cutting tests on steels having a carbon content of 0.30, 0.60 and 0.90 per cent. Also on both hard and soft cast iron.

My decision as to the composition of the steel to supply to the general public has always been for that composition producing a steel that will give the best general all-around results on the above mentioned five different materials.

From this you will see that it is quite possible for the adoption of Mr. Langhammer's system to cause the user not to select the best steel for his purposes, but one that is the best for only one variety of material.

Few manufacturers buy more than one grade of high-speed steel for work on different materials, but make tools from the same bar for cutting all kinds of steel and cast iron, therefore, the force of the above remarks will be apparent.

After careful examination of the analysis given by Mr. Langhammer as ideal, I would remark that providing some of the steels which he considers inferior have been properly made, there is no reason why they should not give first-class results as all-around machine-shop steels. I know of machine shops where the business is of such a class that the steel Mr. Langhammer considers the best, would not give the best results on the kind of material worked.

In testing tools I have always found it necessary for getting comparative results that in addition to careful grinding, all tools should be finished off with an India oilstone. Mr. Langhammer has not done this and its omission has had a marked effect on the results.

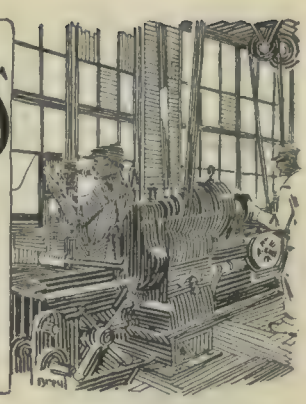
Further regarding the desired analysis mentioned in the articles referred to, the content of chromium stated gives too wide a range and its use in quantities between the maximum and minimum content specified would result in a different high-speed steel.

I would again say how interested I have been in the articles and how much Mr. Langhammer is to be congratulated on the carrying out of his tests.



MODERN PRODUCTION METHODS

By
W P. Basset
of
Miller, Franklin, Basset & Co



WE SAW in the preceding article how current expenditures were started on their way into the finished product through the charge register. There are other charges which make up part of the cost of the product but which are paid either in lump sums or do not entail any cash expenditure whatever. They are the fixed charges, so called because they do not fluctuate appreciably with the activity of the plant.

Taxes and insurance are paid usually once a year, although sometimes only once in two or three years, and yet each unit of output must bear its proper share of these expenses. Depreciation on buildings and equipment is solely a book entry and yet a part of it must be gotten back in the selling price of the product in order that sooner or later the existing buildings and equipment may be replaced. All of these fixed charges are first charged to the various departments of the plant and from there into the product which passes through each department. In a later article we shall describe the principles which underlie the proper departmentalizing of the plant. It is simply mentioned here in passing so that it may be definitely understood that the plant *is* divided into departments.

XII. Fixed Charges

What to do with fixed charges has been a perplexing question for many a shop executive. Here the author tells what expenses constitute fixed charges and explains how to allot to each department its fair share of the total.

(Part XI appeared in the Oct. 28 issue.)

Taxes and insurance admittedly fluctuate somewhat from year to year, but sufficient accuracy can be obtained by carrying into the costs a figure based upon the amount of these two items for previous years. A charge is therefore made to each department on a monthly basis.

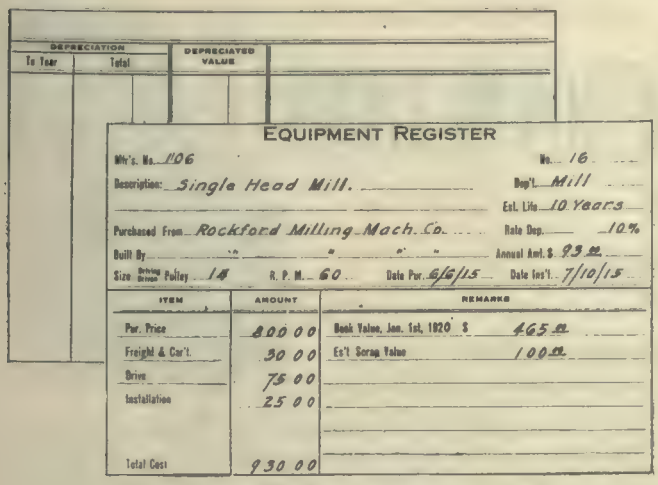
Serious errors may creep into the final costs of the product through incorrect charging of depreciation. It is not uncommon to find concerns which split hairs in an attempt to get labor and material charges correctly apportioned to the various types of product and who then allow their emotions to govern the amount of depreciation charged. The amount of depreciation for any year, in fact, whether any depreciation shall be charged or not, is too often determined by the statement of net profits. In good years an excessively heavy depreciation may be charged; in poor years, none at all. One of the benign results of the Federal Income Tax has been that it forces manufacturers to be consistent in their handling of depreciation.

Conceivably, there are three methods by which the values of buildings and equipment might be figured, the forced sale value, the operating worth, and the cost of replacement. Many a long-winded discussion has taken place as to which of the three was proper. Fortunately, the Treasury Department has given us a ruling which takes this question out of the realm of argument. Buildings and equipment acquired since March 1, 1913, shall be depreciated on their cost. Equipment and buildings acquired prior to March 1, 1913, shall be depreciated on their fair value as of that date.

Another question which has caused a great deal of discussion is the rate of depreciation to be used. The principal cause of disagreement has come from an attempt to use a blanket rate to cover all of the buildings and equipment of a plant. A little clear thought should show that this is ridiculous. The type of construction of the building settles the rate at which it should be depreciated. To be exact, this requires the opinion of a capable engineer. A fair average, however, for the type of buildings ordinarily used by machine shops is 3½ per cent per year. Each machine should be studied in order to arrive at the correct rate of depreciation for it. Mere length of life is not the sole test. Possibility of obsolescence must also be considered. For instance, it is generally true that a drop hammer takes a slightly higher rate of depreciation than a drill press. An automatic machine, however, will have a much higher rate than either of the others, not due so much to greater wear and tear on the automatic as to the fact that new ideas in automatic machinery are being developed rapidly and there is much greater chance of the automatic becoming obsolete.

Because it is desirable to determine the depreciation for each individual item, it is well to record all equipment on some form of record. This may be either a book with a page for each machine and building or a card record. In Fig. 58 is shown a card form of equipment register which has been found to be simple to keep and effective. The sum of the total costs shown by all the cards should of course agree with the total of the asset account on the general ledger of the group to which it belongs.

For the shop which we are considering, the depreciation on machinery figures out to $27,389.12; for jigs, tools and fixtures, $14,129.82; for automobiles, $1,815.10; for the office, $12,000. The total depreciation on the buildings at the rate of 3½ per cent a year gives a money value of $15,833.69.



DEPRECIATION — To Year / Total — DEPRECIATED VALUE

EQUIPMENT REGISTER

Mfr's. No. 106 — No. 16

Description: Single Head Mill. — Dep't. Mill

Est. Life 10 Years

Purchased From Rockford Milling Mach. Co. — Rate Dep. 10%

Built By — Annual Amt. $ 93.00

Size Driving Pulley 14 — R. P. M. 60 — Date Pur. 6/6/15 — Date Ins'l. 7/10/15

ITEM	AMOUNT
Pur. Price	800 00
Freight & Car't.	30 00
Drive	75 00
Installation	25 00
Total Cost	930 00

REMARKS

Book Value, Jan. 1st, 1920 $ 465.00

Est'l Scrap Value 100.00

FIG. 58. EQUIPMENT REGISTER CARD

Let us say that the taxes, not including the Federal Income Tax, amount to $2,200; the insurance to $3,000, giving a total yearly fixed charge, including depreciation, of $65,567.73.

Each month we must charge into our expense of doing business one-twelfth of the total of this fixed charge. We now want to determine how this monthly charge of $5,463.97 finds its way into the product. This cannot be done correctly by spreading it over the entire output.

Apportioning of Fixed Charges

So that each department and, ultimately, each unit of output will carry its correct share of these fixed charges, we set up the fixed charge sheet, Fig. 59. Since our entire business is divided into departments, it is apparent that the fixed charges for buildings and machinery can be distributed among all departments. The fixed charges dependent upon the machinery in any department can be measured by the ratio which the value of the machinery in any department bears to the total value of machinery in the plant. The fixed charges on the building itself can most fairly be distributed to each department in the ratio which the floor space occupied by the department bears to the total floor space of the plant.

We therefore set up Fig. 59 in two parts. At the left is a list of the various departments of the plant. Immediately to the right of this column is the calculation for each item of fixed charge which is a charge on the building and may therefore be distributed on the square-foot basis. The next section of the fixed charge sheet comprises the calculations of the various items of fixed charges caused by the equipment and which is distributed in the ratio which the equipment in a department bears to the total equipment of the plant.

This makes it necessary to determine how much of our taxes, insurance and depreciation is incurred because of the buildings and how much because of the equipment. Equipment, we may say, includes not only machinery but jigs, tools, fixtures and furniture.

The plant register of which we have already spoken, shows a total valuation of buildings and equipment of $822,823.66, of which $452,391.67 is the value of the buildings. This is approximately 55 per cent of the total value. Now, the total taxes on the entire business were $2,200. Therefore, 55 per cent of it, or $1,221, are taxes on the buildings, and $979 on the equipment. Of the $3,000 insurance, we find in a similar way that 55 per cent or $1,650 is insurance on buildings and the rest, $1,350, is insurance on equipment. It should be apparent that distributing these two items of the fixed charge on the basis of value is entirely logical for both taxes and insurance depend upon value.

FIXED CHARGE SHEET

DEPARTMENTS	DISTRIBUTED ON FLOOR SPACE OCCUPIED: FLOOR SPACE OCCUPIED	PER CENT FLOOR SPACE TO TOTAL	BUILDING VALUE	DEPRECIATION	TAXES	INSURANCE	DISTRIBUTED ON MACHINE VALUE: MACHINERY VALUES	PER CENT DEPARTMENT VALUE TO TOTAL VALUE	DEPRECIATION	TAXES	INSURANCE	TOTALS: DEPRECIATION	TAXES	INSURANCE	GRAND TOTAL	MONTHLY CHARGE: DEPRECIATION	TAXES	INSURANCE	TOTAL
Boiler	3600 00	2 40	10858 00	380 01	29 30	39 60	17500 22	3 37	1179 80	32 09	45 50	659 81	62 29	85 10	1707 20	129 99	5 19	7 09	142 27
Power	5400 00	3 60	16282 50	570 01	43 96	59 40	17129 00	4 62	1589 12	45 23	62 37	2159 13	89 19	121 77	2370 09	179 93	7 43	10 14	197 50
Office	4560 00	3 04	13749 67	481 36	37 12	50 01	12189 19	3 29	1200 00	32 21	44 47	1681 34	69 33	94 48	1845 10	140 11	5 77	7 87	153 75
Tool Room	7200 00	4 80	21710 00	760 02	58 61	79 35	18001 12	4 86	2563 84	47 58	65 61	3323 86	106 19	144 96	3575 01	276 98	8 65	12 28	297 91
General Factory	13890 00	9 26	41905 53	1466 35	113 06	152 79	45179 00	12 19	4721 13	119 44	164 53	6187 48	232 40	317 32	6737 20	515 63	19 40	26 45	561 48
Automatic	17850 00	11 90	53834 60	1884 21	145 30	196 35	67478 06	18 21	8777 45	178 28	245 84	10661 66	323 58	442 19	11427 43	888 43	26 96	36 85	952 24
Milling	3000 00	2 00	9047 85	316 67	24 42	33 00	37128 19	10 04	3951 60	98 39	135 54	4268 27	122 81	168 54	4559 62	355 69	10 23	14 05	379 97
Lathe	23400 00	15 60	70573 10	2470 01	190 46	257 40	87192 00	23 55	9102 30	231 36	317 93	11572 31	421 84	575 33	12569 48	964 36	35 15	47 96	1047 47
Planer	9000 00	6 00	27143 50	950 02	73 26	99 00	35529 00	9 59	3629 10	93 87	129 47	4579 12	167 13	228 47	4974 72	381 59	13 93	19 04	414 56
Polishing	3000 00	2 00	9047 85	316 67	24 42	33 00	2725 81	75	296 80	7 25	9 85	613 47	31 67	42 85	687 99	51 12	2 64	3 57	57 33
Hardening	18000 00	12 00	54287 00	1900 00	146 52	198 00	14120 32	3 81	4128 00	36 30	51 44	6028 00	182 82	249 44	6460 26	502 33	15 25	20 79	538 35
Assembling	29000 00	18 00	81430 50	2850 01	219 78	297 00	9885 00	2 67	1052 00	26 14	36 05	3902 01	245 92	333 05	4480 98	325 17	20 49	27 75	373 41
Shipping	12000 00	8 00	36191 13	1266 70	97 68	132 00	11375 00	3 07	2342 90	30 06	41 45	3609 60	127 74	173 45	3910 79	300 60	10 64	14 45	325 69
Selling	2100 00	1 40	6333 48	221 67	17 09	23 10						221 67	17 09	23 10	261 86	18 47	1 42	1 93	21 82
TOTAL	150000 00	100 00	452391 67	15833 69	1221 00	1650 00	370431 99	100 00	45534 04	979 00	1350 00	60367 73	2200 00	3000 00	65567 73	5030 64	183 33	250 00	5463 97

FIG. 59. FIXED CHARGE SHEET

TOTAL CHARGE			MONTHLY CHARGE (Basis Journal Entry)		
Mach. Dept.	45534 04		Mach. Dept.	3711 17	
Bldg. Dept.	15833 69		Bldg. Dept.	1319 47	
Total Dept.		60367 73	Mfg. Exp.		5030 64
Mach. Taxes	979 00		Mach. Dept.	81 58	
Bldg. Taxes	1221 00		Bldg. Dept.	101 75	
Total Taxes		2200 00	Mfg. Exp.		183 33
Mach. Ins.	1350 00		Mach. Dept.	112 50	
Bldg. Ins.	1650 00		Bldg. Dept.	137 50	
Total Ins.		3000 00	Mfg. Exp.		250 00
TOTAL		65567 73			5463 97

We must now divide the fixed charges of the buildings which we have just determined in lump sums among the various departments. The sums we have arrived at are therefore entered at the foot of the columns under building depreciation, building taxes and building insurance. These, as we have seen, are to be divided among the various departments in the ratio which the departmental area bears to the total area of the plant. This is obviously done by measuring the area of the departments, either in the plant itself or on a scale drawing if that is available. At this point, it is well to bring in a check on the accuracy of the figures and see that the sum of the departmental areas as measured equals the total area of the plant.

We have now distributed the fixed charges on the buildings to the various departments. The next step is to distribute those charges which are incurred on the equipment. We have seen that the logical way to make this distribution of insurance and taxes is on the basis of the amount of equipment in each department. We therefore add up all of the equipment listed on the plant register in order to get the total for the plant. For the shop which we are considering, the total of this amount is $370,431.99. We now determine the exact amount of equipment in each department and calculate what per cent of the total equipment each department contains. In the case of the office, for instance, we find that it contains $12,189.19 worth of equipment which is 3.29 per cent of the total.

This department will therefore bear 3.29 per cent of the total fixed charges on equipment, which will amount to $32.21 for taxes and $44.42 for insurance.

The depreciation on equipment is calculated from the Equipment Register cards. As the rate for departments and even different machines in a department will vary, the final figure for each department is the aggregate of the individual figures shown on the register cards. The total equipment depreciation for the plant is, therefore, the sum of the individual depreciation figures, instead of, as in the case of taxes and insurance, being a known total divided upon a percentage basis.

In the lower right-hand corner of the fixed charge sheet we gather together the total depreciation, total taxes and total insurance on a monthly basis in order to prove that we are absorbing, each month, into our departmental expense, the amounts which have been set up on the fixed charge sheet. This also serves as a memorandum on which the cost department makes up the proper journal entries which they give each month to the accounting department.

In practice, it is well to revise the fixed charge sheet about every six months so as to be able to make proper corrections for equipment which has been transferred from department to department and to take care of the installation of new machinery. This is made easy when a plant equipment record, such as has been mentioned, is used. Care put on keeping the plant equipment record up to date will be very well repaid in arriving at actual cost figures. Sometimes, of course, no changes in equipment have been made, in which event it is unnecessary to revise the fixed charge sheet.

Automotive Engineering Standardization and Progress

By COKER F. CLARKSON
General Manager, Society of Automotive Engineers

STANDARDIZATION is the codification of the best consensus of opinion as to what should be specified for those items of materials and dimensions which it is clear can be reduced advantageously to common practice. The purpose is, of course, to improve the conditions of manufacture and operation. The draftsman's time is saved and made more efficient. There is established a very helpful *esprit de corps* as to what can and shoud be done in the way of standardization. The stocking of materials and many component parts of subassemblies becomes possible, time being again saved. The product is improved in quality both as a whole and in detail. Price always tends to become relatively less. The user can maintain the apparatus he has bought more economically as to time and in a pecuniary way. He gains increased knowledge of and confidence in the manufacturer's product by finding therein detail features of construction which are generally known and accepted as good. This is akin to one of the most potent principles of advertising; a feeling of plausibility and propriety is engendered through the effect of general publicity. Common knowledge of this sort is beneficial in all effective commercial operations.

The world would be in a more deplorable state if it did not have a great mass of what are standards in varying degree, although these are not generally appreciated to be standards in the sense that we are considering them. Among such standards are sizes of wearing apparel and of numberless other commodities that readily come to mind. These are not necessarily standards of a high degree of accuracy, such as standards of units of measurement, time and quantity.

One troublesome misconception of the standards we are discussing is that they are mandatory. Another is that they are manifestos of finality like standards of weight or measure. An automotive engineering standard is a thing that is considered, by men well qualified to judge, good or best for the great bulk of the manufacture in our field, in order to facilitate quantity production in the way I have indicated. The Society of Automotive Engineers has no way of enforcing the use of its standards except in so far as their merit is weighty. This is as it should be, and for a like reason the S. A. E. standards work has been successful. It has been demonstrated over a period of years that most of the standards can be reduced to practice by the great majority of manufacturers with marked benefit to themselves, as well as their customers, in fact in all cases where the production is not really special, inherently, or on account of large substantially identical previous production not incorporating the currently desirable standards. The latter condition is almost inevitably a matter of the relative importance of the past and the future to the manufacturer.

*Address at National Gas Engine Association Meeting.

The Society of Automotive Engineers is not commercial in the sense that it can enforce its standards in an arbitrary way. It is commercial in the sense that its standards are of commercial value. The society can conduct its activities on a somewhat broader and less partisan basis than a commercial organization can. A commercial organization of manufacturers, proceeding as such, without giving effect to engineering questions as such, cannot on account of sales competitive reasons get as good results in the formulation of engineering standards as an organization like the S. A. E. can. In more than one instance the society has established standards that have gone into general practice, after the representatives of the manufacturers directly concerned working together, or failing to work together, had been unable to establish them.

Standards should, of course, be canceled or revised when necessary. They should not obviously be promulgated originally unless there is sufficient evidence to assure their holding good for a properly long period of time. But the whole system should be conducted flexibly and not inflexibly.

The more or less chronic stock argument against standardization is that it impedes individual and engineering progress. This is the sort of argument that is legion and perennial in almost every field of endeavor. I believe that no fair-minded man would say that standardization had impeded the progress of the automobile industry. There is every evidence that it has been one of the main reasons for the quantity production in this field, facilitating purchase of materials, improving quality and decreasing cost of maintenance. Quantity production is clearly not possible without a great degree of standardization of some kind, and the standardization the S. A. E. has fostered has surely been most advantageous to the great majority of manufacturers and users in the automotive field. There is a very material saving in the manufacturing cost per car. Screws, taps, dies, spark-plugs, steels and many other materials and parts can be bought at lower prices and for better delivery. The producing companies have saved a great deal of money in lowered materials costs and in lessened production complications. There is no doubt that the standards and recommended practices of the Society of Automotive Engineers have been of incalculable benefit to the automotive industry at large. The cost to the consumer of standard gages has been reduced greatly, compared to what it was when gages were made specially to meet customers' requirements. It is stated that 95 per cent of the lock-washers used in automobile fabrication and operation are S. A. E. standard. These are merely examples of a widespread condition as to S. A. E. standards and recommended practices.

A fundamental maxim of the S. A. E. has always been not to endorse or condemn any proprietary article, nor to endeavor to standardize any practice that would impede progress in design. As a class the standards consist of material and mounting-dimension specifications for those things that are essential in the present types of automotive apparatus. Incidentally it cannot be ignored that the greatest successes have been attained in those automotive fields in which the design of the articles produced has been most conventionalized, conspicuously in the automobile field. Much conventionalization is essential in great commercial success with apparatus individually operated by a large number of people in a mechanical way. The most advanced and efficient apparatus cannot necessarily be operated by the average user. The generally prevalent knowledge of the internal-combustion engine is a principal reason for the success of the vast amount of automotive apparatus in use. Intelligent standardization cannot check but can only assist such a condition. There is no trade advantage to any single company in not participating in the establishment and practice of rational standardization. Neither is there any advantage in the way of design.

In England, recently, there was designed a simple and inexpensive stationary engine for general purposes, such as dynamo driving and farm work, and at the same time to obtain the very high efficiency which had been attained thitherto only in very costly engines, such as those used for aircraft. It is stated that during a 100-hr. run developing 6 hp., at less than 750 r.p.m. governed speed, the fuel consumption was a little over ½ pt. per horsepower-hour, most engines of a similar size consuming ¾ pt. per horsepower-hour. It was figured that with this type of engine the money saving per year for fuel would be $65 per engine. The engine was single-cylinder 4 x 6 in. The oil consumed was 0.012 pt. per horsepower-hour. This performance is decidedly an example of appealing engineering progress. The work of the Society of Automotive Engineers in standardization, research and other respects, has been and is primarily such as to encourage such development, and not in the least to impede it. The whole purpose of the society is to bring about improvement in the entire automotive field, increasing the efficiency of engines and power transmitting devices.

The automotive world is one large growing family, both nationally and internationally, and is making every effort to further and make as effective as possible those phases of efficient production of automotive apparatus of great merit, in which the engineering fraternity takes such a deep interest and which are so essential to the nation industrially and economically. In worldwide trade it is obvious that the maintenance of standardization that will make possible the interchangeability of many materials, parts and accessories, is economically requisite.

Getting the Right Man Through the "Help Wanted" Columns

By A. W. Forbes

On page 611 of the *American Machinist* the article, "Putting Punch Into 'Help Wanted' Ads," appears to be only interested in the quantity of applicants. Quantity may be of interest to some; to others, quality is the only consideration. The big fault that I find with "Help Wanted" ads is the number of applicants it is necessary to meet in order to select one.

In talking with a factory manager, I showed one of the advertisements I was planning to use, and received the reply, "It makes no difference what you say in the advertisement. Anyone who is out of a job will apply anyway." Perhaps this was an exaggeration, but the results seemed to show that it was not.

The advertisement was a blind, but I received a good number of letters in reply. Of these not one showed that he had any of the qualifications called for; not one did I consider worth a reply.

The question I am interested in is not how to put punch into the advertisements. It is how to write the advertisements so that those who are not qualified will not apply.

A Worth-While Training Department

By L. C. MORROW
Assistant Managing Editor, *American Machinist*

Training departments, or vestibule schools, are contributing to the machine industry the greater portion of its skilled mechanics. To a marked extent the quality of the mechanic depends upon the instruction he receives. The worth-while training department told of here is part of a large machine-tool plant in Cincinnati. The department is two years old, its methods have proved to be practicable, and it is turning out efficient young men for the plant.

THE American Tool Works Co., Cincinnati, is operating a training department which parallels the "vestibule schools" of other plants. It was organized about two years ago for the immediate purpose of instructing the unskilled, whom the company found it necessary to take on for war work. However, the organizers established the school with a foresight of its present uses, which include the instruction of several groups, viz.: the specialized worker, who will operate a strictly production machine; the apprentice; the embryo salesman; the young draftsman; and high school and university co-operative students.



FIG. 1. THE TRAINING DEPARTMENT

The training department, shown in Fig. 1, is on the fifth, or top floor, thus obtaining the advantage of good light. There are allotted to it 1,500 sq.ft. of floor space, screened off from the remainder of the plant. Screening definitely bounds the working home of the student, and keeps away from him the merely curious, the too willing volunteer assistants, and the meddlers.

The equipment of the training department is representative of the plant. There are included one 14-in. x 6-ft. lathe, three 16-in. x 8-ft. lathes, two 28-in. shapers, one 24-in. planer, one 2-ft. radial drilling machine, one No. 2 universal milling machine, one speed lathe, one tool grinding machine, one arbor press, one bench grinding machine, three assembly benches and fourteen vises. It has been the policy to choose heavy machines, so that more than the run of small work usually allotted to a school can be handled.

There are two kinds of students—exclusive of those to be trained as salesmen and draftsmen—specialists and apprentices. The specialist is a student who is to go on a specialized job and stay there. He is given instruction only on the machine which he is to operate, or in the line of work he is to pursue. On the average, this work requires about two weeks of instruction.

The apprentice is a young man who has signed an agreement to learn the machinist's trade in the employ of the company, his apprenticeship to extend over a period of four years. The length of the initial stay of the apprentice in the training department is from one month to six weeks. The instruction received and the experience gained during this time fit him for machine-shop work in general and especially for the work of the first department to which he is to be sent. As often as he is changed from one department of the shop to another, he will be sent back to the training department for instruction in the new department. The course, therefore, permits the apprentice to be instructed on all machines and to work in all departments. Furthermore, it permits the spreading out of his instruction over a period of four years and the immediate application of the instruction for each division of work.

After a month's trial in the training department the apprentice receives a toolbox and tools as shown in Fig. 2. These tools he uses as long as he is an apprentice. They become his personal property upon comple-

tion of his apprenticeship. They, and the one hundred dollars paid him at the same time, set him right on his feet just as he begins to travel alone. This tool equipment means much to the boy who takes pride in tools and who has to use them. But it means much more to the boy who in addition is too poor to buy them. The following is a list of the tools included in the set:

1—Toolbox, No. 10 Pilloid, oak finish
1—¾-lb. ball peen hammer.
1—No. 72 Starret thickness gage
1—1-in. Slocomb micrometer
1—2-in. Slocomb micrometer
1—6-in. perfect handle screwdriver
1—9-in. perfect handle screwdriver
1—12-in. perfect handle screwdriver
1—6-in. No. 61 Starret try square
1—Center punch
1—3-in. outside spring caliper
1—3-in. inside spring caliper
1—6-in. outside spring caliper
1—6-in. inside spring caliper



FIG. 2. TOOLBOX AND TOOLS GIVEN TO APPRENTICE

1—6-in. hermaphrodite caliper
2—Starret jack screws, No. 190, with attachment
1—Parallel clamp, Starret, No. 161 C
1—12-in. combination square
1—8-in. Coes knife handle monkey wrench
3—Assorted pin punches
1—Pair 4-in. dividers
1—No. 67 Starret improved scriber
1—Adjustable hack saw frame
1—Surface gage
1—Depth gage
1—Screw pitch gage
1—Center gage
1—6-in. flexible scale
1—Set P & W micrometer standards, 0.2 in. to 2 in.

INSTRUCTION

The first day spent by the apprentice in the training department is devoted to the study of decimals, as it is found that the majority of them do not understand this important subject. How to read the micrometer is included in the lessons on decimals. Should half a day prove insufficient for this work, more time is devoted. Instruction in vise or machine work is begun immediately thereafter.

Vise work is taught partly by example. Two or three good mechanics do their regular work in the training department, acting as examples for the apprentices. It seems that this method is especially well suited for teaching vise work, as filing, scraping, hand tapping and fitting require a great deal of demonstration as well as practice. An assistant instructor, a competent mechanic, is in charge of the vise department. Such units as belt shifters, apron controls for motor driven lathes, lathe turrets and relieving attachments are assembled. Burring is the first operation attempted. It is followed by filing, fitting and assembling.

The first step in machine work is usually the hardest. In this school it consists of learning the machine—what it is for, how it is operated and how to oil it. About the third day the student is started on machining some simple part and from that on his advancement depends directly upon his ability. Each and every piece sent to the department is part of the run of work of the plant and is to be used in assembly. The simple pieces include collars, belt shifter parts and other pieces which require straight turning.

At this stage the student either goes on, drops out or is requested to drop out, as this has been determined by the instructor in charge to be the time at which the adaptability of the student has been tested.

Class instruction is given in shop work, but never in general educational subjects. Such subjects are taught in the Cincinnati public night schools, and since the apprentice is obliged to attend the night schools according to his agreement with the firm, it is not considered necessary to duplicate this work. The boys are required to take mathematics and mechanical drawing at the night school. The class instruction is not according to a prearranged schedule; the students are assembled as occasion arises and given group instruction in the various problems that present themselves.

Throughout the progress of the apprentice through the shop and after he is finally placed in the shop the instructor follows him up, working in conjunction with the foreman of the department to see that he understands his work and is doing it properly. This is a valuable and noteworthy feature, inasmuch as it makes possible a repositioning of the apprentice if he is found not adaptable to the department first chosen. This function of the instructor and the changing about of the employee also apply to the specialized worker, who has been instructed in the training department.

Another phase of the work done in the training department of the American Tool Works Co. is that of instructing men who are to become salesmen. These men are placed in the department under the supervision of the instructor and the construction and operation of the machines they are going to sell are taught them. After completing this course of study they are sent to the shop, where they are shifted about from department to department according to their needs, with a fairly close adherence to a prearranged schedule.

It has been found advisable to instruct girls who work in the drafting room along certain practical lines such as phraseology, nomenclature and function of the parts going to make up the machines manufactured by the plant. The time devoted to this is one-half hour on alternate days and the work has very fittingly been placed under the head of the training department. A similar course is given to the younger male draftsmen.

To further the work, and instill interest in and respect for the trade, an apprentice club has been formed. It is an organization of the apprentices, under a set of rules along parliamentary lines, which meets every other week at the plant, for reading and discussion of papers prepared by the apprentices themselves. They have used such topics as "Safety First," "History of the Machine-Tool Industry in Cincinnati" and "History of the Lathe." It is obvious that the student must do some excellent work in reading and investigating to prepare on such subjects. His ability to face his fellow men in argument and speech is developed and therefore so are his self-respect and confidence. Visitors are frequently allowed to address the club on pertinent topics. No attempt is made in a social way except so far as the method develops poise and self-respect.



FIG. 3. INSTRUCTORS AND APPRENTICES

During the two years of operation of the department 245 students have been enrolled and the majority of them graduated on specialized work. Of these 40 were girls. The normal capacity of the training department is twenty-five pupils; at present seventeen are enrolled in the apprentice course. The system of instructing students for one department for a short time and then placing them in that department for experience, later taking them back to the school, permits a large enrollment with a comparatively light burden on the school at any one time. The average age of the students is 18 years and their schooling, on the average, has taken them through the eighth grade. Fig. 3 shows the present group of students.

The cost of hiring and firing a mechanic is well known. This cost ordinarily applies to an apprentice or an employee for specialized work just as it does to a skilled worker. By the interposition of the training department between the employment office and the shop, about 35 per cent of the applicants sent to the training department have been classed as not fitted or adaptable and therefore eliminated. This is accomplished with much less spoilage and loss of machine-time than would ordinarily occur, and there is a consequent saving in the cost of hiring and firing.

The training department is approved and backed by the shop. Ample evidence of the truth of this statement is given by the success of the students when placed in the shop.

The management is responsible for the school, and explains the necessity for, and the value of it in the following way:

There exists in the machine industry a shortage of skilled mechanics, due largely to the natural growth of the industry. This increase is due to a constantly increasing and developing demand for materials which only the machine industry can supply, of which plumbing supplies and household labor saving devices afford two very good examples. New shops are springing up, and if successful, are growing. Along with this increase in the demand for skilled mechanics there is no central producer of them, and but comparatively few individul producers, i.e., educators and trainers. So it is up to the industry itself to make its mechanics. Nor should this burden be entirely shouldered by a few large shops. Each shop, no matter how small, owes it to the industry to develop a quota of mechanics proportionate to its requirements. The small shop can afford to allot a part

of the time of one or two machines and a smaller part of the time of a good mechanic to this work. There is offered by the small shop owner the argument that in all probability his apprentice will quit him about as soon as he is trained. Possibly. The small shop has then but contributed to a cause to which it owes a contribution. With all shops doing their rightful shares of the same kind of production—that of skilled mechanics—the small shop owner's chances of losing the man he trained are decreased and his chances for replacing him, if lost, are increased.

Among present-day and everyday problems are the selection and procurement of machines, materials and supplies. These are given careful consideration. The selection and procurement of the human part of the factory also receives consideration, but to a much smaller degree and very frequently misdirected. Rather than continually sort over goods on hand, much of which has been already rejected, start with the raw material and manufacture new goods—in other words train men for the industry. As a corollary of this proposition it should be borne in mind that foremen, necessary and controlling factors that they are, are made, not born, and that the way to possess foremen who are modern, in sympathy with present-day production methods and not limited by early conceptions of what can and what cannot be done, is to make them. A training department which will make intelligent mechanics and eliminate the poorer grade is serving the purpose of producing foremen.

It is also the belief of the management that such a training department should confine its efforts to those lines which are to be directly applied to the shop, leaving the so-called higher education to the day and night public schools.

Valuable Features of the Training Department

Not the least valuable feature of the American Tool Works' training department is that nothing is done just as practice. Everything made is bona fide production goods and is used in the company's assembly. Premium work is not attempted, as the object of the department is to teach how to do work accurately rather than rapidly. The speed is gained in the shop.

Another feature of merit, helpful to school and shop alike, is the practice of the plant in sending to the training department the various odd jobs of maintenance and repair. To call forth the exercise of thought and resourcefulness of the student, there is no better work. Of course its value to the shop lies in preventing interruptions of production for non-productive work.

A phase of the work of the training department which adds to the value of the department is that of instructing high school and university co-operative students. The high school course is of two years' duration and the student, while at the shop, pursues a course in practical shop practice in the training department which fits him to take his place in some department of the plant. He also signs an agreement and receives a tool box and tools, although not of the same value as that of the apprentice. Cincinnati University co-operative engineering students as a rule begin their work in the plants a few months before the beginning of the collegiate year. At the American Tool Works' plant they are given, during these few months, a course in the training department which acquaints them with the rudiments of machine work, and no doubt is of noticeable benefit to them in their later work.

The immediate benefits derived from a training department such as that described are many. Future benefits can only be guessed at. They will lie in a financial gain due to more efficient workers, and in the virtue and influence of high-class training department graduates who have grown up with a spirit of loyalty and co-operation.

A Suggestion in the Matter of Designating Finishes

By Jack Homewood

There is great disadvantage in having work done in an outside shop where it is not convenient to give a few personal instructions, such as finishes, fits, and other details, in addition to the information imparted by the blueprint. Can we not make the blueprint more "human" so that it will become more nearly automatic in its instructions to the craft in general by the incorporation of a set of standard symbols?

The ordinary run of workmen do not seem to be able to discriminate in the matter of finishes required on a job. Some men will decorate a job with elaborate finishes and some go so far as to mottle it in spots. It may look very nice to the eye but when such finish is unnecessary it is hard on the pocketbook of the man that has to pay for it.

Other men are just the opposite; they will not use their heads in putting on a finish. They may be over anxious to get the job off of their hands, but there is a little touch of carelessness in not going far enough. A foreman has enough to do without being obliged to attend to every little detail pertaining to the work; he shouldn't have to take a job back to a man and tell him to take a burr off here and there, and he shouldn't be subjected to a "calling down" from the man higher up owing to the elaborateness of one of his men when he was too busy himself with other work to watch the man. He shouldn't be compelled to go to the man after the thing is done and "bawl him out" for his folly.

Some men do not use their brains when it comes to finishes; why depend on them to do so (at the employer's expense) when it can be avoided? We could have a system of symbols that the mechanics could accustom themselves to, just as they do the decimal equivalents. It could be on the order of the following:

FINISHES

(a) Rough casting finish. Burrs and sand removed.
(b) Ground to a finish so as to not injure the hands.
(c) Rough machine finish to have a plane surface.
(d) Broad nose tool finish.
(e) Filed finish.
(f) Scraped finish, several grades: (1), (2), (3).
(g) Mottled finish.
(h) Rough steel finish, scale not removed.
(i) Machine ground finish.
(j) Whatever finish is left after hardening.
(k) Lapped.
(l) Highly polished.

FITS

(m) Running fit.
(n) Rifle fit, to push through by wringing.
(o) Sloppy fit.
(p) Press fit.
(q) Hydraulic fit (specify tons).
(r) Shrink fit (specify amount).

HARDNESS

(s) Very hard (plug gages, etc.).
(t) Cutting hard (for a cutting tool).
(u) Chipping hard (for chisels, sets, etc.)
(v) Spring temper.

The above may look to some like red tape with corrugated edges but the trouble to be overcome is real and this is at least a suggestion for a remedy.

Contracts With Labor Unions

By CHESLA C. SHERLOCK

During these turbulent labor times an article of this nature carries a wealth of enlightening information. Just what the law covers, with regard to disputes between employers and labor unions, is clearly defined.

NO PHASE of the present industrial situation is as timely or interesting as a discussion of contracts with labor unions and the legal points involved.

Trades unions are of comparatively recent origin. They were unknown at common law and just what the courts of those days might have said in connection with the subject is a matter of conjecture. The law has always been reluctant to recognize any body of individuals more or less loosely associated together, having an undefined interest in the enterprise for which they are associated, assuming none of the liabilities of the common purpose, as is always the case where individuals mass together for a specific object but fail or refuse to associate themselves in the manner prescribed by the law itself.

Employers have come in recent years to the point where they freely enter into contracts with the representatives of trades unions, in respect to the hours of work, working conditions, the amount of payment and such other matters as peculiarly affect the individual member of the union.

The Contract

The contract, it will be noted, is entered into on the one hand by the employer—an individual. He may be merely a private individual, a partnership or a corporation. In either sense, he is an individual at law, for from the earliest dawn of time the law has ever sought to deal with *individuals* and not with masses, in so far as specific rights and obligations are concerned. Hence, the use at law of the partnership and the corporate idea.

In the old days, under the common law and back under the ancient law before the Romans gave us the modern corporation, men could not contract together except as individuals. The law could not recognize, in any sense, a status where the individual responsibility of the individual might in any way be obscured or lost sight of when the day of *performance* of the covenant arrived. And, indeed, the sole satisfaction which could be obtained in a contract in those days was by its performance by each individual according to the letter thereof. Shylock was entitled to his pound of flesh and he had a right to it.

All this is interesting when we stop to think that the contracts which employers have been making with labor unions have been outside this old conception of mass contracts. In the case of the labor union, we have representatives coming to the employer and signing a contract with him on behalf of a number of individuals, who are looked upon to perform their portion of the agreement.

From an individual standpoint, the members of the union are not bound to do anything absolutely. The employer may contract with a union representative having in mind that he is to have the service of the members now in his employ. But these members can quit work tomorrow if the spirit so moves them, and less competent and less faithful members substituted in their place.

On the other hand, suppose that the union representative makes an agreement that is distasteful to the individual members. Can the employer force the individual members to live up to the agreement made by their representative? If, at law, he has this technical right, just what can he do to enforce it? Especially, in view of the facts we have set out a few paragraphs above concerning the inability to reach the individual where an agreement has been made with an irresponsible mass.

And, again, suppose that the contract is highly satisfactory to the individual workmen members of the union, but that a change in circumstances makes it highly burdensome upon the employer. Can he refuse to perform his share of the agreement without laying himself liable to individual actions for damages instituted by his employees who are members of the union?

These are only a few of the questions which arise in connection with the contracts which employers are making with the representatives of trades unions. It marks a new departure in the law of contracts, and a new feeling on the part of the courts, doubtless dictated by that poor maker of laws, expediency.

These considerations kept in mind will serve a very useful purpose as we examine the trend of the decisions and see just what the thought of the respective authorities has been in the past.

Some Legal Decisions on This Question

The Kentucky court, in considering a contract where the individual employees were seeking to bring actions against their employer because he had broken the contract entered into with their union representatives, said: "A labor union, in contracting with an employer with respect to wages and conditions of service for a specified period of time, does not establish contracts between its individual members and the employer, a breach of which will sustain actions by the individuals."

In Missouri, it was held that a miners' union as an organization cannot make a contract for its individual members in respect to the performance of work and the payment for it. It is, however, conceded that a labor organization may have rules requiring an employer to designate certain pay days, and, in such case, the employer of a member of the organization who agrees that the employee is to be paid on the designated pay days as established by these rules, thereby makes the contract or rules fix the time of payment. But this is upon the theory that the individual so contracts, and not upon account of his being a member of the organization which has undertaken to contract for him. And a contract on the part of an individual that he will perform certain work under the rules of an organization is not to be inferred from the simple fact that he is a member thereof.

"Persons work for themselves and are free and independent, and agreements improving conditions can only

be enforced when the entire proposition has been stated and by them freely accepted. Hence, where there is no express agreement between the employer and the employee as to the performance of the work involved in the contract, or the time of payment therefor, the law by implication and not by contract between the employer and the labor organization of which the employee is a member, fixes the status of the parties in respect to such work, and when the consideration becomes due and payable."

This view of the matter is consistent with the attitude which the courts have taken from time immemorial in regard to contracts of this nature. It denies the right of a union to enter into agreements which will be binding upon its members as individuals, and the only way in which the employer can be held to maintain certain pay days is by implication and not in any sense by reason of contract.

A New York Case

In New York, the court said: "A contract between an employer of labor and a labor union, by which the employer agrees not to employ non-union labor is valid where it results in financial benefit to the employer and disposes of differences between the employer and a labor organization, provided the agreement is not entered into for the malicious purpose of injuring the non-union employees of such employer, and without the object of compelling such employees to join the union, and no pressure so imperative as to amount to compulsion is exerted upon the employer with regard to the discharge of non-union employees, and there is no conspiracy to compel the latter to join the union, or solely to injure them in their employment."

It can be seen very readily that if the officers of a union enter into a contract with an employer with respect to the employment of none but union workmen, and that if they are actuated by the motives usually credited to them, the contract would not be valid or enforceable in the courts.

It must be kept in mind, however, that this decision rests upon the fact that the employer, at the time of the making of the agreement, had in his employ a number of non-union workmen. A different situation might arise in a shop where all the workers were members of the union, or where the employer was engaging a new force entirely, as where a new concern might just be commencing business.

In fact, in another case involving the different set of facts mentioned, the New York court has said: "A contract by an employer to employ union labor exclusively is valid, at least where the restraint imposed is not unreasonable in view of the surrounding facts and circumstances. Thus, it has been held that a contract by an employer of labor by which he binds himself to employ, and to retain in his employ, only members in good standing of a single labor union, is consonant with public policy and therefore enforceable."

The Spirit of Contracts

It is fundamental in the law of contracts, that no agreement which is grounded in malice, or which seeks, by the use of force, coercion, compulsion or intimidation, to secure some sort of advantage to any of the parties, can be valid. Labor unions cannot, in making such a contract and in driving out non-union workmen, still expect to enjoy the advantages they obtain under such contract by enforcing it, if they have resorted to any of the means not tolerated by the law in obtaining it in the first instance.

The mere fact, however, that an employer enters into such an agreement and that it will injure others, is not sufficient to invalidate the agreement, if it is faultless in other particulars.

The Federal court has said: ". . . a laborer, as well as a builder, trader, or manufacturer, has the right to conduct his affairs in any lawful manner, even though he may thereby injure others. So, several laborers and builders may combine for mutual advantage, and, so long as the motive is not malicious, the object not unlawful nor oppressive, and the means neither deceitful nor fraudulent, the result is not a conspiracy, although it may necessarily work injury to other persons. The damage to such persons may be serious—it may even extend to their ruin—but, if it is inflicted by a combination in the legitimate pursuit of its own affairs, it is *damnum absque injuria* (injury without liability). The damage is present but the unlawful object is absent. And so the essential question must always be whether the object of a combination is to do harm to others, or to exercise the rights of the parties for their own benefit."

The courts, then, care not so much about the object accomplished as they do about the motive. The object may be apparently harmless or at least not out of the ordinary, but if the motive is malicious or unlawful, it will not condone the agreement, however beneficial or harmless the result may be. In fact, this is the identical principle underlying combination agreements as applied to business generally. The cornerstone of the trust laws is none the less greater than this very principle. In fact, this identical expression is the very root of the anti-trust theory and of the statutes and decisions handed down on the subject.

Combinations Allowed by Law

Men may combine, but they must be honest and lawful in their intentions and in the measures which they take to bring about the ultimate object they have in view. This is no harsh dictum applying to labor unions and the agreements they make alone; it applies to every business man just as forcibly.

In another case, the Federal court has said: "The inherent right of the individual laborer to sell his labor, which is his property, in any lawful manner or pursuit, and upon such terms and conditions as he may himself determine to be for his personal best interests, must be upheld by the law just as fully and freely regardless of these union organizations, as it is upheld in all the other relations of our civic life."

No organization, no association, no corporation, no union, can be higher or mightier than the individual in the eye of the law. The courts have ever sought to preserve the individual integrity of each person, no more so than in the law of contracts.

An examination of this point under the law convinces us that an agreement between an employer and a labor union which is absolutely valid and binding, as we find contracts made under other conditions, is a very rare thing. It is not an impossibility, by any means, but it is seemingly improbable, even in those states or jurisdictions where the courts say such agreements "may" be recognized. Some states, as we have noted, consider them invalid from the very beginning.

Derivation of a Formula to Determine Number of Teeth in Contact of Two Meshing Gears

By A. B. COX

The author derives a formula by which may be determined the number of teeth in contact of two meshing gears and gives graphic representations of the results of the application of this formula. He also specifies the disadvantages of the length of addendum of standard gears.

IF IT be assumed that the teeth of a pair of gears in mesh with each other are so accurately cut that all the teeth which theoretically should be in contact are actually in contact, this number can easily be calculated. The numbers of teeth in contact with gears of any ratio and any numbers of teeth can be calculated and plotted in curve form from which certain conclusions of practical value may be drawn.

The following symbols are used throughout this treatise:

P = diametral pitch.
P_c = circular pitch.
ϕ = angle of line of action (degree of involute).
n = number of teeth in pinion.
N = number of teeth in gear.
r = pitch radius of pinion.
$K = n \div N$
x = co-ordinate of point of intersection of line of action with outside diameter of pinion with center of pinion as origin.
L_p = length of line of action intercepted by line of centers and outside diameter of pinion.
L_g = length of line of action intercepted by line of centers and outside diameter of gear.
L_r = length of line of action intercepted by line of centers and top of tooth of rack.
$L_T = L_p + L_g$, or $L_p + L_r$
$M_p = L_p \div P_c \cos \phi$
$M_g = L_g \div P_c \cos \phi$
$M_r = L_r \div P_c \cos \phi$
M_T = total number of teeth in contact in a meshing gear and pinion $= M_p + M_g$, or $M_p + M_r$.

Referring to Fig. 1, it is seen that the tooth contacts are made only on the line of action, and that the distance measured on the line of action from a point on one tooth to a corresponding point on the next tooth is $P_c \cos \phi$. To find the total number of teeth M_T in contact it is therefore only necessary to find the total length L_T of the line of action and divide it by $P_c \cos \phi$. The integral part of this number M_T indicates the minimum number of teeth that will always be in contact (in this case two) and the decimal part of the number indicates the relative length of time the additional tooth will be in contact. In solving this problem it has been found more convenient to find the number of teeth in contact M_p for the pinion only and add to this the number of teeth in contact M_r or M_g, for the rack or gear, i.e., $M_T = M_r$ or $M_g + M_p$.

The derivation of the formula for M_p is as follows:

$$x^2 + y^2 = \left(r + \frac{1}{P}\right)^2.$$

$$x^2 + y^2 = \frac{r^2}{n^2}(n + 2)^2$$

which is the equation of the outside diameter of the pinion.

$$y^2 = (x \tan \phi + r)^2$$

which is the equation of the line of action.

$$x^2 + (x \tan \phi + r)^2 = \frac{r^2}{n^2}(n + 2)^2$$

$$x^2 + x^2 \tan^2 \phi + 2xr \tan \phi + r^2 = \frac{(n^2 r^2 + 4nr^2 + 4r^2)}{n^2}$$

$$n^2 x^2 (1 + \tan \phi) + 2xrn^2 \tan \phi + n^2 r^2 = n^2 r^2 + 4nr^2 + 4r^2$$

$$n^2 x^2 \sec^2 \phi + 2xrn^2 \tan \phi - 4r^2(n + 1) = 0$$

$$x = \frac{-2rn^2 \tan \phi \pm \sqrt{4n^4 r^2 \tan^2 \phi + 16n^2 r^2 \sec^2 \phi (n+1)}}{2n^2 \sec^2 \phi}$$

$$= \frac{-2n^2 r \frac{\sin \phi}{\cos \phi} \pm \frac{2n^2 r}{\cos \phi} \sqrt{\sin^2 \phi + \frac{4}{n^2}(n+1)}}{\frac{2n^2}{\cos^2 \phi}}$$

$$= -r \sin \phi \cos \phi \pm r \cos \phi \sqrt{\sin^2 \phi + \frac{4}{n^2}(n+1)}.$$

$$L_p = \frac{x}{\cos \phi}$$

$$= r\left(-\sin \phi \pm \sqrt{\sin^2 \phi + \frac{4}{n^2}(n+1)}\right).$$

$$P_c = \frac{2\pi r}{n}.$$

$$P_c \cos \phi = \frac{2\pi r \cos \phi}{n}.$$

$$M_p = \frac{L_p}{P_c \cos \phi},$$

$$= \frac{nr}{2\pi r \cos \phi}\left(-\sin \phi \pm \sqrt{\sin^2 \phi + \frac{4}{n^2}(n+1)}\right). \quad (1)$$

$$2\pi M_p \cos \phi + n \sin \phi = \pm n \sqrt{\sin^2 \phi + \frac{4}{n^2}(n+1)},$$

Squaring,

$$4\pi^2 M_p^2 \cos^2 \phi + 4\pi M_p n \sin \phi \cos \phi + n^2 \sin^2 \phi = n^2 \sin^2 \phi + 4n + 4,$$

$$\pi^2 M_p^2 \cos^2 \phi + \pi M_p n \sin \phi \cos \phi - (n + 1) = 0,$$

$$n = \frac{1 - \pi^2 M_p^2 \cos^2 \phi}{\pi M_p \sin \phi \cos \phi - 1}. \quad (1a)$$

When $\frac{1}{n} = 0$ (rack), $\pi M_p \sin \phi \cos \phi - 1 = 0$,

and M_p becomes, $M_r = \frac{1}{\pi \sin \phi \cos \phi}$. (1b)

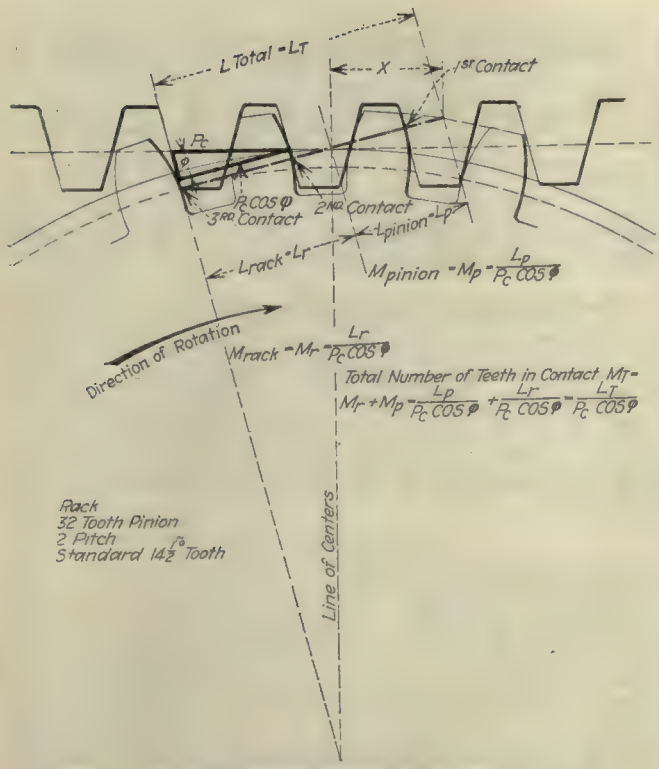


FIG. 1. REFERENCE DRAWING FOR DERIVATION OF FORMULA

account of tooth interference. (See *American Machinist*, Vol. 53, page 707.)

The formula for number of teeth in contact on internal gears is found by a method exactly similar to the above to be

$$N = \frac{\pi^2 M_g^2 \cos^2 \phi - 1}{\pi M_g \sin \phi \cos \phi - 1} \qquad (1c)$$

The 1 to 1 ratio of internal gears of course has no meaning except as showing the theoretical limit of number of teeth in contact as the gear ratio approaches unity.

Now, if for the sake of clearness we suppose a pair of heavily loaded gears made of very elastic material,

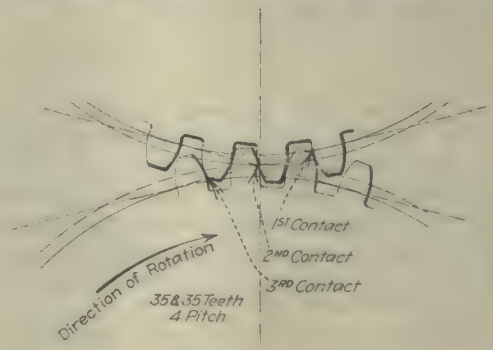


FIG. 4. GEARS WITH TOTAL NUMBER OF TEETH IN CONTACT = 2

Using (1a) as the form of equation most convenient for plotting, values of M for the 14½-deg. standard tooth were plotted against values of n, in Fig. 2. The curves in Fig. 3 are easily obtained from Fig. 2 for any ratio of gears by adding the number of teeth in contact M_p on the pinion side of the line of centers to the number of teeth in contact M_g on the gear side of the line of centers, thus getting the total number of teeth in contact for that particular ratio and number of teeth. For example, with a 1 to 2 ratio of gears M_p for a 50-tooth pinion is 1.075; M_g for the gear which has, of course, 100 teeth is 1.175. The total number of teeth in contact for this particular ratio and numbers of teeth is therefore 2.250. This number indicates that there will always be two teeth in contact and that one-fourth of the time a third tooth will be in contact and sharing the load. Those portions of the curves in Fig. 3 to the left of the dot and dash line cannot be used on such as soft India rubber, it will easily be seen that when the load is carried by only two teeth these teeth will be bent back, but that when the third tooth begins to make contact they will immediately spring forward on account of the lessened load each has to carry. This means a continual vibration. Suppose we choose from Fig. 3 such a number of teeth for the pinion that the total number of teeth in contact is a whole number. For example, two gears with 35 and 35 teeth are shown to have a total of two teeth in contact. A sketch, Fig. 4, of this condition has been made. From this sketch it is seen that just at the time the third tooth is making contact the first tooth is leaving contact, so that the load is carried on two teeth only—no more and no less at any position of the gears relative to each other.

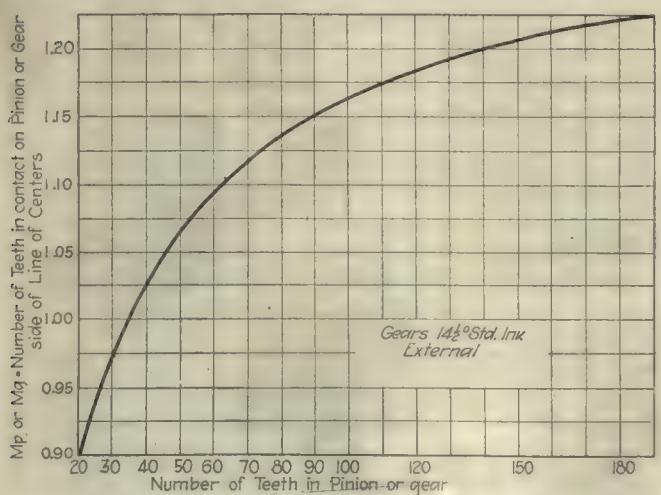


FIG. 2. RELATION BETWEEN NUMBER OF TEETH IN PINION OR GEAR AND M_p OR M_g

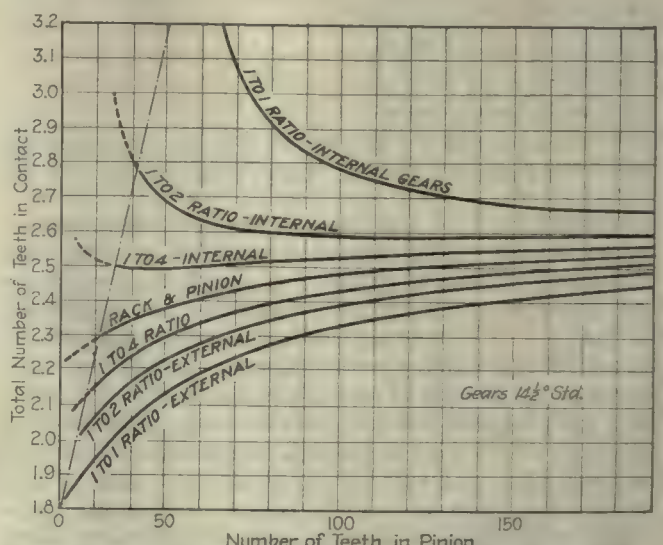


FIG. 3. NUMBER OF TEETH IN CONTACT FOR GIVEN RATIOS, 14½-DEG. STANDARD

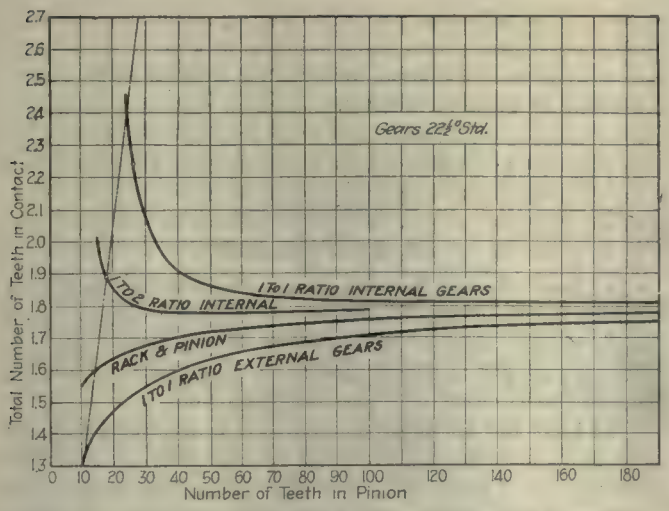


FIG. 5. NUMBER OF TEETH IN CONTACT FOR GIVEN RATIOS, 22½-DEG. STANDARD

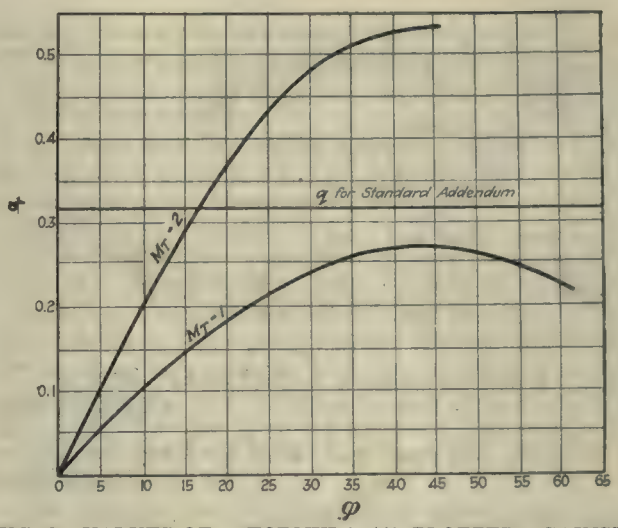


FIG. 9. VALUES OF q, FORMULA (4) PLOTTED AGAINST VALUES OF ϕ

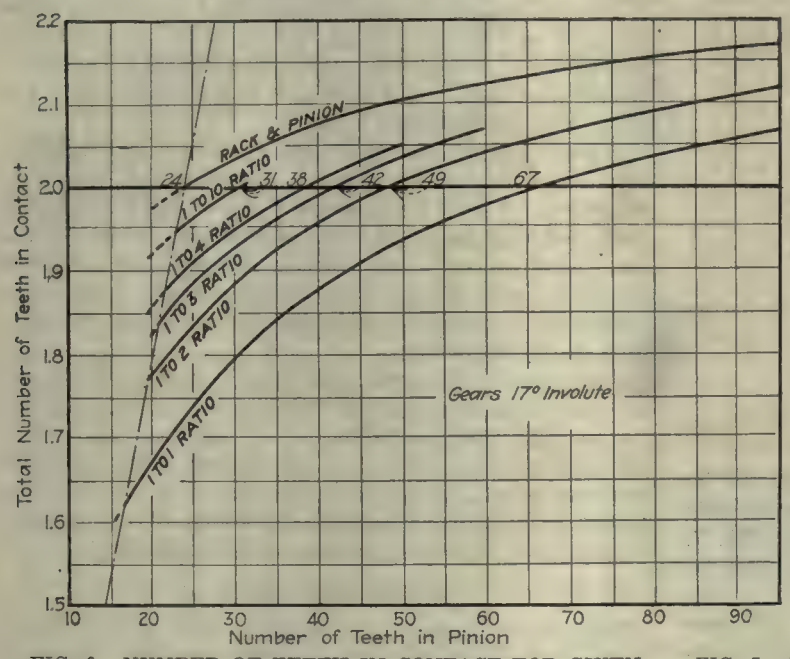


FIG. 6. NUMBER OF TEETH IN CONTACT FOR GIVEN RATIOS, 17-DEG. TOOTH

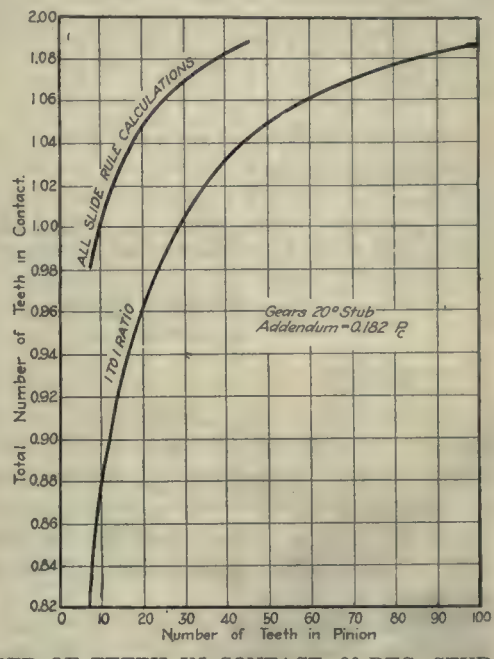


FIG. 7. NUMBER OF TEETH IN CONTACT, 20-DEG. STUB-TOOTH GEARS, ADDENDUM = 0.182 P_c

It is evident that the 14½-deg. standard tooth does not lend itself to this design, and from Fig. 5 it is seen that the 22½-deg. standard is no better. In Fig. 6 are shown tooth contact curves for 17-deg. standard involute gears. It is seen at once that two teeth in contact can be obtained for any ratio of external gears by simply choosing the proper numbers of teeth for pinion and gear. For a 1 to 2 ratio the pinion should have 49 teeth and the gear, of course, 98 teeth, this regardless of the center distance, or pitch.

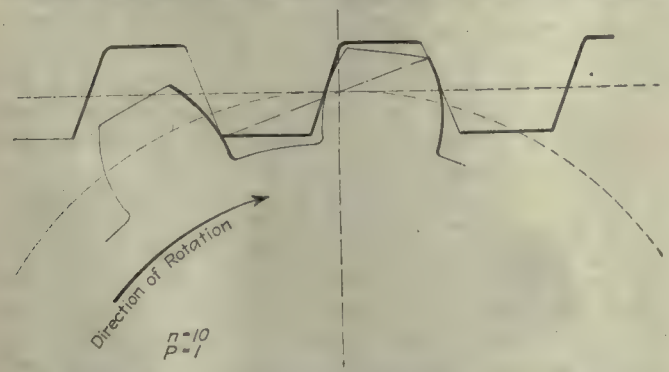


FIG. 8. RACK AND PINION, 20-DEG. STUB-TOOTH GEARS, ADDENDUM = 0.182 P_c

For those who want only one tooth in contact, no matter what degree of involute is chosen, this condition cannot be obtained with the standard length of tooth. It can be obtained, however, in the following manner.

The formula for non-interference of gears (see *American Machinist*, Vol. 53, page 707) was derived for standard-length teeth. If, now, the addendum be expressed as a fraction "q" of the circular pitch the interference formula takes the form

$$K = \frac{4\pi q n - 2n^2 \sin^2\phi}{n^2 \sin^2\phi - 4\pi^2 q^2}. \qquad (2)$$

For the condition of rack and pinion $K = 0$ and (2) reduces to

$$n = \frac{2\pi q}{\sin^2\phi}. \qquad (2a)$$

The formula (1a) becomes

$$n = \frac{\pi q^2 - \pi M_p^2 \cos^2\phi}{M_p \sin\phi \cos\phi - q}, \qquad (3a)$$

which is the general formula for the number of teeth in contact with gear teeth of any length. As before,

when $\frac{1}{n} = 0$ (rack).

$$M_r = \frac{q}{\sin \phi \cos \phi}. \qquad (3b)$$

Combining (2a) and (3a),

$$\frac{2\pi q}{\sin^2 \phi} = \frac{\pi q^2 - \pi M_p \cos^2 \phi}{M_p \sin \phi \cos \phi - q};$$

Clearing,

$$2\pi M_p q \sin \phi \cos \phi - 2\pi q^2 = \pi q^2 \sin^2 \phi - \pi M_p^2 \sin^2 \phi \cos^2 \phi,$$

$$M_p^2 \sin^2 \phi \cos^2 \phi + 2M_p q \sin \phi \cos \phi - (2q^2 + q^2 \sin^2 \phi) = 0,$$

$$M_p = \frac{-2q \sin \phi \cos \phi}{2 \sin^2 \phi \cos^2 \phi} \pm \frac{\sqrt{4q^2 \sin^2 \phi \cos^2 \phi + 4 \sin^2 \phi \cos^2 \phi (2q^2 + q^2 \sin^2 \phi)}}{2 \sin^2 \phi \cos^2 \phi},$$

$$= \frac{-q \pm q\sqrt{3 + \sin^2 \phi}}{\sin \phi \cos \phi}.$$

$$M_T = M_r + M_p,$$

$$= \frac{q}{\sin \phi \cos \phi} - \frac{q}{\sin \phi \cos \phi} \pm \frac{q\sqrt{3 + \sin^2 \phi}}{\sin \phi \cos \phi}.$$

$$q = \frac{M_T \sin \phi \cos \phi}{\sqrt{\sin^2 \phi + 3}}. \qquad (4)$$

When $M_T = 1$,

$$q = \frac{\sin \phi \cos \phi}{\sqrt{\sin^2 \phi + 3}}. \qquad (4a)$$

For 20-deg. stub tooth gears "q" works out to be approximately 0.182. The tooth contact curves for this value of q and a 20-deg. involute are shown in Fig. 7. Fig. 8 shows a rack and pinion and the appearance of the teeth.

In Fig. 9 the value of q in formula (4) has been plotted against values of ϕ. In order to afford a comparison Fig. 10 has been drawn showing 10-deg. teeth with addendum equal to one-tenth of the circular pitch.

In conclusion it would seem that standard gears have a length of addendum which has the following disadvantages:

(a) Reduces efficiency and increases wear by extending the arc of approach and recess. (It is assumed to be well known that the slipping of the teeth of the gear on those of the pinion is greatest at these extreme points and increases very rapidly with increase of angle of approach and recess.)

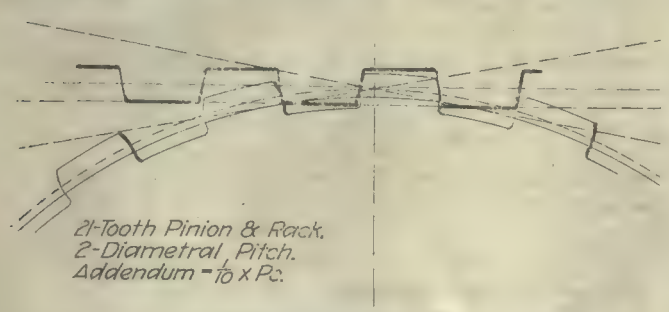


FIG. 10. RACK AND PINION, 10-DEG. TEETH, WITH ADDENDUM = 0.10 P_c

(b) Weakens the teeth by giving a longer leverage for the driving force to act on the teeth.

(c) Causes vibration, periodically causing the number of teeth in contact to vary.

What Is the Most Satisfactory Length of Work Day?

BY E. F. CREAGER

In these days manufacturers are wondering how they can so arrange the schedule of working hours as to meet prices quoted by competitors, satisfy working forces, and get the best efforts of employees as well as the fullest production from machine tools.

We hear the six-hour day, with a lunch period of not less than one hour, advocated by one branch of workmen; the six-hour day, five-day week (some say four days), by the miners, and much other propaganda along the same lines; but I have seen no real analysis made.

Every thinking manager knows that conditions were changed by the war to an extent that precludes the possibility of the present generation seeing a return to the pre-war basis; and I do not believe that there are many who really desire to see it.

One good result brought about by the present competition for help is the greater consideration given to employees. Better light, cleaner shops, more intelligent study and application of safety appliances, better sanitation, lunch rooms, rest rooms, surgical and medical attention, and many other improvements have been introduced in an effort to render their working environment more attractive.

Now what is the most satisfactory working shift and the best lunch hour period considering, of course, both the men and women employees? We have heard it said many times that "you can get out as much work in nine hours as you do now in ten, if you make the change." What is the actual experience of the readers of *American Machinist* relative to this question?

DRUG-STORE HOURS

The writer began his working life in the drug business; opened the store at 6 a.m. and closed it at 9 p.m. with Sunday hours and the privilege of Wednesday evening and every other Sunday off. Since that time in various professions he has seen the gradual shortening of working hours; always with the statement that "just as much work can be done" in the shorter period.

The general manager of a large American factory told me that he knew of an English manufacturer who had "by intensive methods reduced his working hours from eleven to six with a slight increase in total production."——Yes, I thought the same thing you are thinking; but he was my boss at the time and I did not care to tell him so. And then he located the manufacturer in England, and England was at war at the time and no passenger boats were running.

I have heard men rant about the nine-hour day; how they had no time for rest or recreation and no time with their family; yet I have known these same men to leave the nine-hour shop working fifty hours per week for one with the eight-hour basic day, working ten hours regularly and five nights until ten o'clock and nine hours on Sunday, with time and one-half for overtime and double time for Sundays and holidays. Did they weep over being away from the bosom of their

families? Not on your life. They told you proudly that they had "pulled down *ninety-two* bones last pay."

I believe that Saturday afternoon as a working period is a thing of the past, except for rolling mills, furnaces, etc., and also believe that the majority of the working people really prefer the nine-hour day at a reasonsable rate, to the eight-hour day at the same hourly rate. I also believe that as much work can be produced in nine hours in a well-organized factory as is now being produced in the average factory in ten hours.

In the reorganization of a large plant in the Middle West, one of the first changes made was the reduction from fifty-six hours to fifty hours per week, and while it was impossible to get exact figures on the results, a large increase of production was shown and more contented workers of a better grade were noted. This plant, however, was in such shape at that time that almost any change would be for the better.

Some years later, under a different management, a new system of hours and shifts was proposed. A committee of factory executives was appointed to consider and report the scheme, and, though they were unanimous in their adverse opinion, the plan was ordered put into practice. It consisted of two 8-hour shifts, one beginning at 6:45 a.m. and working through till 2:45 p.m.; the second beginning at 3 p.m. and ending at 11 p.m. for the men, and 10 p.m. for the women.

A Short Lunch Period

In each shift fifteen minutes was allowed for the eating of such lunch as the employees brought with them—this lunch to be eaten at a certain time for all, and at their place of work; either bench or machine. No deduction was made from the employees' pay for this time.

Those who desired to do so could take one hour, no less, for lunch. This hour was deducted from their pay and they were compelled to leave the factory for the full period. While not so posted, it was generally understood that those who took this hour for lunch would shortly take a much longer time in the shape of a "permanent vacation."

The advantages claimed by the management for the scheme and the employees were: 1. 50 hours earning in 48 hours of work. 2. Additional time of liberty without interruption of the regular sleeping period, since the plan does not contemplate night work after 11 p.m. 3. Greater period of daylight, rest and recreation. 4. Greater opportunity for outdoor games and exercise. 5. Opportunity to work around the home. 6. More time to spend with the family. 7. Daylight marketing and shopping for both shifts.

You will note that items two to seven say the same thing in different ways. The executive who wrote the above was a member of the committee who reported against the proposed plan and who became a victim of the house-cleaning incident to its failure. The advantages to the factory as claimed by the management were: 1. Increased or double production possible on same machine-tool equipment. 2. Decrease of overhead owing to double production on same equipment. Actual working of the shifts and hours brought up the following points for and against it: Owing to the state laws governing the working of females after ten p.m., they were dismissed at that hour. They were paid for the full time, so that their earnings were equal for the two shifts. This earlier dismissal possessed the apparant advantage of allowing them to get home an hour earlier than the men, but since many of them had male members of the family working there, or else came to work from distant points in automobiles in groups, most of them waited either through choice or necessity until the men were dismissed. The shifts changed every two weeks, the day force becoming the night force; this meant an entire rearrangement of the habits and hours of the employee at each change.

From the younger employees, when on the night shift, came the objection that they could not go to the "movies" or to see their girls. Those of maturer years who had homes near enough to the factory to get home for lunch in the usual one hour period and had become more or less settled in their habits, complained that they could not get their stomachs to conform to the changing hours for food, and they also objected to "cold lunches."

The disruption of family habits was another point raised. Say the head of the family was working under these conditions, another member of the family was working under normal conditions, and there were children of school age; can not you who are men of family easily imagine what the wife's opinion of these hours would be?

The change of all rates to compensate for the two hours less per week for the day workers together with the smaller production increased the cost of the articles made. Salaried employees receiving the same pay as for the longer week constituted an additional expense not in any way compensated for. Records of the production of the late shift never showed more than the usual rate of "night work."

Transportation a Cause of Complaint

Difficulties of transportation was another cause for contention. Employees were drawn from a radius of twenty miles, and while there was but little objection or trouble in the summer time there was considerable trouble during the winter months, particularly where employees dismissed at 11 p.m. missed or were delayed by the trolley service.

The system required double the amount of supervision and inspection force and there was a continual "passing of the buck" from one shift to the other. These latter points would of course apply to any form of double shift.

An unexpected result of the "short hour" day was disclosed when the company had some special rush work to be done and the carpenters and plumbers or steam fitters were needed for extra time. They said they could not come as they could not get away from their other jobs, and an investigation showed that all of the carpenters and most of the steam fitters as well as a number of other employees were "holding down" other jobs.

Fifty hours' production in forty-eight hours was attained by the piece workers only. The day workers gave forty-eight hours' production and no more. Observation did not show that they went to work one minute earlier or worked one minute longer, one stroke faster, or any harder than they did before.

After eight and one-half months the double shift was discontinued with the usual loss of employees and all the difficulties incident to such changes. They are now working a nine and one-half-hour day and a fifty-five-hour week with one-half hour for lunch. The machinists and toolmakers recently protested the nine and one-half-hour day and petitioned for an eight-hour day with time

and one-half for over time, which was allowed. Since then a lunch period of one hour has also been allowed. This is the history of one radical change of shifts which was a failure. The experience gained from it shows that the eight-hour work day was not considered an economical one. Recently the manufacturers of Indianapolis, after having worked an eight-hour day for some time, decided to return to the nine-hour day.

We do not find much objection, where night gangs are a necessity, to their working ten to twelve hours provided they do not work Saturday night, but the proportion of men who will hire for night work is small and usually a premium or higher hourly rate is paid than is current for the same kind of work in the day time; the grade or quality of workmen is lower, the spoilage is greater, and the quantity and quality of work is less.

There is a correct speed and feed for every operation on a machine—"the critical speed"—is there not one for labor? You pay for labor. Are you getting your money's worth? What are you doing to find out? Do you know what constitutes a "good day's work"? Do you know your machine efficiency? Are you making any studies of the operator's efficiency that will enable you to rate him for what he is worth?

In one instance, by a time study of the operators' efficiency, the number of operatives was reduced thirty per cent and more work was produced. The remaining operators were paid in proportion to their per cent of efficiency, and they were satisfied to put out the extra work. I do not think there is thought enough being given to time study, particularly as applied to the employee.

In some cases studies have been made and the efficiency is known, but the operative is still receiving the base rate for that class of work. We should find out what is possible for a "first-class" worker, train him to do a "first-class" day's work, divide the increased profits with him, treat him as a "first-class" worker, and save money on the pay roll.

Production of Boiler Flue Beading Tools in Railway Tool Shops

By J. V. Hunter

Most railway tool shops have found that the boiler tube beading tools made for use in the pneumatic hammers of the boiler repair shops are expensive to maintain. They have to be carefully made and it almost seems as though some inspectors required a needless degree of accuracy in the shape and finish of the working portion of these tools. A gage used for checking the shape of the working end of such a tool is shown in Fig. 1.

The beading-tool forging shown in the same illustration was made in a forging machine and it will be noted that the forging operations have both formed the beading end and necked down the shank to reduce

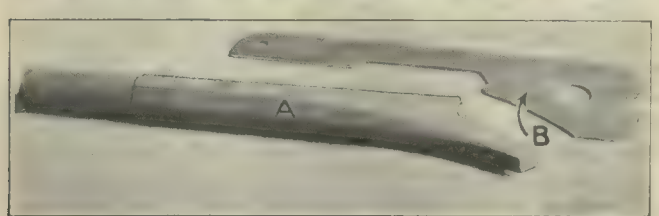


FIG. 1. FORGED BOILER FLUE BEADING TOOL AND GAGE

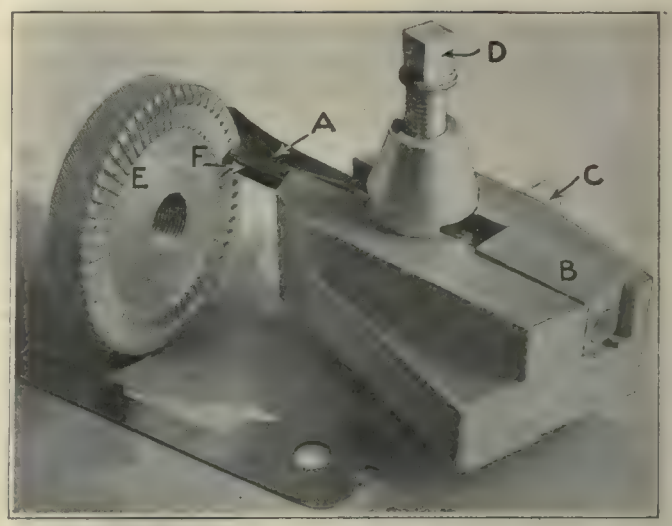


FIG. 2. TOOLS FOR FIRST MILLING OPERATION

the amount of stock to be removed in the subsequent finishing operation. The finish on the working end of these forgings is usually by filing and as this must both fit the gage and at the same time have its edges carefully rounded the rate of production is only about four per hour.

The tools shown in Figs. 2 and 3 were exhibited by W. H. Casson at the annual convention of the American Railway Tool Foremen's Association and represent the method employed in his shop for finishing them.

The method requires only a lathe for the machining operation and the models are photographed in the relative position that they will occupy when set up on the machine. The rough-forged beading tool *A*, Fig. 2, is held in a special tool block on the lathe carriage, and its previously turned shank is carried in the block *B* held by the setscrew *C;* the whole being held down by the screw *D*. The milling cutter *E* is threaded to screw on the nose of the lathe spindle and is knurled on the periphery to facilitate its removal. This cutter roughs out the notch for the bead and finishes off the heel of the tool at *F*.

The second operation is performed by the hollow milling cutter *A*, Fig. 3, which screws on the spindle nose of the lathe. This mill is made with removable cutter blades of high-speed steel that are ground on their cutting face to a contour to match the portion *B*, Fig. 1, of the gage. The small inside diameter of this hollow mill produces the required radius heretofore obtained by the slower process of filing. The round nose on the tips of the blades finishes the notch *B* next to the heel of the tool. Very little hand filing is required to complete the work.

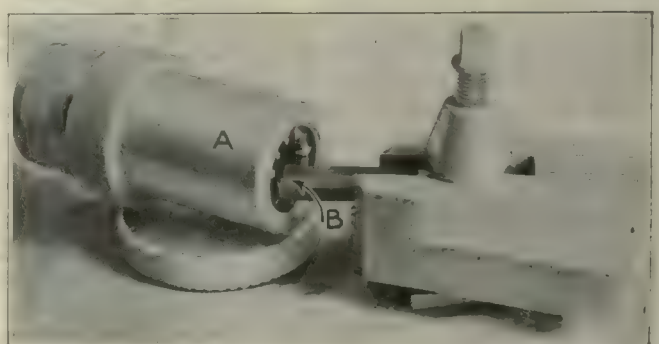


FIG. 3. HOLLOW MILL FOR FINISHING OPERATION

False Starters

By J. D. HACKETT

The narrow viewpoint still existent in some plants, that the duty of the employment office ends immediately when the applicant is hired, is undoubtedly responsible for much labor turnover. This becomes apparent when a study is made of some facts seldom referred to by the employment manager and altogether unsuspected by the "man higher up."

THE "False Starter" is one who has been tested, selected and approved by the employment department but has failed to get on the job. The false starter is, of course, nothing new in industry but, as yet, his mode and kind have hardly been observed, much less considered. In some plants his existence is still unsuspected; in other places he is a recognized nuisance, while in a select few places active steps are being taken for his elimination.

In one of the Youngstown steel mills in 1916, it was found that out of 16,326 men hired, 1,118 or 6.85 per cent, failed to get on the job although they had gone through the same procedure as all the others. During the war there was a great increase of "shoppers" who, after being selected, took a sharp observant look around the plant and left without a trace. In a munition plant during 1918, where 14,841 were hired, 2,521 or 17 per cent failed to start at a time when the need for production was particularly acute. But this loss still continues. In a New York plant during 1919 where many young women are employed, the "false starters" amounted to 12 per cent of the total hired and the figures this year show averages as high as 20 per cent for single months.

These figures prove that much of present employment work is thereby wasted effort, and, until some constructive measures are adopted, the loss is going to continue. Solution of the problem presents some special difficulties because the applicant will continue to fade away without giving anyone an opportunity of knowing the real, specific, immediate cause. Even were such facts ascertainable they would only disclose indirect or remote approaches to a remedy.

Causes that Help to Make False Starters

The discoverable causes may be sought in the employment office or in the plant itself. The primary causes are few and apparent, the secondary causes are many and subtle. As long as the labor market is "short" the difficulty of the "shopper" and consequently of the "false starter" will remain to some degree.

Intrinsically the secondary causes are difficult to ascertain. They lie wholly with the applicant, the employment office or with the foreman, apart from the conditions of employment or the plant itself. These contributory causes may not be removable readily but they can be mitigated if they are clearly recognized. The remedy is usually within the sphere of influence of the employment manager since he is in a position to influence the attitude of his assistants and of the foremen and, often, their education in man handling, which is an important factor.

The applicant, if he be a "shopper," is waiting to be persuaded that the place is as good as can be found and it is here that the employment office generally fails. The interviewer seldom rises to the occasion, with the result that little real effort is put into the task of "selling" the job. The applicant has usually some preconceived and unfavorable notions about the plant that can easily be dispelled if the interviewer goes to the trouble of ascertaining what they are.

Applicants Want to Know About Employers

Not so long ago it was the exclusive privilege of the employer to ascertain all he could about the applicant. We have now arrived at the period when the applicant requires to know something about the employer. Unless his curiosity is satisfied, he will join the ranks of the false starters.

The fact is that the hitherto shadowy "wage contract" is now showing a distinct tendency to become less of a one-sided affair than ever. It is a good thing for both the applicant and the employer because, when conditions are more clearly understood, there will be fewer false starters and considerably less turnover.

Not many interviewers have thought out the technique of their jobs sufficiently to discover that there are two distinct phases in the interview; the first, in which he concentrates upon the discovery of reasons for rejection, and the second, in which he seeks valid cause for selection. The object of the former is to eliminate the unsuitable at the earliest possible moment; the idea in the latter is just the opposite. It requires a certain amount of "nerve," under present conditions, to adopt this attitude but it avoids loss of time on both sides and saves the credit of the employment department in the shops. A sensible interviewer must satisfy himself that the contract is mutually beneficial, otherwise it will not be permanent or successful. If, for instance, the applicant lives an hour's ride away from the plant and has to pay two or three fares, he will not take up work unless compensating circumstances exist and are carefully pointed out. The interviewer has a job to sell, the applicant has a job to buy and the former wins if he is a good salesman. Unless, however, wisdom has been shown in placement and the bargain proves to be good to the buyer the sale will not be permanent.

Courage Lost by Needless Delay

It is a mistaken notion that, because a man is out of a job, he has plenty of time to waste. One is easily deceived by the apparently placid appearance of the applicant, but it is all on the surface. Within there may be a burning desire to get any kind of work but this feeling is disguised because it might interfere with the applicant's prospects. Prolonged waiting often sours the applicant who, illogically enough, loses courage just at the time when his ambition is about to be realized. There might be some excuse for delay in the employment office if there was an effort to make the applicant comfortable in the waiting room, but, the contrary is often the case and the applicant is thus thrown back on his own melancholy reflections, which are bound to react on his attitute toward the prospective work. Then, when the time comes for taking the job he disappears.

Another contributory cause is in the casual treatment applicants usually receive from the interviewer. The job is indefinite, the wages are indefinite and the other conditions, which may be of interest, are not even mentioned. The incipient worker is given a few incoherent, verbal directions as to where to go, whom to see and when to start. He knows, from previous experience, unless he is a "floater" who enjoys such adventures, that the first day's work at any job is the hardest because it is filled with doubts and perplexities which no one seeks to relieve.

Whether rational or otherwise some applicants dislike physical examinations, particularly as no effort is made to point out the possible benefit of such a procedure to them. The brusk and bustling nurse is absorbed in her own duties and has no interest in the troubled mind of the applicant, and so he is gradually acquiring a case of "cold feet," unrecognized in the medical department as a symptom particularly dangerous for the future job.

Even after the whole procedure has been accomplished some simple fact as yet unexplained may cause the applicant to decide that the job is not for him. Besides, he has yet to make the acquaintance of the plant, the foreman and the actual working place where he will be expected to spend much of his waking hours for the future. The connecting link between the employment office and the working place is generally very weak if it exists at all. The worker who would like to be on the payroll is stumbling round the yard without knowing exactly where to go. Since the above are only a few of the contributory causes it will be understood that the remedy for "false starters" must be comprehensive.

Primarily there must be a full realization of the existence and size of the loss through carefully gathered statistics. These will often indicate some obvious remedies but, one of the first things, not apparent from any statistical abstractions, is that the solution lies in the application of teamwork, salesmanship and common sense to the problem by all those who come in contact with the applicant. This means that there must be co-operation all along the line from the time the applicant enters the employment office until the moment when he is firmly planted at work. The interviewer, the connecting link between him and the foreman, and the foreman himself must all be alive to the situation and this is only attained by the education of each in the requirements of their respective duties toward the applicant.

A Chance for Study

Systematization of the interview is an important step provided it is designed to meet the issue. By this is meant not a careful holding to routine but a studied application of ordinary, common sense methods to the problem and the improvement of technique in the procedure. This may or may not involve a knowledge of human psychology, but it does involve careful organization. If false starters are to be eliminated this, at least, is essential.

The applicant's point of view regarding work and the plant must be ascertained. The possible advantages of the work to the applicant must be explained. Few employers, though they may have spent millions to advertise their wares to the public, will not consider spending a cent in advertising the plant to the prospective worker. In the mind of the applicant the plant may have a reputation to live down. It is the function of the interviewer to dissect his point of view.

An important feature is to establish a specific connecting link between the employment office and the job itself. This may involve the creation of a trained messenger service and a proper system of introduction whereby the applicant is continually kept in hand until he is put to work or provided with such literature and information as will make him want to return in case he does not start work immediately. In some plants a moving picture show, full of interest and information, is provided for such as are about to work. The pictures first show the sources of raw material, the small beginnings of the plant, the method of manufacture, the personnel, some safety lessons and health hints. Thus the monotony of waiting is relieved and the applicant is prepared for his future career.

When the Pay Should Commence

It is obviously a good plan to get the new man to work as soon as possible, but this is hardly essential if interest has been aroused. Earl B. Morgan, of the Curtis Publishing Co., writing recently upon this subject, finds it advisable to give the new employee a full day's pay for the first day if he starts work as soon as approved by the employment office. The cost is inconsiderable in comparison with its influence in sweetening up the new man's feelings. The percentage of false starters is found to increase progressively with the length of time which they have to wait before beginning work, but, even there Mr. Morgan has succeeded in having forty-nine girls report over Sunday out of a possible fifty-one and the two delinquents sent messages regretting their absence! That is a good performance and it is accomplished by means of a re-interview after the applicant has had a full opportunity of learning the best and the worst concerning the work about to be undertaken.

The general appearance of a plant is not unimportant by any means. Sloppy or dusty roads, a broken gate and a dirty exterior must convey an impression of disorder and unattractiveness within which cannot fail to affect the desire of the worker. If, on the other hand, the entrance has a well kept, prosperous look the inference is naturally drawn that it must contain prosperous employees. The employment manager will, therefore, do well to see that the condition of the entrance and its surroundings is kept as trim as possible. A little gardening adds much to appearances and such small details are not without their effect on the elimination of the false starter.

England Investigating Her Water-Power Resources

The British Government has begun an investigation into the water power resources of the United Kingdom to determine how far "white coal" may be relied upon to supplement the nation's coal resources. Through its English information service the Bankers Trust Co. of New York is advised that special committees appointed by the British Board of Trade and the Privy Council are at work on the investigation.

Furthermore, an official water-power resources committee has already examined and reported favorably upon nine separate schemes of water-power development in the Scottish Highlands. These nine schemes, it is estimated, would yield an aggregate of 183,500 hp. at a cost much below the present cost of generating power in Scotland by the use of coal.



Making a 52-In. Planer from a 36-In. Machine

By Donald A. Hampson

In most manufacturing machine shops, the planer work forms the basis, or foundation, for the product; frames, bases, slides, special fittings—all have to go on the planer first for machining the surfaces to which other parts are attached and fitted.

There is shown in Figs. 1 and 2 a planer that was put in without straining the factory's capital. A 52-in. planer was needed to keep the planer work up with the increasing orders as well as to keep down the cost of the work, which was all plain cutting of the kind where one man can easily attend to two or three machines.

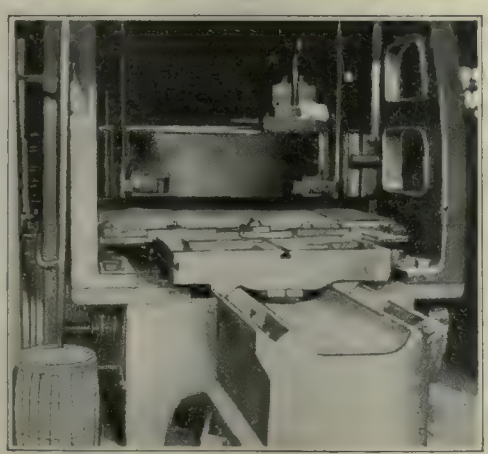


FIG. 1. REAR VIEW OF WIDENED PLANER



FIG. 2. FRONT VIEW OF WIDENED PLANER

A 30- and a 42-in. machine had been in the shop a long time but the great need was for a machine that would handle the 51-in. castings that came along, as well as the narrower ones made in larger quantities. A survey of the field showed that there were no used machines of this capacity with tables less than 14 ft. long—and the shop's work never ran over 7 ft. in length. The extra floor space, the excess of power required to move the big table, and the prices of nearly five figures put these machines out of the question.

After it had been decided to get along without another planer, a representative of the plant visited the warehouse of one of the "Searchlight" advertisers to get some milling machines. These had been inspected and the representative was being taken to the shipping door to see the dealer's railroad facilities, when he spied a planer off in a dark corner. "That's a 36-in. machine," said the warehouse man, "she's all shot though, no good for anything but stone work. You can buy that for $700 as she stands, but it's too small for your work." However, the representative took a good look and made some measurements. He did some hard thinking going over on the ferry to the office. The result was that he got the planer "thrown in" with his millers for $500—and another $140 put it on the floor in his plant.

A study of Fig. 1 will show how the machine was widened to 52 in. At the shop's hourly rate, it cost $260 to do this work, including the refitting and the putting in of new parts. Some parts of the machine *were* "shot"—parts to replace those were bought from the makers. Other parts, such as the V's, had plenty of metal in them for replaning. The new parts cost $265 delivered, and they included new gears and longer shafts. Thus for $1,165 a very satisfactory machine was delivered on the floor ready to belt up.

It will be noticed that the cross-rail elevating screws are several inches inside the uprights and also that the clamps for the rail are put inside of the housings instead of outside; likewise that the rail, which was extra long for a 36-in. machine, does not quite reach the outside of the uprights in their new setting, though long enough for 52 in. feed. All of these drawbacks were weighed against the service to be required of the planer and it was decided that they offered no serious hindrances and that it would be worth while to save the cost of altering to standard type. The work to be done on the machine never ran over 4 in. in height, making it rather special in character. Several months of service have justified the saving in alteration expense.

The widened planer had a table of the same width as the 42-in. machine already in the shop, so that the same work and fixtures go on without any changes. Its length of 7 ft. was admirably suited to the space and needs of the shop. For the widest castings planed brackets are used to support the overhanging ends and center. The forward brackets act also as posts, or stops. This machine and the 42-in. planer are operated by the same man. To save time and walking the planers face in opposite directions, so that both controls are near the operator.

Some one rises to remark that the best paying tools are the most modern ones (and these are the highest priced). This is generally true. But it is likewise true that many concerns run their businesses without any too much capital, when they come to pit it against present day prices, and they must buy, if at all, within their means. And again, there are jobs which may be tooled up or arranged so that older machines in multiple will do as much as the modern machine in standard practice—the man of limited means must use his wits to beat his pocketbook. And finally, it is a known fact that countless machining operations consist of cuts so light that the power of the most up-to-date machines cannot be more than half utilized; for such work the older tools will answer just as well if in good physical shape.

A Hob-Grinding Attachment

BY R. A. WILSON

The hob-grinding attachment here described was designed and built by the Autocar Co. for grinding hobs with helical flutes, but it can, of course, be used for grinding hobs with straight flutes.

The attachment is shown in Fig. 1 mounted on the table of a Cincinnati universal cutter and tool grinder. In Fig. 2, part *A* is the body of an indexing head that carries the center *D*, on which is mounted the dividing plate *E* and handle *F*. Keyed to *E* is the gear *G*. The casting *A* houses also the rack *H* meshing with gear *G* and giving the center *D* a rotary motion, which is in turn transmitted to the arbor *I* through the dog *J*.

Part *B* is an arm suitably mounted on the saddle of the machine and having a slot milled throughout its length, in which slides the block *K* fastened on the end of the rack *H*. The angle to which the arm *B* is set with the table determines the travel of the rack *H* and the angular movement of the gear *G*, the travel being zero when the arm is parallel with the table. *B* is bored to receive the stud *L* that is tapped into a boss in *C*, which, in turn, is bolted to the saddle of the grinding machine. The arm *B* can be locked in any position by the nut *M*.

To grind a hob, which is mounted on the mandrel *I* between centers, the arm *B* is set to the angle required to suit the helical angle of the flutes, the edge of *B* at the pivoted end being graduated in degrees to facilitate this. The indexing handle *F* is adjusted to the proper circle of holes on the indexing plate by loosening the nut *N*. It will be noticed that the handle is slotted and fits over flats on the end of center *D*. The handle *F* carries a spring plunger *O* which engages the holes in the dividing plate *E*. The stops on the table are next set to give the necessary travel, and the end

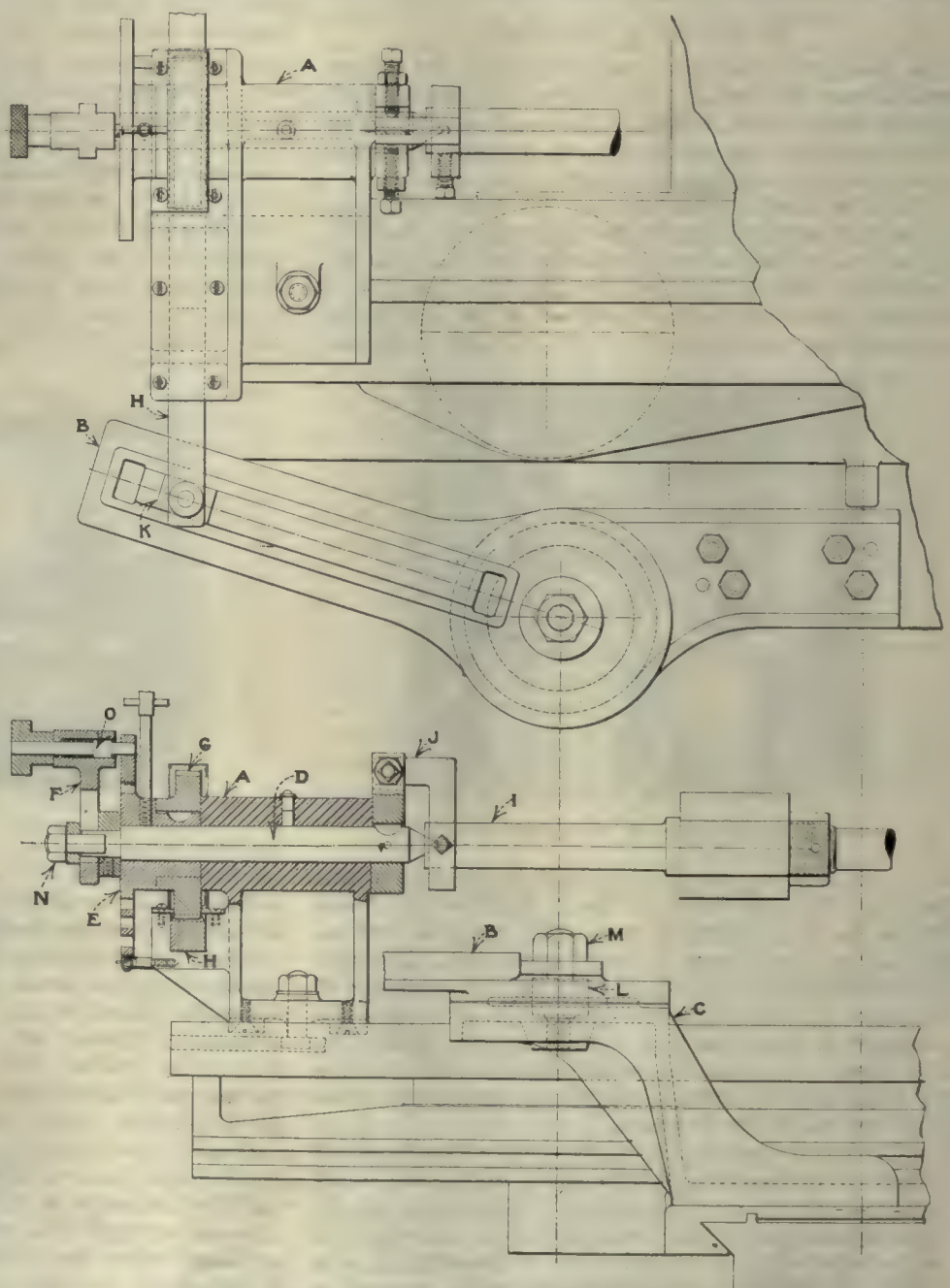


FIG. 2. DRAWING OF A HOB-GRINDING ATTACHMENT

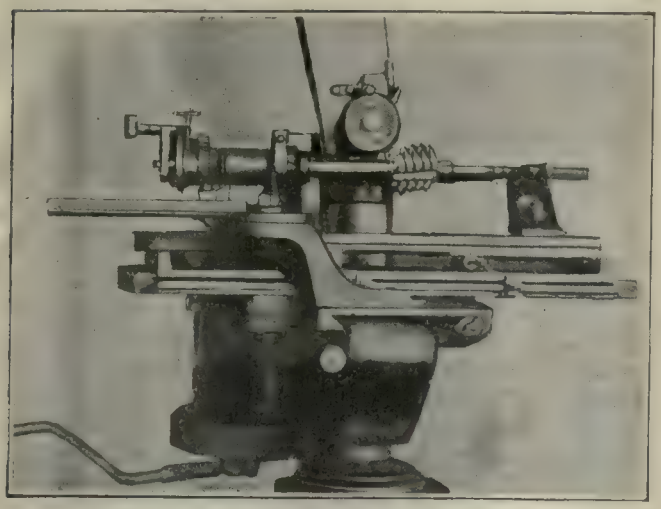


FIG. 1. HOB-GRINDING ATTACHMENT ON A CUTTER GRINDER

of the first flute is brought in line with the wheel. Rotation of the hob while grinding is automatic, as the reciprocating movement of the table causes the block *K* to slide in the slot of the fixed arm *B*, thus moving the rack back and forth and imparting a reciprocating motion to the gear *G*. The motion is transmitted through the indexing plate and handle to the hob. After grinding one flute, the hob is indexed by hand to the next, and the grinding continued.

Strength of Shafts and Beams

BY JOHN S. WATTS

The size of a shaft necessary to carry a given load, as a beam, with the load concentrated at the center and supported at both ends in bearings, can be readily determined by the use of the chart, Fig. 1.

Knowing the load and the centers of the bearings, the size of shaft required can be read directly off the chart at the intersection of the diagonal line for the load with the vertical line for the centers of the bearings. Or, given any two of the three factors, size of shaft, load, and distance apart of bearings; the other can be determined at a glance.

For example, to find the diameter of shaft required to carry a load of 13,000 pounds with the bearings spaced 50 in. center to center. Following down the 13,000 diagonal line to its intersection with the 50 vertical line, we find from the next higher horizontal line that the diameter required is $6\frac{3}{8}$ in.

The chart may be used for any span beyond its range by remembering that the load a beam will carry varies inversely as the span, and therefore if the span is over 100 in., we may take one-tenth of the span and ten times the actual load, and the diameter given by the chart will be correct. It is not essential to take ten as the divisor; any other number will give the correct result, so long as we multiply the load by the same number by which we divide the span.

For instance, if the load was 10,000 lb. and the span 120 in., we could take 60 in. span on the chart and 20,000 lb. as the load, using a divisor of two in this case.

The formula used in making up the chart is, of course, the one for beams supported at each end and with the load concentrated at the center of the span and is:

$$W = \frac{4fz}{l}$$

Where W = load in pounds
f = stress in pounds per square inch
z = modulus of section $= \frac{\pi}{32} d^3$
d = diameter of shaft in inches
l = length in inches, center to center of bearings.

The load on the shaft given by the chart is the total load, and when the distance between the bearings is great the weight of the shaft itself should be deducted from this load to arrive at the net safe load. But in the average case the weight of the shaft may be neglected.

The stress used in making up the chart is 6,600 pounds per square inch. This may seem to some a very low stress, but the writer's experience has proved that a higher stress will sooner or later cause a fracture of the shaft, and instances of such breakages will be given as proof further on. It should be remarked in considering the stress that can be allowed on a shaft carrying the pull due to belt pulley or a rope sheave, that the stress is rapidly alternating between the maximum in compression and the maximum in tension, because each half revolution of the shaft changes the stress in the outer part of the shaft from the maximum tensile stress to the maximum compressive stress. With a shaft running at say 200 r.p.m., this will mean 200 × 60 × 10 = 120,000 alternation or reversals of stress per ten-hour day. The writer, some years ago, had knowledge of a

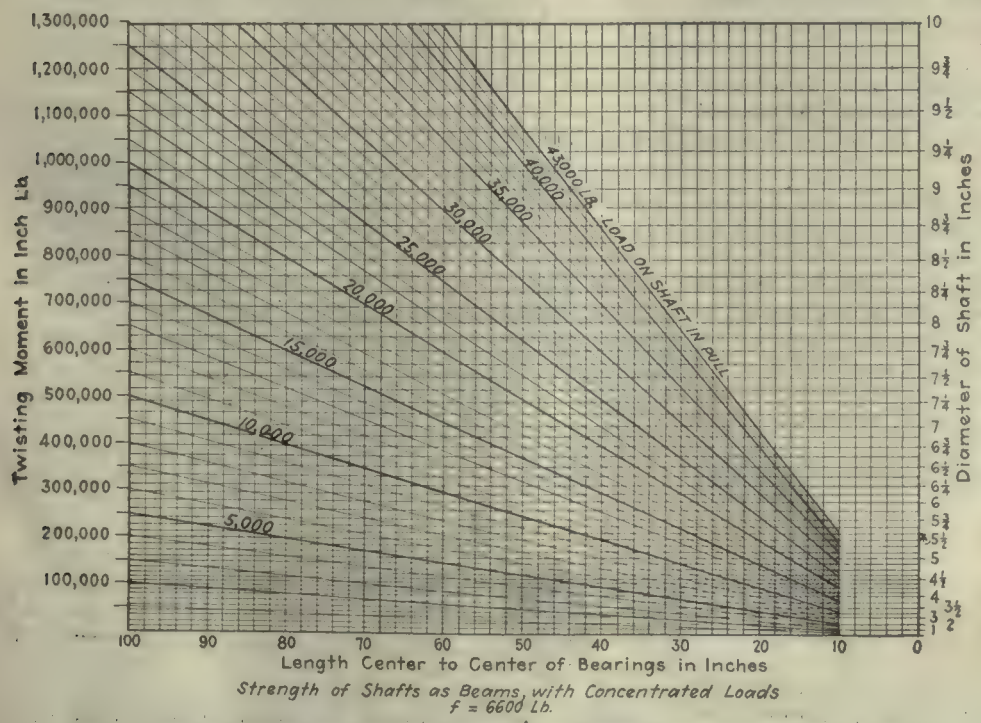


FIG. 1. CHART SHOWING STRENGTHS OF SHAFTS CONSIDERED AS BEAMS

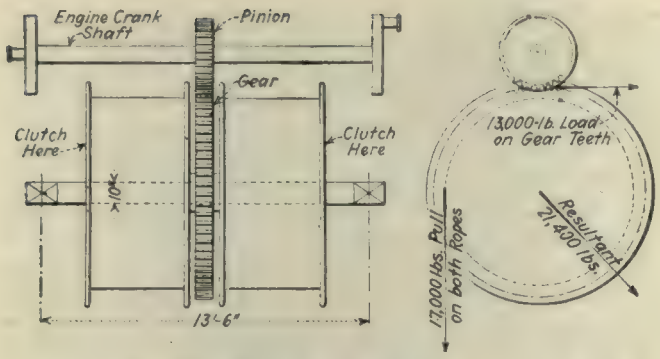


FIG. 2. ARRANGEMENT OF BEARINGS AND GEAR ON SHAFT THAT BROKE

case of a mine haulage machine in which a shaft carrying the rope pulley, and not subject to any torsional stress, but only the bending stress due to the pull of the rope, was originally made 10 in. in diameter. Owing to the lengthening of the slope and gradual increase in the output of the mine, the load ultimately became too much for the shaft, and it broke.

Calculation showed that the stress on the shaft due to the pull on the rope was about 14,400 lb. per sq.in. It was decided to increase the shaft to 11½ in. diameter, which reduced the stress to around 9,500 lb. per sq.in., but this new shaft only stood for about six months when it also fractured, although the load had not been increased during that time.

The owners were not convinced that the stress was too high and blamed the quality of the steel in the shaft, but analysis and tests showed that the shaft was of a good average quality of steel. Finally another shaft was made 12 in. in dia., thus further reducing the stress to 8,400 lb. This shaft stood up to the work for about a year, when it too broke, and this time was replaced by a shaft 13 in. in diameter, which gives a stress of 6,600 lb. per sq. in. This last shaft has now been in commission some seven years and shows no sign of distress.

Another case that came to my knowledge was that of a hoisting engine. The main shaft was 10 in. in diameter and carried two drums, being driven by a gear in the center.

The drums were loose on the shaft and were driven by clutches on the outer or bearing sides of the drums, so that the shaft was under torsional as well as bending strain.

The general arrangement is as shown in Fig. 2. The pull on the rope hauling up the full cars was 13,000 lb., and on the other rope, letting down the empties, was 4,000 lb., making a total pull of 17,000 lb., pulling horizontally on the shaft, practically in the center of its span when both ropes were at the inner side of the drums. The pressure on the gear teeth would be that due to the loaded cars coming up, namely 13,000 lb., acting vertically downward, and the resultant of the two loads works out to 21,400 lb.

This gives a stress on the shaft, from the formula:

$$W = \frac{4 f z}{l}$$

$$\therefore 24{,}000 = \frac{4 \times f \times 101.9}{162}$$

$$\therefore f = 8{,}560$$

In addition to this, we have the stress due to the torsional moment, which is 13,000 lb. at 54-in. radius, and, calculating the stress from the formula:

$$\text{Torsional moment} = T = \frac{\pi}{16} d^3 \times f_r$$

$$\therefore 13{,}000 \times 54 = \frac{\pi}{16} \times 10^3 \times f_r$$

$$\therefore f_r = 3{,}580$$

Combining the two stresses we have

$$\text{Total stress} = \frac{f}{2} + \sqrt{f_r^2 + \tfrac{1}{4} f^2} = \frac{8560}{2} + \sqrt{3580^2 + \frac{8560^2}{4}} = 9{,}860 \text{ pounds.}$$

As might be expected, this shaft has broken repeatedly, a new shaft lasting only some five to eight months. At present the slope at which this hoist is installed is not being used so no attempt has been made to remodel the hoist, but I do not believe the shaft would stand unless increased in diameter sufficiently to reduce the total combined stress to not over 6,600 lb. And even then the arrangement is a poor one, as the gear, being so far from a bearing, will inevitably tend to set up vibration in the shaft. The proper cure would be to widen out the engine and install a third bearing next to the gear in the center of the shaft.

The chart is made up principally for shafts under bending strain only. For shafts under both bending and torsional strains the easiest way is to convert both into a total equivalent twisting moment by the formula:

$$T_1 = B + \sqrt{B^2 + T^2}$$

Where T_1 = equivalent total twisting moment in inch pounds

B = Bending moment = $\frac{W \times l}{4}$ in inch pounds

T = Twisting moment in inch pounds

W = Pull on shaft in pounds

l = Length between bearings in inches.

And then calculate the diameter of shaft required from the formula:

$$T_1 = 0.196\, D^3 \times f \quad \therefore D = \sqrt[3]{\frac{T_1}{0.196 \times f}}$$

using 6,600 lb. for the stress f.

To facilitate this calculation a scale of twisting moments has been added at the left-hand side of the chart. This gives the twisting moment that each diameter of shaft is good for at a stress of 6,600 lb. per sq.in.

For economy of material the shafts carrying rope sheaves are generally made like Fig. 3.

The chart will much simplify the determination of the various diameters, as the diameter required at any point A, to have a strength equal to that of the larger diameter in the center, can be found by reading from the chart the diameter required for the same load on a shaft with a span equal to 2 X; X, being the length from the center of the bearing to the point A.

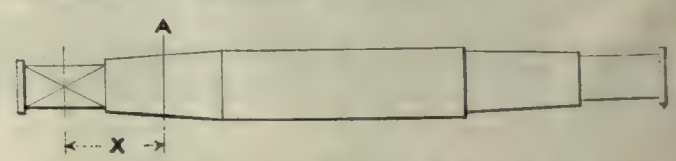


FIG. 3. CONVENTIONAL DESIGN OF SHAFT BEARING CENTER LOAD

The English and the Metric Measuring System—A Comparison

By C. C. STUTZ

Considerable confusion exists as to just how the metric system differs from the English system, and why the compulsory adoption of the metric system would cause untold trouble and expense. Many advocates of the metric system are mixing the metric system with a decimal system. Because a certain measure is expressed in decimals does not mean that it is a metric measure, although many think so, and pro-metric advocates deliberately foster this mistake. This article also disabuses the mind of the common error that a carat is a metric unit.

THE fundamental importance of a system of weights and measures is, as a rule, not realized by the individual for the simple reason that the system has become automatically a part of his thought activity. He uses the system's units of length, weight and volume to visualize things, descriptions, expressions, conditions, relations, events, values, abstract facts and natural laws. His familiarity with them has become a habit and he uses them subconsciously. They have become, in fact, a part of his mental equipment. Thus they are taken for granted.

They are intimately interwoven into the business life, the home life and the intellectual life of every human being, man, woman and child. None can do without them. In every line of work they are used as tools and on the system they collectively form are based all achievements, are systematized and standardized all results of thought and work.

Based on them has been gradually built up during the years the life of the nation in its multiplicity of endeavors, represented by production, invention, industry and trade making for advancement, knowledge, betterment and comfort.

Now the suggestion is made that this system be changed for a radically different one, a system for which some advantages are claimed, but which has not as yet proved its superiority in the experience even of those who have accepted it.

The change from one system of weights and measures to another involves not only the stupendous task of changing the daily habits of the people, but also involves the application and use of both systems during the protracted period of education, incidental to which confusion and errors are a natural consequence. Nor is such a change accomplished without an enormous effort, which spells a cost practically beyond computation.

In the face of such conditions it behooves us, therefore, to examine very carefully the merits of the system of measurements offered to us in order to properly balance the advantages to be gained against the disadvantages so very evident. Such a comparison will be found in the succeeding paragraphs.

The metric system was, no doubt, at the time the eminent scholars conceived it, an earnest effort to create a scientific system of weights and measures. Unfortunately in those days industrial development was in its infancy and the men charged with the task, having no practical considerations to guide them, brought out a system based purely on theoretical lines.

Since then conditions have changed. Industry has claimed an increasingly important position and has enlisted in its service an ever-growing number of individuals. This multitude of artisans, in whose hands any system of measurements is but a tool like any other, has progressed or lagged behind according to the handiness and convenience of the system imposed upon it. Today the great industrial nations are the United States and Great Britain, both of which have resisted the introduction of the metric system as an implement lacking the qualities so necessary for rapid development. This does not imply that the English system of measurements is perfect. Some of its units and sub-divisions have become obsolete by disuse. This is as it should be. It is a matter of evolution and growth stimulated by experience and changed conditions and applies to most criticisms of this system.

Measures of Length

We have as Units of Length:

1 Yard = 0.9144 meters
1 Foot = 3.048 decimeters
1 Inch = 25.4 millimeters

And conversely:

1 Meter = 1.0936 yards
1 Decimeter = 3.937 inches
1 Centimeter = 0.3937 inches
1 Millimeter = 0.03937 inches

The accompanying illustrations, Figs. 1 and 2, show some relative comparisons of English and metric units of length. A study of Inch-Foot-Yard and Centimeter-Decimeter-Meter will show at once that the former three dimensions harmonize perfectly for practical use, while in the latter the unit sub-divisions of the meter represent too great a step from the meter itself. In the "inch" and "centimeter" the same defect is apparent to which is added the "indivisibility" of the centimeter

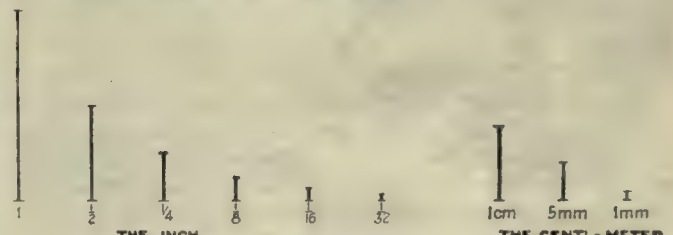


FIG. 1. FULL SIZE COMPARISON OF "INCH" AND "CENTIMETER"

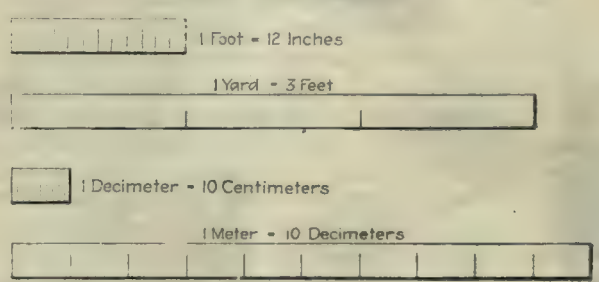


FIG. 2. RELATIVE COMPARISON OF ENGLISH AND METRIC UNITS OF LENGTH

as compared with the inch. To the mathematician this is a matter of indifference, but not so to the workman. Divide the inch into 1,000th's and the millimeter into 100th's, as required in work of precision, and the metric unit is too small.

The 1/1000th of an inch by means of the micrometer is used by the workman as easily as the inch itself, while the 1/100th of a millimeter, which is about 40 per cent of the former, requires an especially developed touch to be readily perceived. Thus the former dimension becomes a handy unit while the latter lacks this characteristic. In work of precision to cut down to one-half the allowable limit as a general rule, doubles the expense of production. On the handiness of the tools he used depends a workman's output. This explains why the American workman has made a success of the system of "interchangeable parts" and thus has made possible "standardization" in practically every line of endeavor.

There is no metric unit comparable with the "foot." This English dimension is used so universally that it would be a hardship to use the meter in its place.

The kilometer (1,000 meters) is the largest unit of length and is equal to 0.631 miles and conversely one mile equals 1.609 kilometers.

The nautical or sea-mile equal to 1.853 kilometers and being used universally by all maritime agencies the world over will probably never yield to the kilometer, because it is based on a rational and, for purposes of calculation, convenient basis. Sixty nautical miles are equal to one degree of the earth's circumference at the equator and therefore one nautical mile equals one minute of the arc.

Measures of Area

The common units are the square foot and the square inch and in the metric system the square meter and the square centimeter.

1 square foot	=	0.093 square meters
1 square meter	=	10.764 square feet
1 square inch	=	6.452 square centimeters
1 square centim.	=	0.155 square inches

The multiple units in our system are the acre and the square mile, several lesser multiples being very little used and practically obsolete.

The metric multiple units are:

The are	=	100 square meters = 0.0247 acres
The hectare	=	10,000 square meters = 2.4710 acres
The square kilometer	=	1,000,000 square meters = 0.3861 sq.miles

Here especially is noticeable the great difference in the values of units between the two systems. The English units evolved by experience and ante-dating the creation of the metric units have no convenient equivalents in the latter system.

Measures of Weight

The unit of weight in the metric system is the kilogram, equal to 2.2046 pounds. That this unit is an unhandy one because too large, is proved by the constant use in metric countries of the ½ kilogram as a substitute unit which is called the pound in everyday retail transactions in France, Belgium, Germany, Italy and Switzerland, and such expressions as ½ and ¼ pound are common in these countries at the present day. The tendency to use old local units is admittedly still pronounced in most European countries.

For goods handled and traded in bulk we have used the long ton of 2,240 pounds, but experience has shown that the short ton of 2,000 pounds is handier and this latter unit has displaced the former to such an extent that the long ton is being used less and less and will soon be obsolete showing clearly the adaptability of the English system to conform to changed conditions.

The metric ton of 1,000 kilograms is equal to 0.9842 long tons and equal to 1.102 short tons. It corresponds, therefore, closely to the long ton or the unit we are discarding.

A few words may be added here on Troy and Apothecaries weights and on the carat. These units have been devised for special purposes, where particularly small sub-divisions are required.

The Troy pound is never used, but its sub-divisions are employed to weigh gold and silver only; its smallest division is the grain. The grain is a uniform standard of weight, the same for the Avoirdupois, Troy and Apothecaries pound. The former has 7,000 grains while the latter two each have 5,760 grains.

The Apothecaries pound, or rather its sub-divisions are used only by physicians and druggists.

The carat is used only to weigh diamonds. Recently this unit was standardized and its value defined as 200 metric milligrams, showing clearly that for this purpose the decimal division of the metric gram was not suited. Though expressed in metric terms it is not a metric unit.

These special units covering small restricted and particular fields are a thing apart from the broad general scheme of weights and measures and bear no controlling influence on same.

Measures of Volume (Dry)

For units of volume (dry measure) we use cubic yards, cubic feet and cubic inches while the metric units are the cubic meter, the cubic decimeter and the cubic centimeter. They compare as follows:

1 cubic yard	=	0.7645 cubic meter
1 cubic foot	=	28.317 cubic decimeters
1 cubic inch	=	16.387 cubic centimeters
1 cubic meter	=	1.308 cubic yards
1 cubic decimeter	=	0.035 cubic foot
1 cubic centimeter	=	0.061 cubic inch

While the cubic meter is considerably larger than the cubic yard, its sub-divisions are so small that we have practically no approximate equivalent for the cubic foot and the cubic inch, units which have become indispensable, as shown by the far wider application they enjoy than the cubic yard. The wide divergence between them and the metric sub-divisions, which would have to be used in their place, points prominently to the unhandiness of the latter.

A unit for dry measure used extensively by the vast farming community of the country and those connected with its trade is the bushel. The standard United States bushel is a measure in cylinder form 18½ inches in diameter, 8 inches deep, containing 2154.42 cubic inches. One bushel = four pecks of eight quarts each, with two pints to the quart.

Because of the greater convenience of measuring many farm products by weight, especially when handling very large quantities, the practice has developed of adopting units of so many pounds, as per example 60 lb. for potatoes, 48 lb. for barley, etc.; and calling these units bushels. These weight bushels are approximations of the capacity bushel. In view of the ingrained character of the bushel standard to which the farmer clings tenaceously, the weight bushel which permits the buying and selling of farm products by weight serves a useful purpose.

When we consider liquid measures, we find in use the gallon which equals 3.785 liters, the metric unit. Conversely one liter equals 0.264 gallons.

The gallon is the largest unit. We have no multiple units of the gallon, because no need for such has developed, while in the metric system we find one decaliter = 10 liters and one hectoliter = 100 liters. These multiple metric units are confusing because of the limited call for their use.

On the other hand, experience has shown the need of a great many sub-divisions of the gallon hence we have quarts, pints and fluid ounces, a field which is very poorly covered by the decimal parts of the liter.

Binary and Decimal Divisions

During the centuries preceding the invention of the Metric system, which system was put together in the eighteenth century, systems of weights and measures were evolved by the various peoples living separated and apart from each other. Invariably such efforts were based on the binary system of division. The reason for this is plain. The mind works logically in that direction. Taking a measurement, be it length, area or weight, what is more natural than to halve it, then halve each part again and so down to the size which, for the problem before it, becomes the quantity wanted. This method presents the quality of ease and handiness, thus the path of least resistance is followed.

The method adapted by the metric system is to divide the original measurement or unit by ten and then express the quantity required as a multiple of one-tenth. In other words we compel the mind to travel in one direction and then retrace its steps.

A good example of the tendency to binary division is found in metric European countries where the expressions pound, half pound and quarter pound are much used in retail trade to indicate respectively ½, ¼ and ⅛ kilogram, the correct values for these expressions being in the order named 500, 250 and 125 grams.

Individual units of the English system such as the inch, foot, yard and mile are often divided decimally to serve a given purpose. This must not be confused with the decimalization of a system which means the establishment of a decimal ratio between the units themselves.

Conclusion

Briefly stated the metric system is devoid of the English system's handiness and convenience; its units are either too large or too small for the every-day requirements of industry.

From the English system many sub-divisions have been dropped, having outlived their usefulness; thus proving the English system's adaptability to the requirements of progress. The metric system, on the other hand, presents a rigid structure incapable of modifications and requiring conditions to adapt themselves to its use.

Selling American Machinery in Foreign Markets

By H. M. HEIN
Manager, Machinery Department, Smith-Eisemann Corporation of America

THE average manufacturer in this country now realizes the possibilities of exporting machinery to foreign markets. He has heard "export" for the last five years, probably obtained a fair amount of orders and desires to continue increasing the demand for his machinery abroad. If his organization is a large one he will appoint a Foreign Sales Manager, giving him the necessary power and authority to develop the business in a large way and to "build business" by maintaining and increasing his relationship with foreign dealers or agents who have represented him or who are desirous of handling his line.

Some Serious Problems

Here the serious problem confronts the manufacturer. He will be satisfied to expend only a limited amount of money in the development of the export business, therefore the average export executive must rely absolutely upon the connections he has made, chiefly through correspondence. Does the average dealer in foreign lands want to be confronted with the problems of receiving a factory's quotation, all prices based f.o.b. factory; comparing the prices of one factory with another; translating an English technical catalogue into Spanish or any other language; paying cash (in most cases) against inland railroad bills of lading; converting American standards into metric system; and numerous other difficulties which arise, making the problem of the importer or agent a serious one?

The ideal method of introducing machinery in foreign countries is for the broad-minded manufacturer to establish an export department and conduct it along the exact lines he has used in developing his domestic business. Establishing such a department means more than obtaining the services of a high-priced executive. The export office should have its staff of travelers. These men should be representative, well acquainted with the countries' conditions, possess the proper technical knowledge and experience, know the languages of the countries thoroughly and be to a large degree conversant with their banking terms, conditions of sale, import duties and the like. Such men are hard to find and demand large salaries. Their expense accounts often prove disastrous to the factory that desires results.

Sending College Men Abroad

The alternative is to send bright young men, preferably college graduates, who are well acquainted with the factory's products, to foreign lands and give them sufficient time to get acquainted and make good. In addition to the selling force assistance from "back home" is necessary and the successful export department should have estimating clerks, shipping assistants familiar with packing and freight rates and French and Spanish stenographic forces. All of this means considerable expenditure and only the largest factories in this country are prepared to make an adequate investment for future returns.

We have yet to take into consideration the extension of credits in foreign countries. Volumes can be written on the subject of credit. It is a fact that the buyer is accustomed to longer terms than the average domestic dealer. The careful National banks in this country are all advocating a limitation of credits for export, yet the life of export depends upon the credits we are willing to extend to our foreign buyers and the subject must be carefully investigated by the credit department of the factory. It is the big end of the business and the life and growth of the volume of business depend largely upon handling it in the correct manner. If the average manufacturer has not the facilities to pursue this mode of operation the only other sensible alternative is to operate through an American engineering exporter.

Development of Business Through Exporter

Much has been written and said about the desirability and the undesirability of the American exporter. The word "exporter" has been applied to large technical engineering export-firms, who have been established for years, in the same breath as the "mushroom garden" variety of exporters who have sprung up during and since the war. The manufacturer should differentiate between these classes and get in touch with a firm of exporters who have representatives and offices in foreign countries and who are conversant with the line of machinery to be handled, thus developing and building up the business of the manufacturer in the various countries of the world. The exporter then eliminates for the manufacturer the cost of conducting an export department and at the same time enjoys the benefit of export business.

The average manufacturer should treat the exporter fairly, should not exact from him terms that are more stringent than he could ever hope to obtain from his domestic dealer, should give him the co-operation of the factory and all discounts that are furnished his domestic representatives and should appropriate a budget for *real* export advertising. It is also necessary that he place his confidence in the exporter in order to procure proper results. The contract between the manufacturer and the exporter should be for a minimum period of three years, to allow the proper time for each foreign branch and its representatives to introduce the goods and to develop and concentrate their efforts in behalf of the manufacturer.

The manufacturer should be willing to prepare his catalogs and price lists in the various languages, having the translation done by an efficient translator who understands technical phrases and their adaptation to Spanish or other foreign languages. This is an important matter as the language used in the description of a machine means to a great degree its saleability. Proper thought given to exporting of machinery will be the means of fostering our foreign relationship.

It is the writer's intention to alone emphasize the salient features based upon his knowledge and experience in development of foreign markets. The exporting of machinery requires more intensive sales promotion and concentrated efforts than any other articles, either raw products or finished, offered in foreign markets. The productive efforts of concentrated promotion would bring the desired results to our manufacturers and enable them to give just and due consideration to the export business.

A Modern "Contemporary" of an Old-Time Machinist

By James Tate

I very much enjoyed reading the "Reminiscences of an Old School Machinist," on page 533 of *American Machinist*, as it brought back to me very vividly the memory of my own apprenticeship days.

You will doubtless think that to have worked in a shop such as he describes I must be at least very nearly as old as Mr. Huntington, such has been the advance in shop equipment in this country in the past fifty years. Not so; it is a mere twelve years or so since I first received a warning "crack on the jaw" from the "heel tool" as we knew it, and to my knowledge, the same tools are still in use in that shop. This was in the machine shop, or rather "mechanics shop" of a weaving factory in Belfast, Ireland.

Center drills, as Mr. Huntington says, were unknown, the center was first prick-punched and then driven in with a heavy centerpunch and "batten hammer." When turning small studs, screws, etc., a "turner," as the lathe hands are known over there, would not think of changing gears and sharpening tools to cut one thread, but would take the material to the hand lathe, which consisted of a head and tailstock, with the necessary rests, mounted on the end of the bed of a long lathe, and proceed to rough out the piece, and cut the thread by hand, finishing with the chaser; completing a job in very good time, indeed, astonishing time compared with the work of some of our present-day mechanics.

We had no emery except the "buffing wheels" made as Mr. Huntington describes, and perpetually bald in spots; all our tools were ground on a heavy, slow-speed grindstone, which one of the apprentices would true up every Saturday, using a broken round file as a tool.

I have also used the machine he describes as a "cotter drill" for cutting keyways; although ours was improvised from an old drill press, using the compound rest of a lathe clamped to the table to hold the work and to get the feeds which, of course, were by hand. All our keyways and slots were cut on this machine, except when it was busy and we had no time to wait; when we would cut keyways on the shaper, or, failing that, clamp the shaft in a vise, mark off and cut the keyways by hand.

All keyways in pulleys, crank webs, etc. were cut out by hand, using a small, home-made T-square to mark the location in the hub, then chipping out the slot with a cape chisel and finishing it with a file.

The ordinary day's work in many a small repair shop of this character in the "old country" would make the boss of many modern machine shops engaged in maintenance work over here gasp for breath. I don't know the reason for it, except perhaps that the mechanics working with such meager equipment must use their brains more than those who have everything they need at hand, and that this stimulated intelligence is reflected in their work. However it may be, there is a great deal to be said for the old-time mechanic, who would tackle anything and get away with it; and by old-time mechanic I mean not only those who are really "old-timers" but those who, by virtue of working with the same kind of equipment and under the same handicap, become imbued with the energy, initiative, and versatility which made the "old-timer" the grand mechanic that he was.

WHAT to READ —for the man in a hurry



Suggested by the Managing Editor

FRED COLVIN has by no means exhausted his supply of information on the machine work connected with the manufacture of passenger automobiles but this week, for variety's sake, we are switching in a tractor article as a leader. Few of us, perhaps, think of California as anything but a land of sunshine and flowers, good roads and mountain scenery, gold mines and oil wells, but as a matter of fact there are many thriving, well-equipped shops and manufacturing plants. Among them is the tractor plant described where they build a big machine of the track-laying type.

What to read was not a difficult matter to decide two hundred years ago when books were few and magazines unheard of. It is far different now when so much reading matter is offered to pass the time pleasantly or profitably as the reader chooses. We are doing our utmost to make the "American Machinist" not only profitable but indispensable as a clearing house of ideas and news of the machinery world. This page is the editors' advertisement of their section of the paper. It gives the high spots

Passing over the other general articles for the moment we want to direct your attention to the letters from our London and Berlin correspondents on page 923, and particularly to the German one. This issue of the *American Machinist* is coincident with the annual meeting of the Machine Tool Builders' Association and we consider ourselves fortunate to be able to give at this time Mr. Herzog's clear analysis of the machine-tool situation in that unhappy country. As announced before, Mr. Herzog has been appointed to represent the McGraw-Hill papers in an editorial capacity in central Europe. We have arranged to have him send to the *American Machinist* periodical letters on German conditions corresponding to the able ones coming from Mr. Chubb in London. The one appearing in this issue is the first of the series and Mr. Herzog has thought it wise to introduce his letters with a general summary of the status of the machine industry for the past few months. He mentions the wide fluctuations in the export prices of German machine tools—2,000 to 3,300 per cent *above* pre-war figures. The failure and disposal of the plant of the so-called German Niles works is only one among many interesting items. It is a gloomy picture but hardly more so than the one drawn by Chubb in the English letter that follows it. We know what a coal strike is and what suffering and unpleasantness one can cause, but thank fortune we have never had one with an Irish question thrown in for good measure—not to mention a threatened rail strike on top of everything else. Reconstruction seems to be quite as much of a task for England as for the rest of us. Following these letters we have a few notes on the general situation in Italy.

But to return to the front of the paper. Part XII of "Modern Production Methods" starts on page 889. The immediate subject is "Fixed Charges" and Mr. Basset proceeds to explain what to do with them in a convincing way. But his outstanding feat in these few pages is to find something good in the Federal Income Tax Law! You will have to read the article to find out what it is.

This being an off-week in Mr. Morris's apprentice training series we are slipping in a description by L. C. Morrow of the staff, of the training department in one of the big Cincinnati machine-tool plants. Specialists as well as apprentices are trained.

When is a contract not a contract? "Always!" we hear some disillusioned machine-tool builder murmur and recent events in a certain field make us wonder if he isn't right. But aside from the present temporary difficulties the one time when a contract is likely not to be binding is when the labor union is one of the parties. It probably isn't entirely the fault of the union but the real trouble is beyond the wit of the layman to discover. Chesla Sherlock gives some of the facts in the case and quotes decisions to prove his contentions, beginning on page 897.

Two more articles on employment matters will be found on pages 902 and 905 and seem to indicate that this issue deals principally with management. Such was the purpose although not to the exclusion of other articles as the ones on number of teeth in contact of two meshing gears, page 899, precision gages, page 884, and design of taps for steep lead, page 887, will testify.

Breach of contract to the average individual means something scandalous connected with chorus ladies and young (or old) millionaires. What is much the same thing in the eyes of the law is dignified by the term "cancellation" when it comes to business contracts. See page 918 for our point of view on this evil.

Anti-Metric Resolutions

WHEN the pro-metric advocates manage to get some unsuspecting non-industrial body to pass a resolution favoring their cause they immediately try to persuade people in general that there is a landslide coming along in their favor. However, the following resolutions from really representative industrial bodies tell a different story. Please note the recent date in each case.

National Associations

Automotive Wood Wheel Manufacturers' Association, Convention, Cedar Point, Ohio, Aug. 13, 1920:

The Automotive Wood Wheel Manufacturers' Association records its opposition to the compulsory adoption of the Metric System of weights and measures, which various interests are asking Congress to legislate for. We believe that attempts to compel its adoption in the United States are unwise, unnecessary, and calculated to disturb seriously the standards of measurement now uniformly used in this industry.

Hickory Products Association, Convention, Cedar Point, Ohio, Aug. 12, 1920:

The Hickory Products Association records its opposition to the compulsory adoption of the Metric System of weights and measures, which various interests are asking Congress to legislate for. We do not oppose the Metric System as such, but believe that attempts to compel its adoption in the United States are unwise, unnecessary, and calculated to disturb seriously the standards of measurement now uniformly used in this industry.

Photographers' Association of America, Convention, Cleveland, Ohio, Aug. 26, 1920:

Whereas, The members of the Photographers' Association of America, in annual convention assembled, have heard the arguments in opposition to any change in the present form of our standard weights and measures, and

Whereas, It is universally conceded that any change to any other system would work a great inconvenience in a business such as photography, where weights and measures are a part of the daily routine,

Therefore, Be It Resolved, that this association go on record as opposing any action, legislative or otherwise, that would bring about any change in our present form of standard weights and measures; and further be it resolved that the activities of the American Institute of Weights and Measures on behalf of the present standard weights and measures be highly commended.

Steel Barrel Manufacturers' Association, New York City, Aug. 3, 1920:

This association is in sympathy with the efforts to maintain our present system of weights and measures.

District Associations

Southern Metal Trades Association, Convention of North Carolina Division, Norfolk, Va., Aug. 26, 1920:

Resolved, That the North Carolina Division of the Southern Metal Trades Association hereby declares its opposition to any legislation having for its purpose the adoption of the Metric System in the United States as the exclusive legal standard of weights and measures.

Resolved further, That we commend the work of the American Institute of Weights and Measures in opposition to the compulsory adoption of the Metric System.

Southern Supply and Machinery Dealers' Association, Convention, Atlantic City, 1920:

Be It Resolved, That it is the opinion of the Southern Supply and Machinery Dealers, in convention assembled, that the adoption of the Metric System would seriously interfere with long established methods of doing business, and that without any degree of benefit, and we, therefore, desire to go on record as being opposed to any change from the present standards.

State Associations

New Jersey Lumbermen's Association, Executive Committee, Newark, N. J., Sept. 14, 1920:

Be It Resolved, That the New Jersey Lumbermen's Association is decidedly and unanimously opposed to the adoption of the Metric System. It is felt that the adoption of this system would result in endless confusion and great expense, and there is no necessity for a change in our system of weights and measures.

Michigan Implement Dealers' Association, Board of Directors, Aug. 17, 1920:

Whereas, Certain interests are using their best efforts to have passed by Congress a compulsory Metric System of Weights and Measures, and as this would cause endless amount of confusion and expense, we, the directors of the Michigan Implement Dealers' Association assembled, are opposed to any change of our present system of weights and measures.

Kentucky Manufacturers' Association, Board of Directors, June 4, 1920:

The directors expressed unanimous disapproval of the measure now pending in Congress and which provides for the adoption of the Metric System Standard of Measurements in the United States. The motion carried with it instructions that the resolution be placed in the hands of the chairman and members of the Committee on Coinage, Weights and Measures in the House.

Oregon Retail Jewelers' Association, Executive Board, Albany, Oregon, Sept. 1, 1920:

The Executive Board of the Oregon Retail Jewelers' Association wish to go on record as being opposed to any change in the American Standard of Weights and Measures as are now in use. We consider it unwise to enact any laws that will cause business men of the country any unnecessary work or inconvenience at the present time.

Hawaiian Sugar Planters' Association, Trustees, Honolulu, T. H., Sept. 17, 1920:

This association is opposed to any change being made in the American standard of weights and measures.

City Associations

The Master Builders' Association of Boston, Board of Directors, Aug. 4, 1920:

Re. the efforts being made by the World Trade Club of San Francisco to establish the Metric System in place of the present system of weights and measures existing in this country . . . The Board of Directors of this association is strongly opposed to such a change.

Muskegon Employers' Association, Muskegon, Michigan, Governing Board, July 13, 1920:

Whereas, The industries of this nation have been built upon the English system of weights and measures, and

Whereas, National legislation is proposed to make the Metric System compulsory, and

Whereas, Such a change would cause great confusion, require enormous expense and would be generally detrimental to business, now therefore, be it

Resolved, That the Governing Board of the Muskegon Employers' Association, representing 95 per cent of the manufacturers, merchants and others of this community, does hereby condemn and oppose all legislation which would

provide for the compulsory use of the Metric System, or which would change our present system now in general and satisfactory use.

Chambers of Commerce

Waterbury, Conn., Chamber of Commerce, Board of Directors:

On record as opposing the Metric System of weights and measures, and as favoring the retention of the present system.

Newburgh, N. Y., Chamber of Commerce, Board of Directors, April 13, 1920:

This question has been discussed by the officers and directors of our Chamber of Commerce and the secretary has been directed to inform you that our association is decidedly opposed to the adoption of the Metric System on account of the endless confusion and great expense that will be caused by making the change, and also on account of the lack of necessity for so doing.

Syracuse, N. Y., Chamber of Commerce, Board of Directors, Aug. 9, 1920:

Be It Resolved, That the Syracuse Chamber of Commerce is unanimously opposed to legislation intended to promote the compulsory adoption of the Metric System of weights and measures in this country.

Hoboken, N. J., Chamber of Commerce, Board of Directors:

The Board of Directors voted to oppose the proposed plan to adopt the Metric System on the ground that at this time any change would be unwise.

Pennsylvania State Chamber of Commerce, Board of Directors, Harrisburg, Pa., April 7, 1920:

Action was taken "opposing any compulsory adoption of the Metric System."

Greater Wilkes-Barre, Pa., Chamber of Commerce, adopted by the Board of Directors, March 16, 1920:

Your committee unanimously advises against the recommendation of the adoption of the meter-liter-gram system by the Rotary Club and Chamber of Commerce of Wilkes-Barre.

Johnstown, Pa., Chamber of Commerce, Inc., Board of Directors, July 22, 1920:

The Chamber of Commerce has gone on record as being opposed to the adoption of this system at this time.

York, Pa., Chamber of Commerce, Board of Directors, Sept. 7, 1920:

The Board of Directors of the Chamber of Commerce . . . put themselves upon record against the official adoption of the Metric System in the United States.

Cleveland, Ohio, Chamber of Commerce, approved by the Board of Directors, June 16, 1920:

Your committee, after consideration of its investigation and of the facts that have come to its attention, earnestly urges the Chamber of Commerce to go on record as being absolutely opposed to the compulsory adoption of the Metric System of weights and measures in this country, and strongly recommends that the Chamber of Commerce direct communications to the members of the Committee of Coinage, Weights and Measures of the Congress of the United States, and to all of the representatives of Ohio in the Congress of the United States, opposing a legislation which will in our opinion be so disastrous to all of us.

Springfield, Ohio, Chamber of Commerce, Board of Directors, Aug. 9, 1920:

Be It Resolved, That the Board of Directors of the Springfield Chamber of Commerce are opposed to the adoption of the Metric System.

Flint, Mich., Board of Commerce, July 1, 1920:

The Industrial Department records its unanimous opposition to the voluntary adoption of the Metric System and recommends that its entire membership as a body go on record in disapproval of the voluntary adoption of the Metric System.

Moline, Ill., Commercial Club, Board of Directors, July 19, 1920:

On record as being opposed to the compulsory adoption of the Metric System.

Pueblo, Col., Manufacturers' Association of the Commerce Club, Aug. 18, 1920:

Be It Resolved, That the Pueblo Manufacturers' Association of the city of Pueblo, Col., do hereby condemn the efforts now being put forth to effect a change in the existing system of weights and measures. They consider such a move to be inimical to the industrial interest as well as the commercial interest of this country.

Technical Societies

American Association of Engineers, Oklahoma Chapter, Aug. 7, 1920:

The chapter is against the adoption of the Metric System in this country at this time on account of the enormous expense and confusion incident thereto.

The Hydraulic Society, Chicago, Ill., Sept. 20, 1920:

Resolved, That this society is opposed to the movement to force the compulsory adoption of the Metric System in this country, and that a copy of this resolution be transmitted to the appropriate Congressional Committees having in charge the legislation that was introduced in the last Congress with this purpose in view.

The Compressed Air Society, Quincy, Ill., Sept. 18, 1920:

Unanimously voted that the society go on record as being opposed to the Metric System.

The foregoing resolutions opposing the metric system are in addition to the many we have previously published.

Ethan Viall

Editor



EDITORIALS

Sales Contracts and Fair Play

THE spirit of the times is rightly one of give and take. Unfortunately some buyers of machine tools have viewed their contract obligations less seriously than usual and unfair practices have come to light in a few instances. A machine tool sales contract made in good faith should be respected and no cancellation should be accepted unless it is requested for justifiable reasons.

When it is considered that the development and use of machine tools are responsible for much of the world's advancement it is only just that the business of manufacturing them should be productive of a fair return to investors and that such return should come without running the gauntlet of too many risks. The machine tool builders have been asked to bear more than their share of the readjustment burdens and must protect themselves from unethical business practices that are adding needlessly to the load. Many of the other industries have not been called upon to face this problem and do not appreciate its serious nature.

The leather industry is experiencing a dearth of new orders and the same is true of the structural steel industry. However, orders in process are being completed. Cancellations as such are not playing an important part.

In the electrical merchandise and construction fields cancellations appeared to be reaching dangerous proportions several weeks ago but later proved to be false alarms. This is explained by the fact that the fear on the part of dealers that demand was decreasing was unfounded. Reinstatements almost always followed the cancellations immediately and they were frequently accompanied by increases in orders.

Coal is in such demand that there have been few cancellations, although some have been given in the bituminous branch on account of the falling market. Their extent has not been alarming.

While the automobile manufacturers have been experiencing smaller sales, they have not been subjected to uncertainty due to cancellations because their system of selling to dealers a standardized product as stock, permits flexibility in manufacture and therefore more ready adjustment to offset lessening demand.

The textile industry in the spring of 1920 received many cancellations. The mills fought them in many cases, generally insisting that goods in process at the time the cancellation was requested be accepted by the buyer. The American Association of Woolen and Worsted Manufacturers appointed an Unfair Practices Committee to consider and pass on individual cases where cancellations were desired. It has been found that when the facts are determined the decision must generally favor the manufacturer, that is, the mill or its representative. One large firm in New York representing several mills has had only three decisions against it out of four hundred cases.

From California comes the statement of the California Prune and Apricot Growers' Association that while it is willing to co-operate in every way with buyers desiring extensions of time, it will stand firmly on its legal rights on all firm-at-opening price contracts made this year and will institute court action against buyers who repudiate their contracts. Prunes and planers are vastly different but the principles involved in cancellations are much the same everywhere.

The prune growers advance the argument that the buyers made no objection to the profits they obtained for a rising market and should now accept losses from a falling market without whimpering, especially in view of the fact that in both cases prices were determined upon what was considered a fair basis and contracts entered into accordingly.

The Association of German Machine Tool Builders in October, 1918, adopted conditions for the sale of machine tools embodying the following: An order shall be binding only after it has been accepted in writing by the builder. Orders placed with all terms and agreements in writing cannot be revoked. If proof can be furnished that delivery is delayed through actual fault of the builder, the purchaser can demand an indemnity which in no case shall be more than the actual loss sustained and properly certified and shall be in the maximum ½ per cent of the contract price for every week's delay and under no circumstances more than 3 per cent totally. All further claims, also the right of the purchaser to annul his contract are not admissible. In addition to the points noted the purchaser is given certain rights of cancellation if the builder does not deliver within the allowed extension of time and if he does not make repairs as agreed upon.

The German contract is drastic and probably would not be enforceable under our laws even if good business policy permitted its adoption here.

Cancellation of contract, as we have used the term here and as it is generally accepted in the industry, is not recognized at law. The legal term is breach of contract and the remedy open to the injured party is a suit for damages. He cannot force the acceptance of the goods and his damages in most cases amount to the difference between the contract price and either the market price or the cost of production, depending upon circumstances. In any case the cost of extensive litigation is more than likely to eat up the greater part of any damages that may be secured. And the wise business man will hesitate before taking a step that is sure to cost him a customer.

The requirement of a deposit with the order is also open to serious question as a workable scheme to protect the manufacturer. While there is no doubt that such a demand would be entirely justified, it is equally certain that deposits would not be asked for in some cases and would be returned if requested, in others.

There remains only the employment of some sort of Fair Practice Committee like those existing in some of the other industries and trade associations. Many of these bodies have been markedly successful in improving the moral tone of the business practices in

their respective fields. They require the honest and hearty support of the members of the association, however, if they are to succeed, and only such an organization as the National Machine Tool Builders' Association can put through a plan of this sort for the machine tool industry.

The Fair Practice Committee seems to be the logical means to employ, for the reason that the kind of cancellation or breach of contract that is causing the trouble is the one resorted to by sharp purchasing agents or managers who are cancelling existing contracts with the hope of reordering at lower prices. This practice is indefensible on any ground but the wornout saying "Business is business" and merits extreme measures to check it. These measures could be taken by a Fair Practice Committee which would distinguish between justified and unjustified cancellations. Machine tool builders, like other manufacturers, realize that in these days of reconstruction it is often necessary to extend credit beyond the usual limits to distribute the burdens as fairly as possible but there is no adequate reason why they should be made the victims of unfair business methods.

Fundamentals of Standard Hole Practice

MANY of us talk glibly about tolerances, limits and interchangeable manufacturing, but in too many cases there is lack of understanding of fundamental principles which adds materially to the cost of construction. In a recent case which came to notice, the cost of building a lot of machines was reduced twenty per cent by having the drawings gone over by a competent man and the tolerances properly set.

Perhaps the first step in the right direction is to thoroughly understand what is meant by "standard hole" practice. This has been almost universally adapted by leading builders of standard machinery, but there still remains much misunderstanding in regard to it. By getting this firmly and correctly fixed in mind, the problem becomes comparatively simple.

Standard hole practice means that the external member shall never be *smaller* than the basic size and that all tolerance shall be *plus*. The internal member on the other hand, shall never be *larger* than the basic size and all tolerance shall be *minus*. The external member may be a ring or a piece which partially incloses the internal member, as a keyway, the internal member being the key.

This means that the tolerance is always one way on each piece—and not "plus or minus" on the same piece as we are apt to consider it. It means that we must revise our thinking in many cases, and not think of "plus or minus" in the way it is often mentioned.

The advantages of this system are twofold. The tolerances do not allow any overlapping of sizes, which would require selective assembly as no internal member can be larger than the smallest permissible external member. The second advantage is that it permits the use of standard gages as the limit in one direction.

Assuming a two-inch collar and shaft as the example, the minimum diameter of the collar could be determined by a two-inch plug gage while the maximum shaft diameter would be given by a two-inch ring. With a tolerance of 0.005 in. on each part, *plus* on the collar and *minus* on the shaft, the minimum looseness would be 0.000 in. and the maximum looseness 0.01 in. with the average probably 0.0025 in. But in each case the standard gage can be used as a check to insure the parts going together.

This question is now being considered internationally and is a live factor in economical manufacturing.

F. H. C.

South Americans to See U. S. Manufactures

THE success which has already attended the efforts of the American National Expositions, Inc., in planning an exposition of the manufactured products of the United States in Beunos Aires, Argentine Republic, indicates that the affair will be a notable event in the development of our trade with Latin America. The exposition will be held in March and April, 1921, in permanent buildings devoted to such purposes. The offices of the enterprise are located in the Bush Terminal Sales Bldg., New York City.

The Department of Commerce of the United States is co-operating with the management of the exhibit and enthusiastically lending its moral support. The reason for this lies in the fact that the display in South America of a comprehensive collection of products from the United States should be a means of promoting friendship and commerce between the United States and South America.

The exposition is being boosted and advertised extentively in South America by the Chamber of Commerce of the United States of America in the Argentine Republic, which organization has headquarters at Beunos Aires. This body recently issued a bulletin telling the history and the practical value of expositions. The bulletin states that this exposition is believed to be the first one in history to show the products of one nation exclusively to the public of another nation. Another statement is: "The exposition is still what it was of old—*the simplest, most practical method whereby the greatest number of competing lines can be seen and compared by the largest number of persons in the shortest time at the least expense.* A thousand years of progress have brought no better plan."

It may seem that the advantage is all with the buyer; but the manufacturer or the seller who has a product which he is willing to match against that of his competitor can expect to obtain marked results at low cost. One of the best ways of selling goods is by showing them. Goods often sell themselves, merely by suggesting their desirability to persons who did not realize that they wanted them until they saw and examined them. This is the psychology of the show window.

A characteristic advantage of public displays or expositions is that they attract both the wholesale and retail buyer. Most other selling methods are aimed either at the merchant and distributor or at the ultimate consumer. "An exposition gets both at one blow, stimulating distribution and demand simultaneously."

Our manufacturers seem to realize the value of the exposition, not only because of the nature of the plan itself but also because of the possibilities of the territory in which it will be held. The machine-tool builders should be complimented upon the manner in which they have responded to this opportunity for foreign expansion, as space for exhibits is now at a premium.

C. J. P.

SHOP EQUIPMENT NEWS

-Edited By-
S. A. HAND

SHOP EQUIPMENT NEWS
A weekly review of modern designs and equipment

Descriptions of shop equipment in this section constitute editorial service for which there is no charge. To be eligible for presentation, the article must not have been on the market more than six months and must not have been advertised in this or any previous issue. Owing to the news character of these descriptions it will be impossible to submit them to the manufacturer for approval.

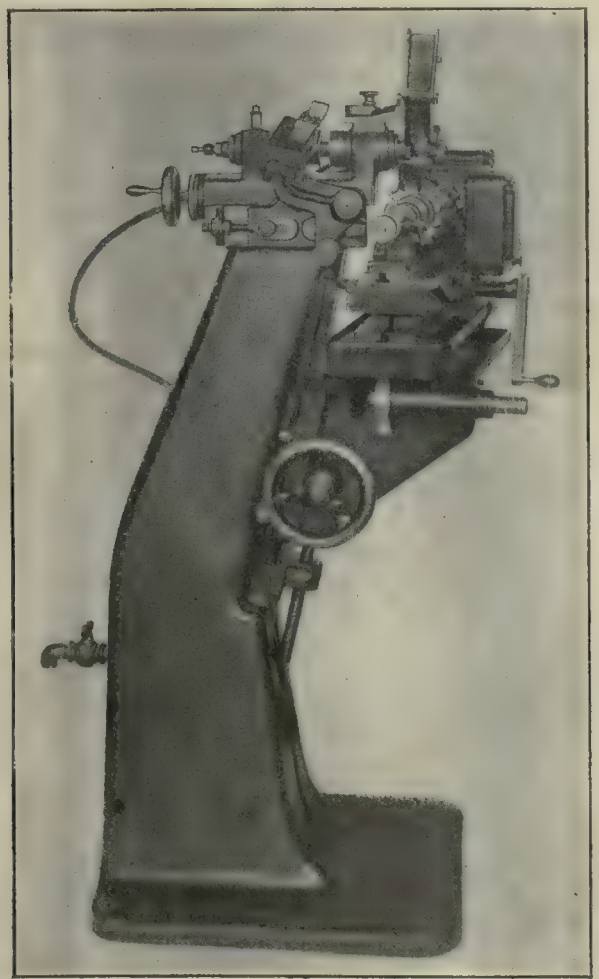
CONDENSED CLIPPING INDEX
A continuous record of modern designs and equipment

Pratt & Whitney "Curvex" Cutter Grinding Machine

The Pratt & Whitney Co., Hartford, Conn., has recently brought out the cutter grinding machine illustrated herewith.

While this machine was primarily designed for grinding the teeth of "Curvex" cutters it can be used on any cutters that require grinding on the face of the teeth. The machine is equipped with a wheel having a beveled edge, being the only shape that will follow the face of a helical tooth of a formed and relieved cutter and maintain the exact contour of the cutting edge. The table on which the cutter is mounted can be swiveled at an angle corresponding to the helix angle of cutter to be ground, the axis of the table intersecting that of the spindle and grinding wheel. The table is reciprocated in the usual way by means of a crank. At the same time a reciprocal rotary motion is imparted to the cutter through a set of change gears selected to conform to its lead.

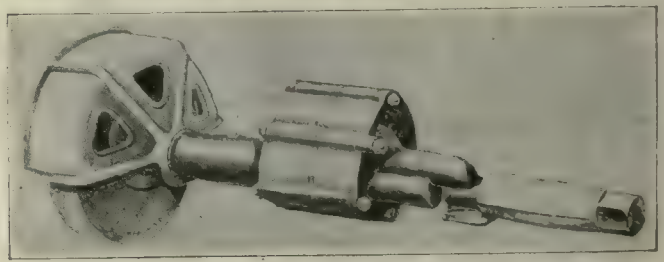
Two features of the machine insure the precision required for grinding formed cutters having helical teeth. The first is an indexing device for successively bringing the teeth in line for grinding instead of holding the back of each tooth against a spring stop. The second is the provision for grinding cutters of different sizes radially without resetting the head or table in any way except in elevation. The knee on which the table is supported slides on an inclined bearing on the column, the angle of inclination being parallel to a line drawn across the beveled face of the grinding wheel. The grinding wheel is so located in relation to the mandrel on which the cutter is mounted that the line of contact between the cutter and wheel passes through the center of the mandrel and so coincides with the radius of the cutter. By this arrangement the grinding line is always radial. An accurately mounted diamond tool is provided for dressing the grinding wheel to the correct shape. The machine can be used for either wet or dry grinding.



"CURVEX" CUTTER GRINDING-MACHINE

Roto-Pneumatic Series-A Grinding Machine

The portable pneumatic grinding machine shown in the illustration is made by the Roto Pneumatic Tool Co., 4,700 Train Ave., Cleveland, Ohio. It is known as the Series-A machine and is intended for light grinding and polishing work. The air enters the machine through the control handle and is applied to the pistons, which are integral with the rotating shaft, no cranks or connecting rods being used. The air control is balanced, so that the throttle will stay in any position in which it is placed. It is claimed that the device is free from noticeable vibration and that it can be easily controlled.



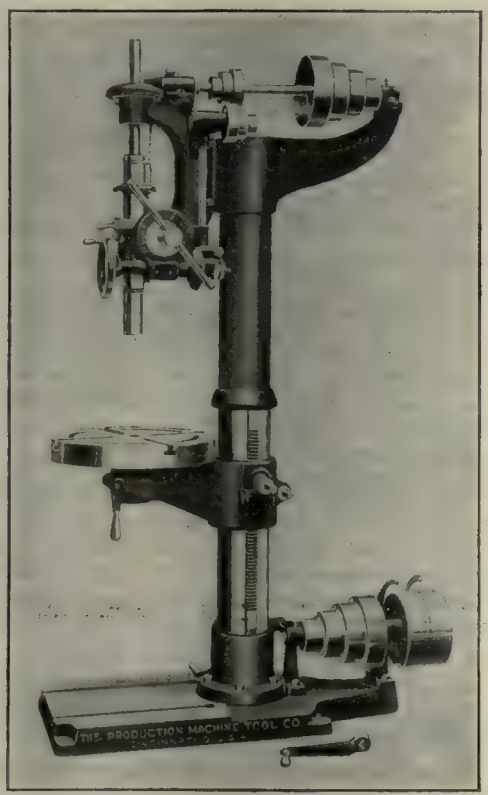
ROTO-PNEUMATIC PORTABLE GRINDER, SERIES-A

The cylinders and valve chest are made of bronze, as also are the bearings. Oil from a reservoir is supplied to the motor bearings through the center of the shaft, and the cylinders and valves are lubricated automatically by the pumping of a small amount of oil through them at each revolution.

It is stated that under average conditions the air consumption is 15 to 20 cu.ft. of free air per minute at a pressure of 80 lb. per square inch. Either a 6-in. or an 8-in. wheel can be used. The weight of the tool is 14 pounds.

"Production" 22-In. Upright Drilling Machine

The Production Machine Tool Co., 629 E. Pearl St., Cincinnati, Ohio, has recently placed on the market a 22-in. upright drilling machine with stationary head.



"PRODUCTION" 22-IN. UPRIGHT DRILLING MACHINE

Specifications: Capacity, drills to center of 22-in. circle. Spindle speed, back gears in, 20, 33, 53, 88 r.p.m.; back gears out, 117, 196, 318, 530 r.p.m. Power feed per revolution of spindle, 0.006, 0.010, 0.015 in. Distance from spindle to base; maximum, 45 in.; minimum, 35 in. Distance from spindle to round table; maximum, 25¾ in.; minimum, 9¾ in. Diameter of round, table, 18½ in. Spindle; diameter, 1 5/16 in.; hole, No. 3 Morse taper; vertical traverse, 10 in. Column diameter, 6 in.

The machine shown in the illustration is intended for drilling, boring, tapping and facing holes up to and including 1½ in. in diameter.

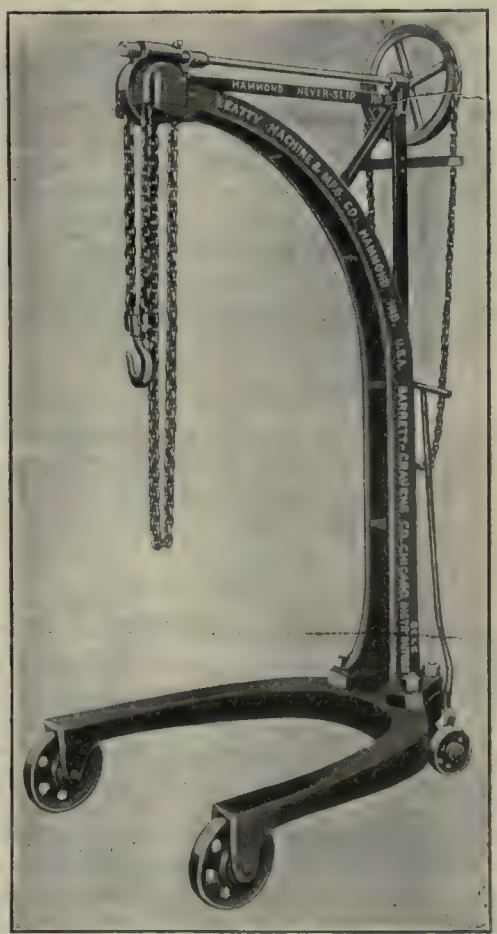
The table-elevating worm is located on the right-hand side, and it is claimed that the controls are all within easy reach of the operator. The bevel gears driving the spindle run at a speed of less than 800 ft. per minute, so as to reduce noise. The spindle is equipped with a ball thrust bearing and is counterbalanced. All bearings are equipped with bronze bushings, which can be readily replaced when necessary.

Four spindle speeds are obtainable on the plain machine and eight on the machine equipped with back gears. The rate of power feed can be varied by means of a belt on cone pulleys, three feeds being provided. The feed motion is transmitted through worm gearing running in oil. A positive clutch is provided to engage the power feed. The power feed mechanism can be omitted if desired and a ratchet feed lever furnished. A tapping attachment can be supplied, as well as any type of drive desired.

Hammond "Never-slip" Portable Crane

The Barrett-Cravens Co., 169-173 North Ann St., Chicago, Ill., is the sole distributer of the portable crane illustrated herewith.

The base and column of this crane are steel castings and the hoisting device is directly supported by the column arm. All wheels are equipped with Hyatt roller bearings and the axles are chrome-nickel heat-treated steel. The hoisting gear consists of a bronze worm-wheel and steel worm inclosed in an oil-tight casing. Besides being locked at all points of travel, the worm gearing permits very close adjustment in the height of the load.



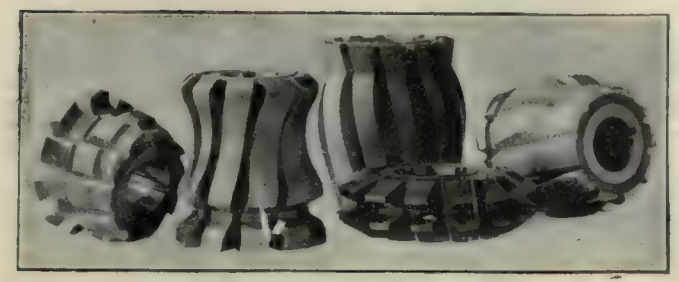
HAMMOND "NEVER-SLIP" PORTABLE CRANE

Specifications: Made in 6 sizes. Lifting capacities, 2,000 to 7,000 lb. Heights, 6 ft. to 10 ft. 8 in. Amount of lift, 4 ft. 10 in. to 8 ft. 6 in. Overhang, 2 ft. 5 in. to 3 ft. 8 in. Floor space, 3 ft. x 3 ft. 6 in. to 4 ft. 3 in. x 4 ft. 10 in. Weight, 575 to 1,400 lb.

Pratt & Whitney "Curvex" Cutters

Formed and relieved cutters with helical flutes, as shown in the accompanying illustration, have recently been put on the market by the Pratt & Whitney Co., Hartford, Conn., under the trade name of "Curvex."

Owing to the helical flutes, each tooth comes in con-



"CURVEX" FORMED CUTTERS

tact with the work progressively and cutting takes place, not along a line, but diagonally across the face of the work with a shearing action. The angle of the helix is such that one tooth enters the work before the preceding one has cleared it, thus eliminating the chopping action of a cutter with straight flutes and minimizing the tendency to chip or break either the teeth or the work.

It is claimed that these cutters can be run at faster speeds and will take heavier feeds than will formed cutters with straight flutes; also that under all operating conditions they will produce a smooth surface free from chatters. The cutters are produced by a single-pointed tool following a templet corresponding to the form of the work they are to produce.

"Curvex" cutters are only made to order and can be cut with either right- or left-hand helices of practically any lead from 1.607 to 125 in. and with any helix angle up to 20 degrees.

Erratum

On page 871 of last week's issue appeared the heading "Nemo" Rust Remover. This is an error—the trade name of the rust remover, marketed by Peter A. Frasse & Co., Inc., 417 Canal St., New York, is "Meno."

Future Power Supply

BY ENTROPY

The earliest recorded power from inanimate objects was water power, in which a slowly moving river was made to pump a small portion of its own waters high enough to be used for irrigation, instead of waiting for the annual inundation. Now we seem to be getting ready for a much more scientific method of using water power, one far reaching, which is thrust upon us not because its use is any more sensible but because, having been thriftless and improvident, we find that the cost of coal and fuel oil makes it necessary for us to become provident. We can only hope that we are beginning in time.

No matter how efficiently we develop water power and no matter how thoroughly it is distributed there is not enough to go around and its price to the consumer is bound to be quite as high as the cost of developing the remainder whether it comes from burning coal, crude oil or gasoline. For that reason we are and always will be much concerned over the supply of fuels.

Coal and petroleum are nothing but the petrified and dissolved remains of vegetable growth of thousands of years in the past. Peat is forming now, but there is nothing to make us think that it will become coal, nor is there enough of it to afford any great supply if it should. There is shale rock in quantities from which oil may be distilled, but what shall we burn to distill the oil from it? The supply of crude petroleum in the United States is likely to be exhausted during the present generation if the scarcity and high price prevail to bring out the supply. The Mexican fields are not showing signs of exhaustion but since they are the most profitable source of revenue to the Mexican government it is more than likely that they will be exploited to their utmost regardless of the length of time they might be made to last. In other words nature has provided just so much and no more of these supplies, and is apparently not making more. It puts it distinctly up to us to provide for ourselves.

It appears then that barring the discovery of additional coal and oil we shall have to produce the power needed over and above water power by some process that will use the energy which is coming to the earth rather than from energy which has been stored up for us. In other words we shall have to produce it by means of the sun's rays.

Direct production of power from the sun's heat has been done but it is cumbersome and does not work when clouds intervene and is least available in the winter when we most need it. The readiest and most simple method of using sunlight for power is by growing trees and cutting them for firewood, but firewood is bulky and not at all adapted to many of our power requirements. We need a more concentrated store of energy for ships, locomotives, automobiles and airplanes. The one such concentrated form just now appears to be alcohol. More than that we have innumerable factories for the manufacture of alcohol that are, for the time being at least, out of business, available with very slight changes, if any, to make denatured alcohol for power purposes.

Experiments with alcohol in internal combustion engines indicate problems no more insurmountable than those met in dealing with gasoline. They are simply different problems. The fact that we had a very good supply of gasoline at a price that was not unreasonable has deterred us from experimenting very thoroughly with alcohol, but whenever necessity, the mother of invention, catches up with us we can most surely make the necessary changes to make the new fuel successful. The trouble is that we have been lacking in thrift, as we usually are, and have been so extravagant in consuming the stores of nature that we have not had time to think about the future and the absolute certainty that before very long all our elaborate science of internal combustion engineering will all be left a waste on our hands if we do not change our policy.

Of course it is possible that other distillates may prove better than alcohol, but the future distillate will probably be something which is raised from the soil, for that is the only way that we now have for storing the sun's energy. Reducing it to alcohol is simply a means for concentrating the energy in a lesser weight and bulk for ease in use. The heat energy of the remainder of the vegetable product can be utilized to some extent to furnish the heat necessary to distill off the alcohol.

If we go on an alcohol basis for power we will truly be using sun-power at very close hand. Vegetation depends on sunshine and water. The water comes because the sun has evaporated it from the ocean and ponds, and the sun light comes direct. This energy cannot possibly be exhausted in a time within our conception.

The Machine-Tool Industry Abroad

The German Machine-Tool Industry Today

By OUR BERLIN CORRESPONDENT

THE GERMAN machine-tool industry has gone through one of the most critical periods of its existence. The unheard-of revival of the trade in 1919, whereby the output was literally torn out of the hands of the manufacturers and orders were given without looking at the price or the delivery time, reached its climax at the beginning of this year. During the months of January and February the demand decreased, but so slowly that it escaped the notice of even the Machine Tool Builders' Association, which is in an exceptional position to feel the pulse of the market. In a meeting of this society, which was held as late as February, 1920, it was proposed to raise the export prices for machine tools to 3,300 per cent of the pre-war standard and some of the members declared this proposal to be moderate and not at all sufficient to exhaust the possibilities. Four weeks later the demand fell off in one sudden drop. It was commonly believed at that time that this drop would be short-lived and would be followed by another rising of the wave of demand in a few weeks. This hope has not, however, been realized. The depression of business which set in last March and which seized all branches of trade and industry has lasted up to now and has only lately given way to a slight improvement.

The intervening time was one of great stress and considerable hardship to quite the majority of works. The foreign buyers kept away entirely and the inland demand dwindled to insignificance. Quite a large number of shops have not received a single order for more than four months. Even inquiries which would have brought encouragement if nothing else were missing. At the same time expenses continued to move upward in a steep line. The prices of materials kept rising from month to month, and after the workmen had received satisfaction as regards their wages, the whole force of employees claimed and obtained readjustment of their salaries, bringing the household expenses of a factory up to giddy heights.

Numerous Factories Offered for Sale

Not all of the German manufacturing firms weathered this storm with unimpaired strength and energy. The number of factories offered for sale in the papers was absolutely bewildering. A large firm of machine-tool dealers which was in the market for a workshop received no less than sixty replies to its advertisements from machine-tool firms, often of old standing. Numerous factories restricted working hours and some closed down entirely. Noteworthy among the latter is the case of the Maschienfabrik Oberschöneweide, formerly known as the German Niles works, which, in spite of its excellent financial connections and intimate relations to the Ludw. Loewe combine, went out of business. Its whole equipment has been bought up by a second-hand dealer. Only the pneumatic tool department will be continued in another shop. The large incorporated companies increased their capital or raised loans, but their smaller brethren went through financial difficulties. If these hard time should last much longer the effects would become still more marked. It is significant that the government has been earnestly occupied with forming plans for relieving the situation in the interest of the industry as well as that of the working classes. The situation for the latter has become very serious as the number of unemployed has increased rapidly.

The improvement which has shown itself lately, although very slight up to now, has been hailed with great delight. It coincides with the renewed drop of the German exchange. In so far it does not afford any satisfaction to the business world which would have wished an improvement independent of the exchange condition. This disappointment has, however, not been the only sore point of the situation. Even more serious is the fact that very few works have profited by the lesson dealt out by the hard times they have just gone through.

Depression Ascribed to Overstretching Prices

The cause of this depression has been commonly ascribed to an overstretching of prices. Thus all-round reduction seemed the only solution of the problem. Manufacturers were reluctant to take the consequences. Months of valuable time have been spent waiting for a return of the demand. When, however, no change for the better took place and the contracts ran out with no new orders coming in, the necessity for lowering the prices prevailed. It was not so difficult to reduce export prices. They have been put down from 3,300 per cent to a little over 2,000 per cent above pre-war prices. Great difficulty, however, was found to reduce the inland prices. The latter have on the average kept 40-50 per cent below export prices. It was commonly stated that these prices contained no profit but involved a considerable loss, which could only be borne by the compensation which the export prices afforded. In the absence of export orders the inland business means therefore an absolute loss. Firms able to sustain such a loss have stuck to their inland prices but many others had to reduce them considerably. A high-speed lathe of 190-mm. height of center (10-in. swing) and 1,000-mm. bed, which was sold in May at 46,000 marks, is now quoted at 33,000 marks. The same machine, 330-mm. height of center (17-in. swing) and 1,000-mm. bed was reduced from 101,000 marks to 78,000 marks. Lathes and drilling machines are most strongly affected by the slump. A radial drilling machine, which in pre-war time cost 3,000 marks, and which in April had gone up to 75,000 marks, is now sold at 50,000 marks. The prices of machine tools for inland consumption now average from eleven to fifteen times pre-war prices, or 20 to 22 marks per kilogram weight.

Situation Out of Manufacturers' Control

It is clear, however, that the price reductions made, in conjunction with the very serious need to sell at firm prices, will not bring such revival of business as is necessary to keep the industry employed. Manufacturers declare that the situation is out of their control. Without reduction of wages and of the prices of raw materials they are, so they say, unable to make further concessions. The annual report of the German Machine Tool Builders' Association for 1919, which has just been issued, gives strong expression to this view, which commonly prevails. There is, however, little hope that the desires of the manufacturers in the direction of reducing prime cost and expenses will materialize. The wages are at present about ten times higher than in peace times, but as they are still below those of other countries and have not increased in proportion to living expenses, the readjustment of wages and salaries can hardly be said to be completed. A reduction of the cost of raw material is quite out of the question. It is inconceivable where such reduction should come from. Germany before the war produced about 20,000,000 tons of iron, which was mostly gained from inland ore resources. It is estimated that now she has to import at least 6,000,000

tons of iron ore in order to keep up a fourth part of the pre-war production. Last year 6,500,000 tons of pig iron were produced, but only with the help of over 2,500,000 tons of scrap. There is still some scrap reserve in the country but it will soon be exhausted. Even this reduced production cannot be reserved for inland consumption, as the mills have to sell a part of their production abroad in exchange for foreign ore. The prices for raw material can in the future be not less than in other countries, but rather more, as the German iron and steel industry, dependent on import of ore and foreign shipping rates, will be seriously handicapped.

Reduction of Wages and Prices a Delusion

Under such conditions to expect relief from a reduction of wages and prices seems rather a delusion. The relief can only come from another direction. It points distinctly to higher economy of production and greater efficiency. In this respect much has to be done, and it is only surprising that so little has yet been done. It seems quite clear that when all the items which compose the household of a factory, materials, wages, power and other expenses are in the process of readjustment, the working methods and the equipment have to follow suit. The German manufacturers will no doubt in time—and after they have recognized that they cannot expect a reduction of wages and of cost of material—sit down and figure out how else they can reduce prices. They will then surely find out how much material can be saved in their designs and how wages and expenses can be kept down by more efficient labor-saving equipment. The time when this necessity will be recognized has not yet come.

Specialization and standardization, which are so much talked about as the harbingers of better times, are only a part of the great work of reconstruction, but even they are only in their first stages. Until the reconstruction and readjustment inside of the shops is seriously taken in hand, the German machine-tool industry will have to pass through very critical times and, as experiences show already, will not survive in full force.

Business Conditions in England

FROM OUR LONDON CORRESPONDENT

London, Oct. 22, 1920.

THE coal strike has started, bringing with it the possibility of a gradual close-down in British industry. Generally the position has been accepted, if not cheerfully, at least without undue complaining, and if the government is firm and fairly capable only one result can be predicted. It is at least possible that in social and economic matters Great Britain is entering on a transition period.

The idea of employment of men simply for the personal profit of the employer has long been a bugbear among the working classes, and Austen Hopkinson, a well-known engineering employer, was at least partly right last night in the House of Commons in ascribing low production to the fear of "making the boss a millionaire." But there are other reasons. The old idea of master and servant having gone by the board, new relationship may be instituted between employer and employed, profit-seeker and wage-earner. A share in the control of industry has been successfully claimed by labor. The trade unions have grown enormously in numerical strength and also greatly as regards funds, although in an absolute sense they may not be much stronger, if as strong, in the latter direction—the purchasing value of money having so heavily deteriorated. Now the trade unions and other organizations have pretty complete control of the situation and up to the present the government, claimed to be one of business men, has always acted with a view to compromising disputes for the purpose of "getting on with the job." This course of action was no doubt necessary during the war period. At the moment some slight change of policy suggests itself, as it has before. The government offer to the miners was in the nature of a face-saving character, as output had merely to be maintained and not increased to justify the advance in wages demanded and agreed to, with the reservation noted. But the offer was rejected very decisively. Of course the payment-according-to-output scheme suffers from some severe practical objections, as a strike or other dispute in a given district, whether justified or unjustified, would necessarily lower total output, and consequently the rate of pay of men in other districts who might or might not sympathize with the strikers. Even if the output were rated by districts or collieries in areas where seams have already been well worked the rate of output, rather than increasing, must necessarily decline. And to some extent the output must depend on the coal owners—they may or may not supply the most efficient colliery gear. In fact complaints in this direction are not uncommon. Most colliers here appear to favor a fixed payment per shift. The demand for reduction in the price of coal to the home consumer of 14s. 2d. a ton having been dropped, the miners' claim for their strike as unselfish disappears, and the dispute is merely one of wages. Much is said regarding control of industry but getting down to facts it is division of product that has caused disputes, so far.

The Banding of Interests

For several years now interests of all kinds have steadily banded themselves together. This is quite obvious in the case of labor where trade unionism is almost omnipotent, but it shows itself in many other directions and in small details. Thus part of the subsidy having just been withdrawn by the government, the price of bread as sold in the shops was necessarily raised. The ministry concerned there stated time after time that a reasonable price for the 4-lb. loaf is 1s. 3d. Nevertheless the shopkeepers—organized on a trade basis—insist on 1s. 4d., or 1s. 4½d. if delivered.

Individual effort beyond a limit is not encouraged in the ranks of the workers, the effort being toward a common uplift and a general rather than a particular raising of the standard of living. So far the process has met with success and, often when urged to it by government officials, employer and employed have sat down together to raise wages and prices and left it at that. Now apparently the limit has been reached and the consumer is refusing to make a demand. But not in all cases. Once again transport fares in London have been raised without any diminution in the number of persons traveling, but rather the contrary effect: the weather may of course be partly responsible. Beyond question however trade is declining as a whole and, apart from strikes, unemployment increases. The unemployed ex-soldier has been making himself heard, not in the pleasantest way, and a riot in Whitehall, preceded by a procession of unemployed, has forced the government to provide work or relief in the form of road-making, half the cost being placed on the London county rates, without the Council themselves, it would seem, being considered in the matter. The same is to apply elsewhere. Thus a further increase will be necessary on the already bloated local rates.

Selfishness Prevails

Selfishness prevails all round; in this regard no side can throw stones at another. For during the war the nation's interests were quite forgotten by the employed class, who were content to work on the so-called time-and-line plan. (Time and lime is held to be more correct, the phrase deriving from the building trades.) On this system the employer was encouraged to pay high wages, being then entitled to charge a corresponding profit. Everybody looked after his own interest and was apt to forget his duties. Workpeople are commonly blamed for demanding high wages, but they are not alone at fault. Their selfishness is simply more apparent.

Nowhere does it appear to be greater than in the building trades, where the demand for workmen is out of all proportion to the supply. For a period of years before the war men had been leaving these trades and by 1914 the number of bricklayers, for example, in this country had been reduced to about 74,000. At the moment the total is officially put at 53,000. Yet all attempts to ease the entry into these trades are definitely resisted and defeated, the excuse being that the housing demand may not last longer than ten years, when unemployment might again be experienced. Much cant is talked too by apologists for the building trades' workers in excuse for the notorious fact that, by means of bribes and similar payments, workers can with some readiness be found for luxury building, where officially permitted, while the building of houses for the working and similar classes is retarded or stopped for want of men. Withdrawal of labor is just as possible in connection with luxury building as with, say, a wage dispute.

Consumer Always Left in Cold

Still, the working men, and working women too, of Great Britain are closely joined together, and though the trade organizations are apt to have regard solely for the interests of their particular industry, the consumer always being left in the cold, yet co-operative action by the unions in regard to strikes is generally threatened, and by all accounts the railwaymen have issued an ultimatum to the effect that if the government does not in a given time take definite steps, of an obvious character, to end the dispute with the miners, they themselves will suddenly cease work. How far by this action they will commend themselves to the minds of the population generally does not appear. For the memory remains of last year's railway strike, with its attempt to hold up the food of the people. Further, the average person understands that before a railwayman can leave work he must give a week's notice. The transport workers, too, promise similar action—their secretary says "it appears better to widen the issue instantly and get the dispute settled in preference to allowing ourselves to drift"—although in this case a wages dispute has been in existence for some time and the strike is not necessarily one of sympathy only.

Meanwhile as regards coal, gas and electricity, supplies have been limited by orders, so that, for instance, no householder can receive more than 1 cwt. of coal a week, and then only on condition that he has less than 10 cwt. in stock, while the consumption of coal for factories, workshops and business premises is to be reduced to half, and gas produced at the gas works is not to have a greater calorific value than 450 B.t.u. per cu.ft. Illumination is being reduced, London's public streets approximating to the condition of the Zeppelin nights.

Short-Time Employment Grows

Directly or indirectly as a result of the strike, engineering and other works are discharging men, though the endeavor is rather to work short time, and thus spread employment as far as it will go. After four days it was estimated that 100,000 workpeople had been discharged and as the strike progresses so will unemployment, but up to a point at an accelerating rate. Apart from the strike, engineering and the iron and steel trades generally show further evidence of decline, but the collapses that have been so freely prophesied, more especially in the motor-car line, have not been announced. The stoppage of the Vulcan shops was for three weeks or so only. The closure of the Martinsyde works for a fortnight is indication of the condition of the aeroplane industry.

The report of E. G. Wrigley & Co., Ltd., Birmingham, manufacturers of automobile transmission gears and of twist drills and drilling cutters, for the year ending with April last is hardly exhilarating; it shows a loss of £144,000, attributed mainly to the molders' strike and then to difficulties of getting output large enough to cover dead charges. On the other hand, though not of course engaged in the same branch of engineering, Babcock & Wilcox, Ltd., the well-known boilermakers, are paying 7 per cent for the half year, free of income tax; or, in other words, 10 per cent, and this on a capital increased by half a million pounds, the increased distribution being £54,600 as compared with last year.

The Motor Pleasure-Car Show

The Commercial Motor Vehicle Exhibition, held at Olympia from Oct. 15 to 23, the most complete of its kind yet held in Great Britain, bore at the beginning every promise of success. It has been decided to proceed with the London pleasure-car show, to be held this year both at Olympia and the White City, from Nov. 4 to 13, though the banquet has been abandoned. The cycle and motorcycle show will be held at Olympia, W., from Nov. 29 to Dec. 4.

Recently, but before the miners' strike, more than 1,000 workpeople were discharged from the works of Steel, Peech & Tozer, Sheffield, and the reasons, as stated by A. Peech, are—apart from disputes—symptomatic of conditions here. The action was due to the fact that no orders were left for the particular section of the works concerned, one reason being that competition of Belgian and American material at lower prices is being felt. It is understood, too, that French steel makers have decided to make a special appeal to the British market: they are able to do this on price by reason of the present condition of exchange. The firm, in fact, calls for protection. The second reason mentioned is that confidence as regards capital is shaken by the continuance and increase of the excess profits duty. The third is: "The men never gave us the output they should have done. This combined with the abnormal rises in wages made it an impossibility to quote a firm price, so that a quotation accepted on the first of the month might have risen by 10 or even more per cent by the end of the month, and very considerably more by the time the order was completed and invoiced. Quotations, therefore, had to be given with reservation clauses, so that the purchaser never knew what price he was going to pay for the article he desired to purchase."

Gage Standards

The engineering world was recently astonished to receive notice from the National Physical Laboratory authorities to the effect that the absolute sizes of the accepted standard end gages had been found incorrect, the connection being proportional to the length and being at the rate of minus 12 parts in a million. Thus the accepted size of a 1-in. gage is reduced by 0.000012 in. This applies only to inch measures, not to metric units. The laboratory gave notice that as from Oct. 15 all gages would be tested on the new basis. A table has been issued showing the alteration which should be made in lengths hitherto accepted. It has been pointed out that the change is very small as compared with the change due to temperature-variation and that only where interchangeable parts for the same job have to be made by two different precision engineers is trouble likely to arise.

Shipbuilding Improving

Lloyd's Register here reports further improvement in the position of British shipbuilding relative to the rest of the world, the tonnage in the United Kingdom under construction at the end of last month being 3,731,098, constituting a record, which compares with 3,834,073 for the countries outside, excepting Germany, regarding which the figures available are incomplete. The falling-off outside the United Kingdom is quite covered by a decrease in the United States, a decrease also being reported from Canada, with increases in France and Holland. The output of the United Kingdom in the first three-quarters of the current year amounted to 1,448,435 tons, an increase of about 324,000 tons as compared with the same period of last year. The Clyde district has rather less than 950,000 tons on the way and Belfast rather more than 350,000 tons. The figures do not include war vessels.

In issuing their latest revised lists of standard rolled steel sections for structural purposes the British Engineering Standards Association suggests that on the occasion of the next revision the results of conferences with the American Engineering Standards Committee may be incorporated. The revised issue was adopted by the sectional

committee concerned toward the end of last year, but the American committee named requested delay in publication in order that the American steel industry might be consulted. It appears however that nothing was possible by way of co-operation in the time available, but the British report indicates that "considerable progress toward Anglo-American agreement has already been effected."

The Cutlers' Feast was held as usual this year, on Oct. 14, in Sheffield in the hall of the Company of Cutlers in Hallamshire in the County of York, the master cutler being William Clark, director of the Sheffield works of Vickers, Ltd. American readers may be interested in the statement that this Cutlers' Company was incorporated in 1624, say 150 years before the United States was formed, while the feast was the 292nd of the series. It is often the occasion for political pronouncements.

American engineers who have visited Heathfield Hall, the home of James Watt—and they are quite a company—will regret to hear that George Tangye, who lived there so long, died on Oct. 7 last. Of the brothers who formed the Tangye firm he was the youngest, having been born in 1835. The story of the rise of this firm from a 4s. a week room has been told more than once, particularly as regards the hydraulic jack and the Weston differential pulley block, but it is not perhaps generally recognized that the firm in 1862 introduced a steam engine with interchangeable parts. Mr. G. Tangye had been chairman of Tangyes, Ltd., since 1906 when Sir. Richard Tangye died. When the old Boulton & Watt firm was sold out he secured the collection of drawings and other relics of the two men named, and of Murdoch and many others, that had been made by W. H. Darlington, and he housed them in part of the Soho works which was and is devoted to machine-tool production, this until the local authorities had provided special rooms in the Municipal Reference Library, Birmingham, to which the relics were removed in 1915. Heathfield Hall, and particularly the garret workshop of Watt, could generally be visited by the favor of Mr. Tangye and last year, on the occasion of the centenary celebration, a large party was thus entertained by him. He had a particularly ready welcome for American engineers. An effort is being made to secure the garret workshop at least as a memorial of Watt.

New Regulations Affect Trade With Italy

IMPORTERS in the United States of Italian commodities will be interested in the announcement recently made by the Italian Chamber of Commerce in New York to the effect that, hereafter, American Consuls will issue consular invoices for exports from Italy to the United States on the quotations of the gold exchange which the Italian Government establishes for the payment of railroad tickets sold abroad or involving a trip beyond the boundaries of Italy.

The chamber states that its plea to the United States Treasury Department has been successful, and that the Treasury has agreed to discontinue the valuation of the gold lira at the rate of two paper lire for the satisfaction of custom duties, and to adopt the actual gold exchange instead.

The following letter, dated Oct. 7, was received by the chamber from J. D. Nevins, acting chief, division of customs:

The department refers to your letter of Aug. 12, further in regard to the use of Form 144 by American consuls in Italy. The executive order of Nov. 13, 1919, requires in such conditions as exist in Italy that Form 144 must be used. However, as it appears that the rate established by the Italian Government for the collection of custom duties is more or less an arbitrary one, the department has decided to discontinue the use of such rate. Under today's date, the honorable Secretary of State is being requested to instruct American consuls in Italy to continue the use of Form 144, but, instead of using the customs rate as heretofore, to now use the Italian railways rate which is based on a gold standard and approximates the relative values between the lira and United States money.

In explanation of the new ruling, the Italian Chamber of Commerce in New York issued the following statement:

This means that the American consuls will now issue consular invoices for exports from Italy to the United States on quotations of the gold exchange which the Italian Government establishes for the payment of railroad tickets sold abroad or involving a trip beyond the boundaries of Italy, which tickets are payable in gold lire, otherwise in paper lire at the exchange fixed by the government itself taking as a basis the quotations of the principal stock exchanges of the kingdom.

The Italian Chamber of Commerce in New York is now endeavoring to protect shipments on their way to the United States for which currency certificates of depreciation have been issued under the rule now discontinued, that is, at a value of two paper lire equal to the value of one gold lira.

The chamber has suggested to the Treasury Department that the collectors of customs at the several ports throughout the United States be authorized and directed to permit entry upon proforma invoice with bond for the production of the consular invoice or the replacing of the one already filed and to accept as a deposit at the time of entry the amount of duty based upon the Italian railways rate, as now fixed upon. The chamber had the opportunity of stating in a letter to the Treasury Department under date of Sept. 28, that to require the importer to deposit duty based on 9⅛ or 10 cents per lire would be unjust, in that it would mean to collect duty not on real and true value of the goods, but on the fictitious value, and it would also tie up double the actual amount of duties, through no fault of either the shipper or the importer.

Italian-American Trade for August

During August, the United States imported from Italy goods to the value of about $5,390,000, which is about $1,435,000 less than in August, 1919. The exports from the United States to Italy during the same month amounted to about $18,000,000 as against $28,500,000 in the corresponding month of the preceding year.

The total value of the domestic exports of machinery, during August, from the United States to Italy was $249,555, divided as follows: Textile machinery, $84,519; lathes, $1,999; other machine tools, $63,514; sharpening and grinding machines, $24,726; all other metal-working machinery, $54,456; excavating machinery, $18,400; air-compressing machinery, $346.

Increases in Italian Import Duties on Motor Vehicles

In order to equalize the differences which have heretofore existed between the low Italian duties on motor vehicles and the high tariffs imposed on these vehicles by Great Britain, United States, and France, the Italian Government has decreed substantial increases in rates, the same having become effective Sept. 15, 1920.

Passenger automobiles (with or without bodies), trucks, traction engines (including farm tractors), motor-driven street-cleaning apparatus, and motor fire-engines now pay the following duty in gold per quintal:

	Lire
Weighing not more than 400 kilos	20
Over 400 kilos up to and including 900 kilos	115
Over 900 kilos up to and including 1,600 kilos	65
Over 1,600 kilos up to and including 2,500 kilos	75
Over 2,500 kilos up to and including 4,000 kilos	95
Over 4,000 kilos	60

Automobiles, with or without bodies, weighing not more than 2,500 kilos pay also a surtax of 35 per cent ad valorem. Automobile bodies are classified as automobiles. On automobile parts the following new tariff, gold per quintal, is in force: Frames, 70 lire; gear shifts, 110 lire; rear axles, complete, 90 lire; all plus a surtax of 30 per cent. ad valorem.

The restricions on the importation of automobiles have been continued largely because of the inadequacy of the old duties, but in the near future the increases in the tariff should result in the removal of these restrictions, or at least, in their modification.

Italian treasury receipts for August, 1920, amounted to 877,544,066 lire, as compared with 682,796,669 lire for August, 1919. This is an unusually large increase. The detailed statistics reveal that all items show an increase, with the exception of indirect taxes on consumption. The figures are:

Item	August, 1919 Lire	August, 1920 Lire
Direct taxes on incomes	370,011,482	444,443,730
Indirect taxes on consumption	95,751,199	88,053,361
Taxes on business and profits	71,511,022	104,922,250
Industrial monopolies and lottery	143,345,675	220,636,101
Commercial monopolies	2,177,290	19,498,624
Total	682,796,669	877,554,066

Despite the unsettlement which was brought about by the recent series of labor troubles in Italy, security prices in general on the Italian stock exchanges have held up in a surprisingly firm manner.

A bill providing for the abolition of certain Italian trade restrictions was passed recently by the chamber of deputies. The measure among other things, will limit the activity of the government in the production and distribution of goods, permitting the largest freedom possible under existing conditions; and will result in the infliction of heavy penalties for those convicted of profiteering in articles of prime necessity.

The supply and distribution of newsprint paper, cotton, wool, and other textile materials will be taken from the hands of the government, and the stocks of those commodities on hand will be delivered over to the co-operative associations which will dispose of them under government regulations; the newsprint supply, however, being still below the demand, the necessary regulations for assuring a steady supply to the press and for preventing a "corner" in the market will be issued by the ministry of industry and commerce, which agency, however, will not continue to exercise the direct control which it has been exercising over production; the office controlling the manufacture and distribution of "national" shoes will be abolished.

Within three months from the date on which the law becomes effective, the list of commodities of which the importation or exportation is subject to restriction shall be revised and a number of such commodities taken from the restricted list.

It is also provided that merchants who enter into agreements fixing prices or limiting the quantity of goods to be offered on the market are liable to penalties established by a new law on profiteering, namely, imprisonment for from one to five years and a fine of 1,000 lire or more. The hoarding of food products, raw materials, or other necessary goods, or their withdrawal from their course toward normal consumption, is made punishable with imprisonment up to five years and a fine of more than 500 lire.

Because of the decline in the cost of food and the expectation that other commodities would also show a price recession, the *Navigazione Generale Italiana* has decided to abandon the proposed increase of $15 in the minimum cabin rates to Italian ports, which was to have gone into effect on December 1. Some of the other lines operating between New York and Italy, it is understood, have determined upon the same course.

What Is a Machine Tool?

By Entropy

In some ways it seems as though the discussion regarding this definition had gone to lengths not entirely justified by its comparative importance, but on the other hand it has developed the fact that there is a difference of opinion. An analysis of the situation may help us to agree on a proper limitation of the term.

There are two distinct classes of names; those which are descriptive and those which are arbitrary. A street may be named "Elm Street" because it is lined with elm trees, and the name is descriptive. It may be called "Sixteenth Street" and the name is arbitrary, but also directive because the name in itself assists the person who wishes to find it. In olden times people named a boy Rufus, meaning red, if he showed signs of having red hair. Today the name is simply a name and not more descriptive than John or James. So with other names, they may have had a meaning once which was descriptive and therefore an assistance to the inquirer, but now they are entirely arbitrary.

No one has definitely traced the term "machine tool" to its lair. It may have come about through a contraction of the term "a machine to drive a tool," or "a machine to guide a tool." As a matter of fact there seem to be more people who really look on it in that light than otherwise. A lathe may come under that head or not as one looks at it. An engine lathe, or a bench lathe usually does so. A speed lathe used for polishing does not, unless we stretch the term tool to include emery cloth. If we stretch it, as most correspondents seem willing to do, to cover a grinding machine in which the tool is a grinding wheel, then it would take little more stretching to make it cover a machine in which emery cloth or even loose emery was the cutting tool. The guidance part of the definition may be limited to the guidance of the material worked on, as in the polishing lathe where the work is constrained to revolve on centers; or it may be a complete guiding of both work and cutting tool as in a planer or milling machine. A speed lathe using hand tools is less surely a machine tool by virtue of the lack of definite guidance of the cutting tool. Its classification as a machine tool is justifiable, however, because it is so closely related to an engine lathe. The definition safely includes presses using dies and punches which cut and thus shape the material but would not include forming presses except by a similar analogy to the speed lathe. It should not necessarily include a sewing machine because there is no cutting away of the material sewed.

It would however include all kinds of woodworking machinery, which is not usually classified under this heading. If we want to make the definition agree more closely with custom we can specify that the machine tool is specifically for cutting metals. However, many machines made for that purpose are equally useful for cutting fiber and other non-metallic substances. It is likely that manufacturers of woodworking machinery would rather use that very descriptive term and would prefer not to have their product included under the name of machine tools.

The important point in this, or any other definition is to make the term sufficiently descriptive so that no expensive harm may come to any one who uses the term in a common sense way. If the term "machine tool" is used in ordinary correspondence there is little or no danger of misunderstanding, for a man does not order a dozen "machine tools" but he orders and corresponds about specific machine tools. It is only in cases where these different machines are grouped together for some purpose that harm can come. For example: for purposes of taxation, insurance, and other grouping made by people not in the industry there is apt to be a class of machines called "machine tools." It is this sort of classification which makes a rigid definition necessary in order that there shall be no misunderstandings. For this reason the narrow definition "a machine for guiding and driving a cutting tool, primarily intended for use on metal," may be the best for the simple reason that it does include a class of machinery used in a rather definite type of shop. To be sure those shops may also use wood-working machinery, but the whole atmosphere and methods of a woodworking shop are so distinctively theirs that it seems as though a separate classification were justifiable, and it is doubtful if any serious harm could ensue from their being classified together.



General Electric Employees Given Chance to Buy Stock

The General Electric Co. is offering to employees who have been on the payroll continuously since Sept. 1, 1920, the privilege of subscribing, during November, for from one to ten shares of capital stock at $136 per share. A credit is to be allowed amounting to $20 per share which will represent a net return substantially the same as that which would be enjoyed by anyone purchasing stock on an installment plan, paying interest on deferred installments and receiving cash and stock dividends. Certificates of stock are to be issued to the subscribers when payments amounting to $116 per share have been made.

Payments must be made by deductions from salary or wages, in monthly or weekly installments, as subscriptions may not be paid up in advance. No deliveries of stock will be made previous to the payment of the first installment. The total time over which the payments are to extend is 29 months or 116 weeks.

Arrangements are made to reimburse, with interest at 7 per cent, subscribers withdrawing before making final payment, also for reimbursing subscribers leaving the employ of the company, those temporarily absent because of illness or layoff and those relieved on pension. Employees are under no obligation to make subscription.

That all questions arising under the plan described are to be decided by the board of directors of the General Electric Co., is one of the conditions upon which subscriptions are received.

Shipments of American Locomotives Show Large Gain

In the first eight months of this year the United States exported 1,150 locomotives to all parts of the world, nearly 200 more than in all of last year and more than twice as many as normally exported annually before the war, it is shown by the National Bank of Commerce in New York in the November number of its magazine, *Commerce Monthly*. The largest purchases this year have been made by Belgium, Italy, France, Poland and Danzig.

Representing a rather large outlay of capital, locomotives are bought in quantity only as a definite step in the rehabilitation or extension of railroad lines. A country imports rather than makes its locomotives either because it has not highly developed its manufactures or, as in the case of France, because its manufacturing has been so disrupted by war that domestic manufactures cannot supply its needs.

Before the war the export of locomotives was concentrated in the hands of the great steel-producing countries—Great Britain, Germany and the United States. Under these circumstances American sales to Europe were very small. During the war, however, the United States was called upon to supply locomotives to Europe, and in 1918 even sent 241 to England. Since the close of the war the United States has been the only country prepared to ship locomotives in quantity, and the exports from this country form the chief part of the international trade. As time goes on, British competition may be expected again to become an important factor in the trade, and Canada has also entered the field as a locomotive exporter.

Further Additions to the F. A. E. S.

The interest being taken by engineering societies in the Federated American Engineering Societies is indicated by the number voting to become charter members. The latest activities of the F. A. E. S. follow:

The Engineering Society of York at its meeting on Oct. 18, 1920, unanimously adopted a resolution to apply for charter membership of The Federated American Society of Engineers.

The Washington, D. C., Society of Engineers voted at its meeting on Oct. 20 to become a charter member.

D. J. Sterrett has been appointed a delegate to represent the Detroit Engineering Society at the first meeting of American Engineering Council, to be held in Washington, D. C., Nov. 18-19.

The Buffalo Engineering Society has appointed President W. B. Powell a delegate to the first meeting of American Engineering Council.

Corporation for Direct Selling Proposed

It is proposed by L. S. Devos, an export manager with offices in the Grand Central Palace, New York, to form a business corporation, the objects of which would be to centralize through one channel the export business of its members; to maintain direct selling representation in the New York metropolitan district; to maintain direct selling representation in foreign territories; to appoint proper representation in foreign territories where the amount of business would not justify direct selling; to maintain in foreign districts service men of the members of the corporation; and to centralize through one channel for all members purchasing, advertising, domestic and foreign sales, forwarding and shipping.

Mr. Devos is export manager for the Foster Machine Co., Stockbridge Machine Co., Giddings & Lewis Machine Tool Co., Cincinnati Lathe and Tool Co., American Milling Machine Co., U. S. Machine Tool Co., U. S. Drill Head Co. and Otto Grinder Co.

A meeting will be held on the evening of Nov. 10 at the Hotel Astor.

Co-operative Meeting on Steel Industry Working Shifts

The Taylor Society, described as a society to promote the science and the art of administration and management, will hold a co-operative meeting on Dec. 3 with the metropolitan and management sections of the A. S. M. E. and the New York section of the A. I. E. E. This meeting will be held at the Engineering Societies Building, New York.

Horace B. Drury, formerly of the economics department, Ohio State University, and recently with the industrial relations division of the U. S. Shipping Board and besides author of "Scientific Management" (Longmans), will read a paper on the subject of "The Three-Shift Day in the Steel Industry."

During recent months Mr. Drury has visited practically all of the steel plants in the United States working under the three-shift system in an effort to collect technical data covering the details of their operation and figures showing the results obtained. Mr. Drury's paper will be a general review of his findings and will constitute the first comprehensive contribution on this important subject to American engineering literature. Throughout industry there is a steadily growing tendency to shorter hours. In Great Britain, France, Belgium, Sweden and practically all important steel producing countries the three-shift day has very largely superseded the long two-shift day in the steel industry. It seems probable the three-shift system will come in America and it is the part of conservatism and wisdom for management to prepare for it.

"The Long Day in the Steel Industry," and "The Point of View of the Manufacturers" will be other subjects discussed. William B. Dickson, vice president of the Midvale Steel and Ordnance Co., will read a paper on the latter subject and a general discussion to be led by Robert B. Wolf, consulting engineer, New York, will follow.

LD'S INDUSTRIAL FORGE

News Editor

New Officers and Plans of the A. S. M. E.

Edwin S. Carman, manufacturer, of Cleveland, has been elected president of the American Society of Mechanical Engineers in a mail ballot covering a membership of 13,000, comprising engineers, managers and technologists in every industrial center of the country. Mr. Carman succeeds Major Fred J. Miller of New York, and will take office after the society's annual convention, to be held in New York in December.

John L. Harrington, consulting engineer, of Kansas City; Leon P. Alford, editor, of New York, and Robert B. Wolf, president of the R. B. Wolf Company of New York, were chosen vice-presidents for two years in succession to John A. Stevens of Lowell, Mass., Henry B. Sargent of New Haven, Conn., and Fred R. Low of New York. Three managers, each for a term of three years, were elected as follows: Henry M. Norris of Cincinnati, Carl C. Thomas of Los Angeles, and Louis C. Nordmyer of St. Louis. Major William H. Wiley, publisher, of New York, was re-elected treasurer. The secretary will be elected by the society's council in December. Calvin W. Rice has held this office since 1906.

Following a meeting of the society's council, composed of the president, vice-presidents, managers, past presidents, treasurer and secretary, plans for promoting professional endeavor and public service, particularly as to industrial relations and rewarding engineering achievement, were announced. The finance committee recommended a budget for the ensuing year of more than $500,000. The publication committee reported that the society's publication for the year had involved an expenditure of more than $200,000.

The meetings and program committee detailed plans for the December convention and also announced plans for a congress of mechanical engineers to be held in Chicago next spring.

The engineering foundation fund for engineering research, of which the society is one of the sponsors, will shortly amount to $1,000,000. This fund was established in 1914, by Ambrose Swasey of Cleveland, by gifts to the United Engineering Society, as a nucleus of a large endowment "for the furtherance of research in science and in engineering or for the advancement in any other manner of the profession of engineering and the good of mankind." The fund is administered by the engineering foundation board, composed of members from the American Society of Mechanical Engineers, the American Society of Civil Engineers, the American Institute of Mining and Metallurgical Engineers and the American Institute of Electrical Engineers.

John H. Barr of New York, formerly professor of machine design at Cornell, was appointed the society's representative on the national research council for three years, succeeding W. F. M. Goss of New York. Fred J. Miller, retiring president, was named to fill the vacancy on the John Fritz medal board created by the death of John Alfred Brashear of Pittsburgh, a past president of the society. Mr. Miller will serve until 1923.

The council adopted a recommendation from a special committee on industrial engineering, composed of Dean D. S. Kimball of Cornell, chairman; L. W. Wallace of Baltimore, and L. P. Alford, Frank T. Chapman, and Robert W. Wolf of New York, that immediate steps be taken "to formulate a practical program of industrial relations which will express the viewpoint and beliefs of engineers." The management section of the society was charged with carrying out a plan submitted by Dean Kimball's committee, providing that a committee on agencies of productivity be established to study invested savings, credit capital, organized labor, unorganized labor, employers, managers, society as a whole, economic and productive intelligence service. The committee requested the council to call upon the society's membership for active assistance "in building up a co-operative movement between all organizations which are working for the improvement and upbuilding of industry."



EDWIN S. CARMAN

The council adopted a report as to a system of awards and prizes for meritorious contribution to the science and art of engineering by a committee on awards and prizes headed by Dr. Ira N. Hollis president of Worcester Polytechnic Institute. Among the awards which may be granted by the council in recognition of distinguished service to engineering and the industries are honorary membership, life membership for the best contribution to the literature of mechanical engineering appearing in the society's publications for a given year, a medal for some notable invention or striking improvement in connection with the industries, and honorable mention, appearing as a diploma for such inventions or improvements in engineering as in the opinion of the council merit the attention of the society without being of such far-reaching importance as to warrant a medal.

Awards of scholarships or fellowships for exceptional attainment in college work, the report stated, are under contemplation. Other awards include a junior medal or cash prize for the best paper or thesis submitted by junior members and two student medals or cash prizes for the best papers or thesis submitted by student members of the society. All awards are granted by society's council, which holds about seven meetings a year in New York and other centers. The council is aided in preliminary decisions by an executive committee and by an elaborate organization of standing committees in charge of fundamental activities.

The society has formed an aëronautic section with a large membership, including Orville Wright, Howard E. Coffin, Edward A. Deeds, Jesse G. Vincent and Elmer A. Sperry.

Crane Co. Registers in Thirty-One Countries

Thirty-one countries, necessitating ninety-three separate registrations, have been chosen by Crane Co. in which to protect its three trade marks.

The Crane Co., a Chicago institution, was established in 1855. It is its business to manufacture some twenty thousand different articles more or less closely associated with pipe and piping, and to distribute, as merchants, numerous other manufactured articles.

Soon after the orders had been forwarded to the thirty-one countries, it was discovered that "piracy" of the trade mark "Crane," had developed in a South American republic. Hope is expressed that the applications for these foreign registrations will have been filed in time to forestall the work of the "pirates" in all of the countries entered.

German Import Restrictions on Machine Tools

The German branch of the National Cash Register Co., which up to now had only a shop for repair work and assembling, is now planning an enlargement of its workshops for the purpose of manufacturing

The firm intended to equip its new shops with American machine tools and had applied for a license to import a number of such tools. This license has, however, been declined on the ground that similar tools are being made in the country. This decision has evidently been made to enforce the American company to buy German machine tools.

German firms applying for import licenses for American machine tools have obtained them without great difficulty. It is, however, necessary for the buyer to state that he cannot obtain tools of the same kind and quality in Germany.

Machine-Tool Market in Bolivia

In the near future there is likely to be an increased demand for machine tools in Bolivia, but in considering the needs of this market it must be borne in mind that the tools will be required for repair and general work.

Tools designed for quantity production, except small automatics for turning out studs, small bolts and nuts, are not, and for some time to come will not be, wanted, and it will be useless tc attempt to push their sale. At the same time makers will be well advised to send out well-illustrated catalogues, printed in Spanish, describing as far as possible in non-technical language some of the more elaborate of their productions, solely with a view of driving home to the Bolivian user the fact that they can and do make giant machines which are in every way superior to the productions of United States shops. There will be no sale for these, but there will be a large advertising value in such distribution.

Mining Requirements

By far the greatest proportion of machinery imported into and used in Bolivia is intended for mining or closely related purposes. If railway rolling stock, which accounts for about 25 per cent of the total value of the machinery sent into the republic, is left out of consideration about 22 per cent of the balance is mining machinery, and the rest is spare parts, engines, electrical appliances and machine tools used in connection with mining.

The machine tools required are consequently those which can be used in the repair of crushers of all kinds, crushing rolls, stamp mills, tube and ball mills, pulverizers, mechanical roasters, jigs of various makes, concentrating tables, flue vanners, classifiers and mechanical separators. Tools are also wanted which can duplicate parts of Diesel and semi-Diesel oil engines, turn up commutators of electric motors and generators, deal with broken parts in compressed air drills, air compressors, pumps, mining cars and small locomotives used for hauling ore and other purposes. There is just now a fair and increasing demand for hydraulic and dredging machinery, and tools capable of dealing with repairing and duplicating parts of such machines will be wanted.

Repair Shop Equipment

In addition to the shops connected with the various mining establishments and railways there are a number of privately owned repair shops, most of which were equipped with machine and other tools of German or United States origin. Most of these contemplate the installation of new plant.

Recently motor-car repair has been undertaken, and there is a fair inquiry for machine tools for grinding cylinders and other parts, for gear-cutting and hobbing machines, and incidentally for electric and oxy-acetylene welding outfits. Small electric furnaces for the heat treatment of tools and steel parts are also likely to come into request.

The average repair shop in Bolivia will contain the following equipment:

One medium lathe of ordinary belt-driven three-cone pulley type, with back gear and screw-cutting banjo plate and wheels, for metric as well as other threads. This will be of 12-in. or 16-in. center, with gap to allow of work up to 36 in. being taken, and with a bed length of about 10 ft. Such a machine must be large enough to take the crankshaft of an ordinary traction engine, or to turn up a medium length of countershafting.

One lathe of 9-in. center with gap and bed about 6 ft. 6 in. in length, sliding and surfacing, with ordinary tool rest, three-cone pulley, and back gear.

One lathe of 5-in. center, with gap which will permit of pulleys about 18 in. in diameter being faced and bored. Self-traversing ordinary tool rest and bed about 3 ft. in length.

One high-speed radial drill to take up to 2-in. hole in cast iron, preferably with hand feed. The spindle should be capable of taking chucks to hold drills of very small size as well as the bigger drills. The bed should be such that the machine can take ordinary steel girders. In addition to this big drill there will usually be a smaller radial drill and two or three high-speed drilling machines of the pillar type, and a hand-power bench drilling machine with medium heavy flywheel.

One shaping machine with rising and falling table, adjustable head, quick return motors, and capable of at least 12 in. travel. In addition there may be a small high-speed shaper and a 30-in. planing machine, the French type of this tool being preferred.

A medium-sized miller, one small power grinding machine, a small saw-grinding machine, one power-driven punching and metal-cutting machine, and two or three small hand-operated punching machines.

—*London Times.*

Manufacturers' Sales Co. Organized

The Manufacturers' Sales Co. has been organized. with offices in the Leader-News Building, Cleveland, Ohio, to represent in Cleveland and surrounding territory, one or possibly two large reliable manufacturers for the sale of their respective products.

C. C. Bradford, for a number of years sales manager of the U. S. Light & Heat Corporation and more recently sales manager of the Marlin Rockwell Corporation, has been selected to manage the affairs of this new enterprise. Mr. Bradford is widely acquainted among manufacturers and buyers throughout the Middle West and has had extensive experience in developing large sales organizations.

Kansas State College Makes Lathes for High Schools

Two sets of lathes made in the shop practice department of the division of engineering of the Kansas State Agricultural College were shipped out during September, one going to the board of education at Alton and the other going to the board of education at Clyde.

The department has been building wood lathes as a part of the regular class work for engineering students. Sixteen of these have been in use since 1917 in the woodturning and pattern shop.

During this period the lathes have been closely inspected for weak places. As soon as any weak point was discovered it was corrected and the changed part thoroughly tried out to be sure no weakness would result.

The lathes are mounted in pairs on a substantial stand and are driven from underneath. The moving parts are all enclosed except the spindle on which the work is mounted. This insures "Safety First," as all shifting of belts is done by simply shifting a lever.

Lathes Made Interchangeable

The method used in the college shops in making these lathes is practically the same as those used in commercial shops. Jigs, fixtures and gages are used to insure all parts being interchangeable. This means that the college can furnish parts for the machines in case they are broken or wear out in use with the assurance that the parts will interchange with the old parts. The parts which go to make up the machine are numbered in such a way that no difficulty is experienced in ordering any part that should be needed.

The shop-practice department secured from the war department a large assortment of up-to-date machine tools for the machine shop recently.

With the use of the new machinery it will be possible to turn out a much greater number of pieces than was formerly possible and within the next year there should be quite a number of these lathes available for use in high schools and other schools in Kansas, the plan being to supply them in units of two or more mounted on a very substantial bench in such a way that they can be readily attached to a motor, or a gas engine, or a line shaft. The college supplies the lathes at a price that approximates the actual cost of materials used in their construction.

Decline in Shipbuilding

According to figures of the Bureau of Navigation private American shipyards on Oct. 1 were building or under contract to build for private ship owners 331 steel vessels of 1,236,277 gross tons, compared with 345 vessels of 1,236,547 gross tons on Sept. 1, 1920.

These figures do not include government shipbuilding or contracted for by the United States Shipping Board out of money voted by Congress.

Southern Commercial Congress' Progress in Export Trade

In order to form commercial alliances with foreign business concerns, principally with companies located in Latin-America, and thus to further expand and broaden the foreign market for Southern industrial concerns, manufacturers, business men and bankers of Atlanta are planning the organization of the Atlanta Export Club. This club will be the result of the recent training school for Pan-American Commerce, conducted in Atlanta under the auspices of the Southern Commercial Congress, and widely attended by business men and manufacturers of the Atlanta trade territory. The course was intensified into a month's training, covering the most important phases of foreign commerce, and under the direction of men long experienced in this field.

During the past two or three years the expansion and growth of foreign trade between Southern industrial centers and Latin-American countries has been remarkable, the principal products now finding a market in those countries being machinery, machinery supplies, machine tools, and iron and steel products. It is the purpose of the Southern Commercial Congress to further increase this trade by the establishment in various industrial centers of the South of inland consulates, in charge of men experienced in foreign commerce and familiar with the trade conditions in the countries they represent.

That this plan is the most feasible is indicated by the enormous amount of export trade now carried on between Atlanta and Cuba and Atlanta and Panama. Both of these countries are represented in Atlanta by consuls who devote a large part of their time to the development of this business. Dr. Guy King represents Cuba, and John Ashley Jones, Panama.

These two countries, the consuls say, offer at this time a very fertile and stable market for machinery and machinery products of almost any kind, and machine tools. The same is true of Peru, Brazil and the Argentine, and efforts are being made by the Southern Commercial Congress to have all of those countries establish consulates in the inland cities of the South.

France Reorganizes Foreign Trade Bureau

The "Office du Commerce Exterieur" of France, although bearing the name of a bureau that has been in existence for some time, has recently been reorganized on a more ambitious scale. This department of overseas trade is a practical link between official France and the general public at home and abroad. It is now aided on the financial side by the new Foreign Commerce Bank. It controls the service of French commercial agents, and is responsible for organizing trade exhibits in France and other countries.

The department supplies trade information in the form of loose-leaf pamphlets, or in response to verbal and written inquiries, and at the same time welcomes the opportunity of helping foreign traders seeking information as to the French market. The department will soon begin the publication of a periodical similar to the British Board of Trade *Journal*.

The commercial exhibition plans include at the present time a "touring fair" for Canada, the Colonial exhibition at Marseilles in 1922, and an inter-allied exhibition which is planned to be held in Paris in 1925. Permanent exhibitions are being provided for branch offices of the department in the principal countries of the world. These exhibitions have already been opened in Spain, Switzerland, Czecho-Slovakia, the Balkan States and in London.

Kelly-Reamer Changes

Coincident with moving into its new plant, the Kelly Reamer Co., Cleveland, Ohio, has made the following changes:

A. H. HOWARD, formerly operating an independent office as the A. H. Howard Sales Engineering Co., has joined the organization, and will represent the company in Cleveland, Toledo and northern Ohio territory.

R. W. MARTINDALE, formerly with the E. A. Harper Tool and Supply Co. of New York and Philadelphia, will handle the Pittsburgh territory.

W. B. LEONARD, formerly connected with the Standard Tool Co., will handle the Buffalo territory.

New Officers of Cost Engineers of Indiana

D. E. Nauman, of the Midwest Engine Co., was elected president of the Association of Manufacturers Cost and Efficiency Engineers of Indiana at a dinner meeting held at the Hotel Lincoln, Indianapolis, recently.

Other officers named were H. J. Wilson of the Warner Gear Co., Muncie, vice-president; G. F. Buxton of the vocational education department of Indiana University, secretary, and D. M. Milholland of the Milholland Machine Co., treasurer.

R. A. Mouron, statistician of the Nordyke & Marmon Co., spoke on "Graphic Presentation of Business Control," illustrating his talk with a number of interesting and instructive charts.

Appreciation of Long and Faithful Service

On November first the Watson Stillman Co., Aldene, N. J., presented to Thomas Watson, a machinist who has been continually in its service for fifty years, a gold watch suitably inscribed and a check for one thousand dollars in appreciation of his loyal and faithful service.

At the same time, Wm. Graudorf, T. W. Hammond, A. D. Carnes, J. Hardy, Wm. Koshwitz, Wm. Meily and C. J. Wessels were each presented with a gold watch and Carl Wigtel was presented with a watch fob; all in recognition of long and faithful services.

Clark Equipment Co. Has New Motor-Truck Axle Plant

The new Battle Creek plant of the Clark Equipment Company of Buchanan, Mich., which has been under construction since March 1, is almost completed and the work of "tooling up" the plant for the manufacture of Clark axles will soon be in progress. Much of the machinery has been purchased and is ready for installation. This plant of the Clark Equipment Co. will be used exclusively for the manufacture of Clark motor-truck axles.

The plant's site comprises twenty-three acres with a 4,600-ft. frontage on the main line of the Michigan Central Railroad and a smaller frontage along the Grand Rapids and Interurban Railroad. It is located on the extreme western side of the city. The manufacturing building is 99 x 440 ft. and a warehouse parallel to it is 50 x 144 ft. The two buildings are connected by two closed passageways. A third building houses the power plant.

All sales, engineering, purchasing and general administration will be handled as before through the general offices at Buchanan, Mich. There will also be put into force at the Battle Creek plant the same progressive policies of plant management and profit sharing, which have proved so valuable at Buchanan.

J. J. Arnsfield Elected President of Engineering Advertisers' Association

At a recent meeting of the board of directors, J. J. Arnsfield, advertising manager of Fairbanks, Morse & Co., was elected president of the Engineering Advertisers' Association of Chicago to fill the vacancy made by the resignation of A. H. Hopkins, who severed his connection with the C. F. Pease Co. to take charge of the domestic advertising division of the J. Roland Kay Co. Keith J. Evans, advertising manager of Jos. T. Ryerson & Son, was elected vice president, and Julius Holl, advertising manager of Link-Belt Co., was elected to the board of directors to fill the vacancy made by Mr. Hopkins' retirement.

Metal-Working Machinery Exports for September, 1919 and 1920

Exports of metal-working machinery fell off slightly in September, 1920, as compared with the exports of September, 1919. The figures, as compiled by the Bureau of Foreign and Domestic Commerce, are as follows:

METAL-WORKING MACHINERY EXPORTS FOR SEPTEMBER

	1919	1920
Lathes	$724,960	$506,781
Other machine tools	841,956	1,176,175
Sharpening and grinding machines	313,581	333,844
All other	1,991,005	1,190,343
Total	$3,871,502	$3,207,143

New Safety Club

The Syracuse Safety Engineers' Club was organized last week as an adjunct of the Syracuse Safety Council of the Chamber of Commerce.

Personals

P. Z. VERNON, of Alfred Herbert, Ltd., who arrived in New York on Sept. 9 for a few weeks to familiarize himself at first hand with conditions in the United States, has recently returned to England.

J. M. HENRY has been transferred from the position of assistant research engineer of the Pratt & Whitney Co., Hartford, Conn., to the publicity department of the Niles-Bement-Pond Co., New York. He will also have charge of the publicity connected with the Pratt & Whitney Co. products.

J. B. PETERSON, formerly with the Bureau of Standards, Washington, D. C., is now in the production department of the Royal Typewriter Co., Hartford, Conn.

HERBERT A. CARHART has resigned as assistant superintendent of the Lincoln Motor Co., Detroit, and organized the firm of Carhart Bros. Foundry, Inc., Syracuse, N. Y., producers of gray-iron castings for textile machinery and other light medium machine parts. Mr. Carhart is president and manager of the new firm.

O. P. PALMER, purchasing agent of the Pratt & Whitney Manufacturing Co., Hartford, Conn., was elected president of the Connecticut Purchasing Agents' Association, at a recent meeting.

BENJAMIN L. COE, treasurer of the Steel & Johnson Manufacturing Co., Waterbury, Conn., has recently been chosen president of the West Side Savings Bank of Waterbury, Conn.

GLEN R. ANDERSON has recently entered the Pacific Coast sales organization of the Gilbert & Barker Manufacturing Co., of West Springfield, Mass. Mr. Anderson will cover the district in and about the City of Tacoma, Washington.

FRANK FAULKNER has been appointed assistant production manager of the Walworth Manufacturing Co., South Boston, Mass. Mr. Faulkner has been with the company since October, 1919. He graduated from Dartmouth in the class of 1919, and is a son of President Faulkner of the Oliver Typewriter Co., Chicago.

J. F. GEARY, formerly assistant superintendent at the Chicago plant of the American Brake Shoe and Foundry Co., is now manager of manufacturing for the Federal Radiator Co. at Zanesville, Ohio.

J. F. BOYD, formerly with the Cyclops Steel Co., has been placed in charge of sales of Wetmore expanding reamers in the Chicago district, which includes Illinois, Missouri and northern Indiana. The Scully-Jones Co., Chicago, will continue handling Wetmore products as heretofore; Mr. Boyd's office is at 846 Marquette Building, Chicago.

FRANK E. CABLE, formerly treasurer of the Porter-Cable Machine Co., Syracuse, N. Y., has retired from active business on account of his health, and is now residing in Nantucket.

RALPH K. POWELL, formerly equipment engineer at the International Motors Corporation, has become a director and vice president of Hubbard & Harris, Inc., consulting engineers, Bridgeport, Conn. He will interest himself particularly in the machine and equipment designing department.

GUY E. MARION, former president of the Special Libraries Association, has completed his war work in New York City with the Community Motion Picture Bureau. He will now return to his own professional work of organizing special libraries for corporations, business houses, associations, and other enterprises requiring correct and up-to-date information within their fields. Mr. Marion still resides in Upper Montclair, N. J., but will soon resume his old address at 27 State St., Boston, Mass.

I. F. MACKAY, formerly secretary-treasurer of Willys Overland, Ltd., has been appointed general manager of the John Morrow Screw and Nut Co.. Ltd., Ingersoll, Ont.

G. E. ANDERSON, formerly assistant Eastern sales manager of the Duff Manufacturing Co., Pittsburgh, has been promoted to the position of sales manager, and placed in charge of its new branch office located in the Railway Exchange Building, St. Louis, Mo.

WILLIAM J. MCCANN has recently been appointed service manager of the Chapman Valve Manufacturing Co., Indian Orchard, Mass.

Obituary

Joseph Kinne Sharpe, Jr.

JOSEPH KINNE SHARPE, JR., inventor and president of the Indiana Manufacturing Co., died at his home, 1314 North Delaware St., on Oct. 26, from the effects of an operation undergone about a year ago. Although Mr. Sharpe had appeared to be in excellent health since the operation, physicians agreed that his participation in athletics soon after the operation caused his death. He was 65 years old.

Mr. Sharpe was a native of Indianapolis, a graduate of private schools here and of Wabash College. He entered the leather tanning business established by his father in 1885, and assisted in the organization of the Indiana Manufacturing Co., which was formed to exploit one of his own inventions in 1891. In January of the same year he married Miss Alberta S. Johnson, daughter of Dr. W. P. Johnson. Mr. Sharpe became president of the company in 1907. The invention which caused the formation of the Indiana Manufacturing Co. was an appliance for threshing machines which was sold widely throughout the world's wheat belts.

ALEXANDER J. MCCONE, founder and president of the Fulton Engine Works at Los Angeles, Cal., died at St. Vincent's hospital in that city on Oct. 27 from apoplexy. Mr. McCone was born 61 years ago and had resided in Los Angeles for five years. He was one of the founders of the Harron, Rickard & McCone Co. of San Francisco, wholesale dealers in machinery. Mr. McCone once served as speaker of the lower house in the Nevada Legislature. His wife and four children survive him.

FRANK WILLIAMS, president of I. B. Williams & Sons, belt manufacturers, died at his home on Oct. 27 after an illness of two years.

Business Items

Articles of incorporation have been filed in Indiana by the Laporte Machine and Tool Co., a newly organized company that will engage in the manufacture of machine tools. The company's directors are T. W. Witters, Albert E. Hommann and Lawrence Johnson, all of Laporte.

The capital stock of the Wheeling Machine Products Co., Wheeling, Va., has been increased from $50,000 to $100,000. E. W. Krause is treasurer and general manager.

C. W. Hunt Co., Inc., announces the formation of the C. W. Hunt Engineering Corporation, with offices at 143 Liberty St., New York, for the purpose of handling all sales entailing engineering in connection with the Hunt products.

On the application of the Vonnegut Machinery Co. Charles O. Roemler, of Indianapolis, and Robert M. Fuestel, of Ft. Wayne, were appointed joint receivers for the Spacke Machine and Tool Co. by Judge Harry O. Chamberlin, in circuit court recently.

The Tacony Steel Co., 1417 Sansom St., Philadelphia, announces the appointment of D. J. CROWLEY as Michigan sales agent. Mr. Crowley's office will be in the Dime Bank Building, Detroit, Mich. The Tacony Steel Co. has also appointed D. B. CARSON as sales manager for the Cleveland district.

The Wyman & Gordon Co., Worcester, Mass., has reduced its capital stock from $4,400,000 to $3,850,000.

The W. C. Briddell Co., Inc., Baltimore, Md., has been incorporated with $100,000 capital stock to manufacture and deal in goods, wares and merchandise in any part of the world, including the purchase and sale of rails,

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Slow Speed vs. High Speed Balancing

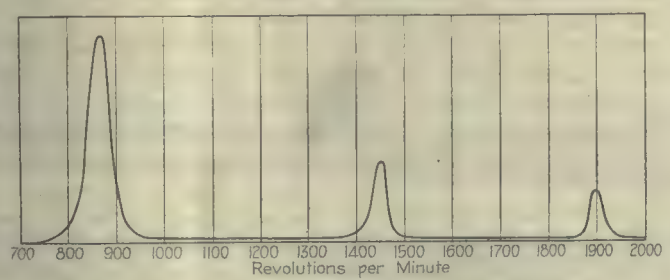
By N. W. AKIMOFF

The problem of balancing crankshafts for automotive uses is being more carefully considered than ever before. Some contend that proper balance can only be secured by running the crankshaft at its maximum speed and that on this account balancing machines are of little value. The conclusions of the author, whose experience is wide, are of special interest at this time.

ONE of the fundamental principles adopted by the writer several years ago, and from which there never was a single occasion to depart, can be put down as follows:

Any rotative body for which slow speed balancing is insufficient or is not conclusive cannot be balanced at all.

By balancing is meant plain correcting for static or dynamic unbalance but not *counterweighting*, which is a different matter. The writer always did and will insist upon the fact that there are two distinct classes or kinds of balance: drafting room balance and shop-balance; in other words balance depending upon design and that due to perfection of manufacture. A body may be in perfect balance from the standpoint of design and yet badly out of balance in actual performance, as for instance a counterweighted shaft, which often will exhibit more vibration due to unbalance than the same shaft would with counterweights taken off but placed in good running balance. As a rule, however, a shaft provided with counterweights and then properly balanced will prove satisfactory from every standpoint. As an example of an arrangement where the design alone is responsible, and where balancing will be of very little help, we might mention a four cylinder or an eight cylinder engine; here neither the counterweights nor most careful balancing will help much, and there will remain a noticeable vibration *at some specific speed.* Now, to revert to the subject of speeds at which to balance, the writer will submit that there are two radically different classes of rotating bodies:



CURVES OF FREQUENCIES AND AMPLITUDES OF VIBRATION

1. Rotating bodies whose shape change with the speed, so that for every speed we have different bodies; and, 2, bodies whose shape is practically speaking, independent of the rotative speed.

Under the first class naturally come such bodies as loosely riveted blowers; weak crankshafts of usual types; armatures of electrical machinery where windings "shift," etc.

Under the second class we might mention: well-made wheels of turbo-blowers, designed for 4,000 r.p.m. and over, well-designed crankshafts of not less than 2¼-in. diameter, preferably counterweighted although not necessarily so; turbine rotors of usual heavy design; armatures of electrical machinery, "baked" in special ovens, or else brought to full speed, preferably under heavy current, prior to balancing.

It is clear, therefore, that a body, whose shape is a function of speed, cannot be balanced or in any way improved by means of any conceivable type of balancing machines; in this case a balancing machine will only indicate faulty design or inferior methods of manufacture, which could just as well be seen from the drawings and specifications. Crankshafts of 2½-in. diameter or less, the writer submits from several years' practical experience, almost invariably result in failure from standpoint of wear and vibrations; yet, in discussions we often see some one describe a 2-in. or 1⅞-in. shaft that was satisfactory; it is safe to say that such never was or could possibly have been the case; 2¼ in. is the minimum diameter for short shafts and 2⅜ in. for longer shafts of three- and four-bearing type; for seven-bearing shafts 2⅜ in., or 2⅝ in., for that matter, is not enough if a satisfactory result is desired from the standpoint of not only smooth running but durability as well. All aviation engines have weak shafts and for this reason balancing, at any speed, becomes a joke; but so is the operation if compared with the faithful performance of an ordinary automobile engine of high or even of medium grade. The reasons or principles, underlying the construction of slender shafts are still weaker than the shafts themselves, and the writer regrets that this subject is somewhat too remote from the one we are considering in the present discussion.

A crankshaft, like any other elastic body can, of course, vibrate in several different ways, both transversely and torsionally, with a considerable variety of periods. However, considering it as a practically rigid body, possessing merely a certain amount of unbalance, we should bear in mind that it is the remainder of the car that constitutes an elastic body, having its several "periods," and the unbalance of the shaft simply acts as an external periodic force, exciting the elastic system to vibrate with the frequency of the former (the shaft). This is the well-known phenomenon of *forced*

vibration, where the frequency of the elastic system does not in any manner depend upon its own physical (elastic) properties but only upon that of excitation.

Now, it is one of the fundamental properties of forced vibrations, that whenever the frequency of the exciting force is equal, or nearly so, to that of any of the free periods of the elastic system, we have *synchronism* with an enormous amplitude, much greater than would appear at first glance, consistent with the magnitude of the exciting agency proper.

A comparatively slight increase of speed—and the condition of synchronism is passed, and the vibration becomes quite negligible. As we increase the speed and approach the next free period (of the system, not of the shaft), the vibration is again increased and reaches its maximum at the exact coincidence of the disturbing frequency with that of the new free period, and again vanishes. As a rule an elastic system has a very great variety of periods, but in practice we are only interested in the first two or three; higher periods would correspond to speeds at which we do not operate our engines. Graphically this state of affairs could be represented as follows: On the axis of speeds are laid off either frequencies or simply the r.p.m. On the axis of ordinates are laid off the amplitudes of the forced vibration of the system (say in fractions of an inch, each way, from the neutral position). The curve will then illustrate the relation between the extent of vibration and the r.p.m. The peaks indicate synchronism. The amplitudes, corresponding to synchronism, should really be infinite, at least in theory. In actual practice, owing to resistances of various kinds, they are not infinite but simply large, considerably greater than under conditions remote from synchronism.

Periods Not Arranged According to Series

It should be well understood that these periods are not ranged according to the series 1:2:3, etc.; so that if there is a vibration at say 850 r.p.m. it does not at all follow that the next "period" will be at 1,700 r.p.m. This is illustrated by the speeds marked on the sketch; the second period may be only 1,450 or so; and the third period may be in the neighborhood of 1,900 r.p.m. All these data are of course meant only for illustration, no two cases being exactly alike, even when the elastic systems look pretty much the same. To predict or figure out these "periods" in advance is much too complicated a problem, and the best we can do is to firmly understand the essence of the problem itself. Now, as soon as the disturbing cause is removed, all excitation stops and the periods disappear. This is what good balance does, in connection with bodies that *are* fit to be balanced. The writer hopes that it is clear that the speed at which to balance does not in any manner enter into this reasoning. But, the reader will object, are not all shafts weak, more or less, under high speed? In other words is not it a fallacy in itself, to consider any shaft to approach the condition of an absolutely rigid body?

By way of answer the writer can only state the following facts from his own experience:

Disregarding the seven-bearing shafts, also the four-throw shafts, in other words confining ourselves to six-throw shafts of three and four-bearing types it is safe to say that these can be (and actually have been) designed to act very nearly like rigid bodies, so that careful balancing is all that is necessary to remove *all periods* (which, as we have just seen, are the periods of the chassis, etc., and not necessarily of the shaft proper).

We are not concerned in this discussion about torsional vibrations, which show up very much like those due to ordinary unbalance. However, the writer finds that if the shaft diameter is not too small and the number of bearings is not over four, the smooth operation, which it is perfectly possible to realize, shows that the torsional "periods" are much too high to give any trouble.

The Writer's Conclusion

The following is the writer's conclusion: If the body is so slender that balancing at low speeds is "not conclusive," it cannot be balanced at all, at any speed. If the body is strong enough, perfect balance can be obtained at low speeds (200 r.p.m., more or less) and remain perfect at high speeds. To balance a body at full operative speed or, as some specifications seem to prescribe, at "overspeeds" of 25 per cent or so, means nothing whatsoever.

Why Johnson Didn't Cut Prices

By John R. Godfrey

About once in so often the preachers tell us about casting bread on the waters and having it come back full of raisins, with nice fresh butter on the side. And once in awhile you find it works out as in Johnson's case.

I've been telling off and on about some of his methods since he fired the gang of high binders who posed as efficiency experts and nearly lost him his "rep" for square dealing and human feelings with his men. But he's been working some other plans that I haven't mentioned because he wanted to try 'em out longer before he sprung them on an unsuspecting public.

But I can't keep it quiet any longer in the face of the way he is winning out in these times when many other motor makers are working short time, are cutting prices or explaining why they don't, and are generally uneasy over the situation.

When Johnson took the reins in his own hands once more he also took his men into his confidence. Not in the patronizing way that always riles a real he-man, but by laying his cards on the table, face up. First of all he considered wages and the increased cost of living. And he boosted wages to meet it without waiting to be asked or threatened. Didn't pick out a few favorites and slip them a $50 bill once in awhile but he looked after them all—that is, all who were worth keeping.

Boosting the Pay Envelope

He called his foremen in one day and said, "Boys we're going to start on a new basis. The old game was to keep a man down to the minimum wage as long as he'll stand for it. The result is the man does just enough to hold his job—and the shop suffers as well as the man. We'll try a new way.

"From now on it's your job to see how much the men in your departments can *earn*—not how little. Don't forget I said *earn*—not get. If experience counts for anything a man ought to be worth more to us the second year than the first—and so on. It's your job to make 'em worth more. The cost of living is going up and we've got to meet that—and more. Whenever your men are worth more to the company let me know at

once—don't wait to be asked for a raise. If they are not worth more there's a reason, and you're the goat. They are either on the wrong job or you haven't handled 'em right. We want them to be worth more. And the more you make them worth to us the more valuable you are to us yourself—in dollars and cents, not in flowery language which the grocer won't take at a discount."

Wages Doubled—Production Doubled

To make this part of the story short, wages have gone up over 100 per cent in Johnson's shop as they have in many others—but—and here's where Johnson's fine handiwork shows up—production per man has just about kept pace with wages! Labor costs per piece are no higher than before. And Johnson motor prices only advanced 10 per cent, while his competitors who thought he was crazy boosted theirs 10 per cent every new moon until they got all the traffic would bear.

They got more, too. They made every customer sore and the bread they cast on the water hasn't come back with raisins—most of it got waterlogged and went to the bottom. Now they are trying to cut prices without admitting they were too high before. But they can't touch Johnson's price because their production costs are away above his, so he is busy while they are flirting with receivers and bankruptcy.

I asked Johnson to tell me how he did it and, in a more or less rambling way, this is the way he told it.

"You see, Godfrey, that jolt I got when those two bugs made the men think I'd grown horns instead of wings set me to thinking and I decided to try playing the cards face up. The more men know and understand the better work they can and will do. So I started in to see that they knew what was going on. I posted figures from our books for several years back, showed what part wages and material played in total costs and how these costs could be lowered.

"We told the men, through their foremen, the value of the different machines, what an hour's delay meant in dollars and cents, and in decreasing output. When we put in new machines we told them what they cost and what they could do—also what they *must* do to be profitable. We posted the cost of material and what it meant to spoil a piece at various stages of its progress, this including labor already performed.

"Then we did the wholly unorthodox thing of posting both cost and selling price, including overhead of course, and this meant showing the profit on each engine or each lot of engines. And, just to go the whole figure, we told 'em just how much profit we divided and who got it, and how much we put back into the business in the way of new tools and equipment. We've limited our profits to 8 per cent, same as the White Co., and the men know it and what's more they *believe* it. When we can earn more than this after putting what we need into equipment, we'll see about reducing prices, not before.

"You see, Godfrey, men will come across when you play the game squarely with them. There isn't any bonus or any profit sharing and no promise of any. But they know we don't play hog at profits and they know our prices mean keeping busy long after the other fellows are shut down.

"They told me I couldn't get production without elaborate piece work or bonus systems, but it's all day work and not even a bonus. And it's all because we've never broken faith with 'em once. If we ever do — the jig is up. You can't get production like ours unless the men know you're square and they feel like part of the family. You can't get a man to work very hard when he knows or suspects that you are making an exorbitant profit. He may be getting big money but it seems small beside some of the war profits that have been made and he has no ambition or incentive to really see what he can do. When he *knows* he's getting his share or that you are not getting more than your share, he'll dig in and play the game just as you or I would.

"Human nature is about the same whether it's in the office or the shop. But we mustn't forget to make more allowances for lapses on the part of the men because of their lack of vision and education. Those of us who are managing businesses should have a broader viewpoint than the average men in the shop. The community and the world have a right to expect and to demand more of us than of the men. And the low-down manager who tries trickery and wants to have hard times so he can get even with his men, is a disgrace to the human family. I'd like to help ride him on a rail myself. He's the chap who will get us into trouble—if trouble comes as I sure hope it won't."

Johnson Gets the Pick of Good Men

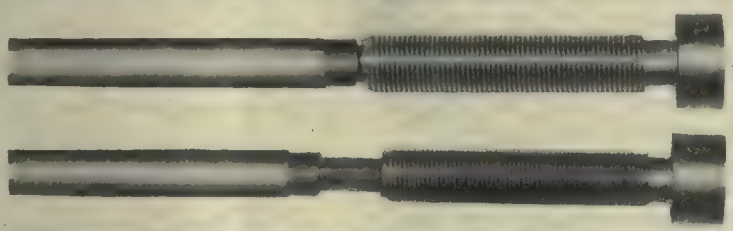
Do you wonder that Johnson has his men with him—that they give him the best they've got—that they'd fight for him at the drop of the hat? He gets the pick of the men in our town and he has the respect of everybody but the old-time managers. He won't ever be a millionaire—but he's worth more to the country than many of those who are.

Correction

A serious error appeared in the article on making micrometers on page 605 of the September 30th issue.

In this article we stated that the spindle and screw were made of one solid piece of tool steel. The accompanying illustration shows that the spindle and screw are separate pieces and NOT *one piece of tool steel, the screw being drilled out at one end and forced or shrunk on to the spindle as shown.*

We are sorry that this misstatement occurred and are glad to make this correction in justice to the J. T. Slocomb Company, who manufacture the only micrometer having the spindle and screw of one solid piece of tool steel.



THE UPPER VIEW SHOWS THE PARTS OF THE TWO-PIECE SPINDLE SLIGHTLY SEPARATED. THE LOWER VIEW SHOWS THE PARTS ALMOST PULLED OUT

The Law of Coriolis

By HENRY N. BONIS, B.S., M.E.
Assistant Professor of Mechanical Engineering,
Purdue University

Under this somewhat forbidding title the author gives in detail a simplified solution of the problem of determining the acceleration of a point on a flyweight link without the use of the fictitious acceleration of Coriolis. He uses the parallelogram law for velocity and acceleration and proves the correctness of his method by superimposing the theorem of Coriolis solution upon his own.

THE writer wishes to call attention to a misconception usually found in books on Kinematics, for example, on page 149—A. W. Klein, "Kinematics of Machinery"—the following statement is made, in reference to finding the acceleration of a point on the flyweight link of a governor, "But this parallelogram of motions will not in the same sense suffice for the determination of the resultant acceleration of point F," and then proceeds to bring in the supplementary component acceleration $2V_r w_1$ of Coriolis in order to solve the problem. It would appear from the above to the reader that the parallelogram law had an exceptional case in the determination of accelerations, which, however, is not so, as the following article will show that if the proper components are taken, whether for velocities or for accelerations, the resultant in both cases can be obtained by adding two vectors, one vector representing the relative relation of the given point to a point of reference, and the second vector the relative relation of the point of reference to fixed space.

Though in the case of velocities the two components chosen in Prof. Klein's book give the correct resultant velocity, it is because these components are the result of an investigation based on the parallelogram law applied to rotations about two parallel axes, and hence their use gives a correct result.

As far as determining the acceleration of a point on the flyweight link, the following article will show that the Law of Coriolis is not necessary to the solution; that the parallelogram law of accelerations holds, and affords a simpler proof than the one given (which I believe is identical with Dr. Burmeister's in "Lehrbuch der Kinematik") of the fictitious acceleration of Coriolis. It is to be understood by the reader that in dynamical problems it is very often convenient to use axes which themselves move in space and to which the motions of the body under consideration are referred, and the theorem of Coriolis gives us a rule that we may consider the moving axes to be at rest if to the *actual* forces applied to the body fictitious ones be added capable of producing accelerations equal and opposite to the acceleration of moving space and to the compound centripetal acceleration. (See "Routh's Elementary Rigid Dynamics," 1882, page 183, Example 213.)

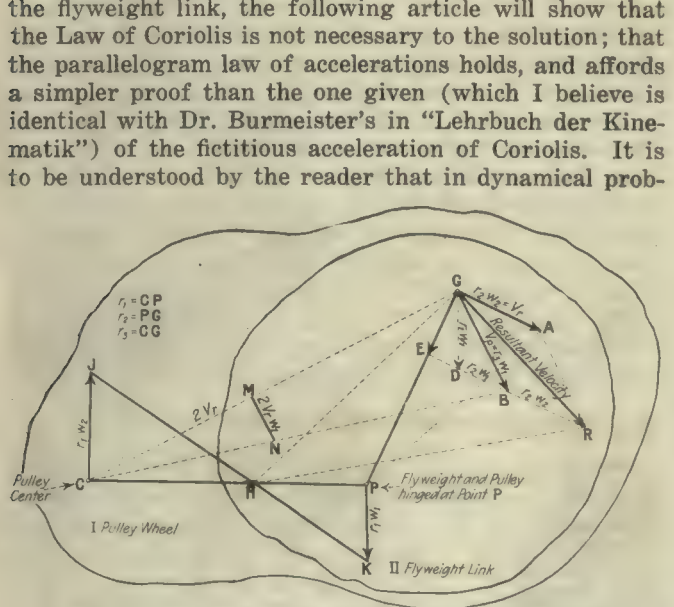


FIG. 1. VELOCITY DIAGRAM FOR PULLEY AND FLYWEIGHT

Velocity Determination

Referring to Fig. 1 we are given the angular velocity w_1 and angular acceleration $Dw_1 = (dw/dt)_1$ of the pulley wheel I about its shaft center C, and the relative angular velocity w_2 and relative angular acceleration $Dw_2 = (dw/dt)_2$ of the flyweight link II with respect to the pulley. The flyweight link and pulley link are hinged together at P (see Prof. A. W. Klein, "Kinematics of Machinery," Chapter X, page 148) or Fig. 2.

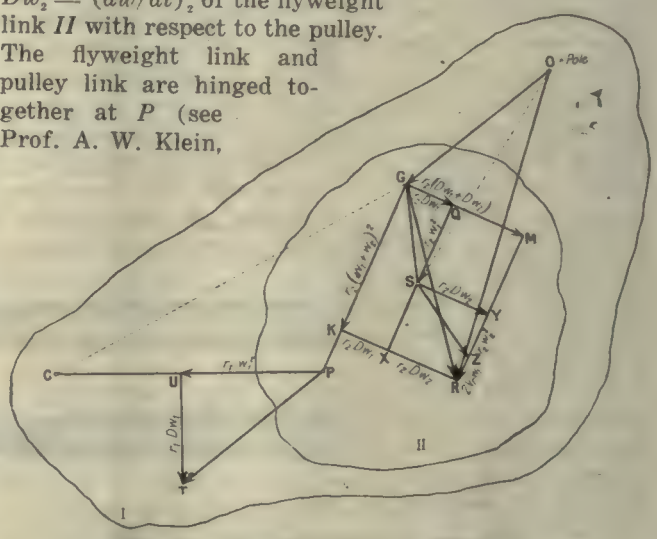


FIG. 2. PULLEY WITH FLYWEIGHT

Symbols.

$r_1 = CP$

$r_2 = PG$

$r_3 = CG$ = distance from shaft center C to point G on pulley directly under G on flyweight.

$V_r = r_2 w_2 = GA$ velocity of flyweight point G relative to plane of pulley I.

$V_P = r_3 w_1 = GB$ = velocity of point G on pulley I about C.

In order to find the resultant absolute velocity of point G on flyweight, the usual procedure is to combine the two components V_r and V_p into the resultant velocity GR.

From another point of view if we consider the line CP in the plane of II we will note that as the motion of plane II consists of rotations about parallel axes P and C the point C of line CP has only the velocity $CJ = r_1 w_2$ perpendicular to the line CP about center P and the point P has only a velocity $PK = r_1 w_1$ about center C, we can easily determine the instantaneous center of the line CP (and hence of the plane II) by

joining the ends J and K of these normal velocity vectors, by the line JK, and the intersection of JK and CP is the instantaneous center H. The velocity of G can now be determined by making the angle $GHR = PHK$ or CHJ and drawing GR perpendicular to HG.

The instantaneous center H could also be found by the rule of composition of angular velocity about parallel axes by dividing the line CP inversely as the angular velocities w_1 and w_2 which is evident from the construction as triangles HPK and HCJ are similar, thus

$$\frac{HP}{HC} = \frac{PK}{CJ} = \frac{r_1 w_1}{r_1 w_2} = \frac{w_1}{w_2} \qquad (1)$$

Again the angular velocity of any point in Plane II about the instantaneous center H is $(w_1 + w_2)$ as proven thus

$$\text{angular velocity} = \frac{PK}{HP} = \frac{r_1 w_1}{HP}$$

But from equation (1) we have by composition

$$\frac{HP}{HC + HP} = \frac{HP}{r_1} = \frac{w_1}{w_1 + w_2}.$$

$$\text{Therefore angular velocity} = \frac{r_1 w_1}{r_1 w_1} = w_1 + w_2$$
$$w_1 + w_2$$

We have thus proved that the plane II or any line in plane II as GP is rotating in fixed space with an angular velocity $w_1 + w_2$; but this fact is self-evident, because if the line PG on flyweight has no motion relative to line PG on pulley its angular velocity would have been w_1 the same as any line on plane I, but as PG on plane II has an angular velocity relative to PG on plane I its angular velocity in fixed space is evidently the algebraic sum of $w_1 + w_2$. Now if the line PG is rotating in fixed space with angular velocity $(w_1 + w_2)$ *the relative velocity of point* G to point P is $r_2(w_1 + w_2)$ perpendicular to the line PG, and since we know the absolute velocity of point P, that is PK, we can get the resultant velocity of G by the vector sum of $PK = GD = r_1 w_1$ and $DR = r_2(w_1 + w_2)$ drawn perpendicular to line PG.

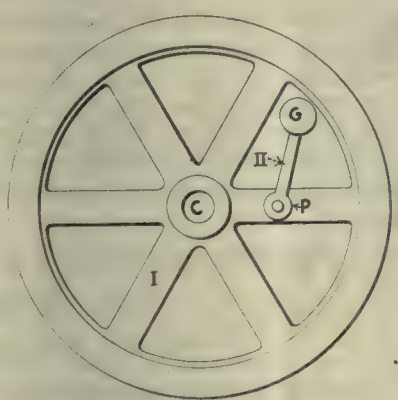


FIG. 3. ACCELERATION DIAGRAM FOR PULLEY FLYWEIGHT

It is well for the reader to note that the components GE of the velocities GD and GR along the line GP are identical, otherwise the points G and P would change their distance from each other, and furthermore the fact that the relative velocity of G to P can only be perpendicular to PG, since P acts as a center about which G is rotating.

Superimposing both velocity diagrams, and comparing the triangle GDB with triangle CPG on the pulley-wheel, we find that these triangles are similar, having their sides respectively perpendicular, and hence using G as a pole the triangle GDB is a triangle of velocities, for the points C, P, G on pulley wheel, the ratio of the sides being $w_1 : 1$ as it should be, since the triangle CPG on pulley is moving as a whole about the shaft center C. Hence $DB = r_2 w_1$ (which is the relative velocity of point G on pulley about P). But since $DR = r_2(w_1 + w_2)$ we have $BR = r_2 w_2 = V_P$. We also have from the above similar triangles $GB = r_1 w_1 = V_P$, and hence we see that the use of these components V_P and V_P gives us the same resultant velocity GR as GD and DR.

Total Absolute Acceleration

In order to find the total absolute acceleration of point G on flyweight we proceed in a similar way; namely, find the relative acceleration of point G to P and then add to this relative acceleration, the absolute acceleration of point P. The angular velocity of the line PG of the flyweight in fixed space is $(w_1 + w_2)$ and therefore the relative centripetal acceleration of G about P is $r_2(w_1 + w_2)^2$ which is laid off to scale equal to GK—from G to K. (See Fig. 3.) Similarly the angular acceleration of the line PG in fixed space is $(Dw_1 + Dw_2)$ and hence the relative tangential acceleration of G about P is $r_2(Dw_1 + Dw_2)$ which is laid off to scale equal to GM. Combining these two components into a resultant GR we have the total acceleration of point G relative to point P. Again since P is a point on the pulley, we know its absolute acceleration PT (since centripetal acceleration $PU = r_1 w_1^2$ and tangential acceleration $UT = r_1 Dw_1$ both about C are known), and hence if we add the acceleration vector $OG = PT$ to the relative acceleration GR, we get the total absolute resultant acceleration OR of the point G in fixed space.

Method Employed by Using Theorem of Coriolis

The method employed by using the theorem of Coriolis in the determination of the total absolute resultant acceleration of point G is to add together geometrically the three following acceleration vectors. (1) The total acceleration of point G on the pulley about its center C. (2) The total acceleration of point G on flyweight about its center P. (3) The fictitious acceleration of Coriolis $2 V_r w_1$ at right angles to the velocity vector V_r. In order to show the relationship of both solutions it will be necessary to superimpose both methods. Thus—Draw OS equal to the acceleration of point G on pulley. Draw SZ equal to the acceleration of point G on flyweight about P. Draw ZR at right angles to GM equal to $2 V_r w_1$ and we get OR as the total absolute resultant acceleration of point G on flyweight.

In order to prove that the points R of both methods coincide we will analyze our composite acceleration diagram. In triangle OGS we have OG, OS, and point O representing the accelerations of the points P, G, and C respectively of the triangle PGC on the pulley. (This acceleration triangle is termed the image of the original configuration PGC.) Hence GS represents the relative acceleration of point G on pulley about P. Draw XSQ through S parallel to PG and SY perpendicular to PG. The relative acceleration of point G on pulley about P is composed of the relative tangential component $GQ = r_2 Dw_1 = KX$ and the relative centripetal component $QS = r_2 w_1^2 = MY$. Again SZ is the acceleration of point G on flyweight about P and is composed of the tangential acceleration component $SY = r_2 Dw_2 = XR$ and centripetal acceleration component $YZ = r_2 w_2^2$. Now $GQ + SY = r_2 Dw_1 + r_2 Dw_2 = KR = GM$. Hence point Z falls on MR, also $MZ = MY + YZ = r_2 w_1^2 + r_2 w_2^2$. But $ZR = MR - MZ = GK - MZ = r_2 (w_1 + w_2)^2 -$

$(r_2w_1^2 + r_2w_2^2) = 2r_2w_1w_2$. Hence $ZR = 2V_rw_1$ since $V_r = r_2w_2$ which is the acceleration of Coriolis and hence both points R coincide. *Q.E.D.*

It is evident from the above solution that I furnish a very simple proof of the Law of Coriolis.

In the execution of the problem it is not necessary to calculate $2V_rw_1$ as it can be obtained graphically by laying off CM in Fig. 1 on the line CG equal to $2V_r$ and drawing MN perpendicular to CG and limiting N by the line CB. MN is then equal to $2V_rw_1$. This is evident since triangles BGC and NMC are similar and

$$\frac{MN}{MC} = \frac{GB}{GC} \text{ or } MN = MC\,\frac{GB}{GC} = 2V_r\,\frac{r_3w_1}{r_3} = 2V_rw_1\,.$$

As regards the direction of $2V_rw_1$, it is evident from the figure that if w_1 and w_2 are of opposite signs, the point R would fall between M and Z, because $MZ = MY + YZ = r_2w_1^2 + r_2w_2^2$ and $MR = GK$ would equal $r_2(\pm w_1 \mp w_2)^2 = r_2w_1^2 - 2r_2w_1w_2 + r_2w_2^2$ and therefore MZ would be greater than MR. Hence $2V_rw_1 = ZR$ would have to be laid off in the direction of P to G. This statement is in accord with the one given in "Kinematics of Machinery," page 156.

Looking back at the foregoing proof it may be said that the point P was chosen as the point of reference and the relative velocity or acceleration of point G on flyweight to point P has been combined with the relative velocity or acceleration of P to fixed space, and two vectors have been obtained in either case to give the resultant velocity or acceleration. Thus in Fig. 1, in the case of velocity, we have DR and GD as the components of the resultant velocity GR, and in Fig. 2, in the case of accelerations we have GR and OG as the components of the resultant acceleration OR. But the point of reference is entirely arbitrary and the same result will be obtained if the relative velocity or acceleration of point G on flyweight with respect to any point of reference is combined with the absolute velocity or acceleration of this point of reference. Thus if we choose the point G on the pulley as the point of reference, we must determine the relative velocity or acceleration of point G on flyweight to point G on pulley, and combine this with the absolute velocity or acceleration of point G on pulley.

Now the relative velocity of G on flyweight to G on pulley is the vector sum of the relative velocity of G on flyweight to point P and the relative velocity of point P to point G on pulley. But the relative velocity of G on flyweight to P is $r_2(w_1 + w_2)$ perpendicular to PG, and the relative velocity of P to point G on pulley is $-r_2w_1$ (that is equal to and opposite to the velocity of G on pulley to P) also perpendicular to PG. Hence the relative velocity of point G on flyweight to point G on pulley is $r_2(w_1 + w_2) - r_2w_1 = r_2w_2 = V_r$ perpendicular to PG; and therefore combining V_r with the velocity of G on pulley, $V_P = r_3w_3$, will give the same resultant velocity GR.

To determine the relative acceleration of point G on flyweight to point G on pulley, we proceed in a similar manner. Thus the relative acceleration of G on flyweight to G on pulley is equal to the vector sum of the relative acceleration of G on flyweight to P, and the relative acceleration of P to G on pulley. But the relative acceleration of G on flyweight to P (see Fig. 3) is GR, and the relative acceleration of P to G on pulley is $SG = -GS$ (since acceleration of P to G on pulley is equal and opposite to acceleration of G on pulley to P) and hence the relative acceleration of G on flyweight to G on pulley is the vector sum $GR + SG = GR - GS = SR$ (not drawn in Fig. 3). Hence the total acceleration of G on flyweight is obtained by combining the acceleration SR with the acceleration OS of the point G on pulley to obtain the same resultant acceleration OR.

It is to be noted that the theorem of Coriolis shows that this relative acceleration SR is the vector sum of SZ and ZR and hence in the determination of the total acceleration of point G on flyweight we can use three vectors, for the law of Coriolis does not claim that the parallelogram of accelerations has an exceptional case and does not always hold. In fact, in the case of velocities, when point G on pulley was assumed as the point of reference we have three vectors, $r_2(w_1 w_2)$, $-r_2w_1$, and r_2w_1, but as the first two are parallel and can be added algebraically we have actually only two to work with, r_2w_2 and r_2w_1. The confusion therefore arises from the assumption of the point of reference. If, as has been done, the point P is chosen as the point of reference only two vectors are necessary, a much simpler solution is obtained and the law of Coriolis does not have to be utilized.

Conclusion

In conclusion the writer desires to state that the solution of most problems in Kinematics of Machinery can be solved by the proper use of fundamental concepts and principles, and that it is better psychologically for the student and practically for the engineer to understand the fundamentals thoroughly than to use a complex formula which may be misapplied.

Improvised Extension for Small Twist Drills

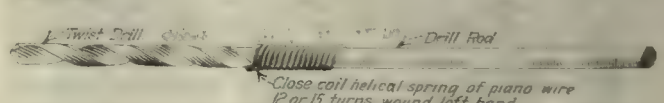
By J. C. Nicholson

Here is a quick way to improvise an extension for a twist drill.

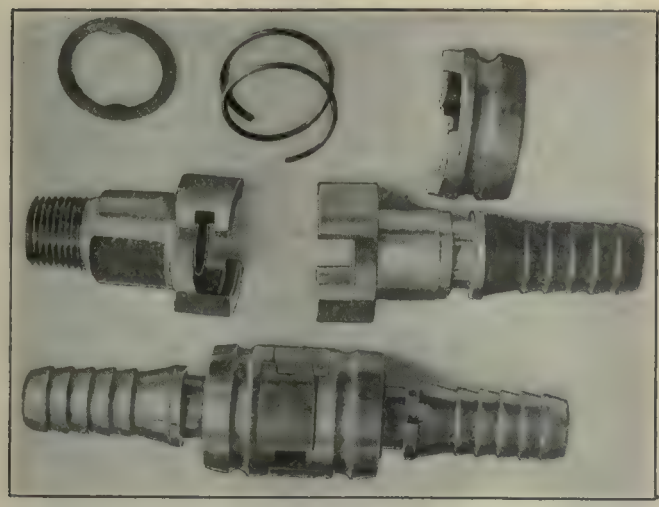
Wind a left-hand closed coil helical spring out of piano wire of about one-third or one-fourth the diameter of the drill and use this as a coupling to connect the drill with a piece of drill rod or other stock of about the same diameter. There should be about a dozen coils in the spring and the inside diameter should be slightly smaller than the drill and extension piece to allow them to be driven into it. The ends of drill and drill rod should be ground square with the axis where they abut.

The torsional stress on the spring causes it to grip the drill and extension firmly. The drill may readily be driven out of the spring by means of the extension. One spring will serve for drills varying several thousandths in diameter.

It may not be known to some that such a spring may easily be made in the vise with a monkey wrench. Grip the arbor and wire in the vise together and make one coil by hand. Then close the monkey wrench to the outside diameter of the spring and use it to bend the wire around the arbor to a uniform diameter.



TWIST DRILL EXTENDED BY MEANS OF COIL SPRING



Making Thor Quick-Action Air Line Couplers

By J. V. HUNTER
Western Editor, *American Machinist*

The couplers for air-hose lines must be carefully made to insure the same degree of air-tightness that is found on high-grade valves and other fittings, and yet their design must be such that a tight coupling can be made very quickly. This article describes the main machining operations used in producing couplers in large quantities.

THE day seems to be rapidly passing in which the boss riveter has to send his helper to look around among a mess of plumber's fittings to find a couple of small pipe-nipples and couplings that can be used for attaching the air hose to the line or for joining a couple of sections. Today different makes of quick-action couplers have gained popularity since their use has shown that they afford a uniform quick connection with the additional advantage of lesser air leakage than frequently occurs with poorly fitting pipe connections.

The Independent Pneumatic Tool Co., Chicago, has equipped a complete department in its Aurora factory for the manufacture of the Thor quick-action coupler. Numerous special tools and devices are used to speed the production of these parts and to insure accuracy. A completed hose coupling together with the different metal parts that go to make up its assembly are shown in Fig. 1.

The more interesting machining operations are found in connection with the production of the main body pieces which are made in two styles, either for insertion in an air hose or with a threaded end for attaching to a standard pipe connection. With the exception of few screw machine operations to finish the connection ends, their manufacture is identical. The "connection end" is that portion which attaches to the hose or pipe, and the "coupling end" refers to that portion which joins the other section of a coupler.

The first screw-machine set-up for finishing a hose connection end is shown in Fig. 2. Standard tools and an air-operated chuck are used. This operation is followed by the screw machine operations on the coupling end, Fig. 3, with the work centered in a collet chuck.

Following the screw machine operations is a straddle milling operation, on the pipe connectors only, which gives two parallel faces for the application of a wrench.

The form milling cutter used in the next operation, Fig. 4, is applied to both styles of connectors and removes approximately a quarter section of the larger end. The same milling fixture is employed for both pipe and hose connectors and when milling the former, the special block *A* is inserted. After milling one side the holding block *B* is depressed by means of the small lever *C*, permitting the piece to be turned with the other side up. For the second cut the spacing block fits into the section already milled away and locates the piece in the position shown.

The locking feature for holding the two halves of the coupler together is provided by milling the small notches *A*, Fig. 5. This milling operation is performed on a hand milling machine and the fixture employed is somewhat similar to the one previously described. The spacing block *B* aligns successively the two sectional cuts as these are turned up for cutting the notches. The connection end of the coupler passes through the fixture and is locked in place by a quick-acting clamp operated by handle *C*.

Two small grooves *A*, Fig. 6, milled in the sides of the main body piece, serve as keyways to guide the locking sleeve. To perform this operation an old screw

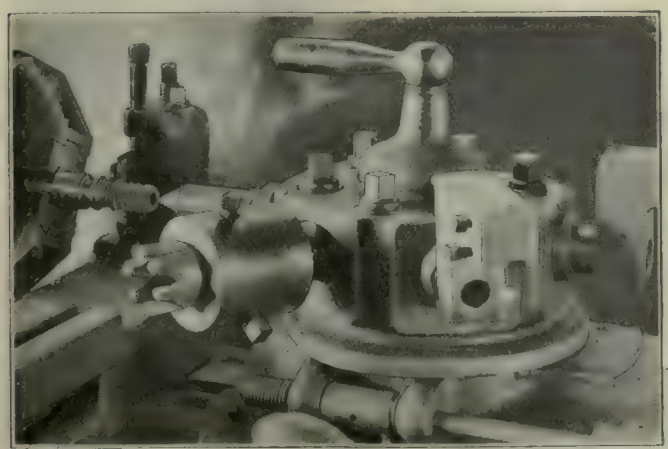


FIG. 2. FIRST SCREW MACHINE OPERATION ON CONNECTION ENDS

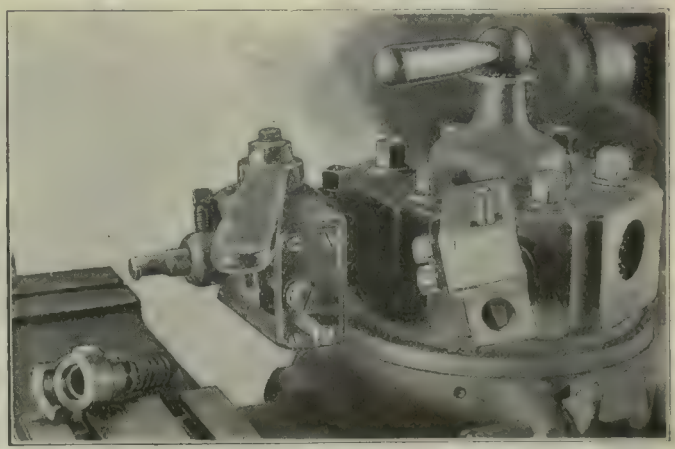


FIG. 3. SCREW MACHINE TOOLING FOR FINISHING COUPLER ENDS

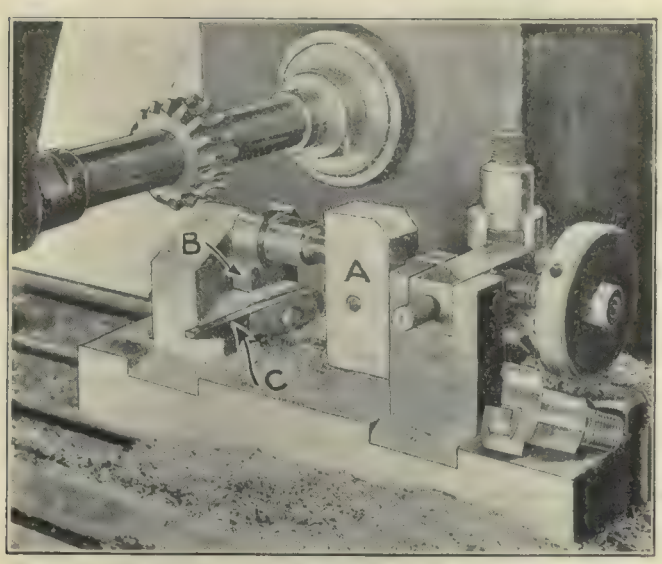


FIG. 4. FORM MILLING OPERATION ON CONNECTORS

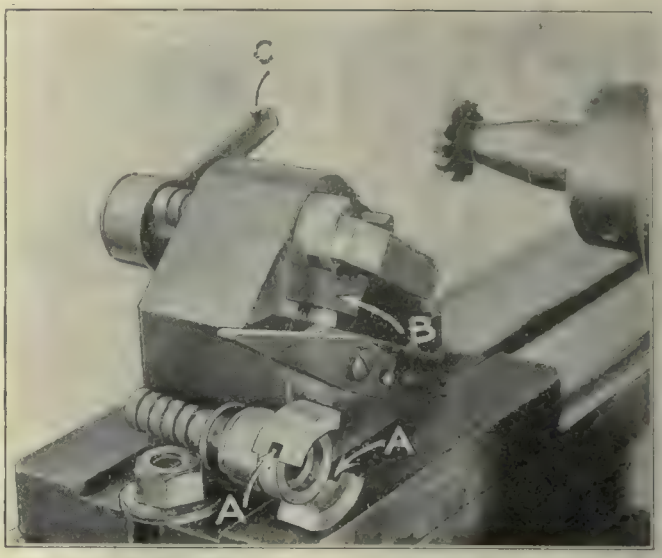


FIG. 5. MILLING LOCKING NOTCHES IN COUPLING END

machine has been rebuilt and fitted with a spindle head mounted on the toolslide and carrying two small milling cutters B. When the toolslide and spindle are brought forward by the hand lever the sleeve *C* passes over the connection end of the coupler and the cutters mill the grooves as shown. The forward motion of the toolslide is arrested when the sleeve comes in contact with the large portion of the coupler.

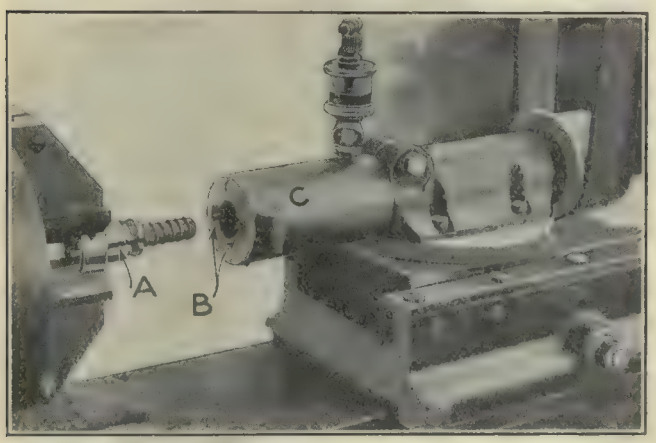


FIG. 6. MILLING GUIDE GROOVES FOR LOCKING SLEEVE

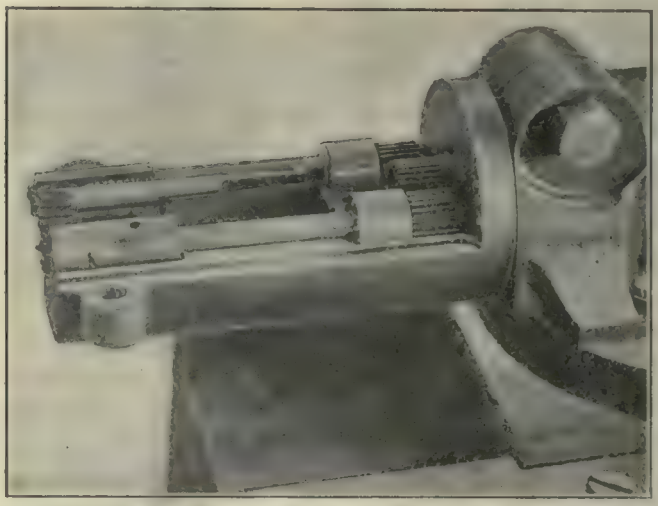


FIG. 7. INTERIOR OF SPECIAL MILLING DEVICE

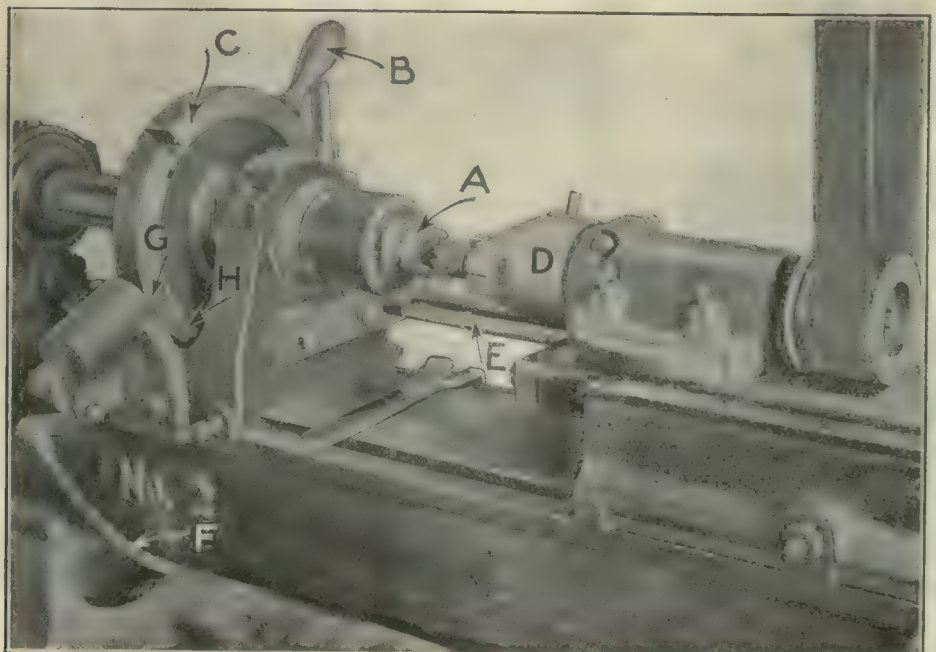


FIG. 8. DEVICE FOR MILLING ENDS OF LOCKING SLEEVES

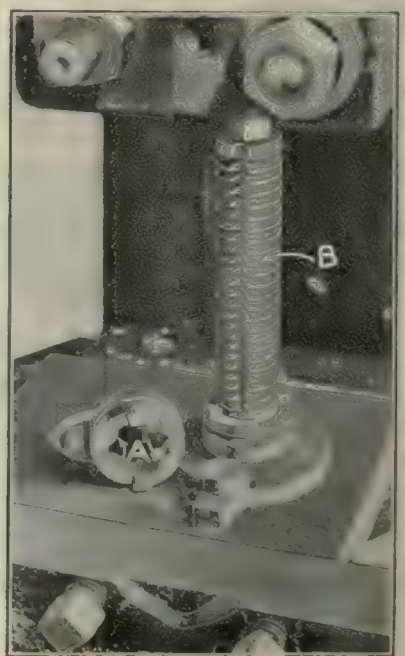


FIG. 9. BROACHING OF LOCKING SLEEVES



FIG. 10. TRAYS FOR TRANSPORTING FINISHED PARTS

The internal construction of this device is shown in Fig. 7. The main spindle is driven by a belt from the countershaft, and in turn drives the two cutter spindles through the gears shown. The operation is performed very rapidly and is expedited by an air chuck for holding the work.

The first operation on the coupler locking sleeve, shown at the lower left of Fig. 1, is on a screw machine. The sections on the right-hand end are then milled off.

A two-spindle milling device, Fig. 8, built for this job, is somewhat similar to the milling device previously described. The work *A* is held in a pneumatic collet chuck which can be rotated by the handle *B* for indexing by the notched dial *C*. The double-spindle head *D*, provided to carry the two cutters, is mounted on the toolslide so that it may be fed forward and back by the hand lever. This forward feed motion is continued until the cutters cut the deep notches in one section of the sleeve, when the feed is arrested by the stationary stop-bar *E*. After cutting the pair of deep notches the toolslide at the end of its return stroke, through suitable connections, draws down on the chain *F* which pulls out the stop-pin *G* and permits the index plate to be rotated, bringing the sleeve in line with the cutters for the shallow cut. The stop-pin falls into the proper notch to hold the index plate when the tension is removed from the chain by the forward movement of the slide. The second cut is to only one-half the depth of the first and this is controlled in the following manner: In rotating the indexing dial an additional stop-plate *H* riveted to its face, is swung over in line with the stop-bar *E* and the forward motion of the slide is thus arrested at the proper point.

The final operaion on the locking sleeve is broaching, to leave the half-round keys on the inside as seen in Fig. 9. This operation is performed in a vertical broaching press.

In connection with the work in this department it is interesting to note the means provided for the transportation of the finished parts in order to avoid the danger of their sharp edges being marred or burred before they are encased in the sleeves which protect them from injury. Special trays, Fig. 10, are used, made with wooden dowel-pins which support the parts in an upright position. Each tray holds an even 100 pieces. Iron handles are provided and the loaded trays are not so heavy but that they are easily handled by two helpers.

Labor Turnover in New York City*

Accurate figures on classified labor turnover are always interesting even though they apply only to a restricted locality. These figures for New York City appeared in "Greater New York," the weekly publication of the Merchants' Association of New York. They are well worth studying.

THE average yearly rate of labor shift or "turnover." in 1920 for skilled and semi-skilled factory workers in New York City is 125 per cent, and for unskilled factory workers 265 per cent, according to reports made to the Industrial Bureau of The Merchants' Association by 42 manufacturing concerns representing 15 different industries and employing a total average force of 41,375 workers.

In about two thirds of the plants studied the turnover lay between 100 and 250 per cent, but the total range for all plants extended from a minimum of 16⅔ per cent to a maximum of 338 per cent.

The cost of replacements, according to the testimony of employers, varies from $10 for unskilled to $250 for highly skilled workers. A fair average for semi-skilled employees is $50 or more.

The industries covered in this study and the number of plants in each industry are as follows: Metal products, including machinery, ten; food products, confectionery and kindred lines, eleven; rubber goods, three; musical instruments, three; printing, two; jewelry and kindred lines, two; tobacco products and smokers' supplies, two; stationery supplies, two; and one each of shipbuilding and repairing, marine equipment, shoes, silk goods, men's clothing, women's wear, and fire apparatus.

Food and Metal Products

Special attention was devoted to the food and metal products industries, in order to secure comparative figures for an industry employing principally unskilled labor, as is the case in food products plants, and for one chiefly dependent upon skilled labor, such as the metal industry. The food products industry, using largely unskilled labor, also employs a large proportion of female workers. At first sight, it might seem that

*Prepared by the Industrial Bureau of the Merchants' Association of New York City.

this fact would tend to a somewhat higher labor turnover in this industry than in one employing a majority of unskilled male laborers; but when it is considered that untrained male workers are of a particularly transient character, and are employed so largely in construction work and other seasonal industries, where turnover is especially large, the figures for unskilled female workers are probably not higher than those for unskilled male workers and are therefore fairly representative of the class.

With some exceptions, the period investigated was the first eight months of 1920. In certain trades, especially those of a seasonal character, the figures for the last twelve months were covered. In all cases the percentage of turnover has been computed on an annual basis.

Pre-War Figures Unavailable

In compiling this report an effort was made to secure pre-war figures for comparative purposes. This was found impossible, however, because the figures are not available. It is only within the last few years that employers generally have come to realize the importance of accurate employment records, and even for the purposes of the present study it was necessary to reject 35 per cent of the reports received as not sufficiently complete or accurate to warrant their use as a basis for conclusions. Incidentally, it is probable that the turnover in the factories covered by this study is smaller than in many other local establishments which could not be included because they did not keep records, and otherwise paid little or no attention to employment methods. Fragmentary data obtained while making the study supports this conclusion.

Stability Increasing

It is the general opinion of employers that the turnover of factory labor has increased greatly during the past few years, especially during the war period and for some time after the signing of the Armistice. The tendency now, however, seems to be in the opposite direction. Labor turnover at the present time is on the decrease. This is doubtless due to a certain extent to the increasing activity on the part of employers to reduce turnover, but principally to the appearance of some unemployment, a condition which always makes the worker hesitant about changing his place of employment.

To most people, labor turnover is equivalent to labor replacement and is generally expressed in the form of percentages.

For the purpose of this report, therefore, labor turnover has been computed by diving the number of employees replaced during a year by the average number of persons on the payroll during the same period. For example, if there was an average of 100 men on the payroll of a concern during the year, and 200 additional employees had to be secured during that time to replace those who were fired, died, or quit for any other cause, the turnover would be twice the average number on the payroll, or 200 per cent. In a decreasing payroll, replacements will equal the number of people hired, while in an increasing one they will equal the number of separations from the plant.

The accompanying table summarizes the results of the investigation.

The above summary shows that slightly more than one-fifth of the plants had a turnover below 100 per cent a year, half of them less than 150 per cent, and one-third had an annual turnover of 200 per cent or more.

PRESENT ANNUAL RATE OF LABOR TURNOVER IN 42 MANUFACTURING PLANTS IN NEW YORK CITY

Classified turnover (Percentage)	Plants in Each Class Number	Percentage
Under 50	4	9.5
50 and under 100	5	11.9
100 and under 150	12	28.6
150 and under 200	7	16.7
200 and under 250	8	19.1
250 and under 300	3	7.1
300 and under 350	3	7.1
	42	100.0

Comparing these figures with the results of a labor turnover study made during the war by the United States Bureau of Labor Statistics, covering thirty-seven factories in Cleveland, it appears that labor turnover in New York City today is considerably less than it was in Cleveland two years ago. Only one-tenth of the Cleveland factories had turnovers under 100 per cent, approximately one-fourth of less than 150 per cent, while more than three-fifths had annual replacements of 200 per cent or more.

It is true that the labor conditions in Cleveland during the war were not exactly comparable with those in New York during the same period, but the comparison supports the statement of the majority of the manufacturers interviewed that on the whole there has been a reduction in labor turnover since the signing of the Armistice.

The above table also indicates a very broad range of turnover. In about two-thirds of the plants it varied from 100 to 250 per cent. The reason for this wide divergence is due primarily to the heterogeneous nature of the plants covered. This becomes clear if the forty-two plants be divided into two groups: (1) those employing primarily unskilled help, and (2) those using mainly semi-skilled and skilled operatives.

Skilled and Unskilled Labor

Obviously, it is impossible to draw any hard and fast line between these two groups. Many plants employ all grades of workers, from the totally unskilled to the highest grade mechanics. Nevertheless, it is possible roughly to group factories into these two classifications. The unskilled group includes all establishments in which the majority of operatives require little or no training for their jobs. As a rule, these establishments, at least in New York City, employ a large proportion of female labor. Most food products plants, candy concerns and the like, would fall under this head. All other factories come under the semi-skilled and skilled classification. On this basis, fourteen of the forty-two factories fall under the first head, with the remaining twenty-eight coming under the second.

The upper chart on page 935 gives the result of this classification.

Unskilled Workers Unstable

It is apparent that the turnover among plants employing mainly unskilled workers is much larger than in factories where the operatives are more skilled. In the former group, six out of fourteen, or 43 per cent, of the concerns have a turnover between 200 per cent and 250 per cent. Among the latter group, twelve out of twenty-eight, or 43 per cent, have turnovers between 100 per

COMPARISON BETWEEN THE ANNUAL RATE OF LABOR TURNOVER IN THE 14 PLANTS EMPLOYING MAINLY UNSKILLED HELP AND 28 PLANTS EMPLOYING SEMI-SKILLED AND SKILLED WORKERS

Classified turnover (Percentage)	Plants Employing Mainly Unskilled employees	Plants Employing Mainly Skilled and semi-skilled employees
Under 50	1	3
50 and under 100	0	5
100 and under 150	0	12
150 and under 200	2	5
200 and under 250	6	2
250 and under 300	2	1
300 and under 350	3	0
Total	14	28

cent and 150 per cent. The difference between these two groups is most clearly shown by the actual figures.

At the present time the fourteen "unskilled" factories employ on the average a total of 8,506 persons and require 22,514 replacements annually. This means a turnover of 265 per cent. The twenty-eight plants using more highly skilled workers employ 32,869 employees and hire 41,174 replacements, which is a 125 per cent turnover. In other words, the turnover in plants employing principally unskilled workers is more than twice as large as in factories using mainly semi-skilled and skilled workers.

The following is a comparison between the food products and metal products industries, the two types of industry which were studied in greater numbers than the rest:

COMPARISON BETWEEN THE PRESENT ANNUAL RATE OF TURNOVER OF 11 FOOD PRODUCTS AND 10 METAL PRODUCTS PLANTS IN NEW YORK CITY

Classified turnover (Percentage)	Type of plant Food products	Type of plant Metal products
Under 50	1	0
50 and under 100	0	1
100 and under 150	0	5
150 and under 200	2	3
200 and under 250	4	0
250 and under 300	2	1
300 and under 350	2	0
Total	11	10

The average rate of turnover for the food products group is 268 per cent, as compared with 112 per cent for the metal industries. Nearly 73 per cent of the former had a turnover above 200 per cent, whereas 90 per cent of the latter had a turnover of less than 200 per cent.

Four candy plants are included among the eleven plants classified as Food Products concerns. These employ on the average a total of 2,170 workers and hire 5,262 replacements. This is a turnover of 242 per cent.

It is possible to compare these figures with those of an earlier investigation. In 1914 the New York State Factory Commission made a report on the confectionery industry in New York City. Ten candy factories, with average forces totaling 953, had no less than 3,138 names on their payrolls during the course of a year. In other words, the turnover at that time was 229 per cent, as compared with 242 per cent at the present time.

Reasons for Low Labor Turnover

The reasons for the low labor turnover in the plants which reported a relatively small percentage of replacements may be determined in a general way. The following is a concise statement of reasons for the low figure as given by the management of a half dozen factories having a small annual percentage of turnover.

A

A Food Products Plant Employing Less Than 125 Persons

Though the majority of workers are unskilled, the annual turnover is less than 20 per cent. This is due in part to high wages and good working conditions, but more especially to the magnetic personality of the manager, who takes an active personal interest in his entire factory force. Through sympathy, tact and just dealing, he has bound his workers to him by close personal ties.

B

An Unusually Up-to-date Tailoring Establishment

The management takes a real interest in the welfare of its workers. Seasonal fluctuations have been reduced to a minimum. During the entire year ended June, 1920, this factory had practically no layoffs. Such steadiness of employment is very remarkable in a seasonal industry of this character. It is a very important consideration with the labor force, and the principal reason for the low turnover.

C

A Printing Concern Employing Union Labor Entirely

The relations between the management and their employees are very cordial, and as working conditions are excellent the men are loath to leave. Being union members, they would only receive the same wages elsewhere, while their surroundings would probably be less satisfactory.

D

A Factory Manufacturing Musical Instruments

Most of the employees are very highly skilled workers of the older type. They look upon themselves as craftsmen. Wages are high and work is steady. Moreover, the men have a superintendent they like. As a result, the annual turnover is less than 50 per cent.

E

A Rubber Goods Factory

Though the majority of employees are semi-skilled and many of the operations unpleasant, due to dust and odors, the company has kept down turnover by a liberal labor policy. The management takes a vital interest in the problems of its working force. Primarily, through the dynamic personality of the manager, a real factory pride has been created among the operatives.

F

A Candy Concern

This plant has given much thought and attention to its labor problems. It has a pension and a bonus system, provides free medical attention, gives vacations with pay, and so forth. These welfare schemes indicate the essential points, namely, that the firm takes a real interest in the health and happiness of its employees.

These reports indicate that while wages, hours and working conditions are of vital importance in reducing labor turnover, the most essential factor is the attitude of the management toward its working force. In all the factories where the turnover is low the employers stress the fact that they treat their workers well. As one employment manager put it, "We realize our hands have heads and hearts." There is no patent process of reducing labor turnover, but a feeling of fellowship between manager and men will go a long way toward lowering it.

Modern Aviation Engines—V

By K. H. CONDIT
Managing Editor, *American Machinist*

ON THE Italian front aviation activities were carried on under somewhat different conditions from those encountered in France. The rocky and mountainous territory which lay along the fighting front in the north made flying an extra-hazardous occupation because of the lack of landing places. On the other hand large cities, manufacturing plants and army and naval bases were within easy reach of the bombing squadrons of both the Italians and the Austrians and stimulated the early development of large day and night bombers of the Caproni type. Seaplanes also were largely used because of the shape of the Adriatic coastline, which is very favorable for minor naval operations assisted by aircraft.

In the early stages of the war the activities of the British and French air forces attracted so much attention that little heed was paid to the achievements of the Italian airplane engineers and designers. Fiat and Isotta-Fraschini, however, were hard at work on engines, and Caproni, Pomilio, Ansaldo and others were developing planes. The gigantic Caproni bombers first attracted attention to Italian developments principally because of their great size, but our commissioners when they reached Italy found many other advanced designs in production. For a long time the little S.I.A. scout was the fastest thing in the air and its stunting ability opened many eyes to new possibilities when it was brought to Mineola.

A squadron of these planes under command of Capt. Gabriele D'Annunzio bombed Vienna with propaganda leaflets and returned unharmed to their base. While this expedition probably had little effect on the enemy it attracted wide attention to the Italian service and probably helped to pave the way for the representatives of Italian airplane builders who came to this country, among whom was the son of D'Annunzio. The directors of our aviation policy hesitated between the Caproni and Handley-Page machines for our night bombing work and placed and canceled several orders for each type. There was great difficulty with plans and specifications which did not fit our practice and finally an agreement was entered into with the British under which we were to make the parts for the Handley-Page and they were to put them together at British aërodromes constructed by American construction units. At the same time orders were placed for a few Capronis but only one or two were finished before the armistice.

The Caproni biplanes had three engines, two tractors and a pusher and they were either Fiats or Isottas, whichever were available. With three Liberty engines their performance was very satisfactory and would undoubtedly have added greatly to the power of our air forces had the war lasted longer.

Various types of Fiat aircraft engines were built, some with six and others with 12 cylinders, but the type shown was most used. The 12-cylinder, 750 hp. type was for a time the largest airplane engine built and probably is the largest to be flown.

The Fiat six is in many respects much like the Mercedes. The overhead camshaft operates four valves per cylinder through rocker arms, and the magneto and water pump locations are the same in both engines. The carburetor and intake manifold are quite different, however. The Fiat uses a duplex carburetor mounted at the side of the cylinders, each side of the jacketed carburetor throat feeding three cylinders through a compound intake pipe.

The Fiat engines were equipped, for the most part, with an American-made magneto, the Dixie, on which certain slight alterations were made after delivery to the Italian factory. In addition to building airplane engines the big Fiat factory turned out machine guns, tanks, tractors, trucks, artillery, dirigible balloon engines and many other war necessities.

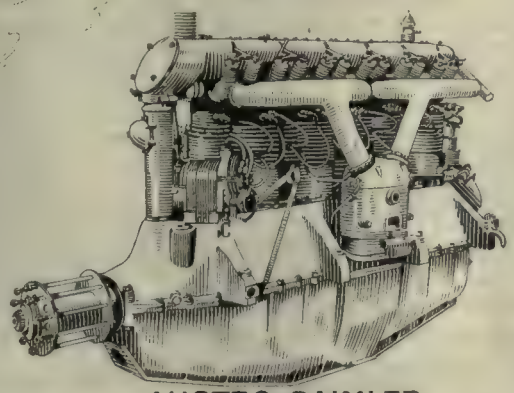
The six-cylinder engines developed by Isotta-Fraschini were not very different from the Fiat engines in size and performance as is evidenced by their interchangeability in the Caproni bombers. In details several sharp contrasts are apparent in the sketches. Where Fiat used individual cylinders with welded jackets, Isotta has two cylinder barrels surrounded by a single water jacket. The clean look which this arrangement gives to the engine is added to by the complete inclosure of camshaft, valves and rocker arms. Benz practice in fitting two separate carburetors is followed although the intake pipes do not seem quite so well arranged for good distribution of the explosive mixture, one of the most important features in the design of the successful aircraft engine. The Isotta design seems to have been particularly adapted to seaplane use as many of the Italian flying boats were fitted with them.

The other Italian engine shown, the Spa, is also a six and is more like the Fiat than the Isotta. It differs from both, however, in having only one inlet and one exhaust valve for each cylinder where they have two. This engine was used in several of the lighter Italian planes but received most notoriety in the S.I.A. scout already mentioned. The demonstrations of this plane given by Sergeant Gino were hair-raising and culminated in the crash which killed him when he attempted a spin too close to the ground while exhibiting the capabilities of the ship to General Kenly and other American officers.

The Austrian air forces opposed to the Italians were fortunate in possessing the Austro-Daimler engine at the outbreak of hostilities. The Austro-Daimler Co. had been among the pioneers in airplane engine design and construction and the early vertical six was so far in advance of its contemporaries that it furnished many ideas to the designers of such engines as our Hall-Scott and the British Beardmore. The Austrians used other engines but this one was by far the best known as their plan of concentration on one type was in accord with that of the Germans.

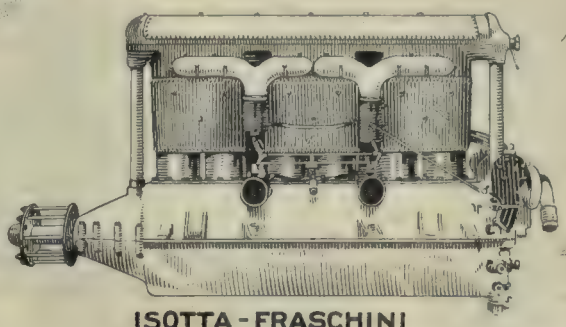
The cylinders resemble those of the Benz with their dual valves and corrugated water jacket plates but the camshaft is overhead like that of the Mercedes and is shifted endwise by the lever shown, to throw a secondary cam into contact with the exhaust valve rockers to relieve the compression for starting.

The stream-lining and clever use of bevel gears for auxiliary drives are features of these engines which stand out in the later models.



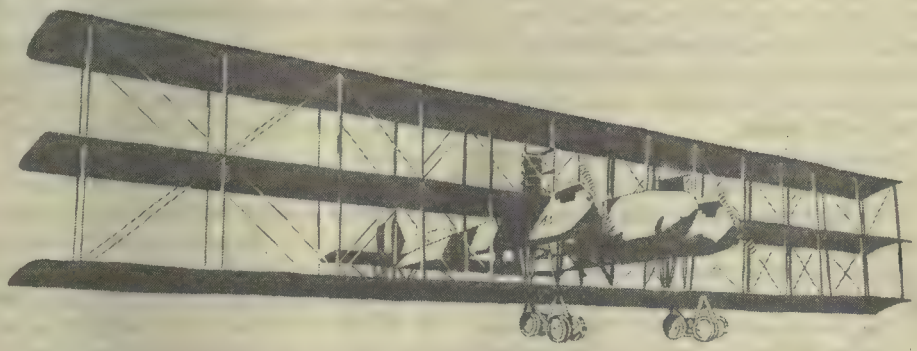
AUSTRO-DAIMLER

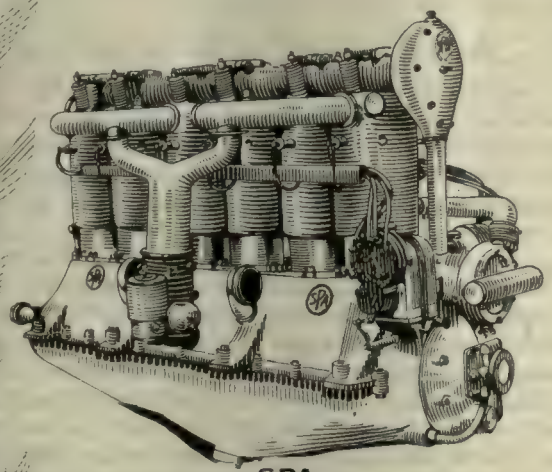
Six cylinders; bore, 5.7 in. (145 mm.); stroke, 6.88 in. (175 mm.); compression ratio, 5 to 1; rated h.p., 200 at 1400 r.p.m.; magneto ignition; dry weight per h.p., 3.64 lb.; fuel consumption, 0.555 lb. per b.h.p. hr.



ISOTTA-FRASCHINI

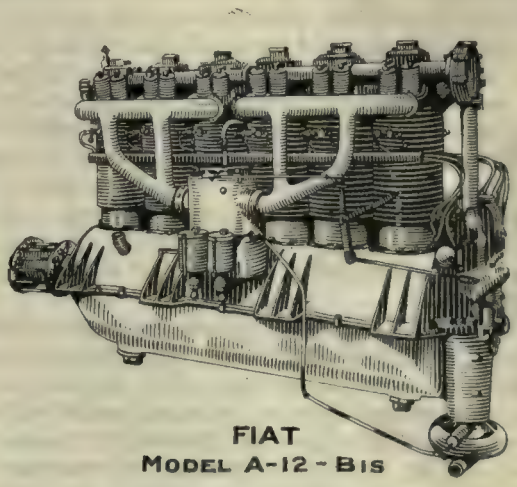
Six cylinders; bore, 5.2 in. (130 mm.); stroke, 7.1 in. (180 mm.); rated h.p., 190 at 1400 r.p.m.; magneto ignition; dry weight per h.p. 3.01 lb.; fuel consumption 0.47 lb. per b.h.p. hr.





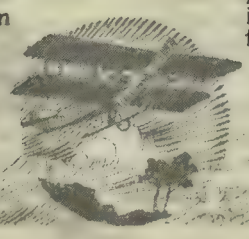
SPA

Six cylinders; bore, 5.31 in. (135 mm.); stroke, 6.96 in. (170 mm.); compression ratio, 5 to 1; rated h.p. 200 at 1600 r.p.m.; magneto ignition; dry weight per h.p., 3.21 lb.; fuel consumption 0.473 lb. per b.h.p. hr.



FIAT
MODEL A-12-BIS

Six cylinders; bore, 6.3 in. (160 mm.); stroke, 7.09 in. (180 mm.); compression ratio, 4.31 to 1; rated h.p., 300 at 1600 r.p.m.; magneto ignition; dry weight per h.p., 3.32 lb.; fuel consumption, 0.49 lb. per b.h.p. hr.



Austrian plane design followed German practice quite closely and the tactics of their aërial squadrons were the same as those of their allies. Easy marks for bombing squadrons were plentiful and within easy reach of the Austrian bases and only the most elaborate sandbag and timber protecting walls saved some of the finest Italian buildings from vandalism. Even these precautions were not sufficient to prevent the destruction of several priceless works of art when the buildings containing them were the targets for direct hits by high explosive bombs.

The Italian flying schools were selected by our own air service to train aviator cadets in the use of heavy bombing machines and several hundred of the early ground school graduates were sent to Italy for that purpose.

The Situation of the Machine-Tool Market in Czecho-Slovakia

By C. A. Heise

In surveying the development of the European machine-tool industry, Czecho-Slovakia may be singled out as having made particularly great strides. Before the war, the machine-tool industry of that new republic had to fight against foreign competition and the quality of the goods turned out was admittedly anything but first class. As to export, the quantity that went abroad was insignificant and most of the output was delivered to the government railroad works.

Since the war, however, there is a marked activity in the machine-tool industry. Apart from the fact that existing machine-tool factories are extending their plants with a view of turning out new types, a distinct tendency on the part of general engineering works is noticeable to specialize in the machine-tool line and it would appear that the banks are backing freely those new enterprises. The principal reasons for the extraordinary development are the following: Severe import restrictions on finished products on the part of the government; keen demand for quick deliveries by those industries which have resumed operations with the end of the war; exorbitant prices demanded by German machine-tool exporters as well as their conditions of payments; and last but not least the absence of American machine tools due to lack of tonnage and to the depreciated currency which rendered business difficult. To this should, of course, be added that the newly gained political freedom awakened a desire for economic independence as well.

There are about twelve to fifteen machine-tool works worth mentioning which, with one exception, are manufacturing general machine tools only; that is, lathes, drilling machines, planers, and shaping machines, while as regards special machines the industry of the country is almost entirely dependent upon foreign countries. As far as the import restrictions permit, the German machine-tool industry is practically supplying all demands to the exclusion of other countries but there is no reason to show why American machine-tool builders should not give more attention to trading possibilities in the Czecho-Slovakian market.

The obstacles caused by the exchange problem should not prove insurmountable. On the other hand, it should be realized that there is a wide demand for American machine tools; in fact, American makes are very popular and, if supplied on a large scale at right prices, they would stand a good chance of ousting German competition.

Another point in favor of the American machines is the outspoken animosity toward everything German; and it is mainly due to her favorable geographical situation, transport facilities, etc., that Germany has so far succeeded in retaining her leading position in the Czecho-Slovakian market. Austrian competition, on the other hand, is of secondary importance in view of the raw material and coal shortage obtaining in that territory which will probably last for some time yet. It should also be remembered that before the war considerable quantities of machine tools were imported from America and that their excellent quality found a widespread recognition, though some drawbacks of certain makes, particularly rapid wear of sliding parts, gearwheels, etc., did not remain unnoticed. These, however, are minor points only and should easily be remedied.

American and German Designs Copied

A close survey of the present situation shows that original designs are few and far between, most of the machines turned out being copies of good American and German types. While in general presenting a smart appearance, there is no gainsaying the fact that many of them have not yet attained that standard of perfection which goes with the name of a high-grade machine tool. There are only two or three factories manufacturing machine tools exclusively, while the line of manufacture of the rest comprises general engineering as well. Specialization has not advanced beyond the rudimentary stage as yet, the only special machines met with being one type of turret lathe, automatic, horizontal boring mill, high-speed lathe and thread cutting machine. Other special machines such as circular cold saws, grinding and milling machines, shears, presses, forging machines, etc., are hardly manufactured at all, which is the more surprising since the productive capacity and skill of the average workman is above normal.

Big Chances for American Products

From the foregoing it will be clear that the Czecho-Slovakian market offers vast opportunities for American machine-tool manufacturers once the present import restrictions are rendered less severe. Manufacturers of special machine tools should lose no time in opening connections with Czecho-Slovakian importers. In sending salesmen to Czecho-Slovakia care should be taken to select men possessing the right frame of mind. If they are going to adopt a "take it or leave it" attitude they will be well advised to stay at home or try to dump their goods in countries where German salesmen are conspicuous by their absence, for the tremendous development of the German industry during the last decade was due to the willingness of the German salesman to study the whims and individual wishes of his customers. The fact that a "Commercial Association of Czecho-Slovakian Banks"—working on the lines of a Chamber of Commerce—was recently formed at Berlin should serve as an eye-opener. The new association, being a joint stock company with a capital of 25 million marks, has been established with a view of furthering and extending commercial relations between Germany and Czecho-Slovakia and will make a specialty of financing commercial transactions. A branch office will be established at Hamburg with the principal object of promoting the export trade.

SEVEN CENTURIES of BRASS MAKING



By O. A. KENYON
ENGINEER RAY D LILLIBRIDGE, Inc.,
NEW YORK*

FOR a number of years brass makers have realized that the electric furnace offered many important possibilities for brass melting, but actual experiments were discouraging in that they revealed difficulties that for a number of years seemed insurmountable, or at least of sufficient importance to prevent the commercial utilization of electric furnaces for brass melting.

Before taking up the description of any particular type of electric furnace it may be well to consider the possibilities resulting from the mere substitution of electric heating for fuel heating. By looking at the problem in this way it will be evident that the electric furnace offers a solution of the brass melting problem only in the event that the proper type is chosen, and the mechanical design carried out in the light of experience in the melting of brass.

All electric furnaces eliminate the possibility of contamination of the metal from furnace gases since there is no fuel used and therefore no gases generated.

All electric furnaces possess the possibility of heat control, but not all possess even the possibility of temperature control when the matter of temperature distribution is considered. In brass making, temperature distribution is of first importance and a furnace that does not rapidly transfer the heat input to all parts of the metal without superheating any local portion, cannot be successfully employed.

On account of the fact that spelter floats on copper, it is necessary that provision be made for stirring the metal, and not all types of electric furnaces possess even the possibility of providing in a practicable way for this essential operation.

All types of electric furnaces may be so well insulated as to remove the disagreeable high-temperature conditions under which the men must work. Also any type of electric furnace may be mounted mechanically so as to facilitate the charging and pouring of the metal, thus reducing to a minimum the skill and labor required.

III. Using the Electric Furnace

It has been stated, in the preceding article, that while good brass can be produced by the crucible process, it is subject to variation on account of the great dependence which must necessarily be placed upon the human element entering into the control. The accompanying installment treats of the electric furnace, particularly its assistance to the maker in reaching a condition of exact control, which will insure a uniform brass.

(Part II was published in the Nov. 4 issue.)

Spelter Loss

All types of electric furnaces offer the possibility of enclosed operation, although the commercial realization of such operation is not always possible. Spelter loss depends not only upon enclosing the space above the surface of the molten metal, but also upon the temperature, the temperature distribution, the pressure, and the length of time that the metal stands in a molten condition. Consequently the effect of the electric furnace on spelter loss depends entirely upon the type and design of the furnace. Some electric furnaces would produce a spelter loss much greater than does the crucible process. In short, the electric furnace offers the possibility of applying scientific principles in a commercial way; that is, an electric furnace designed to utilize all the possibilities presented should parctically eliminate the personal element of the operator and render the process susceptible of accurate control in accordance with carefully worked out plans.

Electric Brass Furnaces

The Bridgeport Brass Co. for the last sixteen years has been conducting a series of investigations in its private laboratories for the purpose of reducing the process of brass making to scientific principles that could be effectively applied in the casting shop.

In the judgment of the company's investigators, the electric furnace offered the only possible solution of their problem. Accordingly, experiments were begun with electric furnaces and these experiments indicated

*Booklet published by the Bridgeport Brass Co., Bridgeport, Conn.

that even the best furnace designs on the market did not meet all the conditions which they considered necessary to the satisfactory solution of the brass melting problem.

Electric furnaces may be classified in various ways, depending upon the point of view. From a metallurgical standpoint the method of heat production may be classified as follows:

1—Heat produced exterior to the metal to be melted.

2—Heat produced on the surface of the metal to be melted.

3—Heat produced within the metal to be melted.

Separate Resistor and Indirect Arc Types

The first method includes the separate resistor-unit type in which the heat is generated in a special resistor and conducted to the metal to be melted through the walls of the hearth and by reflection from the arch or dome of the furnace. One disadvantage of this method is that special provision must be made for stirring. Then, too, the heat transfer from the surface toward the interior does not give favorable conditions for uniform temperature distribution throughout the mass of the metal.

Another type of exterior heat generation is the indirect arc. The disadvantages of this type are the same as in the resistor type except that the source of heat being more concentrated, the tendency to local overheating of the metal is correspondingly greater. In one type of furnace this tendency is combatted by constructing the furnace in the form of a cylinder swung on its long axis and rolling it continually first in one direction and then in the other. In this way the metal is mixed, the heat absorbed by the walls is equalized by contact with the metal, and the surface of the metal nearest the arc is continually changed.

Another type of indirect arc furnace which is successful in overcoming the tendency to local overheating is of the same general form as the furnace described in the preceding paragraph, except that it rotates continuously in one direction and pours from an opening in the end, while the oscillating furnace pours from an opening in its cylindrical surface.

Other than these disadvantages this type of furnace when properly designed may possess all the advantages previously listed. It also may be added that this method of heat generation is not the most efficient from the standpoint of energy economy and the size of the furnace is larger than necessary with either of the other two types.

Direct Arc Type

The second type, in which the heat is generated at the surface, is represented by a direct arc sprung between the surface of the metal to be melted and one or more suitable electrodes. The type of furnace on account of the excessive concentration of heat production is not considered suitable for brass melting and therefore will not be considered here.

Resistor and Induction Types

In the third type, the metal itself is utilized as a resistor and the flow of electricity through the metal may be established by induction from a primary winding, or the electricity may be introduced through electrodes. The disadvantage of this type of furnace is that a molten charge is necessary to start it. When properly constructed to utilize pinch effect, motor action, and heat circulation, this type of furnace can be built so that it will automatically circulate the metal and produce violent stirring with a resultant high degree of uniformity in temperature distribution.

For the high-zinc brasses the Bridgeport Brass Co. adopted the third type of furnace, using as heating elements the induction unit invented by J. R. Wyatt and controlled by the Ajax Metal Co.

The Wyatt heating element consists of an arrangement of circuits as shown in Fig. 16. The primary is connected to the alternating current source and may be wound for any commercial voltage. The secondary consists of a V-shaped mass of metal confined to narrow passages on two sides and open on the upper side. In the narrow passages three forces operate, namely: pinch effect, motor effect and gravity effect. The head of molten metal above the V in the chamber of the furnace

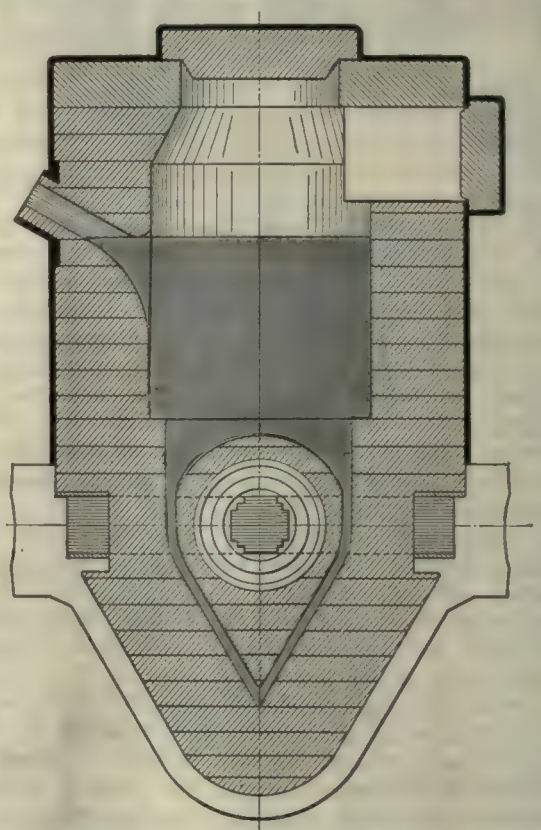


FIG. 16. ELEMENTARY DIAGRAM OF WYATT HEATING ELEMENT

prevents the pinch effect from actually rupturing the circuit, although it does cause contraction which results in motion of the column in the direction of least resistance. Contraction also results in the generation of extra heat which further accentuates the motion.

Theory of Operation

At any instant the electric current in the two converging channels is in opposite directions. Therefore, a repulsion, called motor effect, is produced between the two which tends to throw the liquid out of the passages. Observation has shown that the liquid rises along the outside surfaces of the passages and descends along the inside surfaces.

The application of heat at the bottom of the mass of metal causes circulation which draws the colder metal continually to the bottom and in this way effectively distributes the heat throughout the mass.

The combined effect of these three actions is to cause

a violent propulsion of metal out of both legs of the triangle, which thoroughly mixes the charge and carries the heat to all parts of the bath.

For other copper alloys such as bronze and phono-electric, the Bridgeport Brass Co. uses the indirect arc furnace of the Gillett type. This furnace is built in the form of a cylinder and is mounted in a cradle so arranged that the furnace is rotated automatically first in one direction and then in the other. The electrodes enter in the center of the two ends and coincide with the axis of rotation.

With these furnaces the Bridgeport Brass Co. is able to realize all the possibilities of the electric furnace as listed in the previous chapter; and since the casting shop is operated on the 24-hr. basis, and the grades of metal are thoroughly standardized, it has been possible to build furnaces that are exactly suited to the work they are to perform.

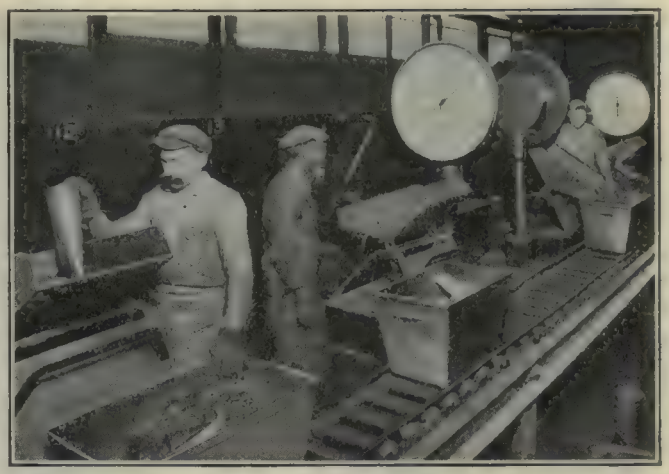


FIG. 19. A LINE OF WEIGHING MACHINES HANDLING THE INGREDIENTS OF THE STANDARD BRIDGEPORT ALLOYS

The Electric Casting Shop

Over three years ago the Bridgeport Brass Co. began to use electric furnaces on a commercial scale, and after developing types of construction suitable to the particular needs of the various alloys, steadily increased the electric equipment until it finally displaced the pit furnace entirely. Accordingly the pit furnace casting shops have been completely dismantled and the chimneys torn down. Figs. 17 and 18 show views of the shops when partially dismantled. The circular stack was only two years old, when it was decided that the best interest of the Bridgeport product demanded its demolition to make way for electric furnace brass. At the present time construction work is under way to more than double the productive capacity of the present electric casting shop. With these furnaces, the Bridgeport Brass Co. has been able to solve the problem of applying scientific principles to the making of brass for use in its sheet, rod, wire and tube mills and manufacturing departments. The process as developed possesses the following advantages:

1—The human element, as far as the actual operation of melting and pouring is concerned, is practically eliminated, because all of the factors which enter into the production of brass of a uniform and definite quality are susceptible of exact determination and control.

2—The heat input is generated within the body of the metal so that the temperature distribution is uniform.

3—The design of the furnace is such that stirring and mixing is thoroughly accomplished; in fact, the most conscientious brass caster could not stir a crucible as perfectly as the metal is stirred in these electric furnaces.

4—The temperature of the metal at various stages in the process is indicated electrically, eliminating entirely any question of skill on the part of the operator in the estimation of temperature.

5—The heat input and therewith the temperature of the metal is always under perfect control and can be adjusted to give any desired heating characteristic. Best of all, the same heating characteristic can be repeated indefinitely.

6—The purity of the metal is guarded by the exclusion of the atmosphere, the furnace chamber being entirely closed except when charging or skimming. A further precaution is the use of a layer of charcoal on top of the molten metal, which maintains a reducing atmosphere in the closed space above the surface of the metal.

7—The heat insulation is so perfect that the operator can lay his bare hand on the outside of the furnace at any time, which indicates the vast improvement in working conditions in the electric casting shop as compared with the pit-fire shop.

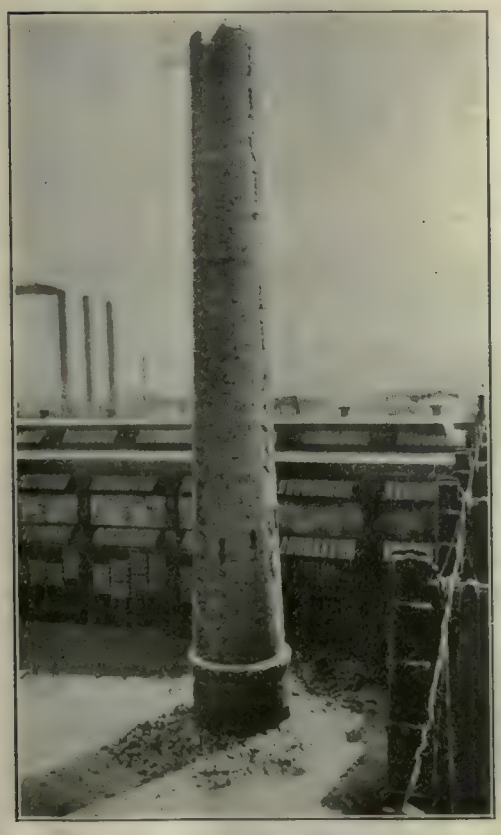


FIG. 17. THE TWO-YEAR OLD STACK BEING DISMANTLED

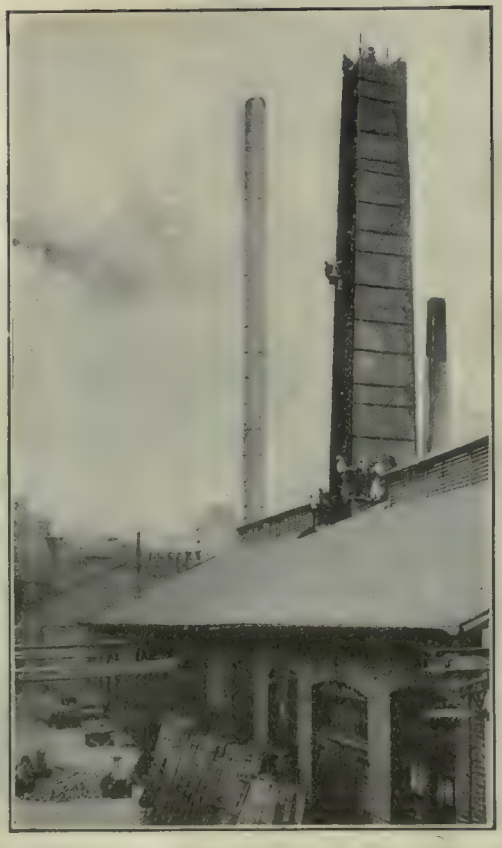


FIG. 18. PULLING DOWN THE OLD SQUARE STACK



FIG. 20. THE CHARGING AISLE OF ONE BATTERY OF BRIDGEPORT ELECTRIC FURNACES

8—By pouring only part of a charge and then re-charging, any slight errors in weighing of the ingredients are equalized by the blending of several charges in the same furnace.

9—Mechanism is provided which gives the operator perfect control of the pouring. He can vary the rate as slowly and accurately as he may wish with the result that any ordinary operator can pour a billet as well as the most expert caster is able to do with the crucible by hand.

The combined result of these various factors is the production of a brass, uniform and homogeneous in quality and of a higher grade than is commercially possible with the crucible process. Due to the accurate control of the heating, the completeness of the protection from the atmosphere, and the entire absence of furnace gases, the composition of the metals is maintained to a remarkable degree of accuracy. In fact, practice has shown that the loss in spelter, so difficult to control with the pit-fire process, is less than one-half of one per cent.

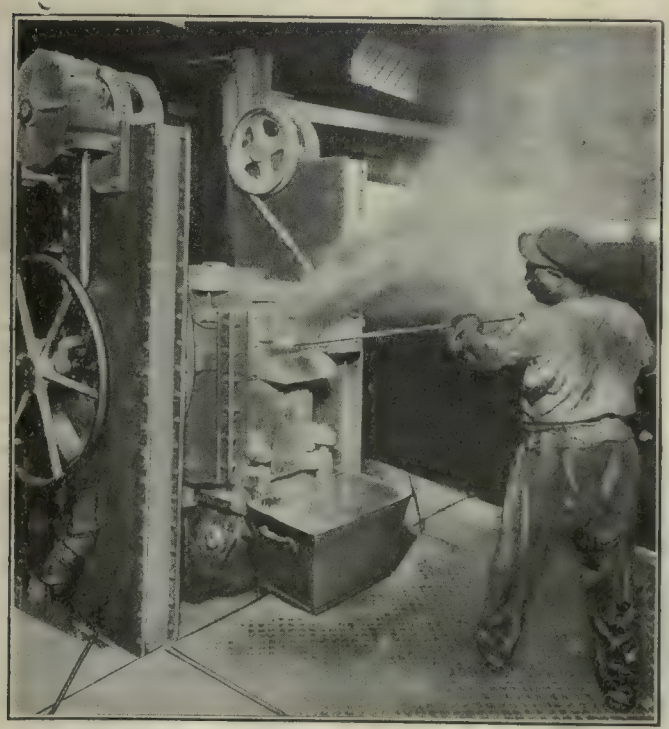


FIG. 21. SKIMMING ELECTRIC FURNACE PREPARATORY TO POURING



FIG. 22. POURING BRASS BARS FOR THE ROLLING MILL

At this point it may be interesting to describe briefly the operation of the electric casting shop in the Union Branch Plant of the Bridgeport Brass Co. At one end of the shop are situated the metal bins in which the raw materials, used in the making of brass, bronze and other copper alloys, are stored. These materials are carefully classified by systematic analyses so as to assure the maintenance of a high degree of accuracy in the composition of the brasses.

Weighing the Ingredients

In order to simplify the operation of weighing the ingredients and reduce to a minimum the possibility of errors, each ingredient is handled by a separate workman. In this way the process is worked out so that the weigher has only one weight and one ingredient to look after. The equipment for weighing is so designed that the material after being weighed is dumped directly into the charging can in such a manner as to eliminate the possibility of loss due to careless handling. All these precautions effectively safeguard the uniformity of the product. One line of weighing equipment is

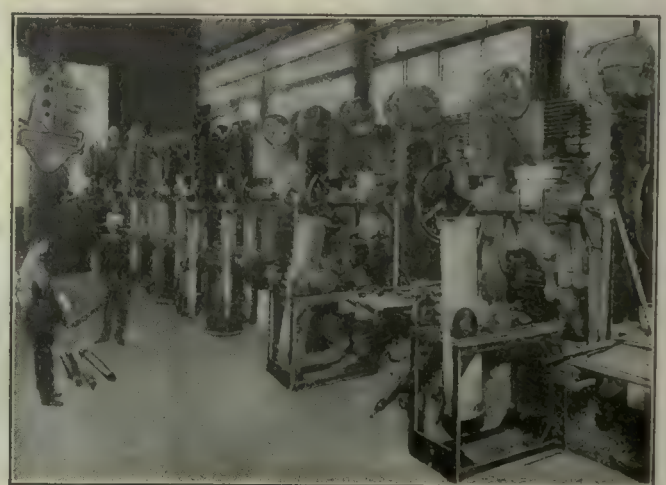


FIG. 23. THE POURING AISLE OF A BATTERY OF BRIDGEPORT BRASS FURNACES



FIG. 24. A LINE OF INDUCTION FURNACES USED FOR POURING BILLETS

shown in Fig. 19. Each man has charge of only one ingredient and has to remember only one weight. In the background are seen bins which contain raw materials classified by careful analyses. It is scientific organization of this end of the casting shop that insures an extraordinarily high degree of uniformity in the composition of Bridgeport brasses and bronzes.

In order to obtain a positive check on every charge, the complete charge is weighed before it is sent to the casting shop, and if the total weight does not check exactly with the sum of the component parts, the charge is re-assembled.

Charging

The charging cans are made of such size that the charge fills them to less than half of their capacity. This procedure avoids the possibility of spilling any part of the charge before it is used. In Fig. 20 is shown the charging aisle of one of the lines of furnaces. The charging cans may be seen at the right. The materials are introduced into the furnace through the charging doors plainly shown in the picture. Before pouring, the furnace man skims the dross from the top through the charging door as shown in Fig. 21.

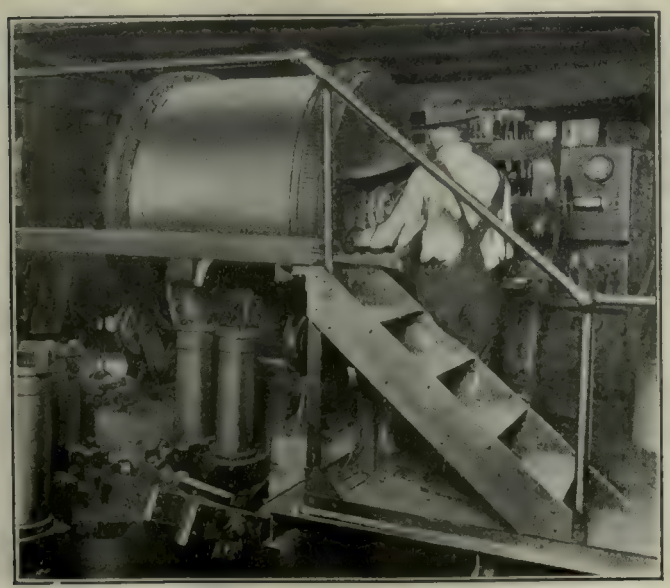


FIG. 25. POURING A BILLET FROM AN OSCILLATING INDIRECT ARC FURNACE

When the metal is ready to pour, the molds, mounted on a rotating stand, are put in place and the pouring accomplished by manipulation of a handwheel (Fig. 22). This wheel is positively geared to the tilting mechanism so that the caster has perfect control of the rate of pouring. At this point it is interesting to note that of each melt a sample is taken, and the results of the analysis of this sample are available before the billets or bars, as the case may be, reaches the mill to be worked into the finished product. A portion of one side of the pouring aisle is shown in Fig. 23. These furnaces are used for pouring billets that go to the tube mills and the extrusion machine. A line of induction furnaces used for pouring billets is shown by Fig. 24. The Bridgeport Brass Co. employs several kinds of electric



FIG. 26. BLACK SMOKE FORMED WHILE POURING A BILLET

furnaces, each furnace handling the same alloy under the same conditions day in and day out. Fig. 25 demonstrates the pouring of a billet from an oscillating indirect arc furnace. The raw material is charged from a platform above the furnace. The pouring is manipulated by means of an electric controller. The black smoke, formed by the grease in the mold during pouring, is shown by Fig. 26. This smoke not only protects the mold from burning, but protects the stream of metal from the atmosphere and absorbs any oxide that forms.

Contrasting the actual operation of the electric casting shop with that of the pit furnace casting shop it will be noted that every one of the most difficult steps of the process is accomplished automatically and is practically independent of the skill of the operator. The heating, the judging of the temperature, the stirring, and the pouring, all of which formerly required the skill of a master caster are now accomplished by the furnace itself.

The accompanying illustrations will give some idea of the equipment employed and indicate how it is manipulated in service. With this equipment, the Bridgeport Brass Co. has been able to produce brasses

and bronzes of a degree of uniformity and homogeneity previously unknown on a commercial basis.

The entire output of the electric casting shop of the Bridgeport Brass Co. is made up into various products marketed by the company, such as tube, sheet, rod, wire and manufactured products. A fairly complete set of pictures has been made illustrating the most important steps in the various processes of manufacture. Beginning with the raw material furnished by the casting shop each one of these processes will be briefly described in future articles.

Pneumatic Painting Machine

By M. Kester

The accompanying drawings show the assembly and details of a portable pneumatic painting machine. The apparatus can be used for spraying whitewash and similar liquids, besides paints.

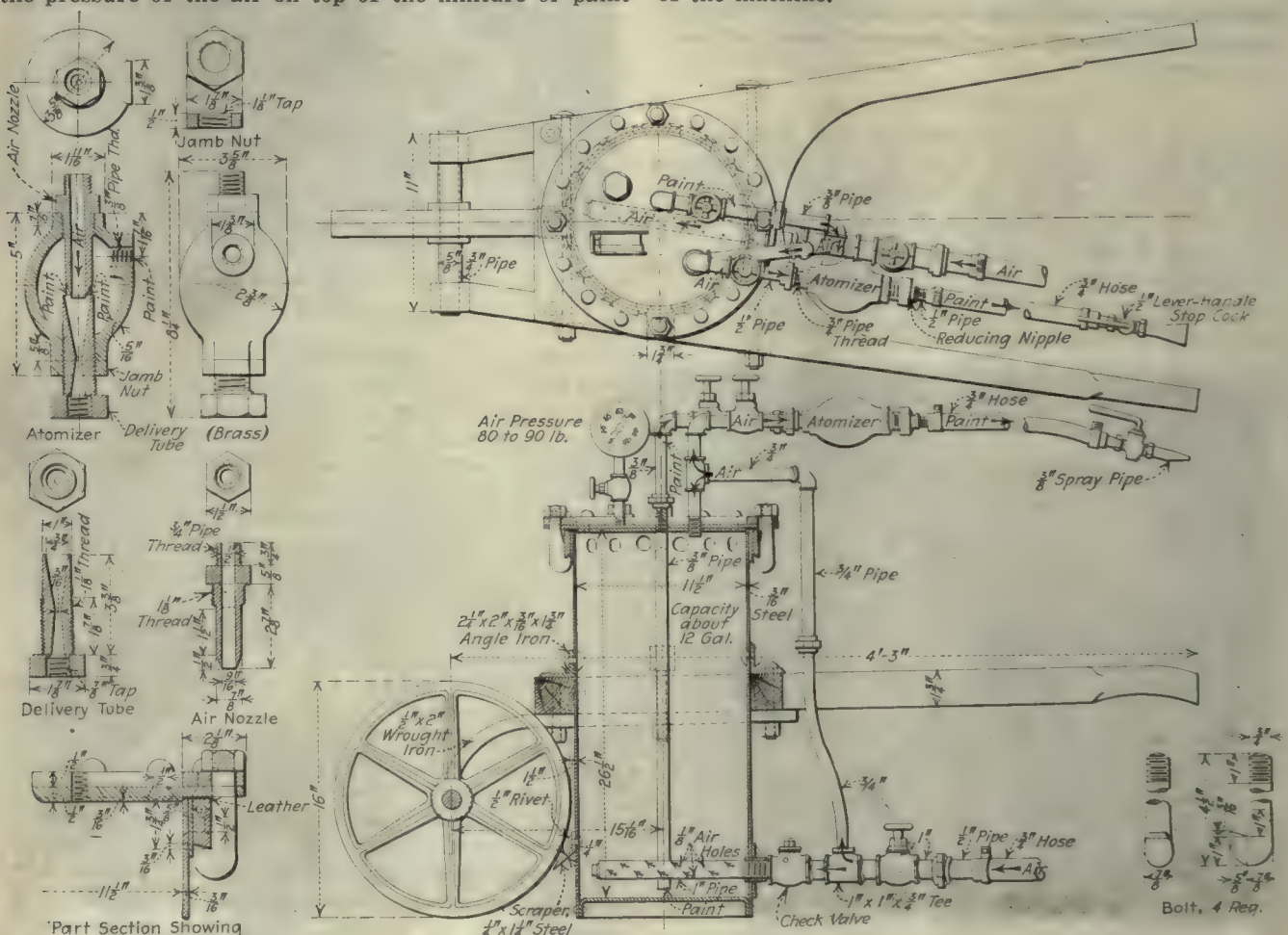
The frame is constructed on the order of a wheelbarrow; and the tank is 11½ in. inside diameter and 26½ in. long, although any convenient-sized tank may be used. The top is made removable with a ring riveted on the upper side. It is relieved where it fits the tank, a leather gasket being used, and it is secured on the tank by four bolts which hook under the bevelled edge of the band riveted to the upper part of the tank.

The short air pipe in the lower part of the tank has a number of ⅛-in. holes drilled in it for the purpose of keeping the mixture stirred up, the end being plugged. A check valve is directly outside of the tank, so that the pressure of the air on top of the mixture or paint cannot force the liquid out through the horizontal pipe. Close to this check valve is a Tee to permit the air to go both in the bottom of the tank for agitation purposes and also up to the top of the tank, where another Tee permits it to go down on top of the mixture and also out to the atomizer. An air gage is provided as shown, and the apparatus works best using 80 to 90 lb. pressure.

The paint or mixture is taken from the bottom of the tank and is forced up through the pipe which extends from within about ⅛ to ½ in. of the bottom of the tank into the side of the atomizer. Valves are provided on both the air and paint lines for controlling the action in the atomizer. From the atomizer the paint goes through a hose 25 to 50 ft. long, or even more if necessary. On the end of the hose is a ½-in. stop cock with a lever handle, so that the man handling the spray pipe can shut off the spray at any time desired. The spray pipe is simply a piece of pipe with the end flattened, and for overhead or other work as may necessitate it, the spray pipe can be 6 or 7 ft. long.

The atomizer is fully shown in the accompanying drawing, the air nozzle being screwed in solidly against the shoulder, while the delivery tube in the opposite end is screwed in so that the width of opening is suitable to the character of the paint or mixture being used. When the proper adjustment is obtained by trial, the jamb nut is tightened.

I have seen these painting machines in use in a number of different places, and I can say that they have proven very successful. The accompanying drawings give all of the information necessary for the building of the machine.



DRAWINGS OF A PORTABLE PNEUMATIC PAINTING MACHINE

Milling Operations on Herbert Lathes

By I. W. CHUBB
Editor, European Edition, *American Machinist*

Milling practice in English shops conforms quite closely to that in the United States. The accompanying illustrations give typical examples of milling work as carried out in a large English shop. The feeds and speeds given for the various operations will enable those doing milling work to compare their practice with that of a representative English concern.

THE notes here given relate to the milling practice of Alfred Herbert, Ltd., Coventry, England, more particularly as applied to the manufacture of their capstan and turret lathes. No attempt is made to show anything in the way of record-breaking, though larger outputs in the way of chips removed in a given time could easily be shown. For example, in surfacing with a 9-in. cutter, taking a cut 8 in. wide by $\frac{5}{16}$ in. deep, it is possible to remove 50 cu.in. of cast iron per minute, using a knee-type vertical milling machine. But commercial output is considerably below this; and in the practice of the firm it is found to pay better to run at speeds and feeds which will insure that a good-sized batch shall be machined without re-grinding the cutter, and, further, thoughts of high speeds and feeds subordinated to the consideration of finish. It may be well to state that in the examples here given all the cutters are of high-speed steel.

Considering first the machining operations on the No. 4 capstan lathe, Fig. 1 shows the use of the firm's No. 22 horizontal milling machine on the base of the lathe headstock. Here the rough surface of the casting is clamped down to points on the fixture, and the upper surface is machined in two operations. The three cutters are 6 in. in diameter, with inserted blades, each cutter being $3\frac{1}{2}$ in. wide. They are keyed on, with an adjustable collar between two of them in order to maintain the width of the gap. Here a comparatively low spindle speed is employed, in order that a good number may be machined without having to take down the cutters for grinding. For roughing, the spindle speed is 20 r.p.m., and for finishing, 39 r.p.m., the feed in the first case being $2\frac{3}{4}$ in. per minute and for finishing $3\frac{7}{16}$ in. per minute.

The same part is shown in Fig. 2, but it is inverted and clamped down to machined surfaces on the fixture. The cutters are of three diameters, the total width of the gang being $15\frac{1}{2}$ in.; an adjustable spacing collar is employed between the two largest cutters to maintain the width of the slot for the caps of the spindle bearing. The largest cutters are $8\frac{1}{2}$ in., the intermediate $7\frac{1}{2}$ in. and the small cutters 4 in. in diameter. Here again two operations—roughing and finishing—are employed, the spindle speed in each case being 20 r.p.m. The width of the cut varies, and consequently two rates of feed are employed. For the full cut the rate is $2\frac{3}{16}$ in. per minute, but in the spaces a speed of 12 in. per minute is used. One gang of cutters will machine 400 headstocks between the grindings.

Arbor Steadying Device

The square turret blocks for the No. 4 capstan lathe are made from steel bar of about 35 to 40 tons tensile strength. The bars having been machined to rectangular section, slots are cut in two pieces at a time, as illustrated in Fig. 3. The two side-and-face cutters are 5 in. in diameter by $1\frac{3}{8}$ in. wide, and the spindle runs at 25 r.p.m., the feed per minute being $1\frac{1}{2}$ inches. Here the work is finished in one cut. The arbor is supported between the cutters by means of the firm's patent roller steadyrest, a separate view of which is given in Fig. 4, which illustrates the fact that the device occupies no space below the arbor, so that cutters of minimum diameter can be used. This steadyrest is supplied as a standard fitting for machines and can, of

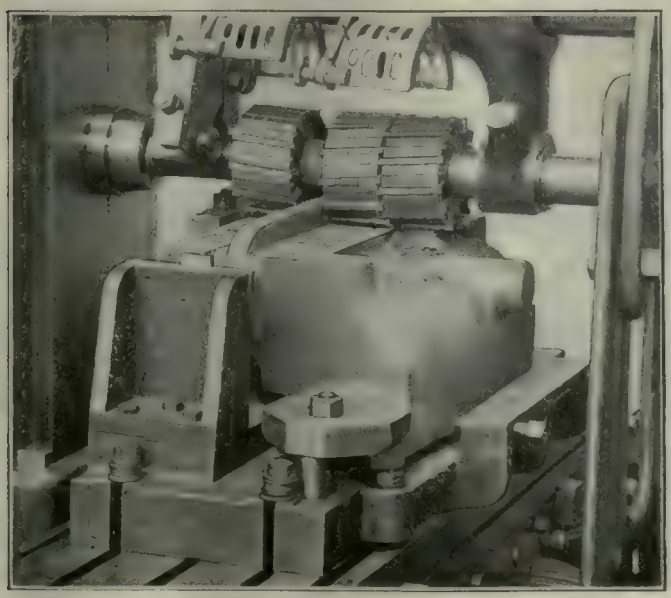


FIG. 1. GANG-MILLING BOTTOM OF HEADSTOCK BASE OF CAPSTAN LATHE

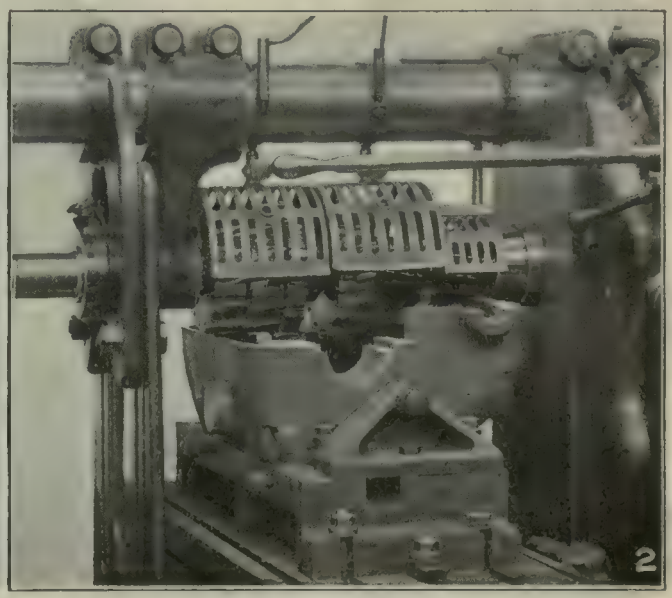
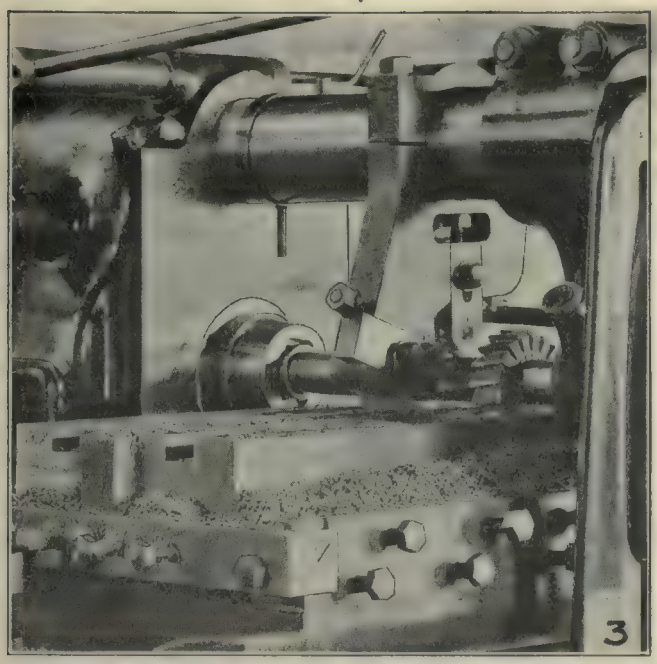


FIG. 2. GANG-MILLING TOP OF HEADSTOCK BASE OF CAPSTAN LATHE



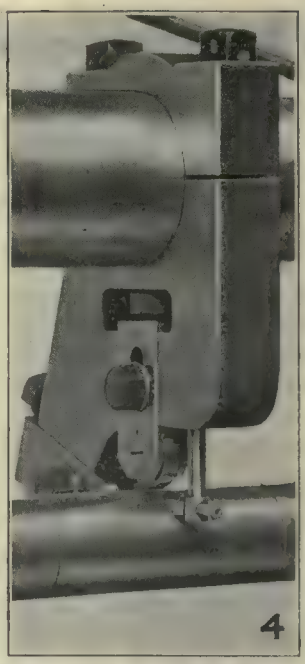


FIG. 3. MILLING SLOTS IN STOCK FOR TURRET BLOCKS. FIG. 4. ROLLER-STEADYING DEVICE FOR ARBOR

course, be used on jobs where the ordinary arbor support could not be applied. It is of special value where gangs of milling cutters have to be kept permanently on their arbors, as of course it can be applied or removed without taking away the cutters. The rollers are independently adjustable and a wiper prevents dirt and chips from getting between the rollers and the arbor. Chattering or spring can frequently be prevented by applying a steadyrest, without changing the cutter arrangement or even stopping the cut.

Still keeping to the No. 4 capstan lathe, In Fig. 5 a gang-milling operation is shown on the cross-slide, where the top, the ends and the slots are machined simultaneously. The gang of cutters includes a pair of 8-in. side-and-face cutters, a pair of 6-in. side-and-face cutters and four cylindrical cutters 3 in. in diameter, the total width of surface machined being 8½ inches. The spindle speed is 31 r.p.m. and the feed 1⅛ in. per minute. Here six castings are operated on at a time, the job being held in place by means of V-ways previously machined on the bottom. Done on the No. 22 horizontal milling machine, the operation is completed in one cut, and between 150 and 200 castings are machined between grindings of the cutter.

The milling of the T-slots in the cross-slide is shown in Fig. 6. The same fixture is used for securing the job and the T-slot cutter is 2 in. in diameter by ⅝ in. thick. The spindle speed is 93 r.p.m., and the feed 2¾ in. per minute, and between 250 and 300 castings are usually finished between grindings. This job, however, is done on a No. 16 vertical milling machine.

In Fig. 7 is illustrated the milling of rack teeth on phosphor-bronze gluts for the draw-in chuck of the No. 4 capstan lathe, a glut being a forked piece to transmit longitudinal movement to a rotating piece. It will be seen that the cutter consists of a gang of two angular hobs, 3 in. in diameter, the total length of the rock being 6 in. with a diametral pitch of 8. The speed of the cutter is 97 r.p.m. and the feed ⅛ in. The work is completed in one cut, the two hobs being staggered to split the load coming on the arbor. Each piece is held by a bar pushed through the previously reamed hole and pulled up by a knurled nut, the bottom end of the fork being set up by screws.

The operation shown in Fig. 8 is of interest, but the speeds and feeds employed, depending on circumstances, cannot readily be stated. Here is shown the machining of facings of white metal cast on gluts. Speeds and feeds are limited by the resistance of the white metal, because this would be torn away from the anchorage if pressed beyond the limit. The side-and-face cutters employed are 10 in. in diameter. The job is held much as described in connection with Fig. 7 and wedges support the pieces underneath. The two operations just referred to are performed on the firm's No. 12 horizontal milling machine.

A vertical milling operation on the sole plates of square turrets for the No. 4 capstan lathe is shown in Fig. 9, the pieces dealt with being drop forgings of about 35 to 40 tons tensile strength. The base and

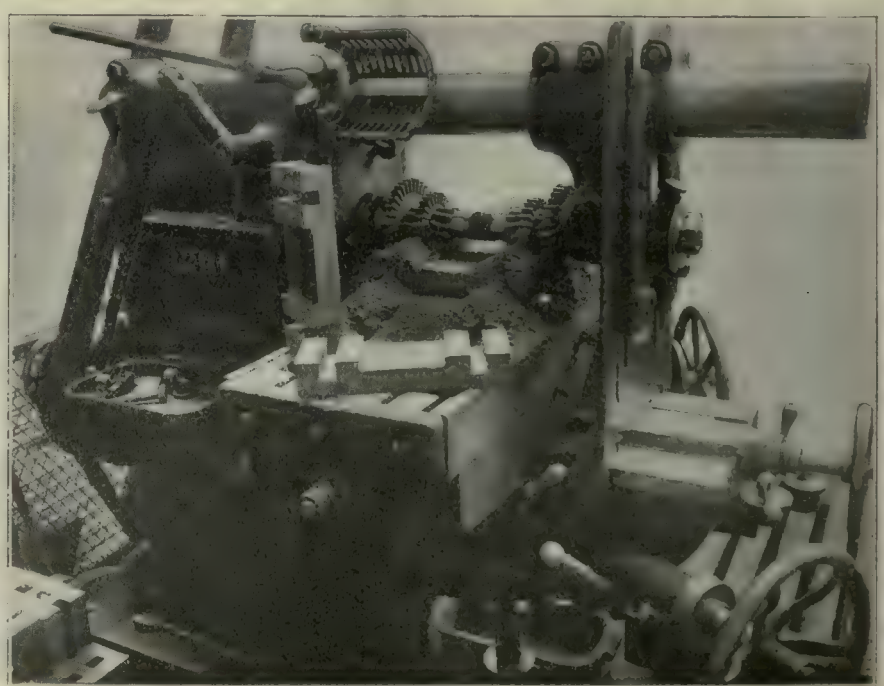


FIG. 5. GANG-MILLING CROSS SLIDES OF LATHE ON NO. 22 MILLING MACHINE

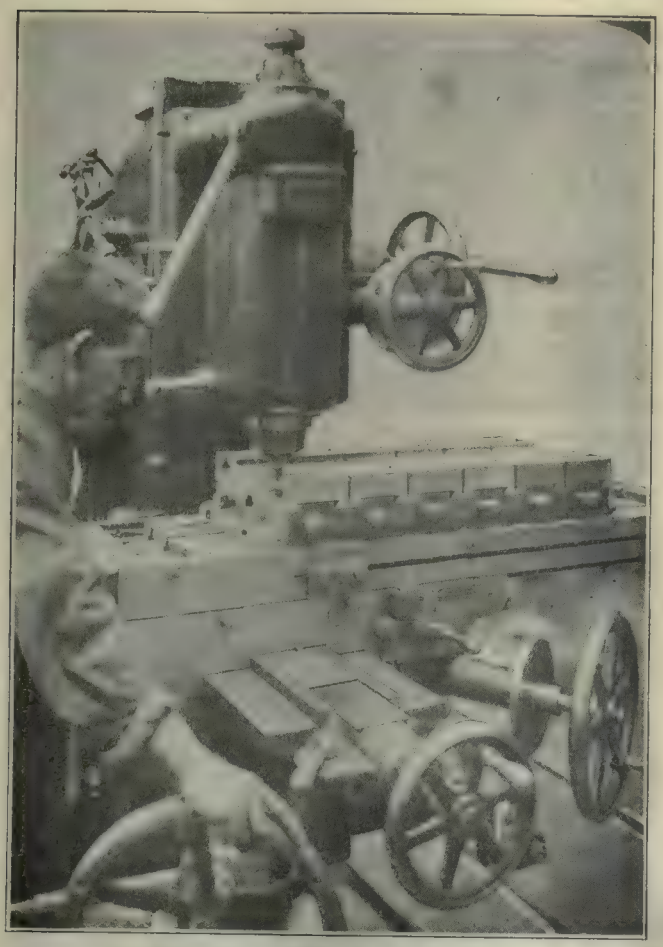
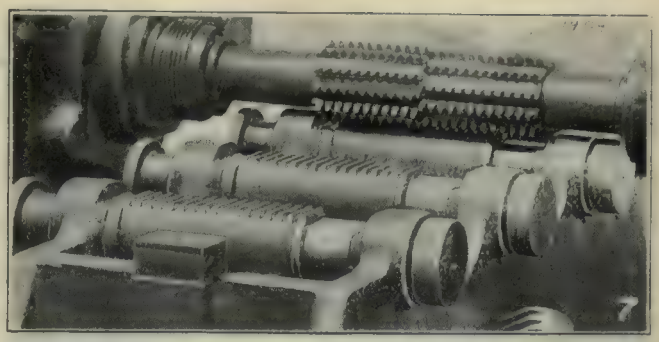


FIG. 6. MILLING TEE-SLOTS IN CROSS-SLIDES ON NO. 16 MILLING MACHINE

clamping-down tongue are both machined, and in order to mill the dovetail portion and the base, cutters of three types are necessary, the cutters being changed in the spindle without removing the work. The pieces are clamped up by setscrews against a knife edge. For the base a 3-in. inserted-tooth cutter is given a feed of $5\frac{3}{16}$ in. per minute, and for the tenon an end mill 2 in. in diameter is used at the same feed, while for milling the dovetail an angular cutter is employed at a feed of $3\frac{7}{16}$ in. per minute. For the latter a cross movement is given and no special positioning device is necessary, as the length of the dovetail tongue is not important within $\frac{1}{8}$ inch. A No. 16 vertical milling machine is employed. The illustration shows the first operation being performed.



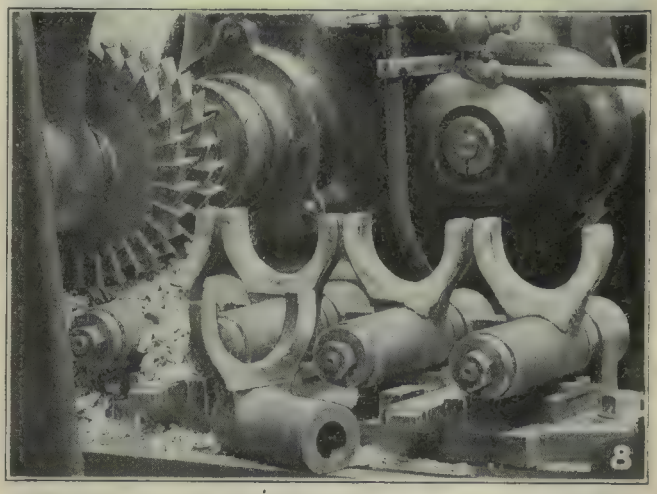


FIG. 7. MILLING RACK TEETH. FIG. 8. STRADDLE-MILLING WHITE-METAL FACINGS ON GLUTS

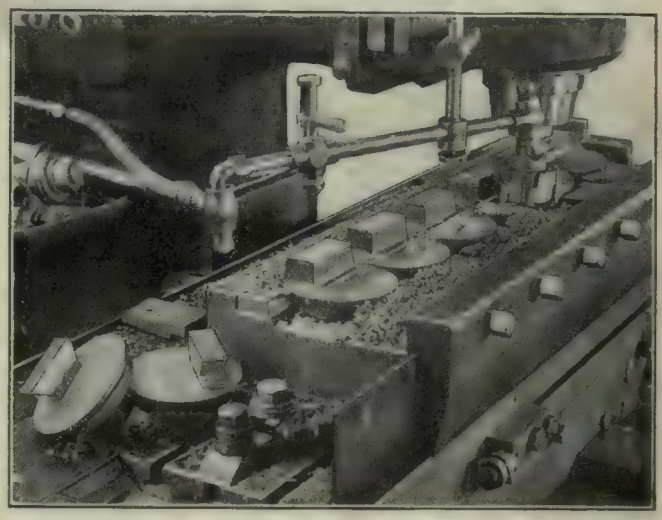


FIG. 9. MACHINING SOLE PLATES OF SQUARE TURRETS

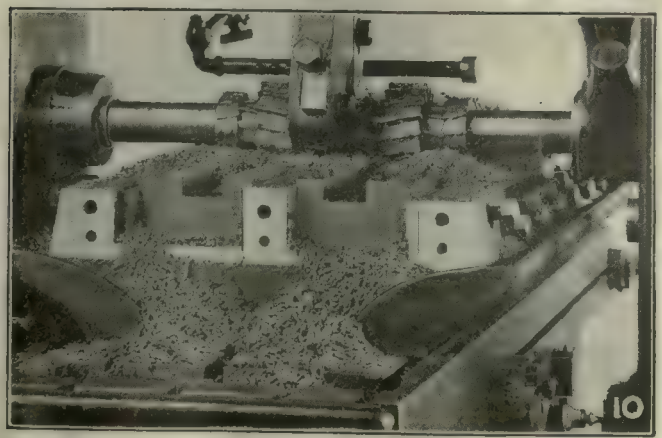


FIG. 10. GANG-MILLING TOOLSLIDES IN THE BAR

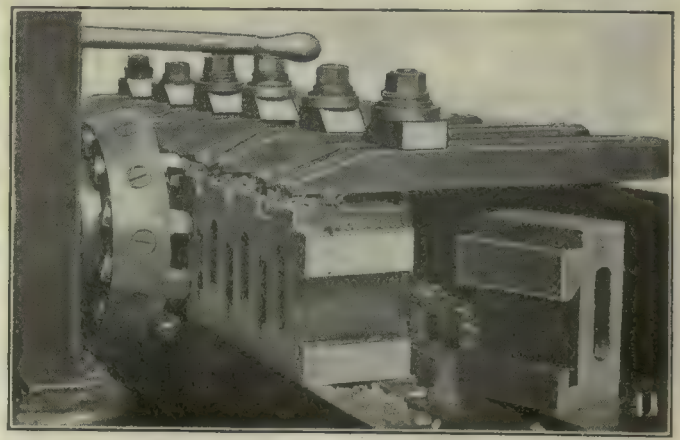


FIG. 11. FACE-MILLING ENDS OF TOOLSLIDES

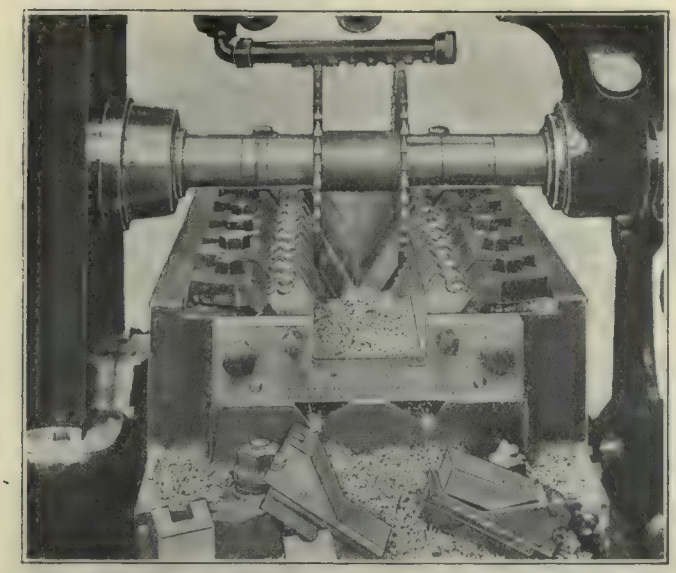
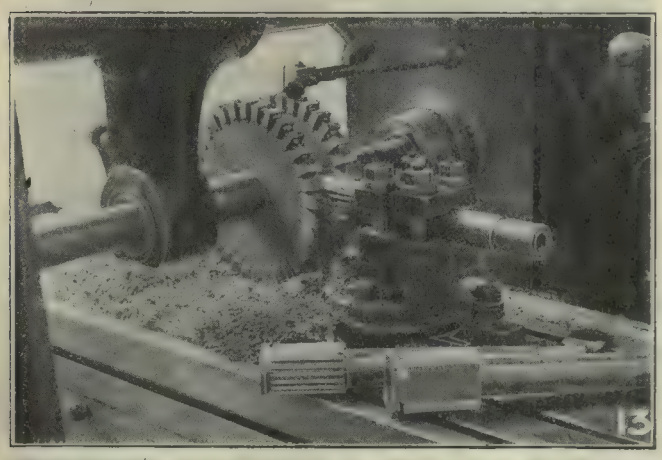


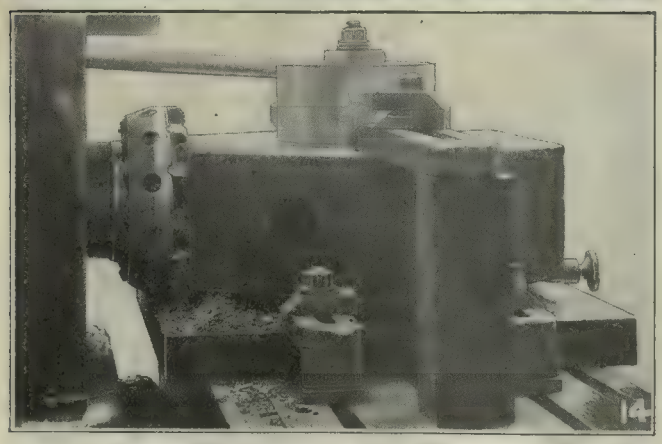
FIG. 12. MILLING OUT A BLOCK OF METAL BY THE INTERSECTION OF TWO CUTS

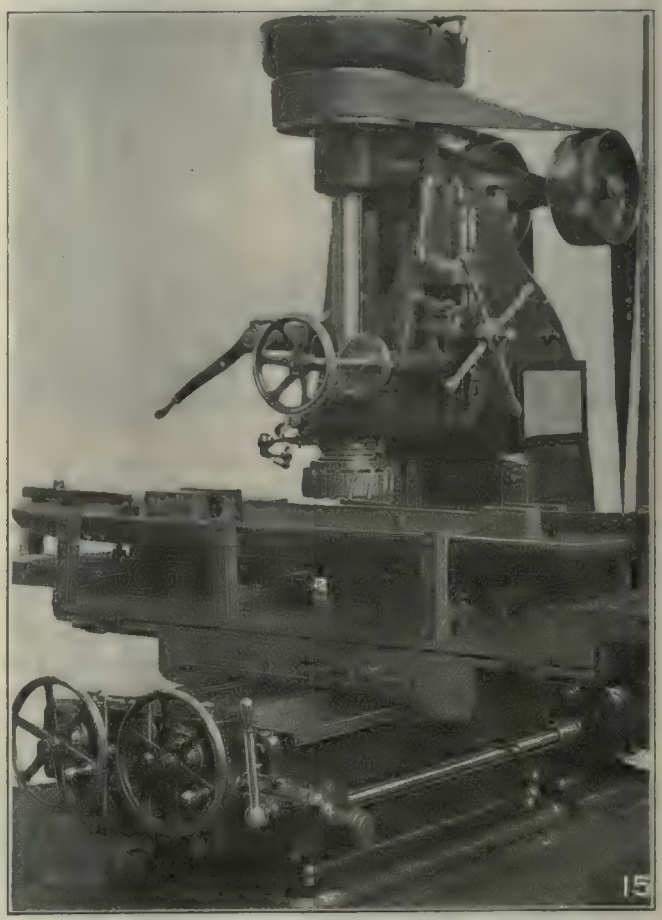
Turning to hexagon turret-lathe details, Fig. 10 refers to the machining of toolslides for the roller-steady turning tools employed. A steel bar of about 35 to 40 tons tensile strength is used and a gang of cutters 10 in. wide is employed, the gang consisting of two side-and-face cutters 5½ in. in diameter, the other cutters being 4⅛ in. and 3⅝ in. in diameter, respectively. The spindle speed is 25 r.p.m. and the feed 1 in. per minute, and the slots produced are 1⅞ in. wide. The use of the roller steady is again shown. In another direction this job illustrates the practice of the firm, namely, making details in bar form by milling to section and then sawing up.

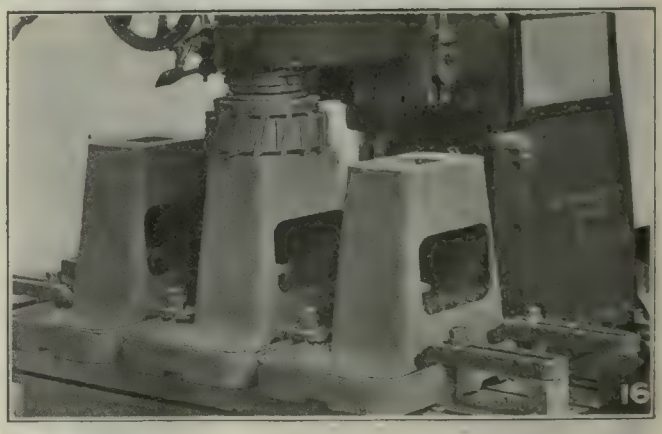
Another operation on the toolslides, face milling, is shown in Fig. 11, an inserted-tooth cutter being employed. The pieces are finish-milled after they have been sawed up, the work being light, and no special fixtures are used, the job being clamped down to the machine table with ordinary tackle and set up against a strip in one of the T-slots. The face cutter is 9 in. in diameter, the spindle speed 25 r.p.m., and the feed 2$\frac{3}{16}$ in. per minute, and the operation is dry. The machine used is a No. 22 horizontal milling machine.

The operation illustrated in Fig. 12 is particularly interesting, showing the milling away of a solid piece of metal by the intersection of two cuts rather than taking it out by slab milling. The job is held better





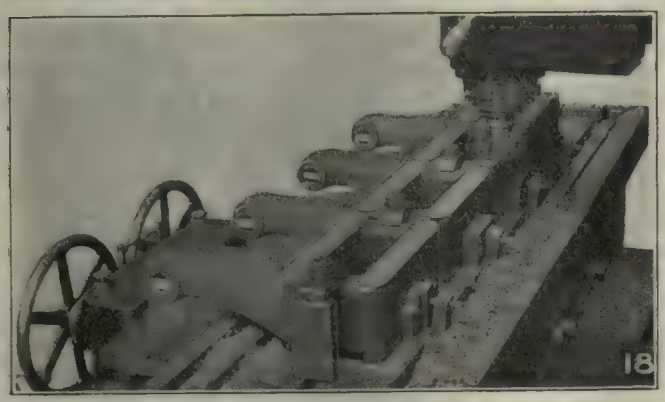


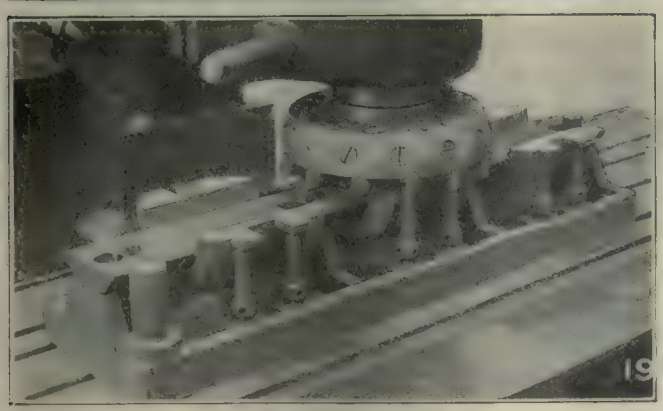


FIGS. 13 TO 16. SOME OF THE OPERATIONS

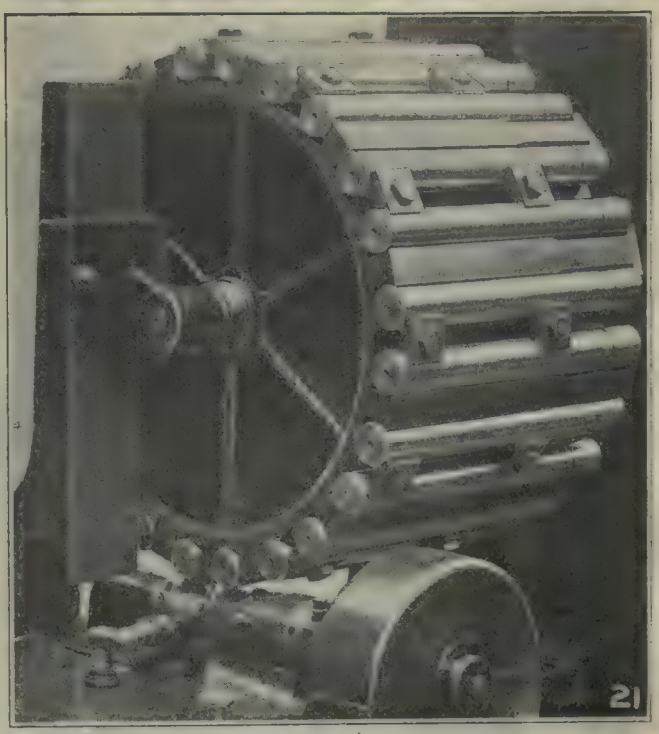
Fig. 13—Straddle-milling glut pinions. Fig. 14—Face-milling sides of a hexagon turret. Fig. 15—Machining trays on No. 8 vertical milling machine. Fig. 16—Facing top of cabinets on a vertical milling machine.











FIGS. 17 TO 21. OTHER MILLING OPERATIONS

Fig. 17—Milling three sides of a hexagon at one cut. Fig. 18—Face-milling stop-rod brackets. Fig. 19—Milling faces of a split bearing. Fig. 20—Continuous milling bases of pumps. Fig. 21—Fixture to hold work in a gear cutting machine while milling keyways.

and the cutting operation does not stress the material so much. The pieces produced are used on the roller slides for the roller-steady turners in the hexagon turret lathes, and the material is 0.5 per cent carbon steel, heat-treated. The slide as finished in this operation is shown on the table of the machine, and the operation illustrated, done by means of side-and-face cutters 8 in. in diameter by $\frac{1}{4}$ in. wide, completes the removal of the wedge piece. The fixture employed holds 40 pieces by means of finger clamps. The strength of the cutters determines the feed, which is usually 1 in. per minute. the wedge piece. The fixture employed holds 40 pieces planers for packing and setting-up strips. The firm's No. 16 horizontal milling machine is used in this operation. Straddle-milling the glut pinions for the No. 13 hexagon turret-lathe headstock is illustrated in Fig. 13, the material being steel of 40 tons tensile strength and the cutters 10 in. in diameter. They run at 20 r.p.m. and finish at one cut, the feed being $1\frac{3}{16}$ in. per minute.

Another face-milling operation on the No. 22 horizontal machine is illustrated in Fig. 14, the job being the turret of a hexagon turret lathe. Here a 9-in. face cutter removes about $\frac{5}{16}$ in. of metal, the speed being 25 r.p.m., and the feed $4\frac{1}{8}$ in. per minute. The castings are specially dense, chills being employed to insure soundness, and the milling operation illustrated is for roughing only, the turret face being finished in position on the machine by a facing tool carried in the lathe spindle. The use of the No. 8 vertical milling machine to finish the facings on the suds tray for a No. 1 hexagon turret lathe is shown in Fig. 15. The inserted-tooth face cutter is 12 in. in diameter, running at 19 r.p.m. with a feed of $5\frac{3}{4}$ in. per minute.

The operation of milling the top facing of cabinets for the No. 9 combination turret lathe is shown in Fig. 16, the machine being again a No. 8 vertical milling machine. The cabinets are clamped direct on the table and a 12-in. inserted-tooth face cutter is emplcyed, running at 19 r.p.m., the feed being $5\frac{3}{4}$ in. per minute. As an average, 50 castings are machined between grindings.

The hexagon stop bars for the No. 9 combination turret lathe are produced from round mild steel bars,

and Fig. 17 illustrates how three sides of the hexagon are machined by a cutter which is 5 in. in diameter maximum, and 2¾ in. in diameter in the center, revolving at 48 r.p.m., the feed employed being 4½ inch. The hexagon is, of course, produced in two cuts, and a completed bar is shown placed across the table, the machine used being a No. 22 horizontal milling machine.

Stop-rod brackets for the No. 9 combination lathe being milled in the No. 8 vertical machine are shown in Fig. 18, clamped direct on the machine table with ordinary shop tackle, this procedure being common with larger machines. The inserted-tooth face cutter is 4 in. in diameter, running at 57 r.p.m. with a feed of 5⅜ in. per minute, and usually three dozen castings can be machined on the two sides before re-grinding the cutters is necessary.

In many of its machines, including, for example, the No. 4 capstan lathe, the firm uses cast-iron bearings lined with white metal, and Fig. 19 illustrates the machining of the joint of the bearings for the head-

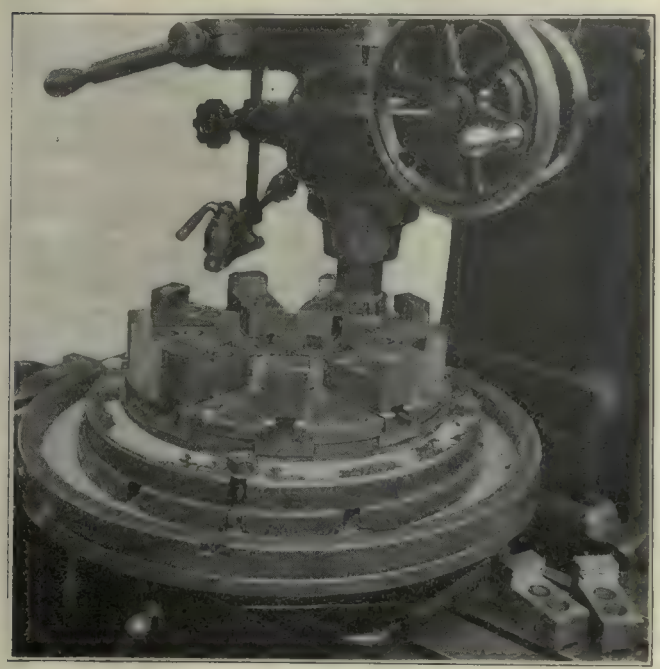


FIG. 22. CONTINUOUS MILLING SERRATIONS ON CHUCK JAWS

stock before the white metal is run in. The fixture shown takes three bearings, and is applicable to the bearings of other sizes of lathes by using different locating and clamping pieces. In the illustration a No. 16 vertical milling machine is shown, using a 10-in. inserted-tooth cutter at a speed of 25 r.p.m., the feed being 5⅛ in. per minute, finishing at one cut.

The remaining examples are of continuous milling. Thus Fig. 20 relates to machining the bases of gear-pump bodies used on the firm's machine tools. The fixture holds 10 castings, one side of the pieces under treatment being clamped against the base by the wedging action of the swinging clamps at the outside. By turning the knobs, the work is forced into V-shaped recesses at the center of the fixture, against wedge-shaped tongues, serrated and hardened, that are fastened in the casting. The fixture is secured to the circular table of a No. 3 vertical milling machine and rotates continuously under a cutter 7 in. in diameter running at 30 r.p.m. The work is finished in one cut, chucking proceeding simultaneously with the cutting. The depth of cut varies from ⅛ to ⅜ in. and the output is 40 pieces per minute.

A gear-cutting machine is shown in Fig. 21 with a fixture mounted on the work arbor to take 24 shafts that have to be splined. Two ways are cut simultaneously by means of a pair of 3-in. slotting cutters running at 80 r.p.m., the feed being ⅛ in. per minute. The splines are ⅜ in. wide by ⅛ in. deep by 9⅜ in. long. The operation is continuous, the machine attendant loading and removing the finished work and, in fact, looking after several machines at once.

As a final example, the continuous milling of serrations on Coventry chuck jaws is shown in Fig. 22, the jaws having previously been finished on the surface to be serrated to within 0.010 in., so that only the teeth are required to be cut. On the fixture used, holding nine pieces, the jaws are secured in exactly the same way as employed for fixing them to the jaw slides of the chuck. The cutter is form-relieved, 2½ in. in diameter and runs at 120 r.p.m., the output being 30 jaws to the hour.

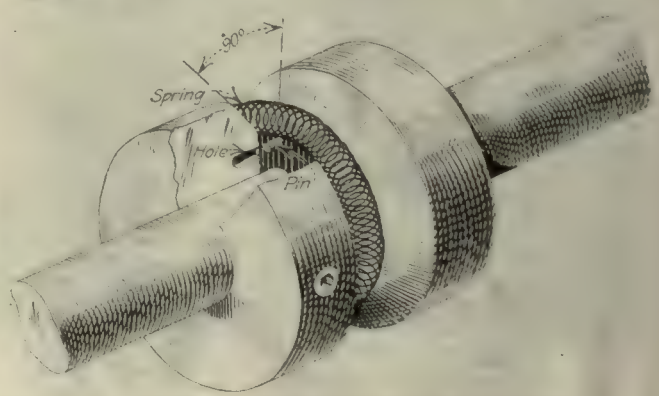
A Self-Adjusting Spacing Collar

By R. H. KASPER

Many machines carry a revolving shaft on which end play is undesirable. To overcome this end play a spacing collar is carried on the shaft, as between a pulley and a bearing. In time this collar wears and again permits end play, which necessitates making another collar. To eliminate the necessity of replacing collars the spacing collar shown in the sketch was designed and it exceeded all expectations. Instead of a single collar there are two collars of the same size which are placed side by side. Each collar has one edge turned so that when placed together a 90-deg. V-groove is formed.

A closely wound spring is then made with a loop at each end. One collar carries a pin on its inner face, which fits loosely into a hole in the inner face of the other collar. After the collar has been placed on the shaft the spring is stretched around the V groove and the ends hooked together. The pressure of the spring causes the two collars to separate, making a close fit in the space allotted to them. The pin keeps both collars moving as one, preventing wear on the spring.

As the tendency of the spring is to close in towards the center, any wear on the outer face of the collars will immediately be taken up by the pressure of the spring. Although this collar adjusts itself readily, it will resist a very severe end thrust before closing together.



A SELF-ADJUSTING SPACING COLLAR

Programs of Apprenticeship and Special Training In Representative Corporations

By J. V. L. Morris



THE Sperry Gyroscope Co. has a splendid new machine plant in the city of Brooklyn, employing in the neighborhood of a thousand men. The products of the plant are a special type of searchlight, gun-fire-control instruments, radio apparatus, and, chiefly, the gyro-compass, for the production of which the shop was primarily established. A special training department has been organized under the administration of the employment department with an experienced mechanic in charge. Equipment is provided for training fifteen to twenty men at a time, this consisting of the usual machine-shop tools. There are, also, provisions for bench work and assembling and some toolmaking practice. Figs. 24 and 25 show views in the training department. Several skilled workmen are employed in the department to work with the men in training and to assist in their instruction. This department is intended to serve two purposes: First, as a "vestibule school," chiefly at times when considerable additions are being made to the working force, and second, for "up-grading" of selected employees during normal or slack periods.

As a vestibule school it offers an opportunity both to try out the fitness of men seeking positions and to give new employees a brief initial training in the practices peculiar to the plant. Upon this basis a workman ordinarily remains in the school for a period of only a few days to several weeks. He is then either rejected as unsuited to the requirements of the plant or, if satisfactory, transferred to regular production work. It is apparent that such a practice relieves the production department of the trouble of testing the qualifications of a new employee and of supervising his initiation into the special methods utilized by the company.

At the time of investigation, however, the second

V. The Sperry Gyroscope Co., Brooklyn, N. Y.

The system of training machinists used in a large-sized plant turning out complicated machines is described here. The method employed in operating the special training department might be useful in other types of machine-making plants. It should be noted that the training consists of a short-time apprenticeship for adult mechanics.

(*Part IV was published in the Nov. 4 issue.*)



FIG. 24. MEN AT WORK IN THE TRAINING DEPARTMENT



FIG. 25. ANOTHER VIEW IN THE TRAINING DEPARTMENT

Form # 1155-B

SPERRY GYROSCOPE COMPANY.

EMPLOYE'S TRAINING RECORD

Name_____ Age_____ Clock No._____ Rate_____ Date Started_____ Time Started_____ A.M. P.M.

Former Occupation_____ With what Company_____

If former employe had already been in the Company's employ.

Occupation	Department	Foreman	Rate	Length of Service	General Character of Service rendered

Reasons for taking Training Work_____

Date of Transfer from Training Branch_____ Occupation_____

Transferred to_____ Department Foreman_____ Rate_____

Employe's Rating during Training (95% - 100% Excellent) (85% - 95% Good) (70% - 85% Fair) (50% - 70% Poor)

Ability Adaptability Attendance		Cleanliness Conduct Disposition		Health Honesty Initiative		Intelligence Leadership Loyalty		Neatness Patience		Average	

FIG. 26. RECORD KEPT OF EACH MAN BEING TRAINED FOR "UP-GRADING"

purpose, that of "up-grading," was being stressed. Some men from the shop were detailed for a 15-month course, and were receiving pay equal to approximately 80 per cent of the earnings they made while on production work. Several were at about third- or fourth-year apprentice age but most were somewhat older, though still young men. About half of the time was said to be spent on jobs selected particularly for value in training, and the rest of the time at small tool work of the regular production department. No organized, part-time, supplementary instruction in the way of drafting and shop arithmetic was provided by the company, though, of course, there was a larger amount of this instruction incidental to the assignment of jobs than would be customary in regular production.

The co-operation of the city public school system, however, offered provision for this purpose. The classes were held in the nearby vocational school directly after working hours rather than in the evening, an arrangement much more convenient to the men. The following classes were provided: Industrial arithmetic with fifteen enrolled, mechanical drawing with twenty-three, and applied electricity which, starting with fifteen, had grown to an attendance of thirty each night. Enrollment was not limited to those pursuing this special training, but was open to all employees.

Some interesting record forms have been developed. The one shown in Fig. 26 is utilized when the employee is undergoing the training for "up-grading." It will be seen that ratings at the bottom of the front face are not confined merely to workmanship, but extend to fourteen qualities, all of which are believed desirable in the superior workman, and that the final rating is an average of the different gradings.

The record on the reverse side of the form just mentioned is shown in Fig. 27, and it has been found a useful check on the time study for an operation studied by the enginering department and entered under "shop method." By the "training section method" a marked improvement has in some case been made, which method is, of course, later utilized by the production department. The other form, "the daily training record," in Fig. 28, serves for the new employees passing through the department for trial and brief initial training.

A School for Foremen, Supervisors and Inspectors

A rather unusual school has been developed for the foremen, supervisors, and inspectors. There are 111 of these enrolled, with meetings held twice a week from 4:30 to 5:30 p.m., directly after work. These meetings are given up to lectures by representatives of the engineering force on the products of the company, chiefly the gyro-compass, a knowledge of whose highly intricate construction and uses is both interesting and very essential to those whose duties consist in the production and assembling of the several thousand parts involved.

TRAINING RECORD

NAME OF PART	PART NO.	OPERATION	MACHINE USED	RATE OF PRODUCTION: SHOP METHOD: QUANTITY	SHOP METHOD: TIME	SHOP METHOD: AVERAGE	TRAINING SECTION METHOD: START OF TRAINING	TRAINING SECTION METHOD: FINISH OF TRAINING	TRAINING SECTION METHOD: TIME	TRAINING SECTION METHOD: AVERAGE	PRODUCTION

SPERRY GYROSCOPE COMPANY.

EMPLOYES DAILY TRAINING RECORD. Form #1114.

Name_____ Clock No._____

This report to be also used for recording absence and lateness of employe.

Date	Name of Part	Part #	Assembling	Filing	Reading Blue prints	Measuring (" Instruments)	Drill Press (Sensitive	" Medium	" Multiple)	" (Spindle)	Engraving	Lathe, Bench	" Engine	Milling Plain	" Universal	Screw Machine	Shaper	Laying Out	Operation	Quantity Passed	Quantity Rejected	Time in hours	Average per hour	Total Production

FIG. 27. (TOP). PRODUCTION RECORD USED IN TRAINING DEPARTMENT. FIG. 28. (BOTTOM). DAILY TRAINING RECORD USED BY "VESTIBULE SCHOOL"

Handling Material in Railroad Shops

By FRANK A. STANLEY

Railroad shops usually do a large variety of work, and they are interesting because of the labor-saving devices that have been developed to suit the particular needs of the plants. The devices shown in the accompanying illustrations are typical of an up-to-date railroad shop.

THE value of special appliances for handling semi-finished and finished parts around the shop is generally recognized, and one of the most important features of many plants today is the equipment provided for just this purpose. Not only is material thus taken care of to good advantage without loss or injury, but, furthermore, there is a marked gain in economy of time and effort upon the part of the force. Also, heavy work may be done without danger to the workmen when suitable apparatus is in use for picking up and moving parts about the shop floors.



FIG. 1. USING HOOKED BARS FOR PILING AXLES

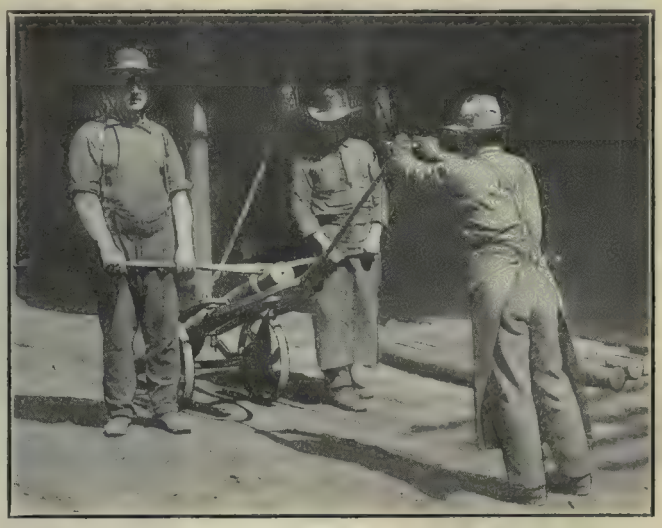


FIG. 2. TONGS AND TRUCK FOR HANDLING AXLES FROM PILE

A few illustrations of equipment for handling railroad-shop work are herewith presented, these views being reproduced from photographs taken in one of the largest of the western plants, namely, the Southern Pacific shops, Sacramento, Cal.

In Fig. 1 is shown a method of piling axles with the aid of special hooks, which enable the men to roll the axles along from one tier to another without difficulty and with no liability of injury to hands or feet. These parts, weighing several hundred pounds, are usually more or less troublesome to stack up into piles where an ordinary bar is used, but the hooked bars shown take care of the job easily and safely. The end of the bar is formed into an S-shape, the outer end of which drops over an axle journal while the upper curve of the S fits under the journal of the axle that is to be lifted. With two hooks, one axle after another can be lifted up and rolled over the curved ends of the hooks into the tier above the one it originally occupied.

Another handy axle appliance is shown by Fig. 2, it being a combination of axle tongs and a truck. The truck is fitted with a steel cradle for receiving the axle, and when the end of the work is lifted by the tongs the truck is easily backed under it. The tongs are so made that when the axle is grasped between the jaws the handles form a straight line, and the axle can be picked up with the tongs held as rigid and straight as a single bar of metal.

A coupler truck is shown by Fig. 3. It is a two-wheeled vehicle with the axle raised at the middle to receive a horizontal tube clamped to the top of the axle. Links are fastened to the horizontal bar at front and rear, and in these are held rings for the short chains by which the coupler is suspended. The longitudinal position of the supporting bar for the coupler is such that the work is nicely balanced and can therefore be lifted from the floor with little effort. The looped handle at the end of the truck is proportioned for convenience in operating.

Another truck is illustrated in Fig. 4. It is used for handling air tanks for locomotives and for supporting them while they are being secured to the engine. The truck frame is of steel angles, light but sufficiently strong. Across the top are two flat plates carrying nuts fitting on 2-in. square-thread screws. The nuts are pro-



FIG. 3. TRUCK FOR HANDLING COUPLERS

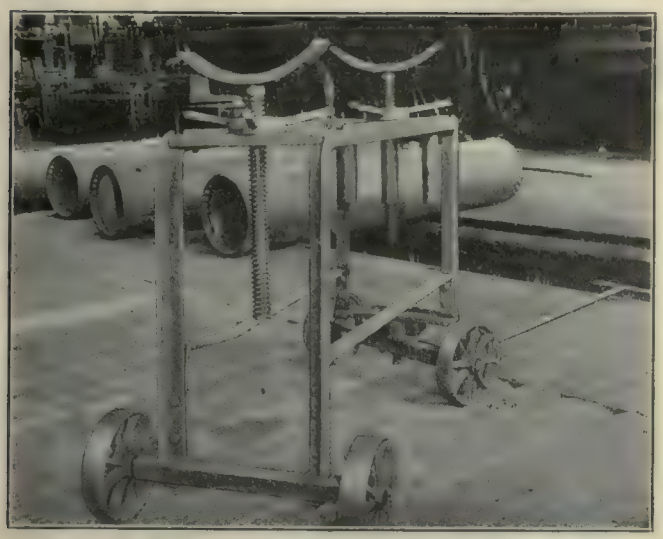


FIG. 4. TANK-SUPPORTING TRUCK

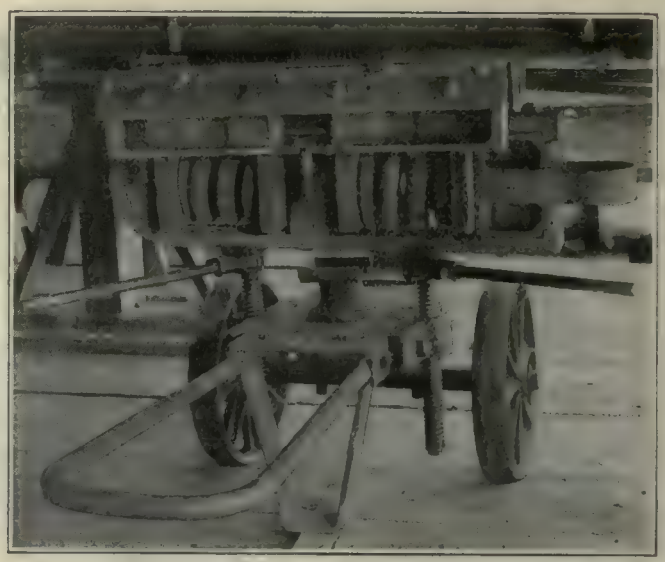


FIG. 5. TRUCK FOR HOLDING DRAFT RIGGING

vided with handles like pilot-wheel spokes, these being operated to adjust the long elevating screws by which the tank is lifted to the height required for the locomotive. The tops of the elevating screws are fitted with arc-shaped cradles of a radius to accommodate the diameter of the tank, and of a length of arc equal to about one-fourth of a circle.

Another truck built along somewhat similar lines is seen in Fig. 5. This one is for handling draft rigging. It is necessarily made with a low body and it combines with the truck features a double lifting jack both for forcing the draft rigging up into place and for holding it while it is being fastened permanently in position. The truck carries at the center of the body a supporting shoe or cradle to receive the work, and the elevating screws are similarly fitted with channeled shoes to suit the lower leg of the yoke. To elevate the screws, each is provided with a ratchet head and a long operating handle, so that the draft rigging can be quickly and rigidly jacked up into place as soon as the truck has been backed into position.



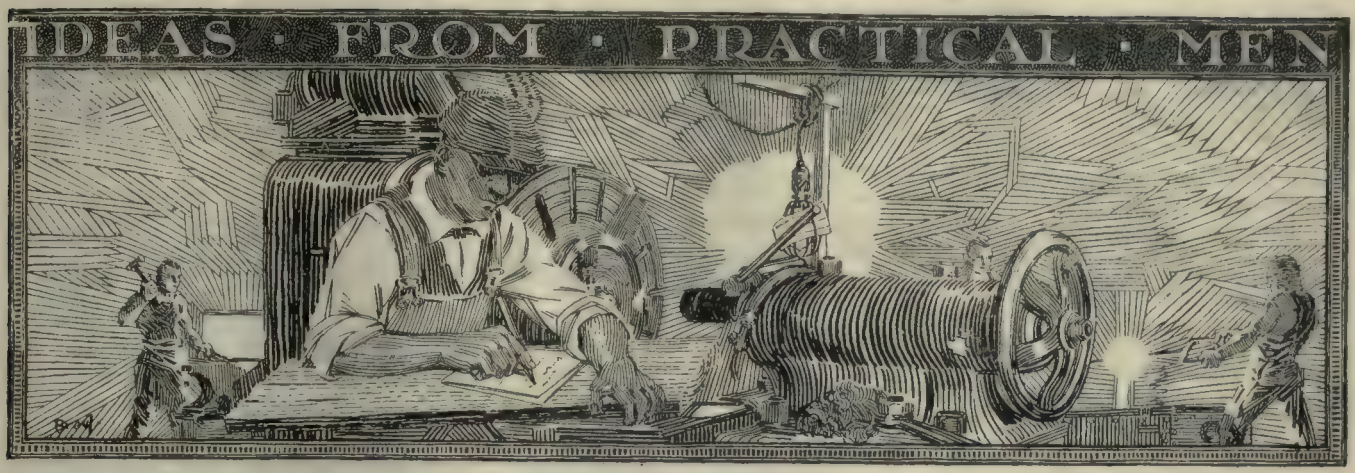
FIG. 7. A LADLE TRUCK FOR THE FOUNDRY



FIG. 6. SPRING-CLAMPING DEVICES. OLD METHOD AT LEFT, NEW METHOD AT RIGHT

In Fig. 6 are illustrated two methods of applying spring clamping devices; at the left is shown the old way, at the right the new method. The advantages over the old method as regards both convenience and safety are well brought out by comparison of the two arrangements. With the newer method, instead of lifting the spring from the top, the jack and its slings are carried beneath, the truck with the jack being run back directly under the job where there is no opportunity for the work to drop. The device is very compact and as readily handled about the shop as an ordinary truck, since it is practically self-contained.

One more form of truck is shown in Fig. 7, which illustrates a truck for handling ladles filled with molten metal about the foundry. The ladle is carried in a ring at the end of a long handle which passes through a bracket on the truck. The support from the truck axle is by means of four coiled springs, which are heavy enough to support the weight imposed upon them, but which also insure easy riding of the ladle and enable the apparatus to be run over the floor without shock and without danger of the metal being spilled when moving from flask to flask.



A Device for Grinding Hacksaws

By Eugene E. Henry

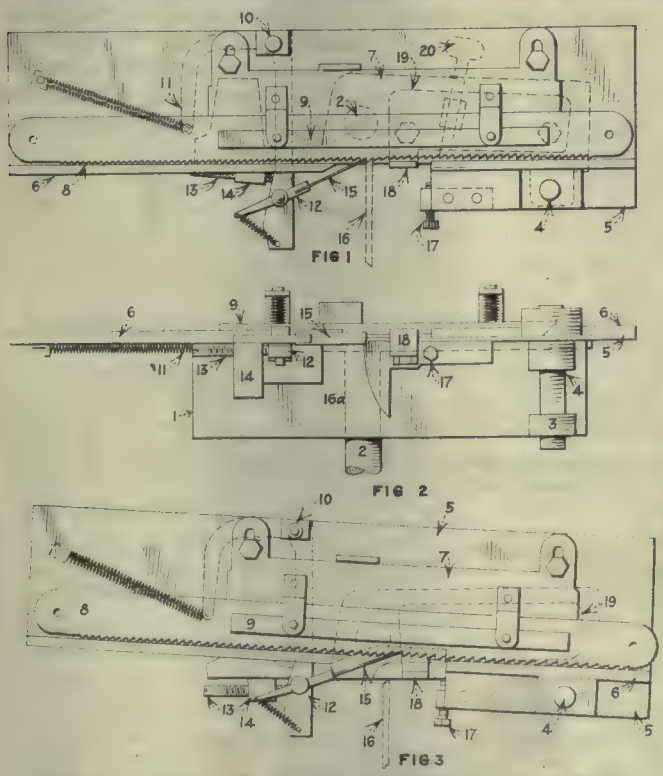
During the war we installed a hacksaw grinding machine and used it some months in regrinding our hacksaws. Being in charge of the tool grinding, it fell to my lot to keep this machine going when I had work for it, and in this way I learned something of an easier way to do it.

I learned at once that very few saws were straight on the front and back and with the machine we had, if the saw was concave on the front, the operator had to keep adjusting the wheel the full length of the saw or it would only hit on the top of the tooth at the center and cut the face away at each end. If the saw was bowed up in the center, it would grind harder and harder as it approached the center or get the same effect as if the saw was wider in the middle.

With crooked saws, straight saws, and some even with two or more different crooks in the face and back I realized that it was almost impossible to grind them on a machine in which the saw fed through on its back. I found that to overcome the difficulties imposed by these conditions it was necessary to make a complete departure from any standard practice, hence the device described herein which avoids the above difficulties and increases the output five times. It has the further advantage of low cost, and of producing better work than the standard machines and can be used on any grinding wheel stand. Fig. 1 is a top plan view of the complete device, showing the saw in contact with the grinding wheel. Fig. 2 is a side elevation of same but looking from behind the grinding wheel. Fig. 3 is a top plan view showing the saw out of contact with the grinding wheel.

1 indicates a stationary base made of a section of L angle iron and is provided with a rigid vertical post 2 which fastens on to grinding stand in the place of the toolrest (see Fig. 4). At the left-hand end of base 1 is mounted in bosses 3 a vertical shaft 4 secured to plate 5. Shaft 4 supports plate 5 above base 1 and allows a horizontal motion to plate 5 pivotally on shaft 4.

The front edge of plate 5 next to the grinding wheel, which is shown at 16, is provided with a guide bar 6 extending its full length, with a portion cut out of the center to allow wheel 16 and spacer or feed finger



FIGS. 1, 2 AND 3. PLAN AND ELEVATION OF DEVICE FOR GRINDING HACKSAWS

Fig. 1—Grinding position. Fig. 2—Front view. Fig. 3—Spacing position.

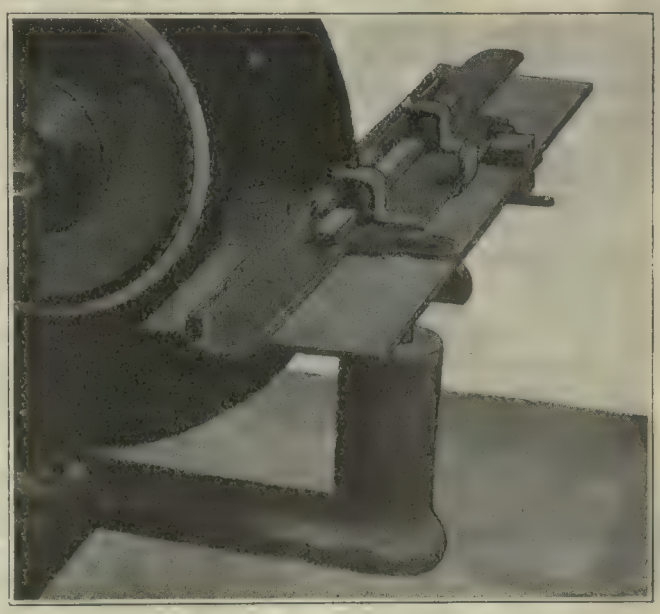


FIG. 4. A DEVICE FOR GRINDING HACKSAWS

15 to come in contact with saw 8. Parallel to this bar and in front is an adjustable guide plate 7 running lengthwise of plate 5 and slotted so as to adjust to different widths of saws.

Bar 7 also carries a tension bar 9 which is adjustable with bar 7 and which holds saw 8 in position on plate 5. Beneath plate 5 and pivoted thereto on 10 is a spring pulled lever arm 11, the outer end of which terminates in a cam shape 12. This cam works against adjustable screw 13 mounted in boss 14 projecting from base 1.

Pivotally mounted on the top cam portion 12 is a spring pulled pawl 15 inclined at such an angle to the plate 5 and saw blade 8 that the outer end of the pawl will engage and hold in one of the teeth of the saw blade next to the tooth in contact with the grinding wheel, as shown in Fig. 1.

16a is a groove in base 1 to give clearance to grinding wheel 16 so it can come in contact with saw blade 8.

The movement of plate 5 to and from the grinding wheel 16 and relative to base 1 is dependent upon the space of saw teeth per inch, as wider space requires greater travel and shorter space less travel and this is provided for in adjustment screw 17 mounted in a boss on the under side of plate 5 and on a portion which overlaps the inner face of base 1.

Movement of plate 5 toward grinding wheel 16, which movement governs the distance of the saw teeth from the grinding wheel and hence the depth of the tooth ground (irrespective of width of saw blade or of crooks) is governed by an upturned lip 18 from an adjacent plate 19 mounted adjustably on the under side of base 1. This adjustment may be regulated to suit all requirements by screw 20.

This is the means of light or hard grinding as you desire.

Adjustment screw 13 regulates the spacing of saw teeth relative to wheel 16 causing cam lever 12 to push further ahead or not, so far as is required.

Referring to Fig. 1 and Fig. 3, the operation of this device is as follows:

The base 1 is mounted in the place occupied by the toolrest in front of the grinding stand. Use a 12 in. diameter $\frac{3}{16}$ in. rubber bond alundum wheel and adjust it so the wheel comes in slot 16a in base 1. Put saw 8 in position by sliding it under tension bar 9 and let first tooth come against lip 18. Adjust lip 18 by means of screw 20 so that when plate 5 is at its most forward point the saw tooth will just fit up to wheel 16 and use screw 13 in conjunction with screw 20 in locating or positioning the saw teeth relative to grinding wheel 16.

With a diamond, dress your wheel so that it fits exactly the back, throat and face of the saw teeth. Now work plate 5 back and forth the full limit of travel allowed by lip 18 on the forward motion and screw 17 on the backward motion. If it spaces two teeth, shorten up on screw 17; if it does not space one, let out on 17. If it spaces the teeth properly in number but does not leave the teeth in proper location for wheel 16, then adjust screw 13 until it comes right.

The center of the saw up and down must be exactly in line and on a level with the center of the wheel arbor and the operator must make a full and complete stroke of plate 5 every time, or it will not space correctly. Also, pawl 15 must space directly in the throat of the tooth that comes in contact with grinding wheel 16 or it also will not space correctly. This is one of the good features of this device as it spaces directly in the throat in which the wheel works.

The speed at which this device works best is 100 to 120 strokes per minute. This seems about the most natural gait, hence the greater capacity over the other machines.

Changing a Straight-Faced Grinding Wheel to a Cup Wheel

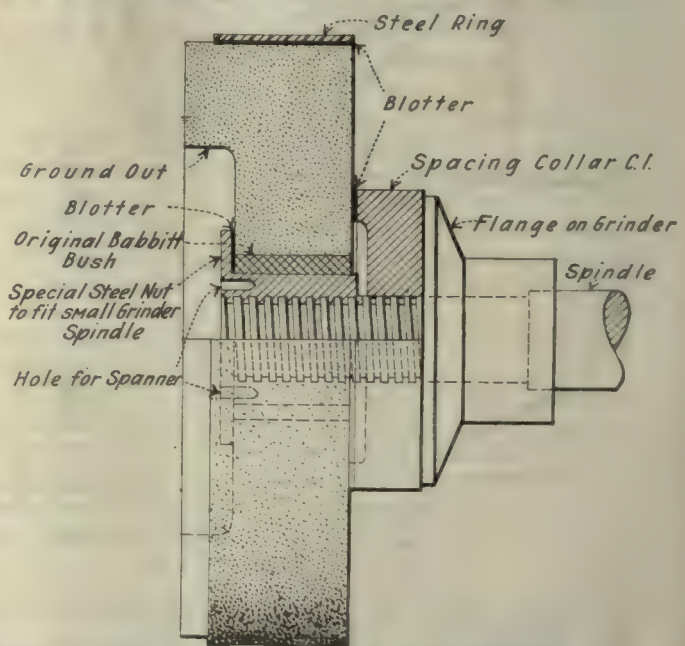
By H. H. Parker

Several grinding wheels were on hand that had been worn down so far that they had been discarded from the grinding stand. As they had comparatively wide faces, and as a smaller grinding stand, running at a much higher speed than the larger one was available, and, furthermore, as the need for a cupped wheel often arose and none were at hand, it was determined to adapt the worn out wheels to the small stand and change them to the cupped type.

These wheels were rather "soft" and wore down fast when their diameter had been considerably decreased, so they were mounted in the lathe and "bored" out by means of old files. The faces were trued at a higher speed with the help of a special abrasive-stick wheel-dresser.

Each wheel had a babbitt bushing and this was left in place. As the small grinding machine spindle was considerably less in diameter than the larger one, there was space for a special nut between the babbitt bushing and the spindle. The nut was made, as shown in the sketch, of steel and threaded to fit the spindle. A wide but thin flange was left at the outer end to hold the wheel in place.

The regular flange was left in place next to the spindle bearing and a cast-iron spacing collar, with relieved face the same as the original flange, was placed between flange and wheel. As an extra precaution, a steel ring was driven on the wheel with a layer of blotter between; it was somewhat narrower than the wheel face so as not to interfere with the work being ground. Gaskets of blotter were also placed between both flanges and the wheel.



USING UP THE OLD GRINDING WHEELS

WHAT to READ —for the man in a hurry



Suggested by the Managing Editor

THE magnitude of the automobile industry makes with a difficult problem in the automotive field, that of dynamic balancing. Mr. Akimoff has not a great deal to say on this subject here but what he does say is full of meat. Next we have one of John Godfrey's interviews with his old friend Johnson. This time Johnson tells how he increased production and got co-operation from his men by taking them into his confidence in the matter of manufacturing costs. Right in the middle of Godfrey's article we have inserted a boxed correction of a serious error that appeared in one of our articles in the issue of September 30. That article was a leader and we have consequently taken the best means we know of to correct our error so that it will reach the attention of everyone who saw the original article. Mistakes of this kind will creep in every once in a while no matter how many times we check a thing up but we are always ready to make the best amends we can so that the suffering of the victim of the mistake will be reduced to a minimum.

What to read was not a difficult matter to decide two hundred years ago when books were few and magazines unheard of. It is far different now when so much reading matter is offered to pass the time pleasantly or profitably as the reader chooses. We are doing our utmost to make the "American Machinist" not only profitable but indispensable as a clearing house of ideas and news of the machinery world. This page is the editors' advertisement of their section of the paper. It gives the high spots

On page 928 is the beginning of the first of three articles by Prof. H. N. Bonis of Purdue. Prof. Bonis is something of a mathematical genius and the subject of acceleration determinations which is so important to machine-tool designers is one of his hobbies. This week he discusses the "Law of Coriolis" (we never heard of this either, we are forced to admit). He tells why and how it is used and then goes on to show how simply the solution of the same problem can be worked out without using Mr. Coriolis' law.

Hunter sends us from Chicago a manufacturing article on the "Thor" Quick-Action Coupler. The work described is mostly screw machine, broaching and form milling work.

Just after Hunter's article, on page 933, we are reprinting the results of a labor turnover investigation in New York City as conducted by the Industrial Bureau of the Merchants Association of New York and published in its weekly organ. New York City is not only the financial center of the United States, it is also one of the largest manufacturing centers and consequently an analysis of labor turnover within its limits contains valuable information for employers and managers elsewhere. The conclusions of the report are significant and are startlingly similar to those arrived at by old Johnson in the story mentioned above. The secret of keeping labor turnover down seems to lie in the selection of the right kind of managers. A brief account of the machine-tool market in the newly-created country of Czecho-Slovakia appears on page 938. Although this region lies in the territory of Mr. Herzog, our Berlin correspondent, we have no hesitation in accepting the statements of Mr. Heise on the possibilities in this market. On the next page is part III of Mr. Kenyon's "Seven Centuries of Brass Making." This installment concerns itself primarily with the use of the electric furnace in the brass industry.

We have no London letter from Mr. Chubb this week but we have something just as good. On page 945 he begins an account of the milling operations on lathes in the Coventry plant of the famous British firm of Alfred Herbert, Ltd. We do not for a minute admit that Mr. Herbert's engineers or machinists know any more about running milling machines than we do on this side of the water, but it is almost always worth while to see how the other fellow does the things that we do every day, and this particular case is no exception.

Mr. Morris' current article on "Programs of Apprenticeship and Special Training" was written about the Brooklyn plant of the Sperry Gyroscope Co. and tells of short term apprenticeship or "vestibule training" for adult mechanics. An important part of the training system is the class for foremen, supervisors and inspectors. It is held twice a week. See page 951.

A short railroad shop article follows the apprenticeship article. It was written by Frank Stanley and describes methods of handling material in the Sacramento shops of the Southern Pacific. We have collected a considerable amount of railroad shop information and while we may not be able to get a railroad article into every issue there will be very few that do not contain something with an appeal for railroad shop men.

Measuring System Not a Subject For Legislative Action

THE following letter is being sent broadcast, with the idea of influencing the New York Board of Aldermen to vote an indorsement of the metric system:

WORLD METRIC STANDARDIZATION COUNCIL
Office of the Secretary
681 Market Street,
San Francisco.

November 3, 1920.

Dear Sir:

Knowing that you are an advocate of metric standardization, I believe that you will be interested to learn that this important subject has been brought to the attention of the New York Board of Aldermen, and that action will soon be taken thereon.

It is hoped that the New York Board of Aldermen may endorse the principle of metric standardization and that it will urge prompt legislation by Congress providing for a gradual transition to the decimal standards.

As you perhaps know, the Chicago City Council unanimously (66 to 0) endorsed that metric standardization movement and urged the United States Congress and British Parliament to take joint action. The great City of New York is perhaps even more vitally interested in this matter than is Chicago.

Please write to your Aldermen—and especially to the Chairman, Committee on Markets, New York Board of Aldermen, to whom this matter has been referred. Urge this committee and the entire Board to take immediate and favorable action.

(Signed) Aubrey Drury,
Executive Secretary.

AD:A

Those familiar with this form of propaganda will at once recognize the "council" as another name for Albert Herbert, the Foreign Trade Club, the World Trade Club, etc.

We wish to insist once more that such matters are not within the province of legislative bodies, the members of which, as a rule, are not familiar with manufacturing conditions.

Any action leading to changes in our measuring system, or questions of standardization, should be taken up only by committees of recognized engineers working in harmony with committees from established industrial or manufacturers associations.

Thos. Viall
Editor

EDITORIALS

The Future of the Automobile Industry

THE magnitude of the automobile industry makes the present slackening of automobile production a serious problem for many other manufacturers. The machinery builders and toolmakers, the parts manufacturers and the tire men are almost as hard hit by the sudden shift of the car market.

Supposedly wise men have been predicting for years that the saturation point of the automobile market had been reached. And yet the demand and the production increased each year. Now this prediction is being repeated and it is well to look the situation squarely in the face to see where we really stand and what we may reasonably expect of the future.

The unprecedented demand for cars that followed the war, together with the high prices which naturally resulted, induced many new builders or assemblers of passenger cars to enter the field. This in turn stimulated the manufacturers of parts and they expanded their facilities to meet the requirements.

The present hesitation on the part of the buying public, which is in many cases merely a return to sanity and a good thing for the country, has in turn checked the demand for machine tools. Some of the newcomers in the field, as well as some of the older builders who were never strong or who have expanded too rapidly, will probably go to the wall.

But the automobile business is going to continue and this is no time to be either downhearted or pessimistic. Every high tide has its ebb, but the world goes on.

One of the reasons for pessimism is probably a lack of appreciation of the business uses of passenger cars, the employment of the common term "pleasure" car probably having much to do with this. But other industries must appreciate the growing use of passenger cars for business and must ask themselves whether they are using them as extensively as they should in their own work.

The verdict seems to be unanimous that the use of the automobile increases the efficiency of the salesman as well as of the delivery of products or materials. In districts where they can be used there is no question as to the saving accomplished. This of itself offers a large field for sales and increased production. Where time is an object (and who will admit it is not in his own business) there is a field for motor transportation.

Considering the passenger automobile from the sane point of view, we know that it is bound to stay and its use to grow until it is supplanted by something better. And its successor, whatever it may be, will require machinery and tools for its production just the same.

While the automobile plants are not likely to increase their capacity as rapidly as in the past, some of them will continue to grow to keep pace with the increasing need of cars for utilitarian purposes. Investigation shows that about sixty per cent of the mileage of passenger cars is for strictly business purposes, not including the mileage traveled when they are used in the place of steam roads or trolleys. In the farming districts this proportion of business use increases to seventy-eight per cent. Better highways will widen the field still further and stimulate the demand for cars.

Ignoring for the moment the normal increase in the number of motor cars needed in this country for 1921, the replacements alone would make a business much larger than any one dreamed possible a few years ago. Assuming the life of a car as five years, a very liberal average, we would require 1,493,617 new cars to replace those built in 1916. The following year would require over 1,740,000 cars to replace those built in 1917 and so on. Add to this the spare parts for replacements, and ample work for the automobile shops seems assured.

Looking beyond the present natural reaction from the over-stimulation of war activities, we can see no cause for discouragement regarding the future of the automobile industry. The coming of spring will see a decided reaction from the present retarded market and builders and dealers who do not have a stock of machines on hand will miss many sales. It is our best organized industry and more than almost any other stands ready to discard present equipment wherever it can be shown that it is economical to do so. Machinery builders themselves might well profit by its example in this respect.

Trucks and tractors have been purposely omitted so far, but it must be admitted that these offer a growing field and one in which economical production must be considered even more carefully than in that of the passenger car. The growth of truck use can be seen on every side. The increase from 74,000 in 1915 to 128,000 in 1917 was of course partly due to the war, but the best known builders are finding a much steadier demand than are the builders of passenger cars.

With a return to what most people consider a normal price for raw materials, prices could be adjusted on a satisfactory basis and nothing would stand in the way of immediate orders for new and improved machinery. Anything which can be done to hasten this condition will go far toward solution of the problem.

The automobile builders, relieved of the necessity of increasing production at any cost, will select their machinery more carefully than has been possible in the past few years. They will demand the machines which will insure maximum production at a minimum net cost. This means that machine tools especialy adapted for automobile manufacture will be in demand as before.

But the automobile builder, like the customer who buys his product, will demand good value for his expenditures for increased or improved equipment. This makes it advisable for machine tool builders to be sure that their own production methods and equipment are as efficient as they should be.

Now is the time for close co-operation between the two industries, the automotive and the machine tool. Now is the time for a getting together on a sound basis of mutual helpfulness and a fair profit. The automobile industry will continue to be a large user of machinery and tools and offers a wide field for new and improved machinery of many kinds. F. H. C.

Engineering Society Action Relative to the F. A. E. S.

At the meeting of the Executive Committee of the American Institute of Mining and Metallurgical Engineers, held on Oct. 28, the following men were designated as representatives on American Engineering Council. Herbert C. Hoover, San Francisco, Cal.; J. Parke Channing, New York, N. Y.; Arthur S. Dwight, New York, N. Y., Edwin Ludlow, New York, N. Y.; Allen H. Rogers, Boston, Mass.; Philip N. Moore; J. V. W. Reynders; Joseph W. Richards, Bethlehem, Pa.

At its regular meeting on Oct. 25 the Grand Rapids Engineering Society adopted resolutions accepting the invitation to become a charter member of the Federated American Engineering Societies and has pledged its "hearty co-operation and assistance in the work undertaken by the federation and is confident that the work as outlined by the purposes and aims of the federation will have a very beneficial and far reaching influence."

The advisory Council of the Iowa Engineering Society at its regular meeting on October 20 voted unanimously to recommend to the Iowa Engineering Society at its annual meeting that the society apply for membership in the Federated American Engineering Societies and designated Professor J. H. Dunlap as its representative to the meeting of American Engineering Council in Washington, Nov. 18-19.

The joining of the societies named raises the total of member-societies, which will be represented at the meeting of American Engineering Council in Washington Nov. 18, 19 and 20, to eighteen. A list of the member-societies follows:

American Society of Mechanical Engineers
American Institute of Electrical Engineers
Technical Club of Dallas
Cleveland Engineering Society
Engineering Association of Nashville
American Institute of Chemical Engineers
Engineering Society of Buffalo
American Institute of Mining and Metallurgical Engineers
Society of Industrial Engineers
Kansas Engineering Society
Alabama Technical Council
American Society of Agricultural Engineers
Detroit Engineering Society
Florida Engineering Society (subject to ratification in February)
Engineering Society of York
Washington, D. C., Society of Engineers
Grand Rapids Engineering Society
Iowa Engineering Society (subject to ratification at annual meeting).

Dimensions of Keyways

By Taro Kuraisi

Tokio, Japan

I was very much interested in the article "Dimensioning of Keyways," by Hans Ernst, published on page 82 of the *American Machinist*. It was presented from the drafting viewpoint. I wish to present it from the broaching viewpoint.

In the broaching process it is necessary to know the value of L, Fig. 1, when we want to know whether or not the broach and broaching mandrel are of the correct sizes for the job. We measure the thickness of broach A and the thickness of mandrel B. The sum should equal L. The difficult part of the calculation to find L is

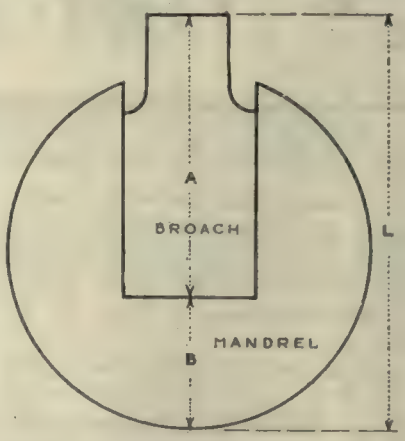


FIG. 1. MANDREL AND BROACH FOR BROACHING KEYWAY

that by which we find the value of F, Fig. 2, and I have made the chart, Fig. 3, to obviate the necessity of making such calculation. This chart shows the values of F for bores up to 8 in. in diameter and widths of keys up to 2 in. L is found from the following simple formula: $L = D + d - F$.

The method of using the chart is easily explained by an example. Assume the diameter of bore is 5 in. and the width of key ¾ in. Find, on the chart, the intersection A of the vertical line at 5 in. with the horizontal line at ¾ in. width of key. We see that A is between 8 and 9 deg. On the left-hand side of the chart find the point B, on the horizontal line from ¾ in. width of key at a corresponding position between 8 and 9 deg. A vertical line dropped from the point B shows the value of F, in this case 0.028 in.

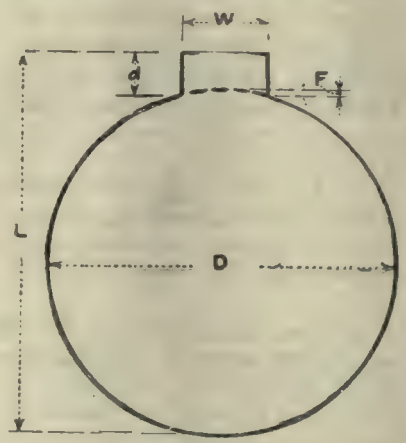


FIG. 2. (UPPER) DIAGRAM REPRESENTING BORE AND KEYWAY

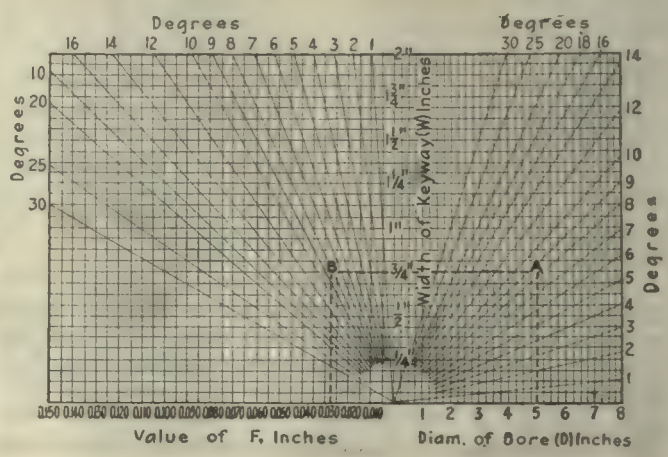


FIG. 3. (LOWER) CHART FOR DETERMINING THE VALUE OF F (FIG. 2) FOR KEYWAYS

SHOP EQUIPMENT NEWS

-Edited By-
S. A. HAND

SHOP EQUIPMENT • NEWS •
A weekly review of modern designs and equipment

Descriptions of shop equipment in this section constitute editorial service for which there is no charge. To be eligible for presentation, the article must not have been on the market more than six months and must not have been advertised in this or any previous issue. Owing to the news character of these descriptions it will be impossible to submit them to the manufacturer for approval.

• CONDENSED • CLIPPING INDEX
A continuous record of modern designs and equipment

Pangborn Rotary-Table Sandblasts

The Pangborn Corporation, Hagerstown, Md., has placed on the market the rotary-table sandblasting machines herein described, some of them being developed from older models of machines made by the same concern. The table is rotated by power, so that the work passes beneath the nozzles. The nozzles are automatically oscillated, so that the blast reaches all portions of the blasting zone, which is completely inclosed. It is claimed that the output is large because of the continuous operation, that the labor requirements are small and that the operator is removed from contact with flying abrasive.

For work difficult to clean or of large size the direct-pressure system is used. In Fig. 1 is shown such a machine equipped with an elevator and a separator using both mechanical means and circulation of air for reclamation and separation of the abrasive for re-use. The reclaimed abrasive is accumulated in storage bins, from which the tank for the blast can be quickly refilled by operating a valve, thus making the operation of the machine practically continuous. The machine is made in two sizes, with table diameters of 70 and 90 in. and a clearance of 15 in. between the table top and the nozzles.

The gravity-feed type of machine, shown in Fig. 2, is intended for work less difficult to clean or where the intensive action of the direct-pressure blast is unnecessary. The machine is self-contained. Both mechanical and draft action are used for reclamation and handling of the abrasive, which is fed by gravity in a continuous cycle to the nozzles. The machine is made in but one size with a table diameter of 84 in., and it has an adjustment of the nozzle arms that permits a clearance of either 10 or 15 in. between the table top and the nozzles.

The self-contained suction-feed machine, shown in Fig. 3, is intended for the cleaning of light work and refinishing. The used abrasive is reclaimed through screens and handled without the use of an elevator. The cleaned abrasive is carried continuously by suction to the nozzles. The machine is made in two sizes, the one shown in Fig. 3 having a table 42 in. in diameter and

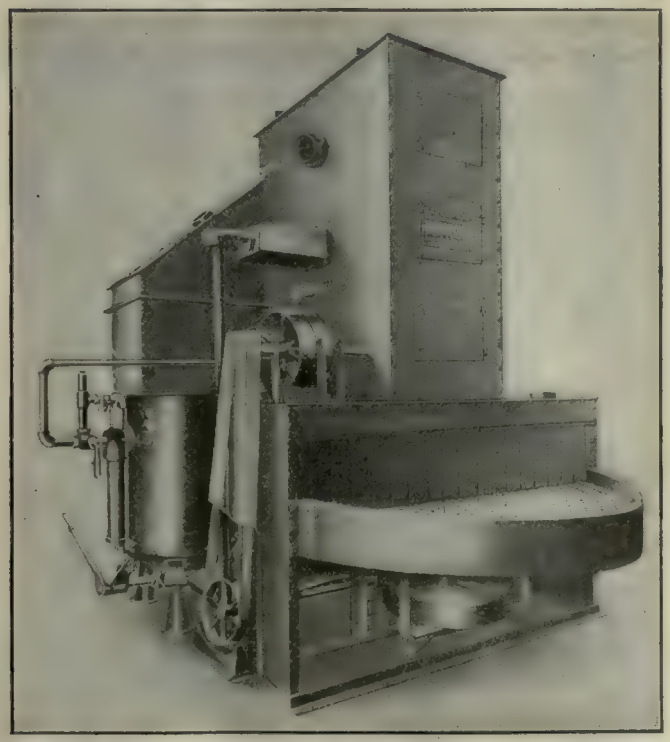


FIG. 1. PANGBORN DIRECT-PRESSURE ROTARY-TABLE SANDBLAST

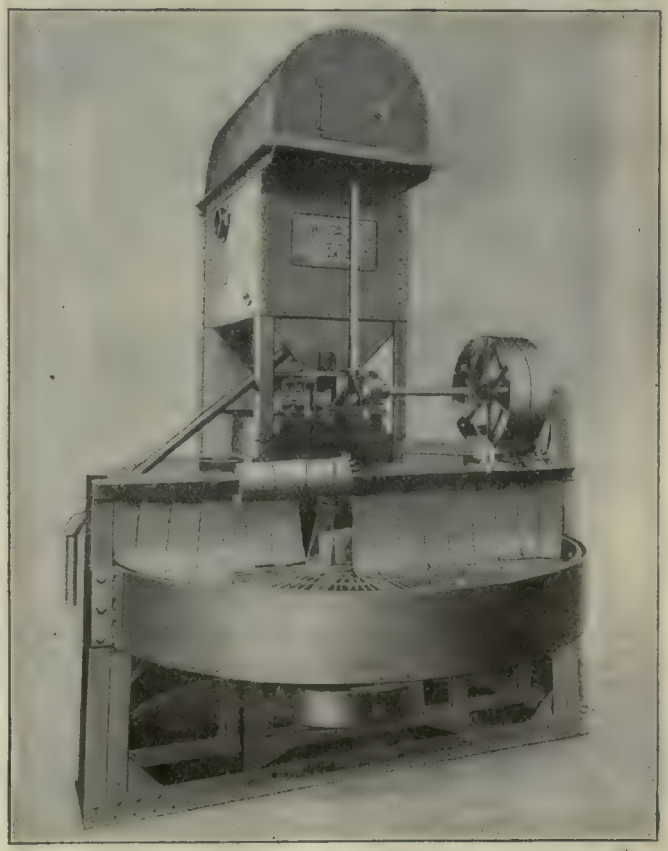


FIG. 2. PANGBORN GRAVITY-FEED ROTARY-TABLE SANDBLAST

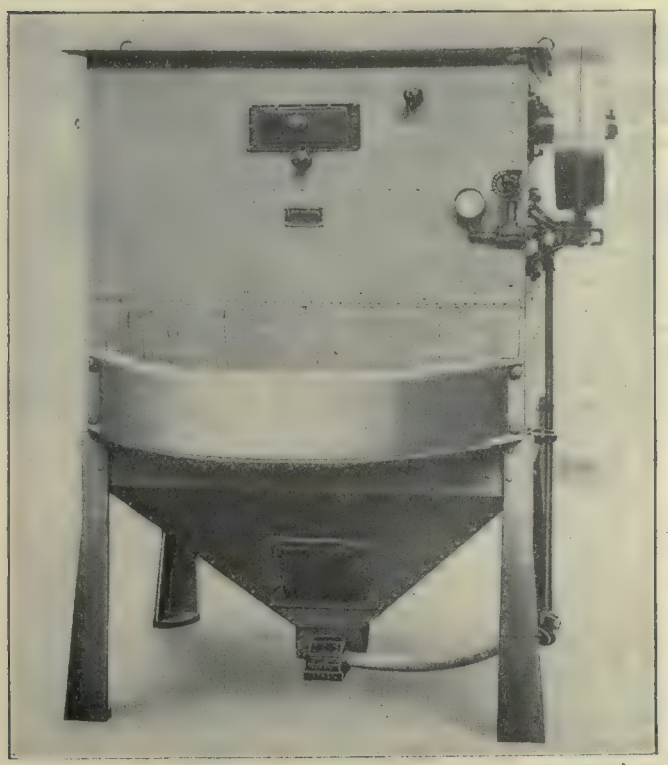


FIG. 3. PANGBORN SUCTION-FEED, SANDBLAST WITH 42-IN. ROTARY TABLE

one nozzle with a vertical adjustment allowing any distance from 5 to 12 in. between the table top and the nozzle.

The larger size of suction-feed machine is shown in

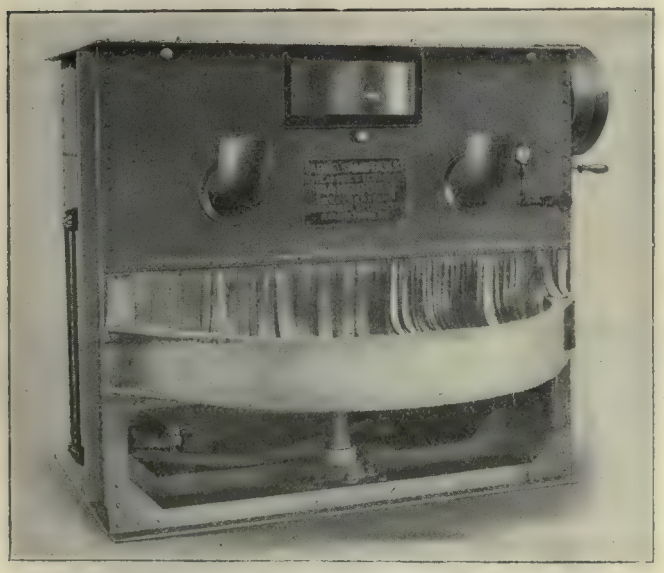


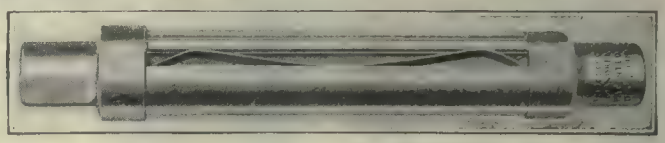
FIG. 4. PANGBORN SUCTION-FEED, SANDBLAST WITH 70-IN. ROTARY TABLE

Fig. 4. It has a table diameter of 70 in. with a clearance of 12 in. between the nozzles and table top, allowing the handling of reasonably large work or a large quantity of small pieces.

Ettco Self-Gripping Mandrel

The Eastern Tube and Tool Co., Inc., Brooklyn, N. Y., has placed upon the market the self-gripping mandrel shown in the illustration. It is intended to hold bushings, gears and similar parts while turning or grinding, the parts being slipped on or off the mandrel by turning them slightly to the left.

The body of the mandrel is made of alloy steel and has three grooves, each of which contains a roller made of hardened drill rod and held in the proper position for gripping by means of flat springs. The collars at each end retain the rollers and springs. When the cut



ETTCO SELF-GRIPPING MANDREL

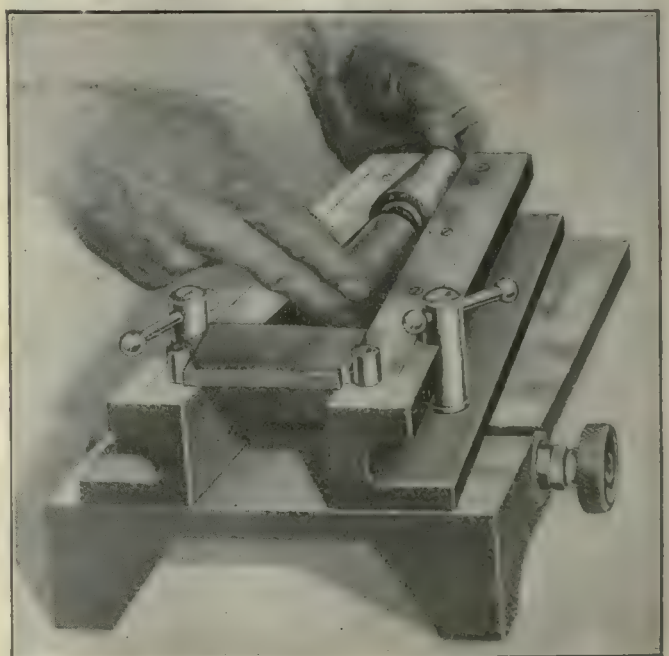
is applied to the work on the mandrel the rollers are caused to wedge and grip the work rigidly. It is said that no driving is necessary when putting on or removing work and that the presence of oil and dirt does not interfere with the action.

The body of the mandrel is ground 0.0002 in. undersize. Due to the action of the rollers, the mandrel will grip work 0.005 to 0.015 oversize. The mandrel is made in a range of sizes from $\frac{1}{4}$ to 2 inches.

Doyle-Wall "Precision" Taper-Measuring Gage

The Doyle-Wall Machine & Tool Co., 318-24 Pearl St., Syracuse, N. Y., make the precision taper-measuring gage shown in the illustration. The device consists of a double sine bar and angle-measuring gage, being intended for use either in originating or duplicating tapers. It is composed of steel parallels mounted on angle-bars, which are each pivoted at one end on pins set in the baseplate. The other ends of the bars are moved simultaneously by means of an adjusting screw, the bars being secured in position by locknuts when the desired taper has been established.

When setting the gage reference is made to a chart, which gives the distance required between the measuring pins in order to obtain the desired angle. Either precision gage blocks are placed between the pins to



DOYLE-WALL "PRECISION" TAPER-MEASURING GAGE

obtain this distance, or a micrometer is used over them, the gage being adjusted by turning the knurled nut until the proper distance is obtained. Tapers from 0 to 4 in. per ft. can be measured. A chart, figured to four points of decimals, is supplied with each gage to show the values of tapers from ⅛ to 4 in. per foot.

It is claimed that the gage can be set up much more quickly than a sine bar, that it accurately measures as many pieces as desired after being set, and that no high degree of skill is required for its operation, because only one measurement is necessary. The parallels and pins are hardened, ground and lapped, an accuracy to within 0.0001 in. being guaranteed. The tool is regularly made in two sizes with 12 or 6 in. centers, but gages for any desired size of taper can be furnished.

Self-Locking Hub Plate

The self-locking hub plate shown in the accompanying illustration has been designed to replace the methods of putting in hub liners which are now in use. This does away with the method of casting the hub plate into the driving box and also of fastening it in by screws or similar methods.

The driving box is bored with an undercut recess, similar to that used for casting liners in place, excepting, as will be seen in Fig. 1, the box is offset as shown at *C* and *D* so as to make it slightly eccentric with the bore for the outside of the crown brass. The hub plate is made in two parts *A* and *B*, as in Fig. 2, with a dovetail on one side to fit the recess in the box.

After the machining work is completed it is only necessary to slip the two halves of the hub plate in position and then force in the crown brass *E* in the usual manner. The outer end of the crown brass acts as a key and locks the two parts of the hub plate firmly in place. The fact that the outer edge of the hub plate is eccentric with the outer edge of the crown brass effectually prevents the hub plate working out of position.

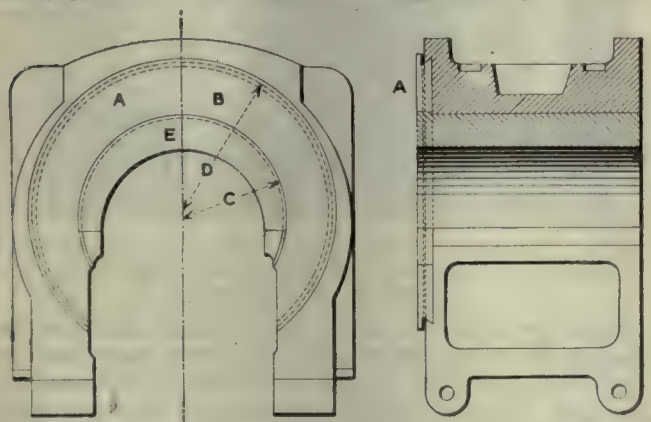


FIG. 1 Self-Locking Hubplate applied to Box

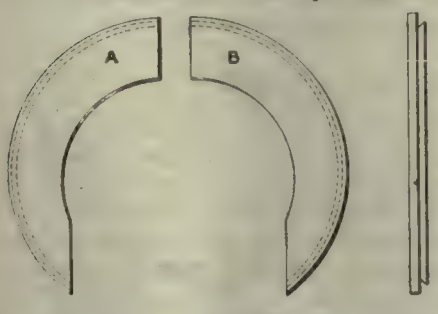


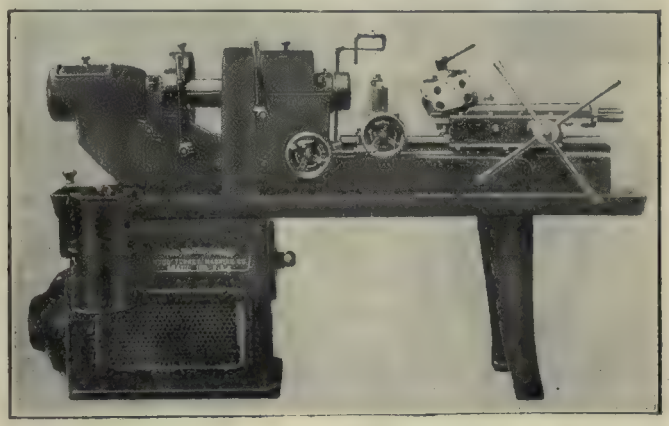
FIG. 2

FIG. 1. SELF-LOCKING HUB PLATE APPLIED TO BOX
FIG. 2. HOW THE PLATE IS MADE

These hub plates are in use on about forty locomotives of a well-known railroad and are giving satisfactory service at a considerably lower cost than the plates formerly used. They are being marketed by J. P. Finerty & Co., Dunmore, Pa.

Motor Drive for Wood Turret Lathe

The Wood Turret Machine Co., Brazil, Ind., has recently brought out the design of motor base and belt drive shown in the illustration for use on its tilted-turret lathes and screw machines. The motor base or cabinet leg is so arranged that the motor may be easily



WOOD TURRET LATHE WITH DRIVING MOTOR MOUNTED IN BASE

removed for cleaning or repair by the loosening of three screws which hold the circular lid at the end of the base.

Power is transmitted from the motor to the large driving pulley on the spindle by means of a double belt passing through the pan and tightened by a double-acting idler, which is controlled by the hand lever shown at the right-hand side of the base. The belt is guarded by means of a cast-iron cover.

This motor-drive arrangement is being supplied on the Nos. 2, 3 and 4 back-geared type of machine, d.c. variable-speed motors being used. The controller-box crank, as well as all operating levers, are so grouped that they are within easy reach of the operator, without necessitating his changing of position.

Speeding Up Machine Tools With Compressed Air

By F. A. McLean

Quantity production on an efficient basis is often dependent on the facilities provided for handling the product during the course of manufacture, and in order that maximum production be maintained it is necessary to make the physical requirements called for on the part of the operator as light as possible. When this is done a workman should be able to accomplish practically the same amount of work toward the close of the day as in the beginning. It this is not done, no matter how strong the man may be, he is bound to feel the strain from his continual exertion and his efficiency and value to his employer is lowered as the day advances.

Any arrangement which will minimize this fatigue on the part of the worker, is worthy of attention from the standpoint of higher efficiency, as the conservation of physical energy, so often spent in non-productive labor, is of primary importance. Aside from the process of

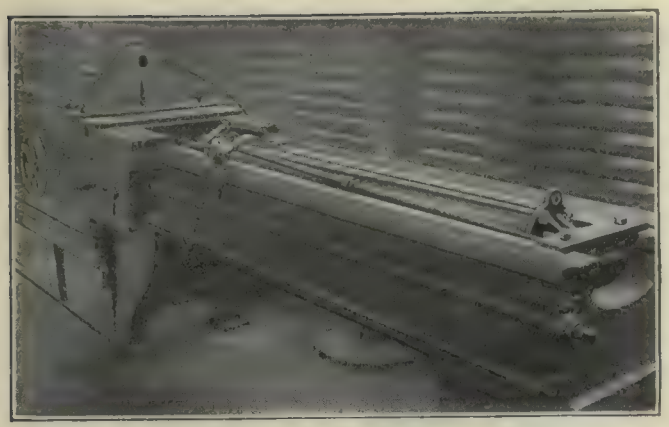


FIG. 1. AIR-HOIST CYLINDER APPLIED TO LATHES FOR RAPID TRAVERSE OF CARRIAGE

moving the work to and from the machine, the operation of the latter generally calls for considerable exertion on the part of the worker, especially in the case of heavy machine tools.

One of the most flagrant offenders in this respect is the ordinary lathe, especially in the larger sizes which require the expenditure of considerable energy in running back the carriage after a cut has been made. In the case of quantity production, this often consumes a large amount of time and labor which could be more profitably applied in other ways. Many of the more progressive manufacturers who realized this fact have applied a direct lift air hoist cylinder to the task with a view to relieving the operator and speeding up the output from the tool. During the war, devices of this nature were quite a common sight in the large munition plants of the United States and Canada, but with the close of the shell contracts, many of these contrivances have gone to the scrap heap, which is unfortunate, as many shops could apply them to the manufacture of their regular products with excellent results.

An arrangement of this kind applied to a 24-in. x 20-ft. lathe used for drilling holes in submarine drill pistons in the plant of the Canadian Ingersoll-Rand Co., Limited, Sherbrooke, Quebec, is shown in Fig. 1. From an examination of the illustration it will be seen that the air hoist cylinder which is 3 in. in diameter by 4 ft. long is placed between the shears of the lathe and supported at each end by rectangular pieces of iron which are clamped to the lathe bed by four bolts. A hole is bored in the lower part of the lathe carriage into which is fitted the end of the hoist piston-rod from which the hook has been removed. This arrangement allows the cylinder to be moved to the most convenient point on the bed or even removed altogether and applied to another machine in a few minutes if desired.

The hoist cylinder is of the double acting type and is controlled by a very simple three-way valve located within convenient reach of the operator. Pushing the handle of this valve to the left causes the carriage to travel toward the headstock and vice versa, while moving it to a central position cuts off the air supply and allows the air in the cylinder to exhaust. A globe valve is placed between this three-way valve and the supply hose to take the strain off the three-way valve when the device is not in use.

Some of the more modern multiple-spindle drilling machines are provided with means for raising as well as lowering the head by power, but in many shops there are machines in use which do not have this feature, and when the machines are of large size it is very tiresome for the operator to have to raise the heads by hand. A simple way of using compressed air to do this work is illustrated in Fig. 2 and consists of a small double-acting direct lift hoist attached to the top of the machine by a cast-iron bracket. The lower end of the piston rod is screwed into a hole bored in the top of the saddle or head of the machine. Supply pipes run from the upper and lower ends of the hoist cylinder are bent to conform to the contour of the machine and terminate in an adjustible valve located near the belt and feed controls of the drill. With a drilling machine fitted up in this way it is possible for an apprentice boy to turn out a larger volume of work than a fully grown man could when moving the drill head by hand.

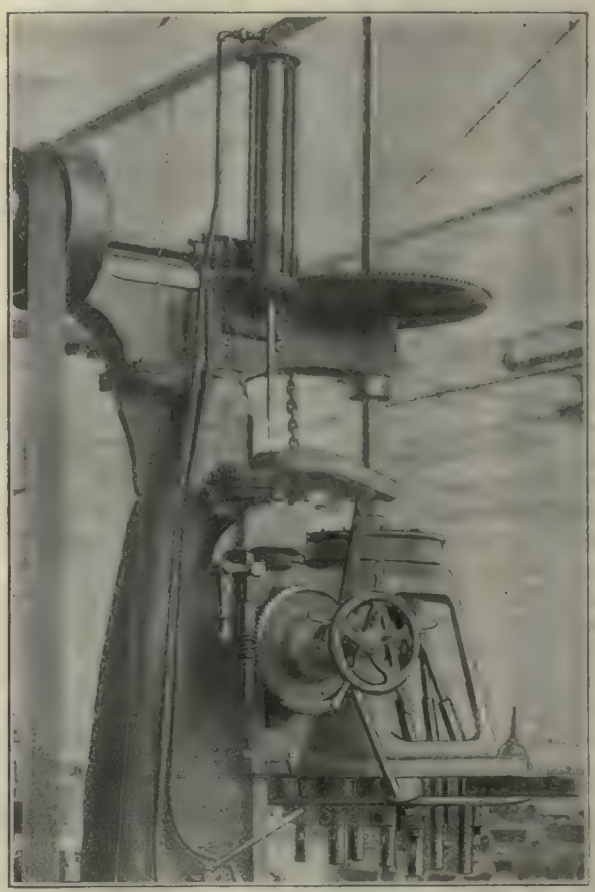


FIG. 2. AIR-HOIST CYLINDER APPLIED TO MULTI-SPINDLE DRILLING MACHINE FOR RAISING AND LOWERING THE HEAD

There are other ways of using air hoist cylinders in connection with machine tools whenever a horizontal or vertical reciprocating motion is required. The number and value of possible applications of this kind will vary with the size of the shop, type of equipment in use, and the nature of the product manufactured.

Weighing Automobile Parts To Determine Amount of Wear

Some rather interesting work has been undertaken for the Motor Transport Corps in connection with its experiments on the deterioration of automobile parts in service. A number of bearings and gears have been accurately weighed on the bureau's balances and have been placed in cars in service. After a certain length of time these parts will be returned to the bureau and reweighed, the difference in weight representing, of course, the loss in metal due to wear.

Fortieth Anniversary Meeting of A. S. M. E.

SEVERAL noteworthy addresses marked the fortieth anniversary meeting of the A. S. M. E., held at the Engineering Societies Building on the evening of Nov. 5. "The Opportunity and Responsibility of the Engineer" was the subject of the evening. Henry R. Towne, the oldest living past president of the A. S. M. E., was the first speaker. In his review of the early history of the society he related that at the October meeting of 1883 the attendance, out of a total of about 600 members, was 150. For the year 1883 the income of the society was $7,560, which looks small indeed compared to the proposed budget of $500,000 for the coming year. Mr. Towne also discussed a paper which he had presented at a Chicago meeting of the society in 1886, entitled "The Engineer as an Economist."

The American Society of Civil Engineers was represented by A. P. Davis, its president, who, after congratulating the A. S. M. E. on its growth and the scope of its activities, expressed the hope that the A. S. C. E. would join the Federated American Engineering Societies.

W. L. Saunders, past president of the American Institute of Mining and Metallurgical Engineers, expressed the opinion that the profession of mechanical engineering is a basic one and is of great importance because men of the other branches of engineering must have a knowledge of it as a basis.

Past-president Scott of the A. I. E. E., by an illustrated talk, showed that engineering progress has been extremely rapid, with the creation of great forces and that the engineer now has the responsibility of controlling and operating these forces. Mr. Scott's statement, "The modern engineer is a director of human activities as well as of inanimate operations," gained applause.

J. Herbert Case, acting governor of the Federal Reserve Bank of New York, pointed out that three directors of the Federal Reserve Bank of New York were drawn from the membership of the American Society of Mechanical Engineers. He called the attention of his hearers to the fact that the constitution of the Federated American Engineering Societies defines engineering as "the science of controlling the forces and of utilizing the materials of nature for the benefit of man." He then went on to develop his ideas that bankers have essentially the same problems before them as engineers; he referred to bankers as financial engineers and said that they are now coming to use essentially engineering methods. He felt strongly that the recent period of inflation, which we are apparently passing in safety, might have developed into a very serious crisis had it not been for the preparations made by bankers to meet just such a contingency. These preparations consisted principally in the establishment of the Federal Reserve system, by which one-third of the number of banks in the country, representing two-thirds of our banking resources, have practically pooled their resources to the end that individual failures may be averted. This action Mr. Case compared to the allowance made by engineers for a "factor of safety"; the idea being, in both cases, to provide beforehand whatever strength will be needed to cope with any emergency that may arise. The speaker suggested that it is not unreasonable to suppose that as a result of improved financial methods we have probably seen our last general panic. "But," he continued, "I look further ahead than that. As engineers are never satisfied with the machines they have created, but continually work and strive to improve upon them, so bankers will finally improve their methods to such a point that they can avoid not only catastrophies such as panics, but even the minor crises and financial disturbances which trouble us so greatly today."

Gompers Invites Co-operation

Samuel Gompers, president of the American Federation of Labor, was the next speaker. The keynote of his address was to the effect that "One of the difficulties that arise nowadays about our discussion of responsibility is that we fail to realize that professional men, whether doctors, lawyers or engineers, should be in a very real sense agents of society and not merely masters in their particular professions." He thought it unnecessary to review the achievements of engineers in mechanical ways, but declared that a very serious error is frequently made in describing manufactured articles as the product of an industry. It is not the inanimate objects produced in the factory that count; it is the men developed there. In other words, "men, not things, are the true goal of civilization." In a realization of this fact lies the engineer's opportunity to develop co-operation between capital and labor. There is a great future ahead for both capital and labor if they will join hands with engineers and make an effort to improve the conditions of labor, to give the workman a chance for self-expression in his daily work and to relieve the deadly monotony of repetition work, which is the principal cause of labor troubles. In our mad rush for efficiency we have allowed the man to become too greatly a part of the machine. The old spirit of craftsmanship has gone, so that men's work today tends to become mere toil. Mr. Gompers drove home his point with this vivid warning: "Beware that the machines you create do not become a Frankenstein and enslave the human race." The avoidance of this danger is a part of the coming responsibility of the engineer. In conclusion Mr. Gompers said: "If you will study the laws of humanity with the same degree of intensity that you study the laws of material science you will render a tremendous service, and as president of the American Federation of Labor it is my firm conviction that the labor movement not only welcomes but invites your co-operation."

Dickson on Economic Autocracy

The next speaker was William B. Dickson, the vice-president of the Midvale Steel and Ordnance Co. Mr. Dickson's address was remarkable for the fact that he so frankly and so whole-heartedly espoused the cause of the workingman. In fact, he was hardly less emphatic than Mr. Gompers himself. For this reason his speech may be said to have been the feature of the evening. Mr. Dickson expressed the same thought which had just previously been spoken by Mr. Gompers; namely, that our modern system of the division of labor, consisting in the assignment of a highly specialized task to each individual workman, has deprived men of the joy which

they once secured through the exercise of creative instinct in their work. The result of this condition, he said, will tend to stunt men mentally, morally and physically, unless it is counteracted by some other vital force. It cannot be met by reverting to original and obsolete methods; our factories must continue to produce efficiently, but not at such a sacrifice of individuality. "This is a human problem," said Mr. Dickson, "and I have not been able to solve it, so I am leaving it to you."

"It has been said," he continued, "that free government is more important than good government. I believe that this is substantially true; and I would say that if there must be a choice it is better to be free and inefficient than to secure efficiency by having men become mere cogs in a complex social machine, operated by a so-called superior class. I am afraid that we are making a fetish of efficiency." There is, however, another broader and more important question than this; it is the great issue between democracy and autocracy. We have been accustomed to consider that this question was solved in 1776, as indeed it was, politically; but in industry the present tendency is to revert to the feudal system of despotism. This has been exemplified in the past few months by restriction of production, and even the closing down of plants, with the object of holding prices up. An example that is still fresh in our memory is that of the large textile mills which were shut down completely, resulting in great suffering to the entire community. It is this "unconscious insolence of conscious power" which is at the root of our industrial difficulties. "Consider, for a moment," said Mr. Dickson, "the despotic power which our modern system of industry gives a few men over the lives and fortunes of thousands of their fellow citizens. By reason of this condition we have the unstable situation of a government founded on the suffrages of men who, for all practical purposes, are industrially bondsmen." We are approaching the time when we shall need an industrial Lincoln to say: "A house divided against itself cannot stand; this nation cannot continue to exist politically democratic but economically autocratic." The appreciation of the audience at this point resulted in a round of applause in which Mr. Gompers took a leading part.

In Favor of a Fair System of Collective Bargaining

Mr. Dickson declared himself in favor of a fair system of collective bargaining and of giving workmen some share in the conduct of business, probably through applying a portion of their wages to the purchase of stock in the company. These systems, of course, must be designed to meet the needs of the particular plants which are to use them; and unless they are permeated with democratic principles there can be no solution of our labor troubles. Some people may claim, however, that they are satisfied with present conditions and do not desire a change. This is only an evasion of the issue. The choice does not lie between industrial democracy and the present way of doing things; it lies between industrial democracy and a condition of chaos and feudalism such as we see in Russia today.

The speaker offered two suggestions to meet the situation. First, he said that we should democratize industry, giving recognition to management and labor as equal partners with capital; and second, we should teach democracy in the schools as thoroughly as we now teach reading, writing and arithmetic, so that the coming generation will be thoroughly grounded in democratic principles.

"I am not looking forward," concluded Mr. Dickson, "to the new era of industrial democracy as a period of peace and serenity, but rather as a time in which the way has been cleared for a further toilsome climb up the spiral of evolution."

Between the speeches President Miller read a number of congratulatory telegrams, notably those from Herbert Hoover, E. S. Carman, the president-elect of the society, Governor Coolidge and Senator Harding.

An Inexpensive Blueprint Machine

By H. W. Armstrong

The average small shop if run on an up-to-date plan requires a large number of blueprints. The old method of enclosing tracing and blueprint paper in a frame and exposing to the sun is slow and many times it is not possible to obtain prints because of lack of sunlight. When prints are needed in a hurry it means delay and inconvenience and sometimes a copy of the tracing has to be made.

Most blueprinting machines are too expensive for the small shop. In our shop we made a small machine, shown in Fig. 1, using three electric light bulbs. This machine did good work, although it was slow, and had the advantage of being independent of the sun. However, as we required more prints than the capacity of this machine provided, we finally adopted the set-up shown in Fig. 2. To the writer's knowledge there is only one other in use for this purpose.

We purchased a Cooper-Hewitt mercury bar lamp similar to those in use in photo-galleries and of the following specifications: F Lamp; Type EJ; Spec. 901; 60 Cycles; 103 to 118 Volts; 6 to 7 Amperes.

This was fastened to the wall and a frame built around it. A blueprint frame was also made, large enough to hold our largest tracing, and when in use was placed on the projecting shelf parallel to the lamp and about 12 in. away from it.

The machine, frame and complete set-up, cost about $100, and the work is very rapid and satisfactory as the mercury light is very much like sunlight and the prints produced are equal to any made in the sun. The time of exposure should be about three minutes.

The machine is perfectly satisfactory and has the advantage of low initial cost and low upkeep. The tubes last a long time and can be replaced at small expense. The light is also very easy on the eyes.

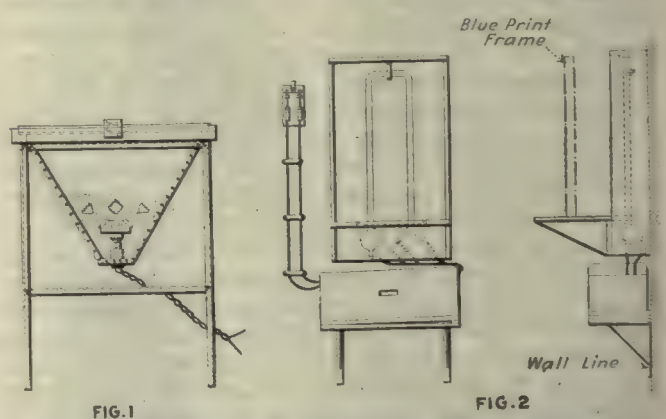


FIG. 1. PRINTING MACHINE WITH INCANDESCENT BULBS
FIG. 2. SET-UP USED IN CONJUNCTION WITH COOPER-HEWITT LAMP

Nineteenth Annual Fall Convention of the National Machine Tool Builders' Ass'n

PRESIDENT NEWTON opened the fall convention of the National Machine Tool Builders' Association Thursday morning, Nov. 11, at the Hotel Astor, New York. His brief address dealt with the present period of depression in the machine-tool business and presented conclusions to the effect that the machine-tool builders must face the existing depression as they cannot stop the downward trend of business. Demand is beyond their control and price reductions would not create reassurance even if they could be given. It is recognized that they cannot be given for several reasons. During the last five years prices have not increased in proportion to the costs of materials and labor and the burden of the cost of experiments and improvements has increased. There could be only one cause to justify a reduction in prices, namely, a reduced cost in materials, and reduced selling prices on such an account are very improbable because the increased cost of overhead due to the limited output will offset any reduction in material costs that may take place.

In regard to cancellations, Mr. Newton said that he hopes the machine-tool builders will take steps to raise orders for machine tools to the dignity of real contracts. He also advised preservation of resources, that is, cash.

The routine business of reports of officers and committee reports was dispatched quickly. An interesting committee report was that of Mr. Bullard showing good progress on the export catalog which will probably be ready for distribution during the spring of 1921. Translations are being made into French, Spanish and German. Foreign dealers are glad that the American manufacturers are going in for advertising in foreign fields.



AUGUST H. TUECHTER, PRESIDENT

Standardization of Electric Equipment

D. R. Weedon of the Westinghouse Electric and Manufacturing Co., delivered a lantern-slide talk on "Standardization." He interpreted standardization to refer to methods of application rather than to the motors themselves. The high spots of his talk were to the effect that the motor manufacturer should be called upon to work out the best way of applying the motor during the design of the machine, not after it is built. The selection of a motor depends upon the kind of tool with which it is used, the method of application, type of control and load factor. Among the kinds named were constant-speed for such tools as screw machines; adjustable speed for planing machines, milling machines, lathes and drilling machines; variable speed for fans and pumps; high starting torque for drilling machines, lathes and light tools; high pull-out torque for grinding machines and others where the strain on the motor is heavy; and high frequency for wood-working machines. Slides were shown picturing belted motor drive, direct drive, motor in base of machine, motor built into the machine and other arrangements. Protection from dirt and economy in space, bearings, shafting and belting were mentioned as advantages of motor drive. Automatic and manual controls were shown and their possibilities explained. The importance of overload relays and low voltage release were emphasized. Builders were advised to design their units to make possible the application of motors of at least two manufacturers to prevent being delayed by limited production in one motor manufacturer's plant.

Frank H. Foster spoke on "Machine Shop Conditions in China." He said that American tools are liked and that American manufacturers have a good chance to get their machines introduced and disposed of.

The afternoon session was devoted to addresses and discussion of financial conditions and cancellation of orders. Francis H. Sisson, vice-president of the Guaranty Trust Co., New York City, spoke on "Financial Conditions as Affecting Business." The following several paragraphs give a summary of his address:

It is probable that now, more than ever before, there exists in business a condition of doubt and little clarity of thought. The business interests of the banker and of the machine-tool manufacturer are to a great extent the same, the banker's great problem being that of credit.

Today we are filling the gaps which the war created and are suffering because of the inflation by which the war was financed and which depreciated the dollar. The United States in 1914 financed the allies indirectly in many ways, extended banking credits and floated foreign securities. Beginning in 1917 the world put $337,000,000,000 into the war and diverted 40,000,000 lives from production to wasteful industry, and lost 10,000,000 lives. Money put into war is wasted and

the National debt is increased, in this instance by $23,000,000,000. For such conditions we are now paying. Bankers have been accused of refusing credit to legitimate business, but the contrary is true as banks have gone the limit in extending credits. Interest prices have not increased in proportion to other rises and money is the cheapest commodity we have. Credit is not an artificial product of banks or government. It is a medium of exchange and represents a transfer of property. Wealth can be created only by human effort. Present German and Russian conditions are the result of trying to create credit by the use of the printing press.

Banks Not Profiteering

The Federal Reserve has loaned up to the limit of the reserve provided by law for the past five years. Since 1914 production and distribution have increased 20 per cent and prices 100 per cent, which means that 120 per cent more capital has been required to handle business, this quantity representing more than 10 per cent of our national income. More than twice the amount of money required in 1914 was required to finance the business of 1919. The banks have not been profiteering and talk to that effect and loose thinking are hazardous to business. What is needed to improve conditions is co-operation between business and banks and a realization of the unity of their interests. Money is sold as is any other commodity, the price being controlled by supply and demand. No control is exercised by the banks; when money is scarce rates are up and when it is plentiful they are down. Rates for call loans, compared to the value that money holds, are so low that it is wrong to indict the banks for high rates. Money scarcity must be offset by thrift and production.

United States Faces a Prosperous Era

The United States stands today very much as did England at the close of the Napoleonic wars. We are the only nation on a sound financial basis and we have health, organizing ability, intelligence and natural resources. World markets and opportunities await our taking and we must put our house in order and commence to take advantage of conditions. We must have an understanding of foreign markets, must send our overproduction to them and must help finance foreign nations. If we follow our opportunities we may have an even greater success than England has had. Foreign trade is no dream, but cold, hard necessity and it represents high service as well as profits. No nation lives for itself alone any more than does an individual and we as well as others are affected by the sore spots of the earth.

Cancellation—or repudiation—of orders by the United States and by foreign merchants causes a deplorable situation. There must be a cure for the breaking down of morale which causes men to repudiate their just committments, otherwise we are going to suffer as other nations have suffered. We must not lend ourselves to such practice as it puts us in a bad light.

As regards the immediate future there is no relief in sight, at any rate not until the first of the year, when conditions will ease off slightly. Until labor is liquidated as well as commodities, until we have filled up gaps caused by the war and until all inflation and profiteering have been antidoted, we will not reach normal. All that goes up must come down. We ought to be glad that the reaction has come as it means that we are getting back to a normal condition. We accumulated a surplus during the war, have at present good crops and a good banking system and are beginning to understand interrelations, so that we face a prosperous era. Our best policy is to stick to old-fashioned guides such as the ten commandments and copybook rules.

During the discussion the opinion was brought out that nothing less than the rehabilitation of Europe can correct the exchange evil and that so long as the European countries continue to print money as they have been doing, such money will stay low in value in comparison to the dollar.

The Legal Viewpoint of Cancellations

"Cancellation of Orders" was the title of an address by W. Randolph Montgomery, counsel, National Association of Credit Men, New York City. He presented the subject from the legal viewpoint, bringing out the point that it is easy to set up moral standards when the market is advancing, but another matter to maintain them on a falling market. Buyers have been speculating on continuous buying and the public has struck, leaving the buyers the choice of standing a loss themselves or cancelling orders. They have had the privilege of cancellation for a year or more because of the easy resale of cancelled goods and when the drop came with a possible curtailment of this privilege they began to examine their contracts and in many cases found that they were not binding. Such statements as "order not subject to cancellation," and "all claims for defective goods must be made within ten days of their receipt," printed on bill heads and packing slips, are worthless. The Uniform Sales Act is a business man's statute, which has been adopted in more than twenty American States and in England and it would pay every business man to have a copy of the act in his library.

Cancellations cannot be prevented. The law gives opportunity for redress, sometimes for price and sometimes for damages. To make enforcement of contracts good the buyer must be able to pay when judgment is brought against him, which significant point must not be overlooked when considering suit.

Four things will help minimize cancellations: (1) Make it less easy to cancel by making contracts legally enforcible, (2) let it be known among competitors that certain houses are given to cancelling orders, (3) insist more often upon legal right to damages for breach of contract, and (4) carry on a campaign of education against reckless buying and in favor of a higher standard of ethics.

E. W. McCullough, manager of the Fabricated Production Department, United States Chamber of Commerce, was the next speaker. His remarks covered many of the points brought out by Mr. Montgomery. He emphasized the suggestion that each division of trade should bear its own burdens, as dangerous ground is reached when one division tries to carry its own and others' burdens. Each trade organization should examine its own line and establish a code of ethics. The golden rule should be used in business so that a man's contract will be as good as his word, and so that constant breaking of contracts will make him a marked man.

That prices of machine tools cannot be reduced was the consensus of opinion of individual manufacturers. The causes for the necessity of price maintenance are

many, chief among them the sustained prices of materials; resumption of sales expense, which during the past few years has been almost negligible; service costs, necessary but expensive; improvements made during recent years; the cost of experiments; the maintenance of the present just level of wages for machinists and mechanics; increased overhead due to limited production; and the fact that prices of machine tools during the last five years have not increased in proportion to the costs of materials and labor.

The morning of the second day of the convention was given over to committee meetings and the afternoon to business. Atlantic City was chosen as the location for the Spring Convention to be held in May. The following officers were elected for 1921: President, August H. Tuechter, Cincinnati-Bickford Tool Co., Cincinnati, Ohio. First vice-president, E. J. Kearney, Kearney & Trecker Co., Milwaukee, Wis. Second vice-president, C. Wood Walter, Cincinnati Milling Machine Co., Cincinnati, Ohio. Secretary, Carl Dietz, The Norton Co., Worcester, Mass. Treasurer, Winslow Blanchard, The Blanchard Machine Co., Cambridge, Mass. Charles E. Hildreth of the Whitcomb-Blaisdell Machine Tool Co., Worcester, Mass., continues as manager.

What Other Editors Think

The Question of Cancellations

(From the *New York Commercial*)

WHENEVER a price movement reverses itself some one is bound to be caught at the end of the line. There is always a leader and always a tail-ender. When it is a matter of a reduction in prices, such as that now under way, some one is sure to be caught at the top and must suffer accordingly. In some trades such cancellations are accepted as a part of trade customs; in others the hardship to the seller is so great that they cannot be accepted.

There are two sides to the question, two distinct points of view. From the legal standpoint there is, of course, only one. A contract requires two parties in the making and it cannot be amended or cancelled without the consent of both parties. Very often the seller considers it to his best interest to agree to such cancellation with the best grace possible. It saves him his customer.

The seller, however, has some moral obligations that should govern, regardless of his legal rights, for moral law is superior to legal law. Shylock found it so and many another has discovered that it does not always pay to enforce the strict letter of a contract. If for instance, a seller, by enforcing a contract yielding him a huge profit, virtually bankrupting the buyer, although its cancellation would have caused him no loss, has violated the moral law. Hence, if the seller is to suffer loss through the cancellation of a contract, through no fault of his own, then the moral obligation rests with the buyer.

During this readjustment period many fine points will have to be worked out on the question of cancellations. If they can be made without injury to either party, well and good. If the buyer can reimburse the seller to the extent of the loss that might otherwise be incurred, there is a good basis for cancellation. If the seller is big enough to stand a partial loss of this kind, rather than to bankrupt his customer, thus saving him for another time, it is good business. These are times for giving and taking, for all will benefit in the long run through the adjustment now going on. There is, however, one class of buyer who is entitled neither to sympathy nor consideration; the one who, finding himself on the losing side, calmly repudiates his contracts without so much as "by your leave" and defies the seller to take whatever action he may see fit.

Where Is That Book of Ethics?

(From *Coal Age*)

WHEN the employer decided, on the simple basis of supply and demand, what wages should be paid the employee, there was little difficulty in determining what that rate should be. Whatever would induce the working or the professional man to enter into a verbal or written contract of employment was considered the correct compensation for the employer to pay.

Just recently when a wage controversy was being arbitrated a decision was rendered allowing a certain electric railroad to continue to pay the wage it had been paying, the arbitrators declaring that the electric road must have been paying a fair wage or it would not have been able to induce men to leave other employment to enter its service.

The public has decided that the law of supply and demand must be laid aside, yet it has elaborated no basis by which it may be replaced. We are henceforth to look to ethics for a determination of wages. But we have no ethical standards, no definitions of what is ethical economically. Shall there be a graduation of pay to suit graduations in intelligence and effort? Shall wages be advanced by flat or by percentage increases? Shall the steady worker get more or only as much as the one whose opportunity is irregular? Shall increases be based on the rates paid in the past or shall the status before the last revision be determinative?

An article is usually worth what people will pay for it. The ethical price concerns no one. The man who cannot pay an ethical price for it, or can buy the article cheaper from some one who can produce it at less expenditure of effort, will not pay the figure demanded, and hence the poor fellow who would have made it is unethically laid idle. A man working in a mine with coal hard to drill, shoot or break, by all *prima facie* elements of ethics should be paid more wages per ton, and even per day, than a man working in a soft seam.

According to ethics, he should, but will he? Only if the hard material is worth more than the softer. Natural laws have a way of paying little attention to what we poor mortals call ethics. The laws of survival of the fittest may not be ethical on their face, but they wipe out the needless industry, the concern which is making what the public does not want or what the public is unwilling to buy at the price at which it must be produced.

Progress Control as a Staff Function

By J. W. McCONNELL
General Master Mechanic, Naval Torpedo Station, Alexandria, Va.

It is advocated that systems of "Progress Control" be instituted in shops where the variety and character of the work have prevented its reduction to systematic, determinate control, and that such progress control be recognized as a staff function.

THERE is and has been for some time much activity with respect to the forms of shop management, the general purport of which is to substitute the determinate for the indeterminate, and thereby the efficient for the inefficient. The gigantic production built up around the automobile industry would not be possible if its many processes and activities were not determinate as to time and production. Other machine products, manufactured in a mere fractional quantity when compared to the automotive industry, but in much greater variety, such as machine tools, power plant units and accessories and transportation and electrical units, are produced for the most part upon the solid foundation of systematic methods of operation and control. But there are many shops where the variety and character of work have prevented its reduction to systematic, determinate control. An important step in this direction is a system of progress control exactly fitted to each local condition.

Of the many functions involved in the operation of a perfectly functioning manufacturing organization aside from the obviously essential details of buildings, power, equipment, materials, working force, etc., with its management, it is a personal view that progress control has not been given due importance by recognizing its identity as a distinct staff function. Though closely allied to production control, which is planning the work, establishing delivery schedules, procuring materials, issuing work orders, etc., yet it works on a different system, has different points of contact with the shops and offices, has no executive functions, has no technical characteristics, is strictly a staff activity, takes due note of all actions, advising alike manager, superintendent, division heads, or anyone else to whom it would be of value to know the standing of work in which they are interested parties.

The manufacture of a machine is predicated upon many things: design, drawings, patterns, castings, dies, forgings, commercial bar stock; commercially machined parts, special alloys (rolled, drawn, forged, heat-treated, tested). So much for materials. But how long does it take to get a steel casting? In this day of complicated and exacting design, of specialized industries and of large organizations, it is frequently a long and arduous passage from the quiet shades of the drawing room to the clean and fragrant confusion of the pattern shop, to the grime and smoke and heat of the foundry, before the castings are on your machine-shop floor. Mention might also be made of equal difficulties in getting forgings, special steels, and other materials. Then there are special tools, fixtures, jigs; operation planning and experimenting; and, perhaps, rate fixing. All of which is preparatory to the actual machining; this done there remains inspection, and finally, assembly. Many a busy superintendent will recognize subjects in this paragraph upon which timely information relating to progress and delay would give him the master key to firm control.

The degree of importance and the extent to which progress control should be employed as a functioning entity of the management staff rests upon the number and difficulty of the various activities involved. In this connection, one cannot but be dismayed when confronted by the multiplicity of activities. Many are of short duration, of easy performance; others are long and difficult; some are subject to consultation, trial, experiment; there are losses from spoiled work and defective material and the laborious, hurried routine for their replacement; they actuate all shops and offices; they are the sum total of practically the entire organization. And yet the very multiplicity of activities involved indicates the necessity of a systematic collection and dissemination of their scope and accomplishment as absolutely essential to harmonic production, smooth, steady, fast, unhurried.

It were well to bear in mind that the progress records of these activities have no future value. Theirs is only a present value. They will show the relation between production assets and liabilities; labor hours available; labor hours pledged; shops over- or under-manned. They will assist the timely transfer of men or work to and from departments and will answer questions as to when a job can be started, when it will be done. It is a too frequent, bad condition when the milling machine foreman telephones that he is ready to start a needed job but the tools are not ready, or the assembly foreman reports that he cannot proceed without some needed parts, not yet supplied. Such a condition necessarily exists without progress control. Word of mouth inquiries as to how this job is coming along, when will we get the forgings, when will the material be in, when will the tools be ready, will not call immediate attention to all delinquent activities, nor supply, on the moment, processes requiring time for their accomplishment. Lost time cannot be redeemed and rush work is an interference to orderly procedure that would not be tolerated were its actual cost in wear and tear in nervous energy and interference with other work known.

Based upon the foregoing conception of the functions and utility of progress control, the following procedure would apply:

(1) The Planning or Production Division prepares, without delay, a route sheet as its first act upon due notice of impending work. If a new job, not yet planned in detail, it is designated as a preliminary route sheet, and shows, in fair detail, all processes, a separate sheet for each part, and for each distinct assembly. Its purpose is to take note of actions needed and through its distribution to advise all concerned of action required of them. This preliminary route sheet is therefore early notice of work order requirements, useful alike to the production division, superintendent, shop heads, tool planner, etc. Revisions should be made in accordance with developed and approved procedure, for use on repeat orders.

(2) Progress control operates through a system of informal pencil memoranda reports of actions taken for the accomplishment of important or designated steps as indicated on the route sheet, or by established routine. All "key" activities, such as the preparation of tool sketches, of operation planning, ordering and delivery of material, release of drawings, and other acts preliminary to actual production should be subject to routine progress reports. It may be observed at this point that the mere requirement of systematic, routine progress reports is of itself one of the most efficient methods of securing the timely performance of duties assigned. The manner and frequency of these reports should receive the most careful forethought. A mass of undigested and indigestible data above all things is to be avoided. It is best to start with a few reports, limited to the most indeterminate ratio of time to production activities, and adding reports on other activities when their value becomes apparent. In any case, their scope depends entirely upon the nature of the product, the organization, and the wage system; they should originate from the person nearest the job having knowledge of its requirements.

(3) The mechanism of progress control must conform to three requirements:

Quick filing and ready reference.

The utmost simplicity of the report forms.

Classification of reports whereby related or specific activities may be quickly scrutinized.

Quick filing and ready reference may be obtained by means of a display board of good size, vertically mounted like the leaves of a book, with pockets or spring clips for holding the progress reports as received, without copying. These pockets or clips should be indexed or grouped so as to form an assembly list. Related activities on parts for assembly into a machine unit are thus joined. With respect to specific activities, that is, those relating to tools, drawings, etc., different colored slips afford visible differentiation. Simplicity of report forms consists in reducing the data required thereon to a minimum, even at the expense of occasional obscurity.

These forms should be printed on medium weight paper, with alternate leaves having a carbon back for duplicate copy, and bound in small perforated pads. The size of these pads should be about 3 x 3 in., although a larger size may have preference for special reasons. These reports would be filed as received, and taken together should show the current standing of all specific or related work orders.

(4) The following differentiation of specific or divisional activities is merely submitted as a guide; each application would be different, if carefully fitted to local conditions and requirements.

(a) A white index card, showing work authorized, and number or identity of route sheet, will be the first to be placed on the display control board.

(b) A blue slip will be used for all releases relating to work orders; auxiliary or supplemental work orders; tool orders; drawings, work and operation; operation schedules; and anything else that may relate to the issuance of authority to proceed.

(c) A yellow slip for all reports and progress information relating to materials; purchase requisitions; contract awards; deliveries; patterns; castings; forgings; and all activities relating to "materials."

(d) A pink slip to denote all tool activities.

(e) A white slip for production work; for operations performed; for operations completed; for work completed; for inspection.

(f) A red slip to denote spoiled work or defective material; breakdowns; arrested or reversed progress; work suspensions.

In conclusion it may be truthfully stated that the mark of efficient management is the determinate control of product with relation to time. It is equally true of the largest establishment as well as of its newest foreman that the mark of efficiency is to be able to make a delivery date, and keep it.

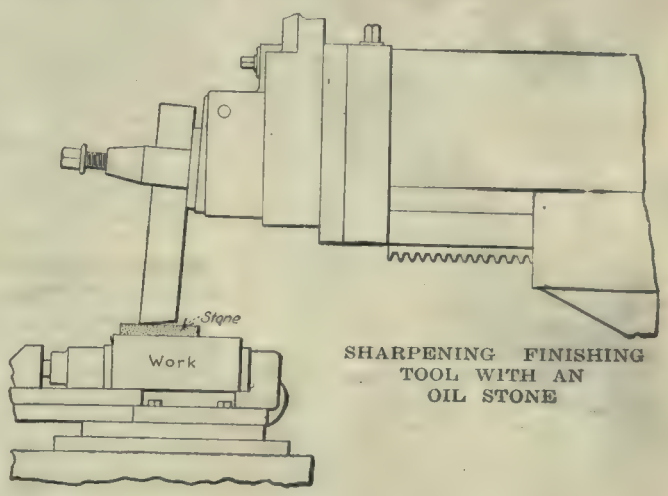
A Shaper Kink

By Charles D. Folsom, Jr.

An old mechanic once said to me, "There are tricks to all trades but the machinist's trade, and that's all tricks." Here's one of them, a trick that comes in handy on shaper and planer work when you are using a flat finishing tool:

When the tool gets a little dull you will as a rule either take it out and regrind it or lift it up off of the work and try to smooth it with an oilstone. In the latter case you generally get a rounded edge which leaves feed marks, and then you have to grind it anyway. To save some of this trouble get an oilstone with fairly smooth and parallel sides and put it on the work directly under the tool. Lower the tool until it touches the oilstone, then lift the clapper box and lower it a little more, just about 0.025 in. or so. This amount of drop depends upon the clearance of the tool, and must be determined by trial; it is right when the cutting edge bears on the stone and the heel barely clears it, as shown in the sketch. Now all you have to do is to push the stone back and forth in the line of the feed, i. e., at right angles with the stroke of the machine. The clapper box must be at right angles with the surface being machined, as it naturally would be on straight finishing; otherwise the tool will cut on one corner.

This trick is useful sometimes before the tool is dull at all, that is, when setting up; it will save a lot of eye strain if the tool is comparatively narrow and in poor light. In such a case it is only necessary to set it approximately true, as the narrow edge can readily be stoned true.



SHARPENING FINISHING TOOL WITH AN OIL STONE



American Bankers To Organize 100-Million-Dollar Foreign Trade Corporation

Plans for the creation of a $100,000,000 foreign trade financing corporation, backed by leading financial and industrial interests of the country, are rapidly taking form, and it is expected that organization of this new instrument for furthering American export trade will be completed early in 1921. Representative bankers and industrial men are scheduled to meet in Chicago early in December at the call of John S. Drum, head of the American Bankers' Association, when definite steps toward forming the new corporation will be taken.

John McHugh, vice-president of the Mechanics and Metals National Bank and chairman of the committee of the American Bankers' Association, which inaugurated the plan for the corporation, believes that such an organization will prove as helpful to the business of the country and the proper financing of it as the Federal Reserve system already has shown itself. Discussing the proposed corporation, Mr. McHugh says:

"In connection with the consideration, on the part of the bankers of this country, of the proposed United States Foreign Commerce Bank, as suggested by the committee on commerce and marine of the American Bankers' Association, it might not be amiss to refer to the present banking system as operated under the Federal Reserve law. There are twelve Federal Reserve banks operated in the interest of the commercial business of this country under the supervision and direction of a central body known as the Federal Reserve Board. These banks have an aggregate capital of approximately $100,000,000. That capital has been supplied under compulsion of law, known as the Federal Reserve act, by the national banks of the country, and such state banks as elected to conform to the Federal Reserve law requirements in order to become members of the system. It has resulted in co-ordinating the banking power of the country in a way that has been of maximum helpfulness in the trying times that we have recently passed through and are now experiencing. It has proved to be a splendid piece of financial machinery for the commercial business of this country, but to that extent and no further can it go under the law.

"The foreign trade of this country, on account of the unique position of the United States in the last few years, has expanded to such an extent that a contraction to pre-war conditions would have a most depressing effect, and, therefore, it has come to be recognized that another large piece of equally important financial machinery is needed in order to finance that foreign trade and maintain it at such figures as will keep our people at work and our avenues of production adequately employed. This can likewise be done under the Federal Reserve law, owing to the fact that a recent amendment to that law, known as the Edge act, makes it possible, but not compulsory, for the banks of the country to furnish the needed capital therefor. It now is to be seen whether the banks of this country, required as they were by the Federal Reserve law to furnish the capital for the present Federal Reserve Bank system, will, without compulsion of law, and of their own free will and accord, rise to the occasion and bring into existence another equally important piece of financial machinery.

"It is estimated that at the present time loans or credits in connection with the foreign trade of American importers aggregate approximately four billions of dollars, and it is a well known fact that a great deal of this is directly or indirectly carried by the banks of the country in short time form, but as much of it must be renewed from time to time it, in fact, represents long time credits. Long time credits are undesirable from the standpoint of prudent commercial bank management and are not in harmony with the spirit of the Federal Reserve act in so far as it applies to commercial bank business. Such long time credits should be handled by an investment corporation of wide and extensive distributing ability, and if they were so handled there would be a marked improvement in the banking situation. Such corporation can come into existence through the co-operation of the banks and business men of this country, and if it be brought into existence I am confidently of the opinion that it will prove as helpful to the business of this country and the proper financing of it as the Federal Reserve system already has done."

Russian Orders for the German Industry

Soviet Russia has been trying for a long time to buy machines in Germany. Negotiations have gone so far that large orders are on the point of being placed. The first order of this kind is one for 6,000 locomotives of various sizes and a large amount of turbines. Contracts have been closed subject to satisfactory methods of payment.

Third National Marine Exposition Schedule for New York in January

Completing the triangle, the third National Marine Exposition will combine with the interest of the first and second a new force and optimism.

The National Marine League is in the midst of lively preparations for a mammoth marine show in New York in January. Having allied with its organization the great latent maritime power of the Middle West, which during the Chicago Exposition showed live interest and active demonstration, this third National Marine Show will carry a new force and well-founded optimism.

The outstanding feature in the first New York show was the arousing of interest in the general public—the bringing of a great mass of American voters to a state of shipmindedness which will eventually take concrete expression in a voting voice for the betterment and protection of the American merchant marine. This lively interest which was so evident on all sides, was instrumental in developing the second project—a marine show in Chicago, 1,000 miles from tidewater.

P. H. W. Ross, president of the National Marine League, who presided at the Chicago show was responsible for much of the success of the undertaking. He visualized to the people in well-grounded common-sense argument the great advantages which would accrue from the opening up of this region—the great land-locked heart of the country. His energy and enthusiasm proved definitely that the National Marine League exists to serve both the inland and oceanic necessities of the United States.

The January show, gathering interest and force, and embracing more and more of the country, will offer larger opportunities, more forceful connections, and broader influences than either of the other expositions. That this is fully realized is shown by the unprecedented demand for space. By Nov. 1 the number of exhibitors had already passed the entire number represented in the Chicago show.

Being set, as it were, almost as a forerunner of the ushering in of the new Presidential administration—an administration pledged to the support of the American merchant marine—the third National Marine Exposition will mark the turning of the tide in things maritime. It will herald a new era—the placing of the American merchant marine in a position of stability which will further its uphill fight for supremacy on the seas.

LD'S INDUSTRIAL FORGE
News Editor

Drastic Tariff Laws To Protect American Manufacturers To Be First Act of New Congress

The tariff bill that will be passed by the incoming Republican congress promises to be the most drastic protective measure that has ever appeared upon the Federal statute books, according to Republican senators and representatives now in Washington. It will be ready early next summer.

Representative Joseph W. Fordney, chairman of the house ways and means committee, is already hard at work upon the schedules and will soon have assistance from Senator Smoot.

The bill, it was learned today, will include every sort of commodity in which America is in competition with foreign countries where labor and raw materials are cheaper, but will be especially aimed at protection of farm products, manufactured goods, steel and iron products.

Summarizing the situation which, in his opinion makes a high tariff imperative, one senator said today:

"Producers of all sorts of farm products, particularly wool, are facing bankruptcy and must be protected. Factories are shutting down all over the United States because American employers cannot produce certain classes of goods in competition with various countries abroad. Unemployment is becoming or soon will become a serious threat. The only logical, sensible, and practical way to meet this situation is to pass a drastic protectionist tariff. The tariff will do much to increase the revenues now greatly needed to meet a mass of indebtedness."

While declining to discuss the policy of a high protective tariff, David J Lewis, a member of the United States Tariff Commission, pointed out today that a low tariff has frequently produced as much revenue as the higher schedule, which shut off revenue by discouraging imports.

The last protective tariff was that provided by the Payne-Aldrich bill. Under it the duty of various imported articles ranged between 1910 and 1914 from 40.03 per cent to 43.15 per cent. Under the Underwood tariff the rates varied from 21.27 per cent to 27.18 per cent between 1917 and 1918.

Germany's Trade with Belgium

The German export trade to Belgium in the first eight months of this year was 486,000,000 francs while the Belgian export trade to Germany was, at the same, 779,000,000 francs. Germany has become the third largest buyer of Belgium.

Hartman Elected to Board of N. C. R. Company

William Hartman, superintendent of the National Cash Register Co., has been elected to the board of directors of that organization. This action was taken at the regular meeting of the board, Wednesday, Nov. 3.

Mr. Hartman has been with the N. C R. for thirty years. He started in the ranks when the factory consisted of but two or three small buildings. He was promoted from time to time, and by hard work and careful study won



WILLIAM HARTMAN

his way to his present position in the organization

During the latter part of 1918 Mr. Hartman became superintendent of all the manufacturing departments, which position he now holds.

His election to the board of directors is a recognition of his industry, integrity and ability.

A. S. M. E. Passes Resolution to Increase Endowment of Engineering Foundation

The following resolution was adopted by the council of the American Society of Mechanical Engineers:

Resolved, That the officers of this society be authorized and requested to co-operate with the officers of Engineering Foundation, and the officers of the Societies of Civil, Mining and Electrical Engineers, in promulgating a plan for increasing the endowment of Engineering Foundation and that when the plan is adopted the officers of this Society are hereby authorized to circularize the membership of this Society with reference thereto.

Fisher Says Lack of Religion and Broken Covenants Are Responsible for Present Conditions

With textile manufacturers and shoemaking concerns of New England facing the choice of closing their plants, running on a part time schedule or requesting their employees to accept reductions in salary as the result of a situation daily becoming more acute in this industrial center because of the heavy cancellation of orders and unsettled market conditions, Oliver M. Fisher of Newton, Mass., head of one of the large shoe manufacturing plants here, advises a return to the ancient Biblical precept of responsibility to God and to one's fellow-man as a solution of the problem.

Otherwise, Mr. Fisher says, the irreligious trend of this country, with 60 per cent of the population not even nominally connected with any church, will break down existing morals in the business world and will put approval upon "a standard of business integrity which before the war no business man would believe existed." A condition approaching chaos is facing the business world, according to Mr. Fisher, due, in a large measure, he says, to the lack of faith of one man in another and the attitude of regarding contracts as "scraps of paper."

Following his recent election as president of the Boston Boot and Shoe Club, Mr. Fisher, who is treasurer and member of the executive committee of the Unitarian campaign under the direction of former President William H. Taft, gave out a statement in which he said:

"This country has been a phenomenal success in everything material. We have been the wonder of the world, but we have lost, to my mind, the balance, and have given far more attention to the material side of life than its importance warrants. The same attention given to the development of the moral and spiritual forces within us could bring about in every community a visualizing force which would make better communities, and thus make better the very business in which we are engaged.

"From my own business experience there is nothing on earth that business needs so much today as religion. By that I mean responsibility to God, to man and to the obligations that go with it, in order that our relations with each other shall be the relations of one brother to another. Obligations must be kept and the covenants we make must be considered sacred and binding: therefore, I have come to feel after a long business life that some form of

Christianity is the heart of the covenant of all business life.

"You who are in business have been conscious of a tremendous overturning recently in business affairs; in fact, a condition approaching chaos is with us at this time. If you will look at the causes of this you will find that it is very largely due to the lack of faith of one man to another in his business obligations.

"Our textile mills here in New England, as you know, are nearly all closed, or practically so. Our shoe manufacturing plants, one of the largest industries of New England, are practically all closed—and why? Not because shoes are not needed, not because textiles are not needed; but because the covenants entered into, the contracts made, have been torn and broken; and in the face of the fact that the merchandise would be needed, that this cancellation or return would mean financial loss and ruin to the other party."

Landis Machine Co. Holds House-Warming Party in New Shop

The Landis Machine Co., Waynesboro, Pa., gave a house-warming party in its new shop to employees and their families, on Oct. 30. The new fireproof building covers a little over one acre of floor space inside its walls, the dimensions being 146 x 308 ft. There are 729,406 pounds of steel which means about 365 tons in the construction of same.

C. N. Kirkpatrick was general chairman, in full charge of the house-warming arrangements. The advisory committee to assist him was made up of S. F. Newman and J. G. Harper.

Nearly 1,400 men, women and children gathered in the shop Saturday afternoon for the housewarming. The gong sounded at 3 o'clock and until a late hour in the evening there was not a dull moment. Provision had been made for the entertainment of young and old and interested participation in the numerous activities emphasized the perfection of the arrangements.

While the very juvenile part of the audience was amusing itself on the swings, teeter-boards, slides and sand piles and filling its stomachs with apples, the more sedate sat upon the rows of benches which were arranged before the platform and listened to the remarks of S. F. Newman, assistant general manager, and J. G. Benedict, general manager, at the beginning of the program.

Motor Truck Association to Hold Exhibit in New York

The annual show of the Motor Truck Association of America will be held in New York City on January 3 to 8, 1921. The exhibition will be staged in the Twelfth Regiment Armory at 62d St., and also in the First Field Artillery Armory at 68th St. These two buildings will afford a floor space of approximately 25,000 sq.ft. Drawings for space were held on Nov. 18 at the office of the association.

Auto Builders Predict Great Prosperity

"The automobile industry is bound to feel the beneficial effects of the election of Senator Harding as President," said A. T. Waterfall, of Dodge Bros. "We are preparing for a release of the pent-up demand for cars and so far as Dodge Bros. are concerned we are working 100 per cent on production in anticipation of better times to come. While as yet unreflected in general lines of business, Harding's election has created a pronounced atmosphere of optimism in Detroit financial circles."

Bankers and some automobile manufacturers who have studied possible effects of the change in administration at Washington declared today that the country is on the verge of the greatest period of prosperity in its history.



—From the "Hex"

The Continental Motors Corporation, of Muskegon, after a shutdown of three weeks has started to hire men.

The Continental is one of the largest makers of automobile motors in the world and its resumption is considered an augury of optimism in the industry.

Equalization of U. S. Exports and Imports Is Improving

The figures in detail of United States foreign trade during August, the last month for which complete data is available at this writing, indicate a further substantial improvement in the process of equalizing this country's exports and imports of goods and commodities. The excess of visible exports over imports in August was reduced to the new low record of $65,000,000, the best previous showing, since an equal balance of trade if not an import excess became desirable, being $78,000,000 export excess in June of the current year. The unfortunate feature of the August record, however, is that the improvement was not brought about by an increase in imports, which as a matter of fact decreased from $537,000,000 in July to $514,000,000 in August, but instead by a falling off of $72,000,000 in August exports as compared with the July total of $651,000,000.

Moreover there are many indications which point to the probability that the shrinkage in American merchandise exports may become more, rather than less, pronounced in the months immediately ahead. This is not likely simply because of increased competition from other industrialized nations, though that, of course, may prove to be a contributing factor in certain lines and localities, nor is it resulting, or likely to result, from a lack of demand from most of the world's leading markets. As a matter of fact it seems to be as true today as it was six months ago that, taking the world as a whole, actual consumer needs still are ahead of actual supplies, though there may be in a few markets and a few lines of goods an apparent oversupply at one or another point in the channels through which goods must flow on their way to final distribution.

What seems most likely to affect adversely American exports are the stringent financial conditions both here and in foreign markets, and the unsettlement in the price situation all over the world. Buyers of American goods abroad find the prospect of lower prices an inducement to delay the placing of business, and in addition there is the very important fact for them to consider that prices in their own markets are by no manner of means stable and that goods bought in the United States now, even at the present reduced prices, may not be readily marketable several months hence when they would be delivered in the buyer's country because of the possibility of still further reactions there.

Lectures at Franklin Institute in December

On the program of lectures, provided during the winter months at the Franklin Institute of the State of Pennsylvania, Philadelphia, appear three very important subjects for the month of December.

On the 2nd a lecture on "The Structure of Photographic Images," by C. E. Kenneth Mees, D.Sc., will be given. Dr. Mees is director of the research laboratories of the Eastman Kodak Co., at Rochester, N. Y., and is well qualified to speak on this subject.

December 9 will hear John S. Shearer, B.S., Ph.D., on "Recent Advances in the Production and Application of X-Rays." Dr. Shearer is a member of the faculty of Cornell University, Department of Physics.

"Some Operating Characteristics of Electron Tubes," will be the subject of W. C. White, E.E., on December 15. Mr. White is connected with the General Electric Co., at Schnectady, N. Y.

James Hartness Elected Governor of Vermont

James Hartness, president of the Jones & Lamson Machine Co., of Springfield, Vermont, manufacturers of lathes, etc., was elected Governor of Vermont on the Republican ticket at the recent election. Governer-elect Hartness has been connected with the machinery industry for a number of years.

Norway as a Market for American Machinery

"American automobiles and trucks are so predominant in Norway that they give a distance American touch to the street traffic," states Trade Commissioner Nels A. Bengtson, of the Bureau of Foreign and Domestic Commerce of the Department of Commerce, in a report just made public.

"American agricultural machinery is prominent in Norway. In general the high quality of American tools and mechanisms is conceded and the expression is frequently heard that American goods rank first in quality but are somewhat higher in price than the same type of goods from the United Kingdom, Sweden or Germany. The United States now ranks first in the trade in metal manufactures as a whole. Before the war Germany ranked first, the United Kingdom second and the United States third," says the report.

Germany Holds Sixth Place in Trade with U. S.

The German-American Trade Society (Deutsch-Amerikanischer Wirtschaftsverband) held a meeting recently after an interval of five years. From a statement made to its members it is interesting to learn that Germany has again assumed the sixth place among European countries with regard to trade with the United States. The society has lately been filled up by a great number of new members recruited from the largest German manufacturing and commercial circles. Great satisfaction has been expressed of this increase of membership as an evidence of the interest in the re-establishment of trade relations with the United States.

Holland's New Largest Incorporated Company

The R. S. Stokvis & Zonen, Ltd., in Rotterdam, one of the largest continental dealers of machinery and known in the United States as a representative of a considerable number of American machine-tool builders, has recently entered into a combine with the Furness Shipping Co. The incorporated company has been formed under the name of "Nederlandsche Maatschappij voor Scheepvaart, Handel en Nijverheid" in Rotterdam (Dutch Company for Shipping, Commerce and Industry) with a capital of 100,060,000 fl. The Furness Co., originally a shipping agency only, now controls large interests in Dutch commerce and shipping. It is the owner of ten companies, among which are the "Nieuwe Waterweg," the "Maschinefabriek Delftshaven" and the lignite mining company Carisborg. It further owns a controlling interest of seven other companies, including the "Alliance Transportation Co." in New York and London which acts as shipping agent for the combine. Stokvis & Zonen maintains eleven branches in Holland and has offices in Paris, Brussels, Petrograd, New York and London, the latter under the style of the "Metal and Hardware Products, Ltd." The New York office is the American buying office of the company. Besides the company owns cycle works, a steel export company in Rotterdam, and the "Automatic Screw Works" in Nijmegen.

The newly formed combine represents the largest incorporated company in Holland and one of the biggest of the whole continent of Europe. Th. Stokvis is one of the managers. Two other of the Stokvis brothers, H. Stokvis and L. Stokvis, are directors.

Penn. R. R. Seeking New Market for Cross-Ties

Owing to the unprecedented levels to which prices of railroad cross-ties have risen in this country the Pennsylvania R.R. has decided to investigate the adaptability of the hard woods of Central and South America for this purpose. Inquiries have been started along several lines not only to ascertain how much more cheaply ties or the material for ties can be purchased in those countries, but also to investigate the question of the longer life of ties made from the Southern hard woods, as compared with those made from the North American native woods heretofore chiefly used.

Under normal conditions the Pennsylvania R.R. System uses from five to six million cross-ties annually. White oak, the most desirable North American wood for this purpose, is becoming rapidly scarcer. The other available woods in this country have a very short life as ties, unless creosoted, which adds materially to their cost.

Changes in Dittmer Gear Corporation

R. H. Bowyer, formerly factory manager of the Dittmer Gear and Manufacturing Corporation, has been appointed sales engineer. This places an experienced and technically trained gear man at the disposal of Dittmer's customers.

George E. Wilkinson, formerly chief inspector, has been appointed factory manager.

E. L. Sherman has been promoted to supervisor of inspection.

Erratum

In a recent issue of *American Machinist* we published a notice stating that the Motor Boat Meeting of the S. A. E. would be held on Dec. 4. The notice should have read Dec. 14 and we are glad to make this correction.

The University of California has opened a new term in the machine shop course, which offers training to the mechanic and the apprentice alike. The classes are being held at night in the Polytechnic High School, First Ave. and Frederick St., San Francisco, Cal.

Brainard Steel Co. Opens New Plant

The J. W. Brainard Steel Co., of Warren, Ohio, is now occupying its new $300,000 plant, the erection of which was started last summer. This plant is located in the new industrial center in the northern part of the city.

The J. W. Brainard Steel Co. absorbed the Fowler Rivet Co., of Braddock, Pa., and has moved all the equipment of that company to Warren. Its specialty was Armco iron rivets, black and galvanized, made for the American Rolling Mill Co., of Middletown, Ohio, which it will continue to make. In addition, Mr. Brainard has added to the product a steel hoop for slack cooperage patented by him, and is now about ready to put on the market a steel head also used in slack cooperage. The market for these last two items is enormous and the demand would indicate capacity output for them for some time.

The officers of the company are J. W. Brainard, president; A. N. Martin, vice-president; and B. A. Brainard, secretary-treasurer.

Obituary

Arthur E. Hauck

ARTHUR E. HAUCK, president of the Hauck Manufacturing Co., Brooklyn, N. Y., manufacturer of oil-burning appliances, kerosene torches, furnaces and forges, died at his home in Brooklyn on Oct. 30, aged forty-one.

He began his career by learning coppersmithing in Germany. After learning his trade, he left his mother country to follow his trade in the navy and ship yards of Belgium, France and later in England. He arrived in this country when twenty years of age. He had only enough funds left when arriving in Philadelphia to pay for his first night's lodging, but the next day he obtained employment at the Philadelphia Navy yards.

After working for three years in the Navy coppersmithing shops in Philadelphia, Norfolk, Baltimore and Brooklyn, he started in the oil-burner business in 1902 with a small shop in Brooklyn. His pioneer work was the basis for a great bulk of industrial oil burning today. His tireless industry continued with the development of the oil-burner business which carried his name. Its consistent growth and development include over a score of important basic patents in burning oil, kerosene, etc., as well as numerous minor inventions and improvements which deal with applications of burning oil for a great many uses.

HENRY C. KING, president of the American Mason Safety Thread Co., Lowell, Mass., died Oct. 28 after a short illness. Mr. King was very well known in industrial circles throughout the United States and was one of the

first to introduce the safety thread in America.

GEORGE BROWN LIMBERT, founder and president of George B. Limbert & Co., and for twenty years a leading figure in the iron industry died recently in his home in Chicago.

JOHN EDWARDS FRANKS, Southern representative for the Lackawanna Steel Co., died at his home in Atlanta last week.

JULIUS GREENTREE, treasurer of the Buffalo House Wrecking and Salvage Co., died on Oct. 22.

Personals

JOHN W. HIGGINS, president and treasurer of the Worcester Pressed Steel Co., Worcester, Mass., was elected a member of the executive committee of the Associated Industries of Massachusetts, at the recent annual meeting held at the Copley-Plaza Hotel, Boston.

H. B. CHAMBERLAIN, who recently resigned as secretary of the Chamber of Commerce, of New Britain, Conn., has accepted a position with the Fafnir Bearing Co., of New Britain.

CHARLES L. ALLEN, treasurer and general manager of the Norton Co., Worcester, Mass., was elected as a member of the executive committee of the Associated Industries of Massachusetts, at the fifth annual meeting of the association held in Boston, Oct. 28.

R. A. SEATON has been appointed dean of the division of engineering and director of the engineering experiment station at the Kansas State Agricultural College, to fill the vacancy made by the resignation of Dean A. A. Potter. Previous to his appointment as dean, Mr. Seaton was professor of applied mechanics and machine design and in charge of the road materials testing laboratory.

DAVID MOULTON, formerly assistant mechanical engineer for Monks & Johnson, Boston, Mass., is now with the Walworth Manufacturing Co., Boston.

GEORGE W. CRAVENS is now vice-president and general manager for the Universal Body Corporation at Mishawaka, Ind.

JAMES D. MOONEY, until recently assistant to A. P. Sloan, Jr., vice-president of the General Motors Corporation, has been made general manager of the Remy electric division of that corporation, Anderson, Ind.

RALPH T. BRATT has severed his connection with Olney & Warrin, Inc., and is now employed in the industrial department of the Locomotive Superheater Co., New York.

JEROME R. GEORGE, vice-president of the Morgan Construction Co., Worcester, Mass., manufacturer of rolling mill machinery, was chosen an executive committee member of the Associated Industries of Massachusetts, at the fifth annual meeting held at Boston recently.

DOMESTIC EXPORTS FROM THE UNITED STATES BY COUNTRIES DURING SEPTEMBER, 1920, METAL-WORKING MACHINERY

Countries	Lathes	Other Machine Tools	Sharpening and Grinding Machines	All Other
Belgium	$84,799	$48,244	$29,667	$25,390
Denmark	.....	1,973	.....	1,671
Finland	.....	863	.....	.....
France	10,447	90,680	15,129	336,680
Germany	.....	.....	1,512	.....
Greece	.....	.....	363	.....
Italy	39,225	57,164	506	24,063
Netherlands	10,981	12,348	3,641	.....
Norway	50	7,506	.....	304
Poland and Danzig	740	.....	400	.....
Portugal	.....	.....	.....	2,048
Roumania	.....	1,816	.....	402
Russia in Europe	.....	42,800	.....	.....
Spain	1,684	17,045	1,582	4,373
Sweden	7,197	10,515	11,220	4,106
Switzerland	2,922	1,277	438	.....
Turkey in Europe	6,356	.....	.....	.....
England	88,531	178,760	107,460	270,109
Scotland	.....	3,240	224	693
British Honduras	.....	.....	23	41
Canada	50,756	136,098	43,035	190,085
Costa Rica	108	33	.....	.....
Guatemala	323	30	.....	60
Nicaragua	24	.....	.....	.....
Panama	.....	550	.....	.....
Mexico	7,316	9,739	9,564	10,731
Newfoundland and Labrador	.....	350	.....	20
Barbados	.....	299	.....	99
Trinidad and Tobago	.....	1,779	.....	.....
Other Brit. West Indies	700	.....	.....	.....
Cuba	32,663	29,721	2,889	21,077
Dominican Republic	2,298	293	.....	.....
Argentina	8,935	16,370	2,604	3,530
Brazil	4,786	17,398	1,297	1,973
Chile	.....	1,322	4,495	154
Colombia	3,402	2,529	728	.....
Ecuador	.....	27	.....	.....
Peru	4,602	1,455	2,752	1,014
Uruguay	2,025	2,073	.....	950
Venezuela	1,923	474	.....	414
China	53,009	238,985	10,931	6,137
Chosen	2,650	.....	.....	.....
British India	16,233	28,143	7,564	31,309
Straits Settlements	.....	221	.....	.....
Other British East Indies	.....	.....	120	.....
Dutch East Indies	482	252	2,142	153
French Indo China	1,725	.....	.....	.....
Hongkong	7,299	43,534	.....	99,117
Japan	13,844	104,571	55,581	116,746
Siam	.....	.....	588	.....
Australia	14,851	36,826	13,701	19,185
New Zealand	11,646	5,506	239	7,086
Philippine Islands	12,249	6,825	2,154	3,258
British South Africa	.....	16,262	1,059	6,317
Kamerun, etc	.....	.....	.....	1,048
Portuguese Africa	.....	279	236	.....
Total	$506,781	$1,176,175	$333,844	$1,190,343

Business Items

The Ilg Electric Ventilating Co., Chicago, Ill., has moved into its new plant at 2850 North Crawford Ave.

The Investing and Manufacturing Co., Bridgeport, Conn., has been organized recently to investigate, develop and aid small manufacturers and other mercantile business to locate, operate, etc. The capital stock is $100,000.

At a meeting of the stockholders of the Columbia Rubber Mills of Sheboygan, Wis., the following officers were elected: President, Leo Hofmeister; vice-president, Dr. F. Nouth, and treasurer, M. Holderson. The company's new plant will be ready for occupancy by Jan. 1, 1921. Rubber belting will be manufactured for wholesale use.

A part of the Meriden plant of the Colt's Patent Fire Arms Manufacturing Co. has been sold to the Aeolian Co. of Meriden. This part sold was used as a toolroom by the Colt company.

The Wickwire-Spencer Steel Corporation, of Worcester, Mass., and Buffalo, N. Y., has recently purchased a tract of land and several buildings in the Port Morris section of the Bronx, in New York City, to be utilized as a New York warehouse. The acquisition of this property will enable the company to use it as a distributing center for the nearby states.

The cotter-pin business of the Ohio Wire Goods Co., of Akron, Ohio, has been purchased by the Falls Rivet Co., of Kent, Ohio, and the machinery in the department is being removed to the Kent plant. The remainder of the Akron plant remains intact.

Forthcoming Meetings

The Federated American Engineering Societies will hold its first meeting at the Hotel New Willard, Washington, D. C., on Nov. 18 to 20 inclusive.

The 1920 annual meeting of the American Society of Mechanical Engineers will be held in the Engineering Societies Building, 29 West 39th Street, New York City, from Dec. 7 to Dec. 10.

The Society of Automotive Engineers will hold its annual meeting on Jan. 11 to 13 inclusive at New York.

November 25, 1920 American Machinist Vol. 53, No. 22

The Sellers 16-ft. Planer

SPECIAL CORRESPONDENCE

The present day requirements of shipbuilders are for some very large machine tools—so large that for transportation by rail, the principal members must be made of two or more pieces—and this calls for extra care in designing so that the machines will maintain their alignment.

THE planer illustrated in Fig. 1 weighs nearly half a million pounds and was recently completed by William Sellers & Co., Inc., 1600 Hamilton St., Philadelphia, Pa., for a large shipbuilding company.

The bed is made in three sections, a central one to which the uprights are bolted and which carries the driving shaft and pinion, and two end sections bolted to the central one with taper bolts.

The bed is of open top and bottom construction, the safety guards being of heavy sheet iron fastened across the top. The main feature of the bed is its rigidity, particularly at the vital section in line with the uprights, through which the principal strains are transmitted. The absence of gearing inside the bed permits the use of uninterrupted cross members. The table is driven by the well known Sellers type of planer drive, through a spiral pinion engaging a rack on the under side of the table. The spiral pinion is mounted on a shaft which is set at an angle of 33 deg. from the center line of the bed. The pinion is about 24 in. long. This drive in action makes contact on at least four of the teeth at all times. These contacts are along different portions of each tooth and, as in the case of Herringbone gears, the resulting action is continuously smooth, there being no tendency for the shape of the teeth, on either the rack or the pinion, to wear more at one point than another. The shaft on which the driving pinion is mounted, is in two sections, which are coupled by an accurately centered jaw clutch, and clamped together to maintain the alignment. The spiral pinion is forced on one section of the driving shaft under very heavy hydraulic pressure, and the construction of the bed and the bushings on the driving shaft, permit the removal of the spiral pinion and the section of shaft on which it is forced, as a unit. The other part of the driving shaft carries at its outer end a large herringbone gear, which is also forced on the shaft in a wheel press. This gear and its section of shaft may also be removed as a unit. With the construction as above noted, the amount of room required to remove the driving shaft from the machine is minimized and the construction and installation made much easier. On the left-hand side of the machine (the side opposite to the usual operating one) the bed carries the bearings for taking the thrust of the main driving shaft in both directions. An adjustment is provided for setting up these thrust bearings, and a continuous oil bath is supplied. Around the spiral pinion is a box, open only at the top, which is used as a reservoir for running the pinion in oil.

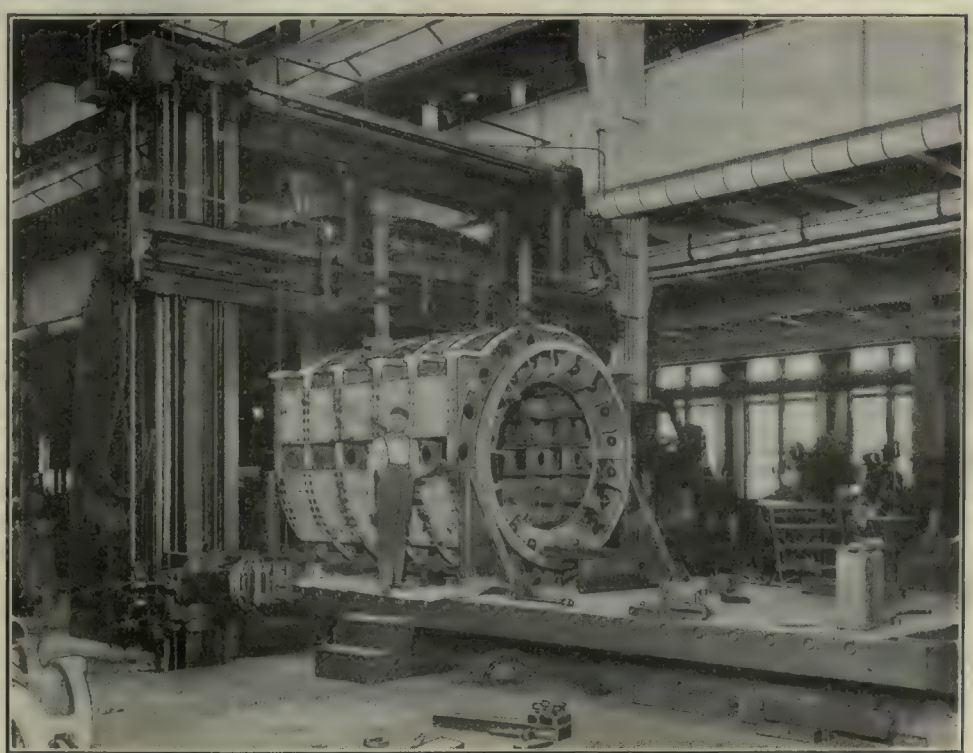


FIG. 1. SELLERS 16 x 13 x 36 FT. PLANER

Specifications: Will plane 16 ft. in width, 13 ft. in height and 36 ft. in length. Width of table, 13 ft. Uprights: width of face, 24 in.; depth, front to back, 10 ft. Cross-rail: face, 27½ in.; height, including reinforcing beam, 51 in. Table rack: pitch, 3¼ in.; face, 12 in. Weight, 412,300 pounds.

On the opposite end of the driving shaft, the main driving gear is carried in a stand or housing entirely

outside of the bed. This main stand also carries the bearings for the intermediate shaft, and the shaft which is coupled directly to the motor. As this brings all of the driving gears outside of the bed, the bearings are open to inspection and care with a minimum amount of effort. The complete driving gear train consists of two pairs of herringbone gears and the spiral pinion in the bed. The gears are completely covered and are supplied with a continuous oil bath.

The motor rests on a separate base plate, supported and aligned on the foundation of the machine and is coupled to the motor pinion shaft by a Francke flexible coupling. The motor is of the regular reversing planer type of 75 hp. capacity, having a speed range of 250 to 1,000 r.p.m. Variable cutting speeds from 20 to 40 ft. per minute are obtainable by the adjustment of a handle on the motor control. Safety devices are provided in the control panel to take care of low voltage, no voltage, overload and emergency stop. The master switch is operated by the usual type of table stops and dogs, and initiates the movement of the electrical contactors in the control panel to produce the cycle of operations of the motor. A portable pendant switch is furnished which may be used by the operator at any time, instead of the control handles, to move the table as desired. It is used mostly when setting up the work on the table. The return speeds of the machine are selective between 40 to 80 ft. per minute.

Table Dimensions

The table is 13 ft. wide, and in order to meet the limits imposed by shipping facilities, is made up in three lengthwise sections. The middle section is 10 ft. wide, and made in 2 pieces, one 18 ft. 3 in. long, and the other 20 ft. 3 in. long. The two side sections each 18 in. wide, run the whole length of the table, 38 ft. 6 in. The sections are held together by straight and taper dowel bolts, and double T-bolts and wedges. The table is provided with parallel grooves for aligning the work and with rectangular holes for the use of stops and bolts. The table is guided upon one flat and one V-bearing, the latter being a combination of the usual V-bearing of wide angle and at the sides, two surfaces inclined at 5 deg. to the vertical. These two nearly vertical surfaces are provided to resist any tendency of the table to move sideways under pressure which might be great enough to force the table upward on the V. Both the flat and the V-bearings are lubricated by oil delivered by a pump installed for this purpose only. The oil enters the ways or bearings at the middle of the bed, is forced along grooves cut on the under side of the table bearings and flows out into the open ways at either end. Drainage tanks with strainers are provided at each end of the bed. The oil is collected by them and flows through return pipes back to the reservoir provided. Catch pans are also furnished at each end of the bed for collecting the oil which may drip from the overhanging table.

William Sellers & Co., Inc., we believe, was the first user of the principle of forced lubrication for planer tables. Records show that the first use was made by that company in 1901. All planers made by it since that date have had this feature incorporated.

The cross-rail is of the extended-back type. The usual and older type of crosshead was reinforced between the uprights by a curved back, which was deepest at the middle of its length and was clamped to the front faces of the uprights. While this curved back extended the horizontal depth of the cross-rail and increased its strength in that direction, it did not increase its torsional strength which was fixed by the section at the point of attachment to the uprights. The "extended back" crosshead in contrast, is of continuous depth between the uprights and is clamped on the inside of the uprights at the back edge of the cross-rail extension, as well as to the front of the uprights on the outside. A groove is provided in each upright for clamping purposes. It can be readily seen that this construction adds tremendously to the stiffness of the cross-rail to resist torsion and also, by providing an additional tie between the uprights, adds considerably to the rigidity of the whole structure. The effect of this rigidity is noticeable in the character of work turned out with this machine.

In a cross-rail with a span of 16 ft. between supports there is usually a small amount of vertical deflection, due to the weight of the rail and saddles. This is eliminated in the machine under discussion by the application of an arched girder bolted to the top surface of the cross-rail and provided with a solid abutment at one end and a wedge abutment at the other. By setting up the wedge a practically perfect straight line is maintained in the guiding surface for the saddles.

Another difficulty caused by the length of the cross-rail, is the tendency of the screws and rods for moving the saddles to sag in the middle. To maintain their alignment, sliding bearings are used. These bearings, three in number, have an automatic latch arrangement, which insures one of them being at the center of the cross-rail at all times when neither of the saddles is at that position.

A limit switch is provided to prevent over running the crosshead when lifting.

A Pneumatic Device for Clamping Crossrail to Uprights

The general practice in building planers is to provide ordinary bolts and nuts for clamping the cross-rail to the uprights. There should be at least eight bolts on a planer of large proportions and in order to loosen and tighten them the operator has to move all over the machine, and frequently operates them under disadvantageous conditions. Considerable time is consumed whenever the cross-rail has to be adjusted up or down on the uprights, and much care on the part of the operator is required to insure that all of the clamping bolts are released or secured. On the planer under discussion, this work is done by pneumatic cylinders. These cylinders are located at the four points of clamping, namely, on the outside and inside of each upright. Each cylinder clamps two bolts.

In this pneumatic clamping device, each piston is connected to an upper clamp and each cylinder connected to and supported by a lower clamp, so that, in opening or closing, each clamp is used as an abutment for operating the one either above or below it. The four cylinders are connected by flexible hose and pipe to an operating valve within easy reach of the operator. A selective movement of the valve causes the cylinders to either open or close. After the cross-rail has been clamped the air passage may be released by the valve, as the clamps are so designed that they will not loosen until air is applied in the reverse direction. This feature is essential in a pneumatic clamp for a planer or other tool, where the length of time consumed on a single job may cover a period during which there may

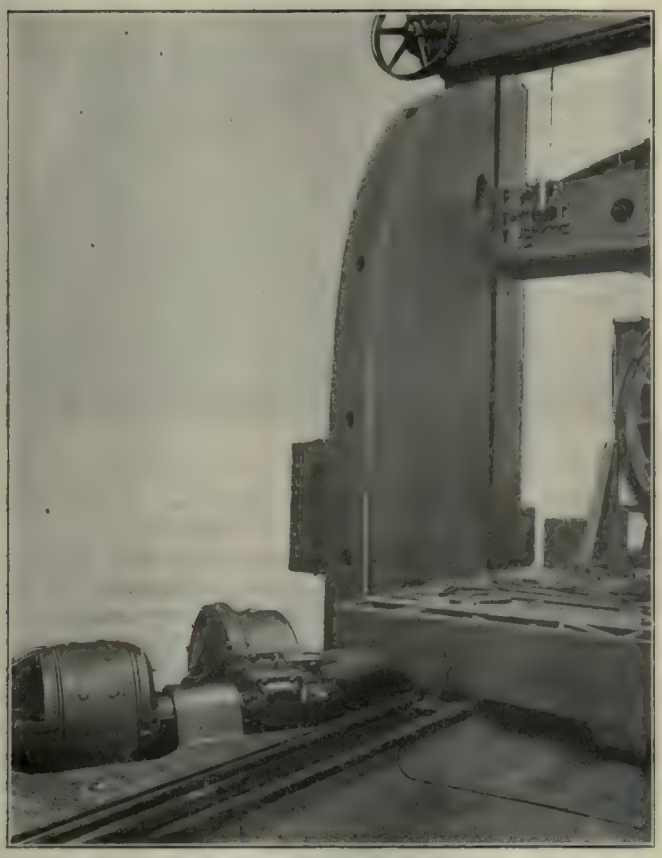


FIG. 2. DRIVING GEAR AND PNEUMATIC CLAMP FOR CROSS-RAIL

be no air pressure to maintain the clamp. If the pressure should fail even for a moment, and the clamp relax, serious results might follow.

The toolheads on the cross-rail are provided with a tool lifting device which automatically operates to hold the tools off of the work during the return stroke of the planer. They are also provided with a power traversing arrangement which moves the toolslides and the saddles. Each head is operated through an independent feed disk at the end of the cross-rail, making it possible to adjust the amount and the direction of the two sets of feeds independently.

A Sidehead Is Mounted on Each Upright

A side head of substantial proportion is mounted on each upright, and in addition to having the usual power feed up and down the upright, it has a power cross or angular feed for the tool slide. Power traversing mechanism is also provided for the side heads up and down the upright.

It is desirable that the feed motion of a planer should operate at a uniform rate of speed, irrespective of the speed of table movement. This is accomplished by the use of a separate motor, mounted on the platform at the top of the machine. This motor drives through belt and gearing to a roller feed box or escapement.

The escapement when released makes one half turn and stops. This half turn operates the slotted feed disks. The escapement is released at each end of the stroke, so that the feed may take place at one end and the reset take place at the other. The operating means between the feed disks and the heads consist of the usual type of gear segments and ratchets.

The difference between this type of feed and the commoner type operated by the driving mechanism, lies in the timing relation of the feed to the table reversal. Electrical connections are made between the table operating switch and a solenoid mechanism which trips or releases the feed mechanism. The time of release causes the feed mechanism to operate during the time taken by the table to reverse and not after the reversal as in the dependent type. Less overrun of the tool beyond the work and a consequent saving of time results.

It is also possible to disconnect the trip or releasing mechanism, from the operator's position, by the throw of a lever. A reverse motion of the lever connects the trip arrangement and re-establishes the automatic timing. When the auto feed is thrown out the table may be operated as desired with the certainty that by a single motion the feed can be resumed at the point where it was discontinued.

In Fig. 1 can be seen the reinforcing beam on the cross-rail, the rope for tool-lifting arrangement, and one line of bolts fastening the side pieces to the table.

Fig. 2 shows the driving gear arrangement at the back of the right-hand upright. The housing for the large wheel is clearly shown as well as the bolts for removing the parts necessary to uncover all of the driving gears. In the upper right-hand portion of the picture can be seen one of the pneumatic clamping cylinders, operating at the back of the extended portion of the cross-rail. The clamping slot in the upright is also clearly shown.

Driving Train Arrangement

Fig. 3 shows the arrangement of the complete driving train from the motor *M* at one end, to the main thrust bearing *B* at the opposite end.

At *A* is seen the spiral pinion for driving the table rack; at *D* is shown the coupling for the two sections of driving shaft; *L* is the long bolt for holding the two sections together; *E* and *G* are the two herringbone gears in the driving train with the mating pinions shown in mesh; *H* is a flexible coupling between the motor and the motor pinion shaft. At *C* is shown the thrust bearing used during the return movement of the

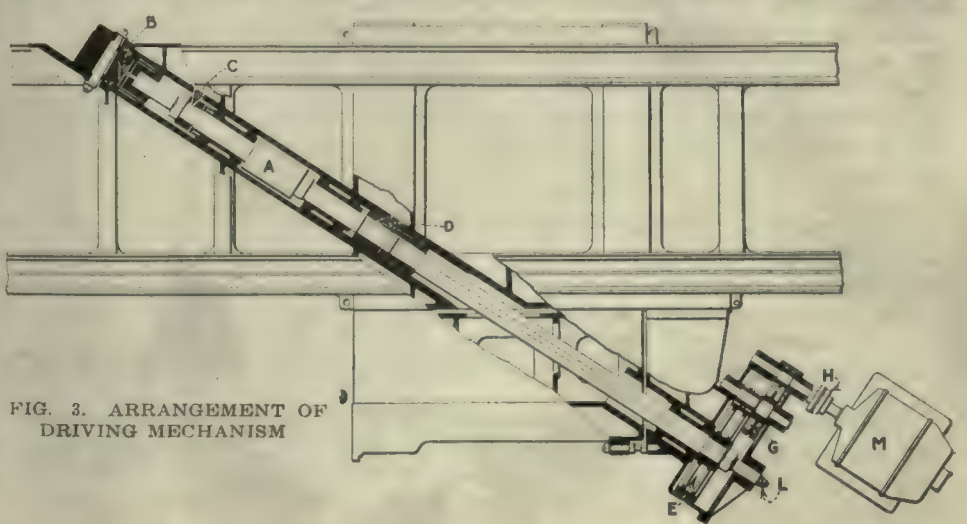


FIG. 3. ARRANGEMENT OF DRIVING MECHANISM

table. The wedge bolt in back of *B* for adjusting the steps is clearly shown. It should be noted that the provision made for the driving gear consists of a continuous hollow cylinder running diagonally across the bed, which increases the strength of the structure instead of decreasing it, as does the spur geared construction. The simplicity of the drive is evident.

Some idea of the size of this machine may be had by comparing its proportions with that of the man to be seen standing on the table in Fig. 1 and by the following weights of some of the principle members in the rough:

	Pounds
BED:	
Center section	65,400
Front section	36,000
Back section	22,000
	123,400
TABLE:	
Center section (front)	60,100
Center section (back)	53,000
Side pieces	38,000
	151,100
Right-hand upright	43,000
Left-hand upright	43,000
Cross rail	23,300
	109,300

Handling Large Work on Small Lathes

BY FRANK C. HUDSON

The usual method of blocking up headstock and tailstock did not suffice for the manager of the Pacific Machine Co., Tacoma, Wash., as a means of handling

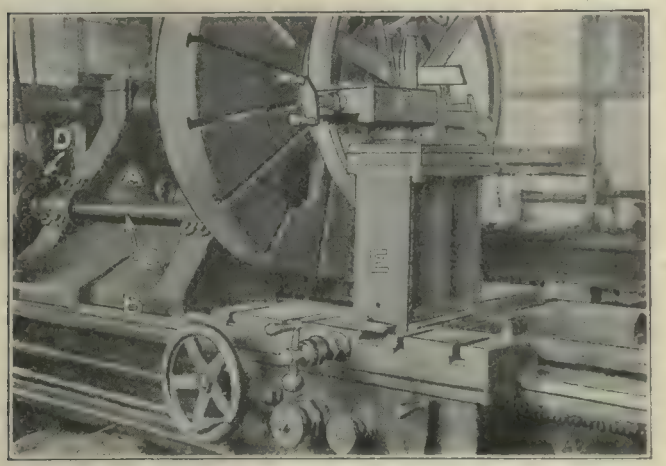


FIG. 1. AN IMPROVISED TRIPLE GEARED LATHE

the large work which occasionally came his way. So, taking an 18-in. Hamilton lathe, as a basis, he built the auxiliary triple-geared headstock shown at *A* in Fig. 1, for use on large faceplate work. This headstock is mounted in front of the regular headstock and rests on all four V's, being cut away at *B*, so as to allow the wing of the carriage to pass by when it is necessary to get the tool close to the faceplate. The shaft *C* is bolted directly to the nose of the spindle in the regular headstock at *D* and its outer end carries a pinion meshing with an internal gear on the back of the faceplate. This arrangement gives great reduction in speed and, in connection with the regular back gears of the lathe, makes a powerful pull at any of the speeds of the regular headstock.

The extension tool block *E* and the toolslide *F* bring the cutting tool up to the proper position and also give it the advantages of the compound rest for boring short holes or turning and boring tapers. This

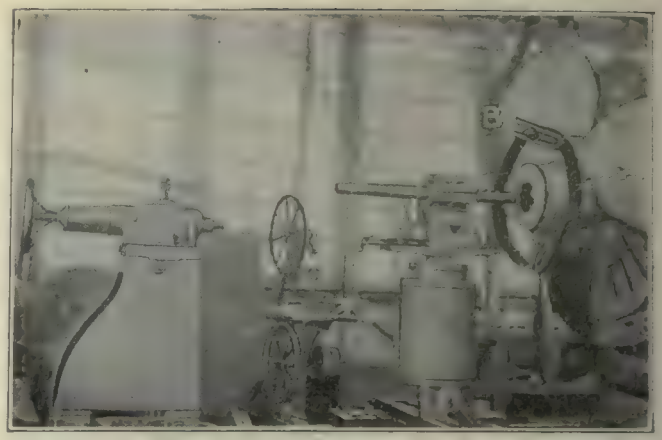


FIG. 2. BORING A THREE-BLADED PROPELLER

arrangement has proved very successful on the kind of jobbing work for which it is used.

Another case of increased lathe swing was found at the Coast Machine Co., a neighboring shop, as is shown in Fig. 2. This is a lathe of comparatively large swing, the head and tailstocks of which have been raised by blocking up in the usual manner. The job in hand is the boring of the taper hole in the hub of a three-bladed propeller. The illustration shows how the propeller is bolted to the faceplate by means of the ring *A* and the three hairpin clamps spaced about equal distances around the ring. The holding bolts go through the faceplate in the usual manner. The boring tool in the bar *B* is fed by hand owing to the taper, this being accomplished by means of the compound rest shown.

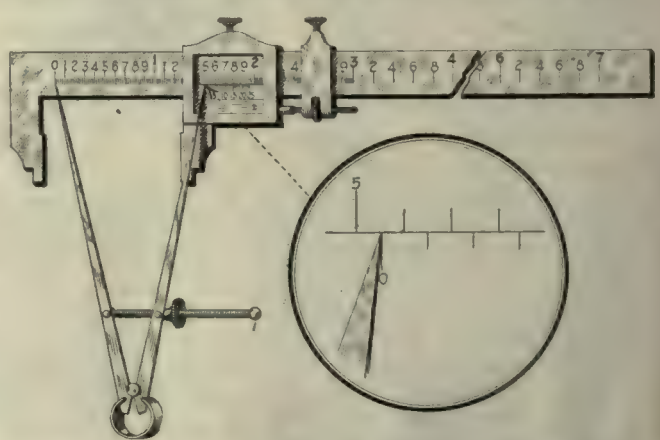
It is the unusual job of this kind that makes a repair shop interesting and gives the workers therein unusual experience in devising ways and means of handling the work and also of machining it.

Laying Off Angles Without a Protractor

BY ANTON BRUNNER

The drawing herewith shows a kink I use in laying out work that requires exceptional accuracy.

In laying off angles to minutes I employ trigonometry instead of a protractor, and as the length of a side might easily be such as to lie between the graduation marks of an ordinary scale I set my dividers by placing one point on the zero line of the bar and the other point on the zero line of the vernier, the caliper having been duly set to the required measurement.



SETTING DIVIDERS BY MEANS OF A VERNIER CALIPER

Acceleration Determinations—I

By HENRY N. BONIS, B. S., M. E.
Assistant Professor of Mechanical Engineering, Purdue University

Following the line of reasoning introduced in his previous article the author goes on to other applications of first principles to the solution of acceleration problems. In this article he tackles the quadric chain and winds up with a general solution for the Whitworth quick-return motion as generally applied to the shaper mechanism.

IN DETERMINING the accelerations of any point of a mechanism we are sometimes confronted with a quadric chain for which the usual solutions given become indeterminate. It is one of the objects of the present article to give means of solving or evaluating these special cases. In view of the importance of the sliding joint to the designer of machinery it seems strange that more attention has not been paid to the problem of determining directly the accelerations in the quadric chain with this joint included. Aside from the special case of the slider-crank chain or steam-engine mechanism the writer knows of no book that takes up this particular problem. The only method given consists of finding a velocity-time or velocity-space curve and then determining the acceleration from this graph. It should be understood that this method depends on drawing a tangent to a curve concerning the geometrical properties of which we know nothing.

The quadric chain, when it consists only of four links and four turning pairs, can be readily solved by any one of several common constructions. In the case of constant angular velocity of the driver we have the Rittenhaus Construction. In the general case of variable angular velocity of the driver we have:

(1) Professor Mohr's Construction.

(2) The construction based upon analytical deduction where the absolute acceleration of a point of a body in uniplanar motion consists of three components, a centripetal and a tangential component about the instantaneous center and the acceleration ($\mu\omega$) of the instantaneous center. This result combined with the use of Bobillier's Construction gives the method employed in Professor Klein's book "Kinematics of Machinery."

(3) The construction based upon fundamental principles and the one that usually gives the simplest solution. (See "Dunkerly's Mechanism.")

All of these constructions can be applied to the case of constant angular velocity of the driver as well.

But when the quadric chain contains a sliding pair the above constructions do not always suffice. Referring to Fig. 1, if the links 1 and 4 become infinitely long, that is if link 4 is replaced by a sliding block, we get the slider-crank mechanism used in the steam engine and all the above constructions give a determinate result. But if link 3 is made infinitely long or reduced to a sliding block which turns about center (23) and slides on link 4 (See Fig. 3) all of the above constructions are inadequate, because the point $C(34)$ (Fig. 1), which is at an infinite distance from its center of rotation $D(41)$, has an infinite acceleration. In other words, the angular acceleration of link 4 is indeterminate from these constructions from the acceleration of point $C(34)$. There is one exception in the case of construction 2, which will be taken up in the discussion of the double quadric chain known as the Whitworth quick-return motion, as shown in Fig. 3.

In what follows the writer will give:

(1) A simple original proof of Rittenhaus' Construction.

(2) A principle by which any constant angular velocity construction can be modified to apply to the general case with application to Rittenhaus' Construction.

(3) An original construction for the general case of the quadric chain;

(4) A complete solution of the acceleration problem involved in the Whitworth quick-return motion by three different methods. In Fig. 1 we have $ABCD$ as the quadric chain with AD or link 1 fixed, AB or link 2 as the driver and the constant velocity and acceleration of point B represented by AB. Construction: Draw AF parallel to BC, and AH parallel to DC. Prolong BC and AD to Q, and BA and CD to P. Join QF and HP. At points K and J erect perpendiculars to AH and AF respectively. Join intersection O with H. Then HO is the acceleration of point C in direction and magnitude. (See *Zeitschrift des Vereines Deutcher Ingenieure*, Vol. XXVII, 1883, p. 287, or Klein's "Kinematics of Machinery," p. 140.)

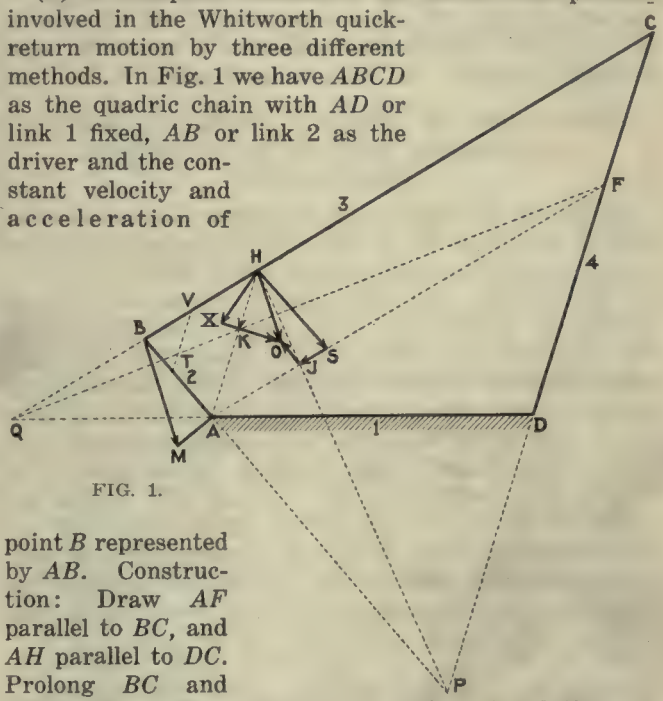


FIG. 1.

Proof: Draw HS parallel to BA.

Since triangles JSH and BHP are similar

$$\frac{JS}{SH} = \frac{BH}{BP}. \quad \text{But } SH = AB$$

$$\therefore \frac{JS}{AB} = \frac{BH}{BP} \tag{1}$$

Also triangles BHA and BCP are similar

$$\therefore \frac{BA}{BP} = \frac{BH}{BC} \tag{2}$$

Multiplying equations 1 and 2 together, cancelling and reducing

$$SJ = \frac{BH^2}{BC} \tag{3}$$

From similar triangles QHK and QCF we have

$$\frac{HK}{CF} = \frac{AH}{CD}. \quad \text{But } CF = AH$$

$$\therefore HK = \frac{AH^2}{CD} \qquad (4)$$

Analyzing the figure $HSJOKH$, which is a polygon of accelerations, with H as pole we notice that

$HS = BA =$ acceleration of point B;

$SJ = \frac{\overline{BH}^2}{BC} =$ centripetal acceleration of C about B;

$OJ =$ tangential acceleration of C about B;

$HK = \frac{\overline{AH}^2}{CD} =$ centripetal acceleration of C about D;

$KO =$ tangential acceleration of C about D;

and hence, vectorially, $HK + KO = HS + SJ + JO = HO$, is the resultant acceleration of point C.

It is to be noted that triangle BAH is a triangle of velocities where AB is the velocity of B, AH the velocity of C and BH the relative velocity of C about B. (See Smith's "Graphics" or Dunkerly's "Mechanism.")

Modification of Constant Angular Velocity Construction to Apply to Rittenhaus' Construction

Referring to Fig. 1, we are given the acceleration BM of the point B of the quadric chain $ABCD$ and are required to find the acceleration of point C.

Construction: Lay off BM to scale so that its centripetal acceleration component is represented by the driver-crank radius BA. Then AM represents the tangential component of BM (AM is perpendicular to AB at A). Then, using BA as the total acceleration of B just as if the point B rotated uniformly, and using Rittenhaus' Construction as under case 1 we obtain the acceleration HO. Lay off $BT = AM$ and draw TV parallel to AH or CD. Make $OX = TV$ and join H and X. Then HX is the acceleration of C when the acceleration of B is BM. It should be noted that OX should be laid along the line OK from O to K when AM is left-handed and vice versa in the case of right-handed tangential acceleration. It will be observed that this method consists of finding the independent effects of the components of B and then adding them together geometrically. Or it may be said that we have combined two systems, one a quadric chain with constant angular velocity of the driver, the other a quadric chain momentarily at rest and with the point B having an acceleration AM. The effect of the first system is to give C an acceleration HO. Since the second system is at rest the centripetal acceleration of C about B is zero, the centripetal acceleration of C about D is also zero, and hence the acceleration of C being perpendicular to CD we can find its magnitude by a triangle similar to a triangle of velocities such as BTV. As constructed, the side BT is equal to AM and therefore TV is the acceleration of C due to the second system. Now $HX = HO + OX$ vectorially and as $OX = TV$ in magnitude, we have the total effect HX. It will also be noted that the direction of OX as laid out is along the line OK which is perpendicular to AH or CD. I have used Rittenhaus' Construction in this article as it lends itself conveniently to the modification, but it will be plainly seen that any other construction for finding the acceleration with constant velocity of the driver may be extended to the general case by the use of this principle of the superposition of two independent acceleration systems in plane motion. This theorem does not seem to be given in any of the modern textbooks on Kinematics.

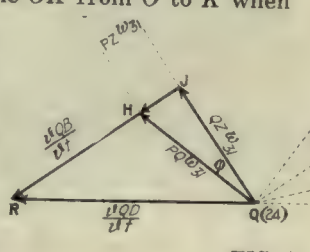


FIG. 2.

General Case of the Quadric Chain

Referring to Fig. 2, we have $ABCD$ as the quadric chain with AD or link 1 fixed. Let ω and A stand for angular velocity and angular acceleration respectively, and the subscripts denote the link and reference link. Thus ω_{41} and A_{41} denote the angular velocity and acceleration of link 4 with respect to link 1. Prolong AB and CD to $P(13)$ and BC and AD to $Q(24)$. Join PQ.

Now we have (Klein's "Kinematics of Machinery")

$$\frac{\omega_{41}}{\omega_{21}} = \frac{24-21}{24-41} = \frac{QA}{QD}$$

Differentiating with respect to time and using $A = \frac{\delta\omega}{\delta t}$, we have

$$\frac{\omega_{21}A_{41} - \omega_{41}A_{21}}{\omega_{21}^2} = \frac{QD\frac{\delta QA}{\delta t} - QA\frac{\delta QD}{\delta t}}{\overline{QD}^2}$$

But $QD = QA + AD$ and $\frac{\delta QD}{\delta t} = \frac{\delta QA}{\delta t}$ since AD is constant. Hence the above equation reduces after clearing of fractions to

$$\omega_{21}A_{41} - \omega_{41}A_{21} = \frac{AD\omega_{21}^2}{\overline{QD}^2} \cdot \frac{\delta QD}{\delta t} \text{ or solving for } A_{41} \text{ we have}$$

$$A_{41} = \frac{AD\omega_{21}^2}{QD^2} \cdot \frac{\delta QD}{\delta t} + \frac{\omega_{41}}{\omega_{21}} \cdot A_{21}$$

But $\frac{\omega_{24}}{\omega_{21}} = \frac{\omega_{42}}{\omega_{12}} = \frac{14-12}{14-42} = \frac{DA}{DQ}$, or $\omega_{24} = \frac{DA}{DQ}\omega_{21}$, hence substituting above we have

$$A_{41} = \frac{\omega_{24}}{QD} \cdot \frac{\delta QD}{\delta t} + \frac{\omega_{41}}{\omega_{21}} \cdot A_{21} \qquad (1)$$

In order to find $\frac{\delta QD}{\delta t}$ we proceed as follows: The point Q as a point on link 3 has a velocity QH perpendicular to QP about P. But if Q is to remain on the line QD the point Q must have a velocity along link 3. Hence, draw QH perpendicular to QP and equal to $QP\omega_{31}$ and draw HR parallel to link 3 and we get QR as the value of $\frac{\delta QD}{\delta t}$.

Draw PZ and AZ' perpendicular to link 3, draw AC' parallel to link 4, draw AQ' parallel to PQ and QJ perpendicular and HJ parallel to link 3.

Now triangles QHJ, QPZ and $Q'AZ'$ are similar and we have

$$\frac{JH}{PZ} = \frac{HQ}{PQ} = \frac{PQ\omega_{31}}{PQ} = \omega_{31} \text{ or } JH = PZ\omega_{31}$$

similarly $$QJ = QZ\omega_{31}$$

Also $$\frac{JH}{AZ'} = \frac{QH}{AQ'} = \frac{PQ\omega_{31}}{AQ'} = \frac{PB\omega_{31}}{AB} = \omega_{21}$$

Hence $$JH = PZ\omega_{31} = AZ'\omega_{21} \quad \text{and similarly}$$
$$QJ = QZ\omega_{31} = Q'Z'\omega_{21}$$

All of these relations could have been derived immediately by use of Professor Roseburg's Phorograph or by a simple application of the elementary notions of the physical properties of a rigid body in plane motion. It will be noticed that the images Z', C' and Q' of the points Z, C and Q have been marked to correspond. (See Angus' "Theory of Machines.")

Again—triangles QJR and $AZ'Q$ are similar and we have

$\frac{QR}{QJ} = \frac{QA}{AZ'}$. But $QR = \frac{\delta QD}{\delta t}$ and $QJ = Q'Z'\omega_{21}$ from above, and

$AZ' = Q'Z' \tan\phi$ where ϕ is the angle BQP or angle $BQ'A$. Substituting we have

$$\frac{\frac{\delta QD}{\delta t}}{Q'Z'\omega_{21}} = \frac{QA}{Q'Z'\tan\phi} \text{ or } \frac{\delta QD}{\delta t} = QA\omega_{21}\cot\phi.$$

But $QA_{21} = QD_{41}$ and hence $\frac{\delta QD}{\delta t} = QD\omega_{41}\cot\phi$. Substituting this in equation 1 we get

$$A_{41} = \omega_{24}\omega_{41}\cot\phi + \frac{\omega_{41}}{\omega_{21}}A_{21} \qquad (2)$$

Dividing by ω_{41}^2 we get

$$\left(\frac{A_{41}}{\omega_{41}^2}\right) = \left(\frac{\omega_{24}}{\omega_{41}}\right)\cot\phi + \left(\frac{\omega_{21}}{\omega_{41}}\right)\left(\frac{A_{21}}{\omega_{21}^2}\right) \qquad (3)$$

Now equation 3 gives us a relation between the tangents of the angles made by the acceleration vectors of any points on links 1 and 4 with their corresponding radii, and lends itself to a very simple graphical construction.

Let G and X be the angles made by the acceleration vectors with links 1 and 4 respectively (see Fig. 2). Then we have $\frac{\omega_{24}}{\omega_{41}} = \frac{AD}{QA}$ and $\frac{\omega_{21}}{\omega_{41}} = \frac{QD}{QA}$. Substituting we have

$$\tan X = \frac{AD\cot\phi + QD\tan G}{QA} \qquad (4)$$

Now let P be any point on link 4 and we are required to find its acceleration, having given the acceleration of any point on link 1. Divide the radial distance PD in the ratio QA is to QD at I by joining Q to P and drawing AI parallel to QP. At D and I erect perpendiculars DM and IK to PD. Draw PM making angle MPD equal to angle G made by the vector of any point on link 1 with its radius vector to center A, and draw KM making the angle KMY equal to ϕ. Join the intersection K of KI and KM to P, and we have $KPD = X$ = angle made by acceleration vector of any point on link 4 with its radius to center D. If we now lay off from P to D the centripetal acceleration $PD\omega_{41}^2$ from P toward D, say PE, which can be easily calculated or constructed graphically, and draw a perpendicular to PD at the point E, limited by the line PK at L, we then have EL as the tangential acceleration and PL as the total acceleration of point P on link 4.

Proof: Draw MS parallel to link 4. Then we have

$$\tan X = \frac{KI}{PI} = \frac{KI}{ID}\cdot\frac{ID}{PI} = \frac{KS+SI}{ID}\cdot\frac{ID}{PI}$$
$$= \frac{KS+MD}{ID}\cdot\frac{ID}{PI} = \frac{KS}{ID}\cdot\frac{ID}{PI} + \frac{MD}{ID}\cdot\frac{ID}{PI}$$
$$= \frac{KS}{SM}\cdot\frac{ID}{PI} + \frac{MD}{PI}.$$

But $\frac{KS}{SM} = \cot\phi$ since angle $SKM = KMY = \phi$

$$\frac{ID}{PI} = \frac{AD}{QA} \text{ by construction}$$
$$\frac{MD}{PI} = \frac{PD\tan G}{PI} = \frac{QD}{QA}\tan G$$

Substituting we get $\tan X = \frac{AD}{QA}\cot\phi + \frac{QD}{QA}\tan G$ which satisfies 4.

In the practical execution of this construction we can use the length PE, instead of PD, if the length of the centripetal acceleration vector permits a conveninent scale, and thereby eliminate the drawing of one line, save time and obtain the resultant acceleration more directly. It should be noted that this construction solves the problem of going directly from link 1 to link 4 without finding the accelerations of points B and C as intermediate steps, and therefore overcomes the difficulty mentioned in the books on Kinematics. (See Klein's "Kinematics of Machinery," page 161, last paragraph; Dunkerly's "Mechanism," page 265, second line, etc.; Durley's "Kinematics of Machines," page 158, top line; Angus' "Theory of Machines," page 281, top and bottom lines; Dalby's "Valve and Valve-Gear Mechanisms," page 289, line 10.)

It also gives a very simple construction for finding the angular acceleration of link 4 when link 3 is a sliding piece, as will be shown under Fig. 3. In all graphical constructions care must be exercised as to the signs of the various quantities involved, and for this construction the same precaution must be taken in laying out the angles G and ϕ. If the angular acceleration of link 1 is left-hand then the angle $MPD = G$ must be laid off on the left-hand side of the radial distance DP. If the angle ϕ, which is the angle between link 3 or BC and the line QP joining centers 24 and 13, is obtained by rotating BC about Q in a left-hand direction, is called plus, then the angle YMK, which is equal to φ, must be laid off right-handed or in a negative direction from the line YM about M.

The Whitworth Quick-Return Motion

Referring to Fig. 3 we have the turning-block slider-crank chain of Reuleux which is applied to quick-return motions. There are two quadric chains, 1234 and 1456. The problem is to determine the acceleration of the block 6 when the angular velocity and angular accelera-

tion of the driving link 2 are given about its fixed center $A(21)$. The procedure in each method will be to find the acceleration of the point $E(45)$ from the quadric chain 1234 and then to find the acceleration of $F(56)$ from the quadric chain 1456. Only one solution of this second step will be shown, as the main difficulty lies in determining the acceleration of point E. The three methods used for the solution of this problem will be based upon (a) law of Coriolis, (b) analytical method, (c) the original construction, section 3.

Solution Using Law of Coriolis

Let BB'_2 represent the velocity of point B about the fixed center $A(12)$. Then if the angular velocity ω_{21} is constant, $BB''_2 = \frac{(BB_2)^2}{AB}$ = centripetal acceleration of point B on link 3. We will first consider the case of constant angular velocity of the driver. Resolve the velocity BB'_2 into its normal BB' and sliding $B'B'_2$ components. Then the velocity of the point on link 4 directly under B on link 3 is also BB'. Join B' and D. Then the angle BDB' will represent the angular velocity ω_{41}. (By saying that a finite angle represents an angular velocity or acceleration I mean the tangent of the angle. If the angle is infinitesimal, then it makes no difference whether we use the tangent or the angle). Draw EE'_1 perpendicular to DE and limited by the line DB' extended and we have the velocity of point $E(45)$. To find the velocity of $F(56)$ draw EF'_1 parallel to the path of F and $E'_1F'_1$ perpendicular to link 5. Then EF'_1 is the total velocity of $F(56)$ and $E'_1F'_1$ is the relative velocity of point F to point E. This completes the solution of the velocity determinations.

Now considering point B on link 3 as having a relative velocity equal to the sliding component $B'B'_2$ along link 4 and at the same time partaking of the angular velocity and acceleration of link 4, we know by the law of Coriolis that the total acceleration of B (which in this case is given and equal to BB''_2) is the sum of three accelerations (see article by the same author on page 928 of last issue). These accelerations are the acceleration of point B on link 4, the relative acceleration of point B to link 4 which we know in this case has the direction of the line of link 4, and the fictitious acceleration equal to twice the product of the relative velocity $B'B'_2$ and the angular velocity ω_{41}. To determine this third component graphically lay off DN on link 4 equal to twice $B'B'_2$ and erect a perpendicular NN' to DN at N and limited by the line BB'. Then NN' is the fictitious component. The direction of the acceleration will be from N to N' in this particular position for if link 2 is considered to be rotating counterclockwise link 4 is rotating clockwise. Lay off BB''_4 from B toward D to represent the centripetal acceleration of point B on link 4, which is equal to $\frac{(BB')^2}{DB}$, draw $B''_4B''_3$ perpendicular to link 4 at B''_4 and draw the line $B''_3B''_2$ also perpendicular to link 4 and

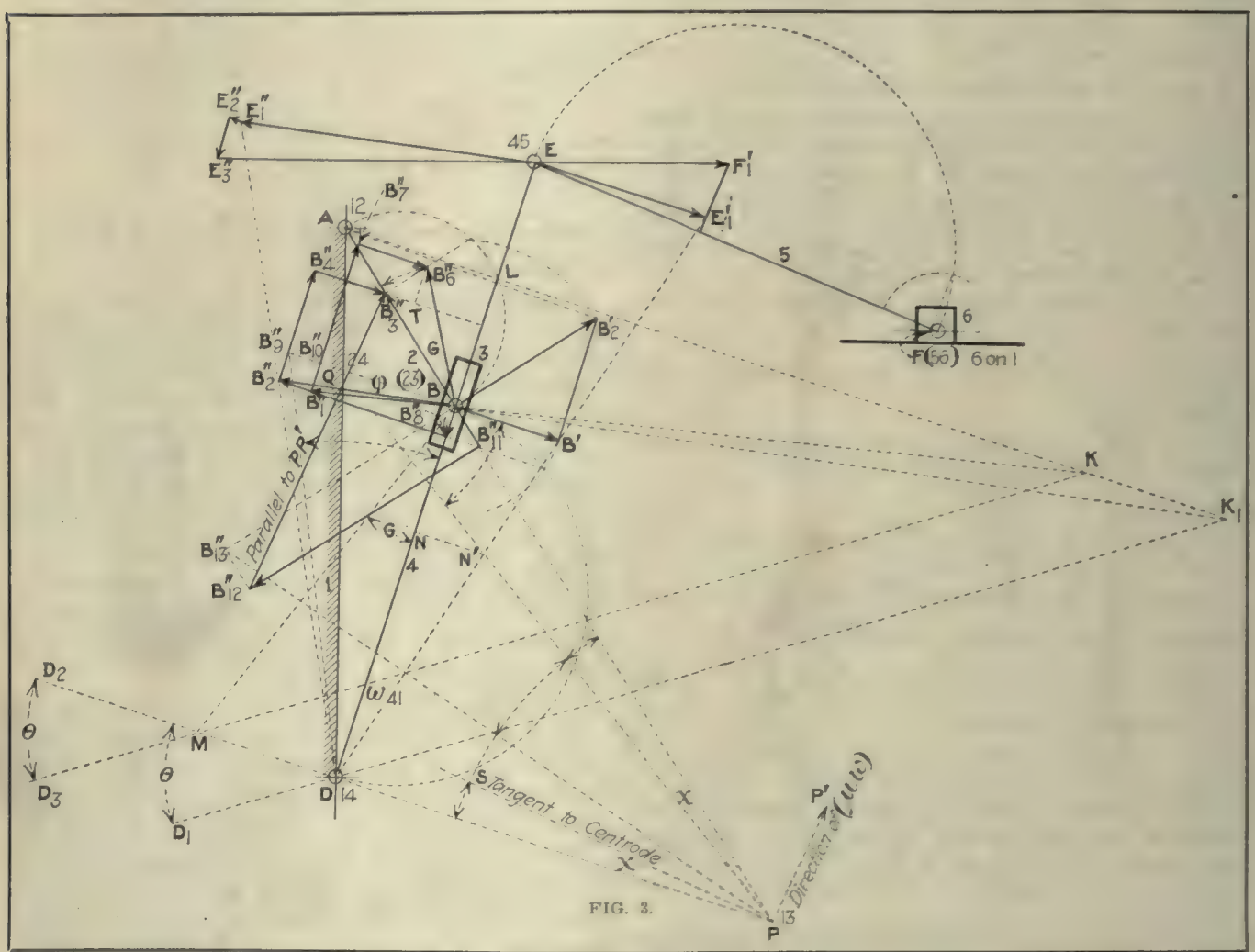


FIG. 3.

equal to NN'. At B''_4 draw $B''_4B''_2$ parallel to link 4 and we have by joining B with B''_2 the acceleration of point B on link 4. The acceleration of point B on link 3 relative to point B on link 4 is $B''_2B''_4$ (that is the block has this acceleration relative to rod 4) and $B''_4B''_3$ is the Coriolis component. These three accelerations add up vectorially to the resultant acceleration BB''_2. Draw $DB''_2E''_3$ and through point E draw EE''_3 parallel to BB''_2 and we have EE''_3 as the acceleration of point E. Draw BB''_3 at B perpendicular to link 4 and we have by joining D with B''_3 the angular acceleration of link 4 represented by the angle B''_3DB.

Draw $E''_3E''_2$ parallel to link 5 and equal to $\frac{(E_3F_3)^2}{EF}$ to represent the centripetal acceleration of F to E and draw $E''_2E''_1$ perpendicular to link 5 to represent the direction of the tangential acceleration of F about E. Since the direction of acceleration of F is known, draw EE''_1 parallel to the path of F and we get EE''_1 as the absolute acceleration of point F.

In case the angular velocity of the driver is variable, and the total acceleration of B is represented by BB''_4 making an angle $G = B''_4BA$ with the driver radius AB, we proceed as before and we obtain $B''_4B''_3 = B''_2B''_3 = NN' =$ fictitious component. $B''_3B''_1$ is the relative acceleration of the block to the link 4 and $B''_2B''_3$ is the tangential acceleration of point B on link 4 and hence BB''_1 represents the total acceleration of point B on link 4 instead of BB''_2 which we found in case of uniform angular velocity of link 2. The angle BDB''_{33} (not drawn) would now represent the angular acceleration of link 4. From this acceleration we can as before find the total acceleration of E and then of F.

It should be noted that the effect of the tangential component $B''_2B''_4$ alone, with the quadric chain at rest, would be to decrease the tangential component $B''_2B''_3$ by $B''_2B''_3 = B''_3T$ and to increase the relative acceleration $B''_3B''_4$ by TB''_4. This relation is self-evident from an inspection of the figure (see item 2).

Prolong AB and draw DP perpendicular to link 4 at D and we obtain center $P(31)$. Draw QB perpendicular to link 4 at B and we obtain point $Q(24)$ on line of centers AB. Join Q and P. Make angle $DPS = QPB$ (marked ϕ in figure). Then SP will be tangent to the centrodes at P. Draw PP' perpendicular to SP to represent the direction of acceleration of the instantaneous center P. (See Bobillier's "Construction"; Klein's "Kinematics of Machinery.")

Draw BB''_{33} equal to $\frac{BB_3^2}{BP}$ to represent the centripetal acceleration of B about P, draw $B''_{33}B''_{23}$ perpendicular to BP at B''_{33} and draw through B''_3 (the end of the acceleration vector of B) the line $B''_3B''_{23}$ parallel to PP'. Then we have $B''_{33}B''_{23}$ as the tangential acceleration of B about P and $B''_{23}B''_3$ as the acceleration ($\omega\omega$) of the instantaneous center.

Draw $B''_{23}B''_{33}$ parallel and BB''_{33} perpendicular to BP and we have the angular acceleration of link 3 about instantaneous center $P(31)$ represented by the angle $B''_{23}PB$. As stated before, we cannot find the angular acceleration of link 4 from the center $C(34)$ which is at an infinite distance and has an infinite acceleration; but since link 3 and link 4 are connected by a sliding joint they have the same angular velocity and angular acceleration, and hence the angle $B''_{23}PB$ also represents the angular acceleration of link 4. For graphical construction, therefore, we have only to make the angle $B''_3DB = B''_{23}PB$ and thus obtain the tangential acceleration of point B on link 4 about D. The centripetal acceleration BB''_4 is obtained as before and we thus obtain the resultant acceleration of point B on link 4. Then proceed as before to determine the acceleration of E and F.

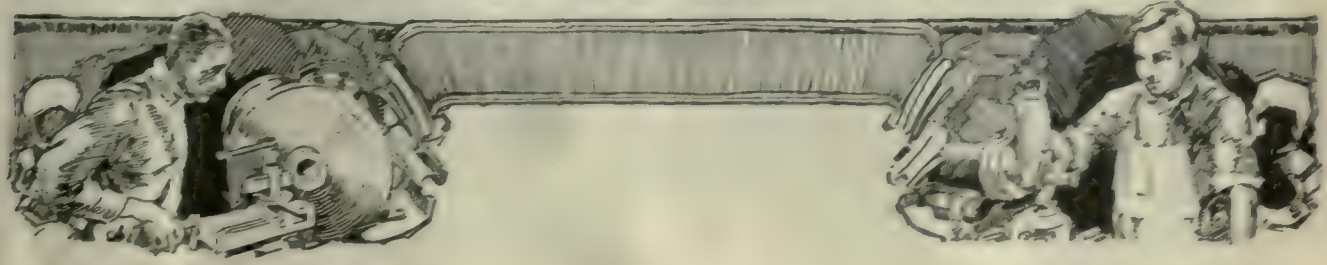
In the case of variable angular velocity the only change will be to draw the line parallel to PP' through B''_4 and determine new points B''_{33} and B''_{23}.

Draw AKK_3 perpendicular to link 4. This intersects link 4 at L. It should be noted that $Q(24)$ lies between A and D, whereas in Fig. 2 Q was external, and hence we divide the distance BD in the negative ratio of QA to QD at L. In the case of constant angular velocity of the driver draw DD_2 perpendicular to link 4 and then draw D_2DK_3 making an angle D_2DD_2 equal to $BQP = \phi$ (see Fig. 2), counterclockwise with D_2D (since QB must be turned clockwise to arrive at QP; see rule under item 3). Join K_3 with B indefinitely and we get the angle B''_3BD as the angle between the acceleration vector for point B on link 4 and radius DB.

In the case of variable angular velocity make angle $DBM = B''_3BB''_4 = G$ and draw D_2MK making the angle $D_2MD_2 = \phi$ counterclockwise with D_2D and we get by drawing KB indefinitely the angle B''_3BD as the angle between the acceleration vector and radius DB of point B on link 4.

The centripetal acceleration BB''_4 can now be obtained and a perpendicular erected at B''_4 and we have BB''_2 and BB'' as the acceleration of point B on link 4 in the cases of constant and variable angular velocity of link 2 respectively. Then proceed as under case (a).

In the quadric chain when the joint (23) becomes a sliding joint, Rittenhaus' Construction fails, because center $B(23)$ is at an infinite distance and has an infinite acceleration. But the reader will find that methods (a) and (c) directly apply, whereas with method (b) a little ingenuity in applying the fact that the angular acceleration of links 2 and 3 are the same will give the tangential acceleration component of center $C(34)$ about the instantaneous center (13). Care must also be exercised in using Bobillier's Construction, as before, in order to take care of the sign of the angle ϕ. In method (b) it will be noted that center $B(23)$ is at an infinite distance and the problem is worked out as hinted above, the components of the acceleration about the instantaneous center (13) of the point $C(34)$. With these suggestions the writer believes that there will be no difficulty in solving this particular quadric chain by method (b).



The New Railroad Shops at San Bernardo, Chile*

By CARLOS VALENZUELA CRUCHAGA, C.E.

In a far off Latin-American country there has lately been put in commission a very complete system of shops and equipment for repairing the rolling stock of a trunk line railway. It should be a matter of pride to the machinists in the United States that the complete plans for this system and its equipment were made under the supervision of one of our large machine-tool builders and that this firm was accepted in competition with plans of a number of other engineers.

AS EARLY as 1910 the repair shops of the State Railways of Chile were inadequate to keep up the necessary repairs to the rolling stock of the road. Money for new shops and equipment could not be had until after the passage of the reorganization capital law in 1914, when an appropriation was made for the purpose. Bids were invited for building and equipping a group of shops having capacity for the rapid and economic repairs of 600 locomotives, 483 passenger coaches and 6,000 freight cars, comprising the total rolling stock of the road at that time.

Prizes were offered for the best plans for the shops and equipment and were competed for by a number of responsible concerns. The first prize was awarded to the Niles-Bement-Pond Co., New York, which submitted a very complete set of plans accompanied by specifications and estimates worked out by George Henderson, engineer, in collaboration with experts of the General Electric Co., the Niles-Bement-Pond Co., and the United States Steel Corporation in their respective fields of electrical equipment, machine tools and structural steel buildings. A general plan of the layout is shown in Fig. 1.

The original decision of the State Railways was to carry out the proposal as indicated by the accepted plan. However, on account of the European war and the high price of steel caused thereby, it became necessary to abandon constructing the buildings according to the original plans and to construct them of reinforced concrete according to plans offered by the Compania Holandesa at the time the bids were opened in July, 1915.

Apart from the difficulties of reinforced concrete construction in a locality having but little available labor trained in that class of work, the change in plan was a good one as the material used offers reasonable resistance to earthquake shocks that are prevalent in this country.

Starting the Buildings

The first part of the work done was on the group of buildings to be used as repair shops for locomotives (6 buildings), leaving the passenger and freight-car shops to be built at a later date.

A plot of ground consisting of 120 hectares (about 300 acres) was purchased for about $5,000, United States gold, in the vicinity of San Bernardo, about 10 miles south of Santiago, Chile. Of this ground about 112 acres was for the general shops and about 188 acres for the workmen's houses. Contracts were made with the Holland company for the buildings for approximately $1,250,000, United States gold.

The machinery was all obtained from the Niles-Bement-Pond Co., author of the general plan, for $604,500, and all the equipment was installed under the direct supervision of engineers associated with that organization. On April 15, 1920, the shops were opened for operation.

The location of the shops at San Bernardo was chosen on account of its being the approximate center of traffic of the general State Railways, although not necessarily in the geographical center. Likewise it was possible here to obtain an excellent plot of ground parallel to the central railway and accessible to both extremities of the line where trains could enter and leave with great facility. The relative nearness of

*This is a somewhat condensed translation from an article printed in the October issue of *Ingeniería Internacional.*

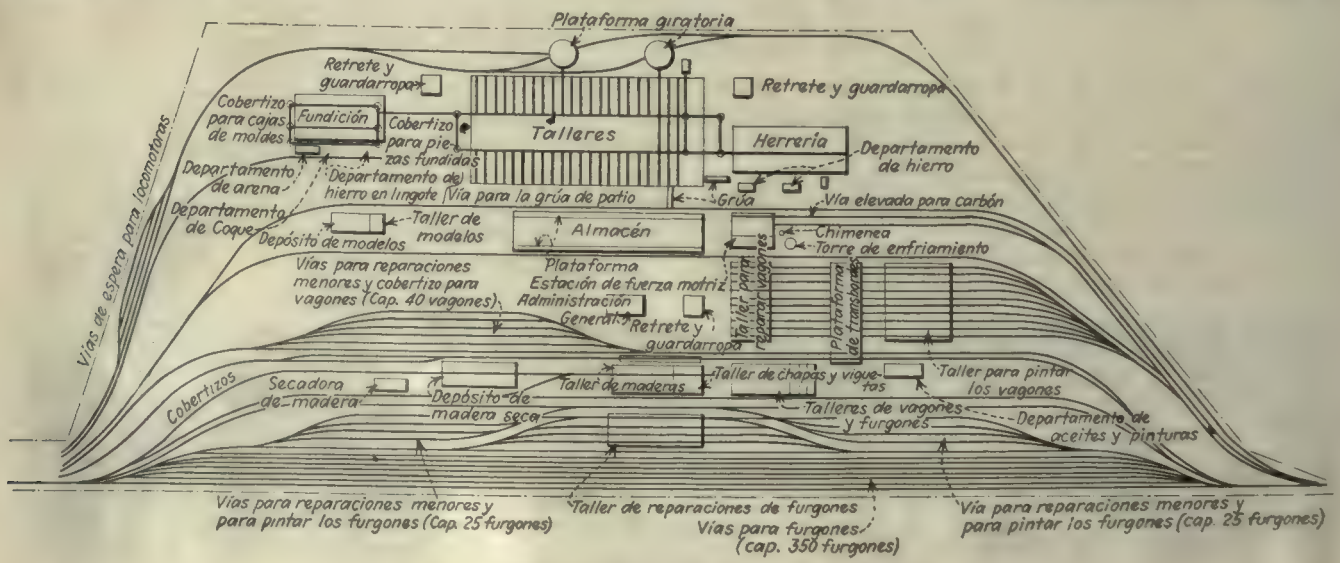


FIG. 1. GENERAL PLAN OF SHOPS AND TRACKS



FIG. 2. GENERAL VIEW OF THE SHOPS

Santiago, which would be the only source of supply in the early part of the work, likewise was a factor in the choice.

The shops as shown in Fig. 2 are grouped along both sides of a long avenue running from east to west and along which a 10-ton bridge crane travels the entire length. This avenue is paved with Belgian blocks, permitting the use of motor trucks for carrying loads of small stuff between the shops.

The locomotive shop touches this avenue on the south and is in the center of the group of buildings, the blacksmith shops and foundry being placed so as to deliver their products to it with ease. The pattern shops and the pattern storeroom are alongside the foundry.

Repairs to freight and passenger cars are made outdoors in yards laid out for the purpose. One of the yards where repairs to woodwork are made is located alongside the lumber yard and the dry kiln and the carpenter shop. In another yard, close to the car and blacksmith shops, repairs to metal parts are made and wheels are replaced. After repairs are completed the cars are painted in whichever yard they may be found. The plans for the car shops (to be built at a future date) call for the installation of tracks and transfer tables so that cars slated for general repairs can be transferred from one department to another.

The shops are all large, well ventilated and lighted and the locomotive shop is of sufficient height to permit traveling cranes to carry material well above any rolling stock that may be on the tracks. The walls are of reinforced concrete 15 centimeters (about 6 in.) thick and waterproofed with "malthoid." The windows have steel sash one-half of which is fixed and the other half arranged to be opened by mechanical means from the floor.

The locomotive shop, a plan of which is shown in Fig. 3 and an interior view in Fig. 4, has five longitudinal bays and at one end there is a transverse bay. The floor dimensions are 187.9 x 87.2 meters (about 176,000 sq. ft.) and is said to be, until recently, the largest area covered by a one-story building of reinforced concrete.

The machine shop occupies the three central bays of the locomotive shop. The center bay of the three contains the light machinery and is equipped with two 5-ton traveling cranes. The two bays next to the center contain the heavy machinery (see Figs. 5 and 6) all of which are served with 15-ton traveling cranes. The two outer bays are used for locomotives undergoing repairs and each is equipped with an 120-ton traveling crane. All the machinery is direct-motor driven. The roof is of the saw-tooth construction, as



FIG. 4. BAYS IN THE LOCOMOTIVE SHOP



FIG. 5. THE CYLINDER DEPARTMENT



FIG. 6. AMONG THE HEAVY MACHINE TOOLS



FIG. 7. SAW-TOOTH ROOF OF LOCOMOTIVE SHOP

may be seen in Fig. 7. The glass faces the *south*, as in the latitude of the location the sun is always northerly. The sash is steel and, like the sash in the walls, half of it can be opened for ventilation. For artificial lighting, lamps of 400 watts are conveniently distributed. The transverse bay at the end is used for the repair of boilers and tenders and is equipped with a 15-ton traveling crane. The runways for the two 120-ton cranes also extend through this part of the building.

The machine equipment includes all such machines as would be installed in the most modern railroad shops in the United States. In arranging the machines two methods and their respective advantages were thoroughly considered. The first method embraced the placing of all machines of one type in a group and the second grouping the machines according to the work to be done. While the first method is more economical in the number of machines required to do the work, the second method eliminates long distance trucking and back trucking and for these reasons it was decided to adopt it.

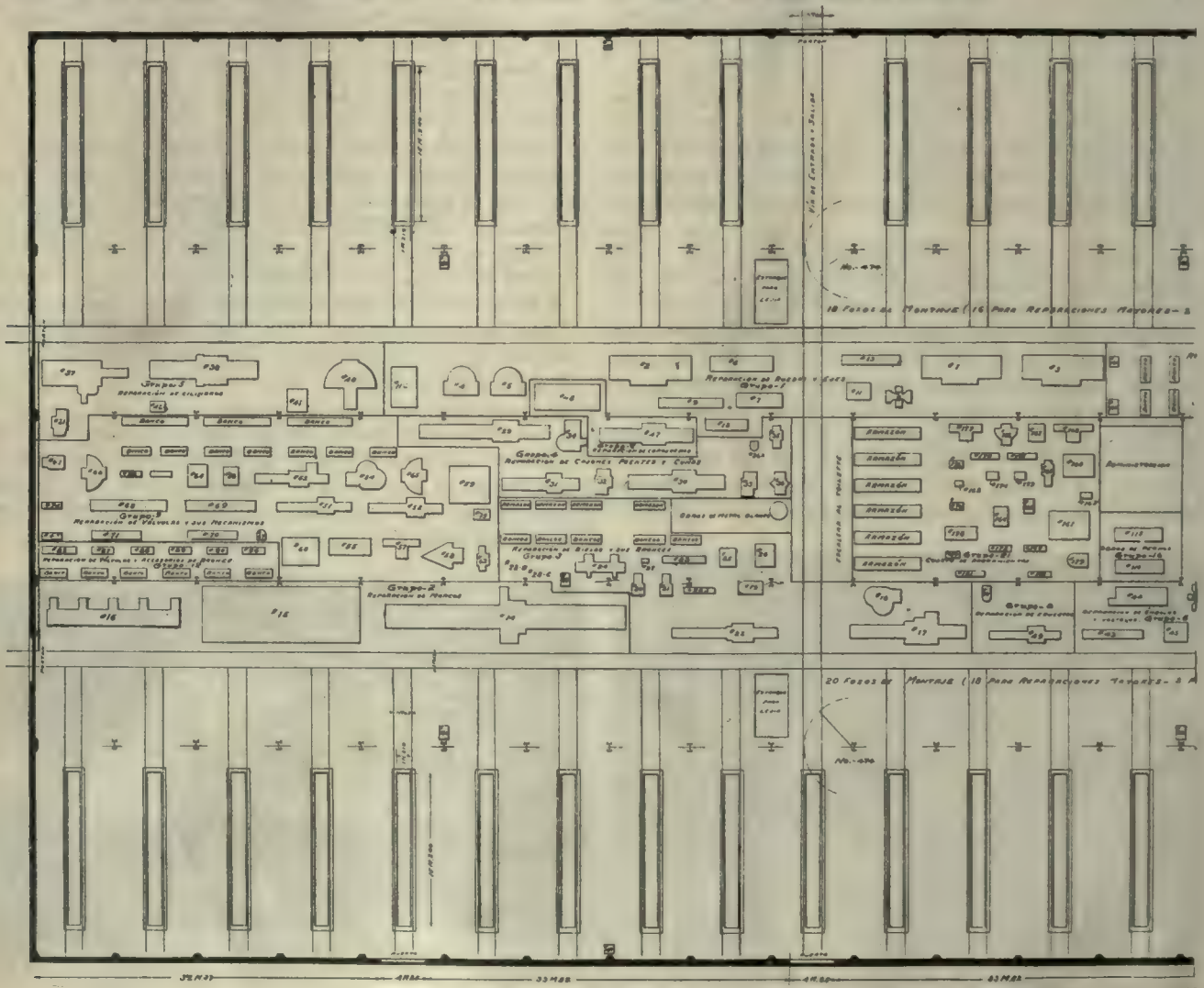


FIG. 3. LAYOUT OF MACHINE TOOLS AND

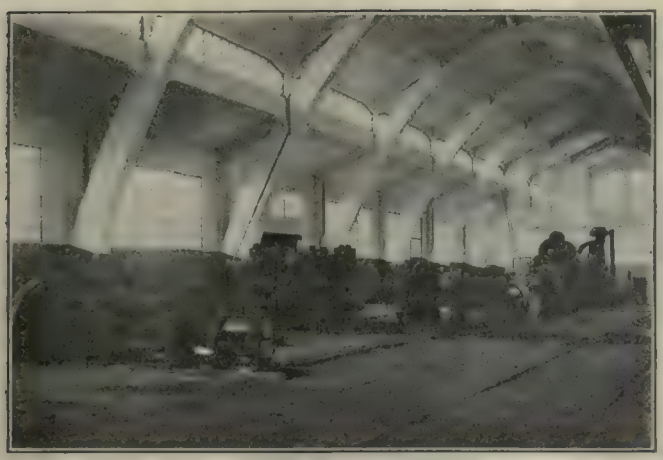
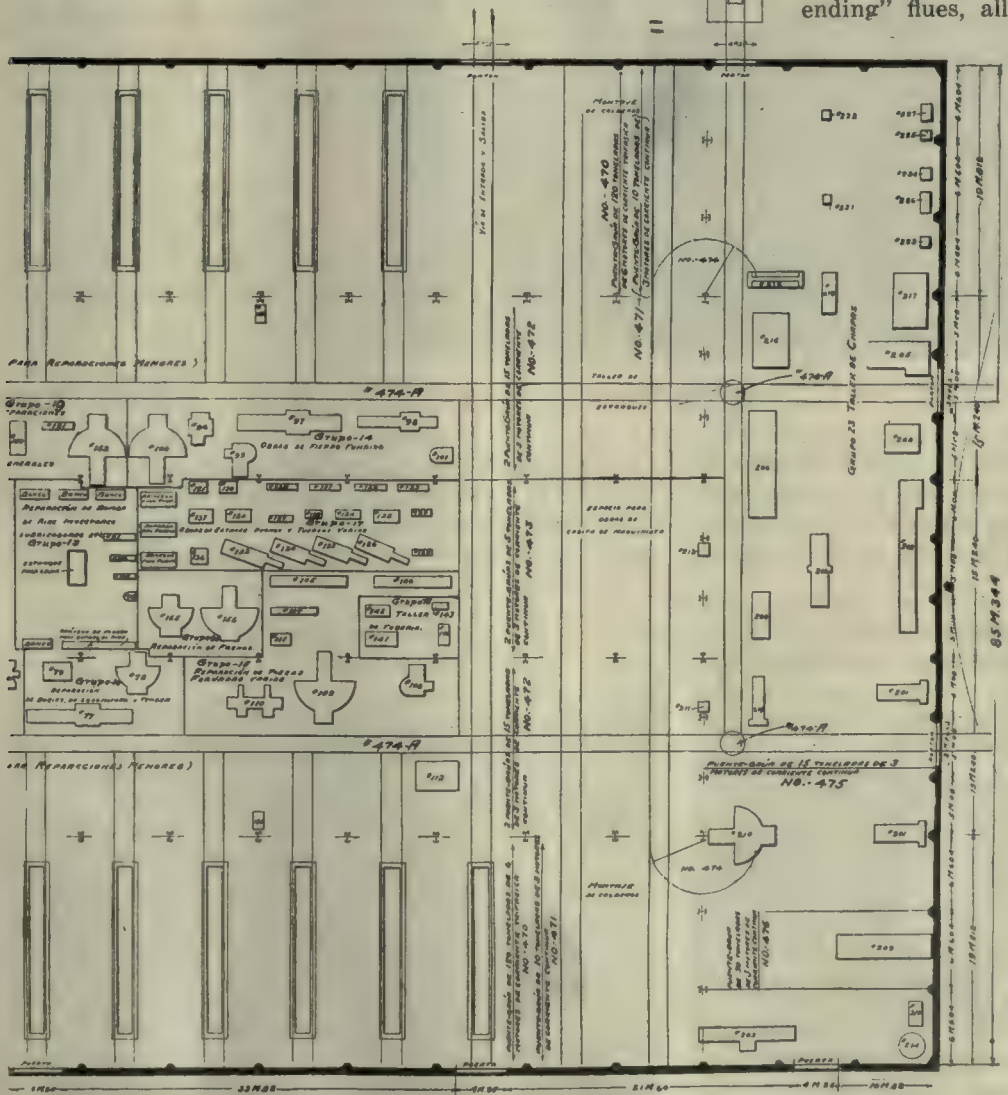


FIG. 9. IN THE BOILER SHOP



FIG. 10. THE FOUNDRY MOLDING FLOOR

Locomotives enter the shop at right angles to its length after being turned on one of the turntables so distributed that free access may be had to them from any point in the yard. Once within the shop they can be transferred to any of the pit tracks by the traveling crane, as shown in Fig. 8. Here the wheels are removed and sent to the machine shop and the engines lowered on to blocking. After the engines are dismounted, their boilers can be taken to the boiler shop by the same crane that delivered them to the pit tracks. The boiler tubes are taken out and carried outside on special cars to the tumbling barrel for cleaning. They are then brought back on the same cars to have the bad parts cut out and new pieces welded on. The boiler shop equipment comprises punching and shearing machines, bending rolls, machines for welding and "safe ending" flues, all of which are served by a traveling crane. An interior view of this shop is shown in Fig. 9.



PIT TRACKS IN THE LOCOMOTIVE SHOP

The foundry is located to the eastward of the locomotive shop and covers an area of 2,789 sq.m. (about 30,000 sq.ft.). The molding floor, shown in Fig. 10, is served by two 15-ton and two 5-ton traveling cranes and three 1-ton hoists. The runways for the cranes extend beyond the building at both ends, so that the cranes can pick up and deliver material from or to the yards. The yard at one end is used for the storage of castings and that at the other end for flasks. Beyond and near the railroad track, sand, coke, iron, etc., are stored.

The foundry was designed to produce 25 tons of casting per day with 35 tons as a possibility. Two cupolas have been provided, one having a melting capacity of 10 to 12 tons per hour, while the capacity of the other is 3 to 5 tons. The small cupola is used when only a small amount of iron is to be melted, and is also intended to be used for melting iron for a Bessemer converter, which it is expected will be installed

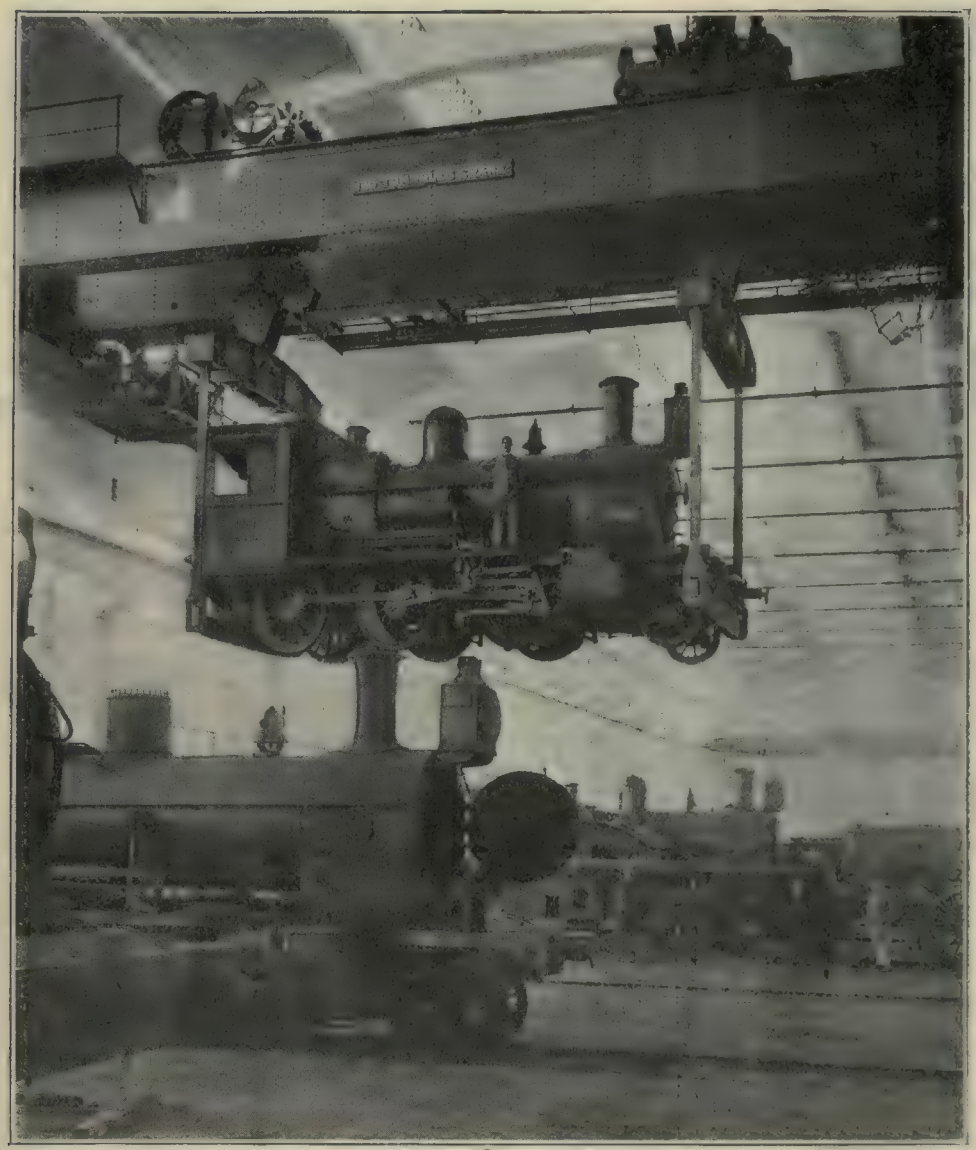


FIG. 8. TRANSFERRING A LOCOMOTIVE

in the future, together with all its accessories. The charging platform is designed for a load of 2,000 kg. (about 4,400 lb.) per square foot, and is equipped with a 2-ton elevator for delivering material for the cupola. Included with the building are the carpenter shops and the cleaning and core rooms.

The pattern shop has a floor space of 667 sq. meters (about 7,200 sq.ft.), and is isolated from other buildings to avoid the danger from fire. The building is divided by a concrete wall into two parts, the small part being used for pattern making and the larger for pattern storage.

The Blacksmith Shop

The blacksmith shop has a floor area of 3,535 sq. meters (about 38,000 sq.ft.), and is located conveniently to the machine shops and the site for the future car shops. It has two bays, one of which contains departments for heavy forgings, spring making and reworking scrap, while in the other stampings and tool forgings are made. All the furnaces are oil fired and air is supplied by blowers or from an air compressor. Several steam hammers and a 2-ton hoist are included in the equipment.

The storeroom is located in a large two-story building, each floor being 79.54 x 24.38 meters (about 21,000 sq.ft.). Platforms are placed on both sides of the building for unloading freight from the cars. The interior is divided into three bays in the center, in one of which there is a 3-ton traveling crane, operated from the floor. The second floor is served by a 2-ton elevator and a stairway.

Power is transmitted from the La Florida (the plant supplying Santiago), the current being a.c. 12,000 volts, and is converted into 220-volt d.c. for operating the machinery by two sets of 500 kw. rotary converters. For lighting a.c. current is used, the voltage being reduced to 220 by step down transformers.

Cost of Electric Power

The contract for supplying power stipulates the price of $0.06 gold per kw.-hr. for the first 150,000 kw. and $0.03 gold for an excess of that quantity, based on a minimum consumption of 85,000 kw.-hr. per month. From April 1 to Sept. 30, inclusive, $0.12 gold per kw.-hr. will be paid for current supplied between the hours of 4 and 9 o'clock p.m.

In addition to the electric equipment there is a 22 x 14 x 16 in. Ingersoll-Rand air compressor driven by a 3-phase synchronous motor, delivering 1,500 cu. ft. of air per minute at a pressure of 85 lb. per square inch. The sub-station is housed in a one story building centrally located so as to shorten the underground transmission lines.

Three toilets and coat rooms, including shower baths, are provided in separate buildings, each 15.54 meters square (about 2,600 sq.ft.) The floors are paved with square tiles. As there is no sewer system the waste from each toilet is taken care of by a septic tank and after being acidulated and filtered is drained into absorbent wells.

Later the director of the State Railways expects to build the shops for the repairs to the freight and passenger cars and four section shops along the main trunk line, as was contemplated in the original plans.

During the progress of the work outlined in this article, Rodolfo Jaramillo was, and still is, superintendent of motive power and shops, all research work and design being in charge of Rafael Edward while the author was resident engineer in charge of the work. The Chilean State Railway is represented in New York by Jorge Beaumont.

Press Tools for Caterpillar Parts

BY FRANK A. STANLEY

Processes in the manufacture of articles made from sheet metal or tubing will bear considerable study. A man well experienced in die work will often be able to design press tools that will do work in one operation where two or more have been previously thought necessary.

THE line drawing, Fig. 1, illustrates a detail of a header tube for the radiator of the Holt Caterpillar, made at Stockton, California.

This header tube is of brass, 1¼ in. outside diameter, and 0.072 in. thick. There are ten holes punched in a line along the tube, these being ½ in. diameter and spaced 1¼ in. apart on centers. At the same time that the holes are punched, a lip or flange is drawn up on the inside of the tube around the hole as shown by the cross section in Fig. 1. In order to produce this internal flange it was formerly necessary to make two operations, consisting first of a drilling operation in a jig where the holes were drilled through the tube wall to ⅜ in. diameter after which the tube was placed in a press and with a gang punch the holes were enlarged to ½ in., the punches drawing down the metal to form the internal lip or flange which is about 1/16 in. deep.

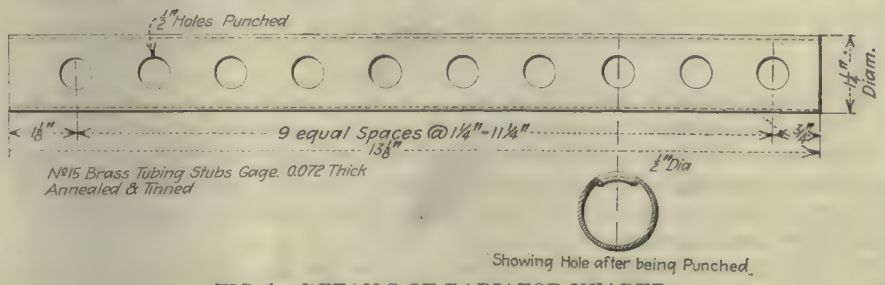


FIG. 1. DETAILS OF RADIATOR HEADER

Later an ingeniously designed set of press tools was made to perform the operation at a single stroke of the press without preliminary drilling. These tools are shown by Figs. 2, 3 and 4 herewith.

The die construction combines a work holding mandrel with the die proper and the latter is fitted also with a long wedge which provides for collapsing the die in the work thus enabling the pierced tube to be readily removed after the press ram has completed the up stroke.

In Fig. 2 the die is shown in place in the press and in Fig. 3 the die and wedge are seen withdrawn from the machine and placed at the side of the die shoe. The construction of the press tools will be best understood by examination of the line drawing reproduced in Fig. 4.

The details of the tools may be identified by the following letters: *A* is the cast-iron die shoe; *B*, the cast-iron punch holder; *C*, the die and mandrel, both of tool steel; *D*, the wedge also of tool steel; *E*, the tool steel piercing punches, ten in number; *F* and *G* are two pairs of tool steel locating blocks for holding the die and mandrel in position; *H* and *I* are hexagon-head screws and dowels for securing the locating blocks; *J*, the fillister-head screws for securing the ten piercing punches; *K*, the handles for the die and mandrel; *L*, the guide pins or pillars for the die shoe and punch holder which are the sub-press type; *M*, the guide pin bushings, both pins and bushing being of tool steel; *N*, a locating block for the end of the work to be pierced; *O*, a button-head screw for this block.

Referring to the front elevation and sections it will be seen that the die proper, *C*, is in the form of a round bar which is machined from end to end to form a flat taper face below the center, the slope being 3/16 in. per foot. In this flat lower face there is cut a guide groove and the wedge *D* which is made to a corresponding taper on its upper face has a tongue to fit the groove. This construction will be noticed in the cross sections in the drawings. The two members, the die and wedge, when together form a cylindrical bar which is relieved on the sides to provide a certain amount of clearance to permit easy removal from the work. When the tube to be pierced is slipped over the die, the die constitutes also a carrying mandrel for supporting the inside of the tube during the piercing operation. For placing the work on the die the wedge is removed from the latter and the tube slipped into place on the die. The wedge is then slipped into place fitting snugly into the tube to be pierced and when the



FIG. 2. THE DIE IN PLACE IN THE PRESS

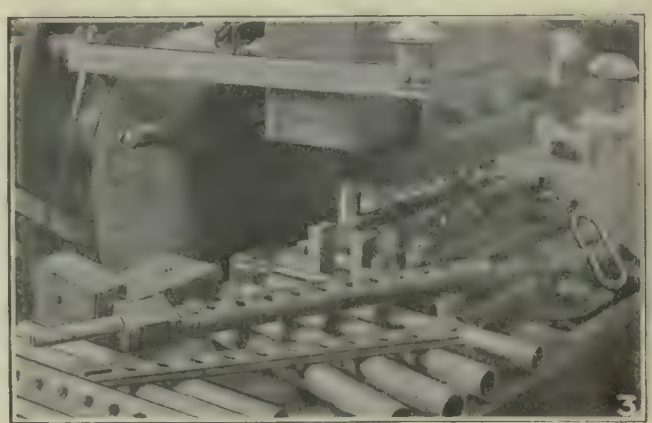


FIG. 3. THE DIE AND WORK REMOVED FROM THE PRESS

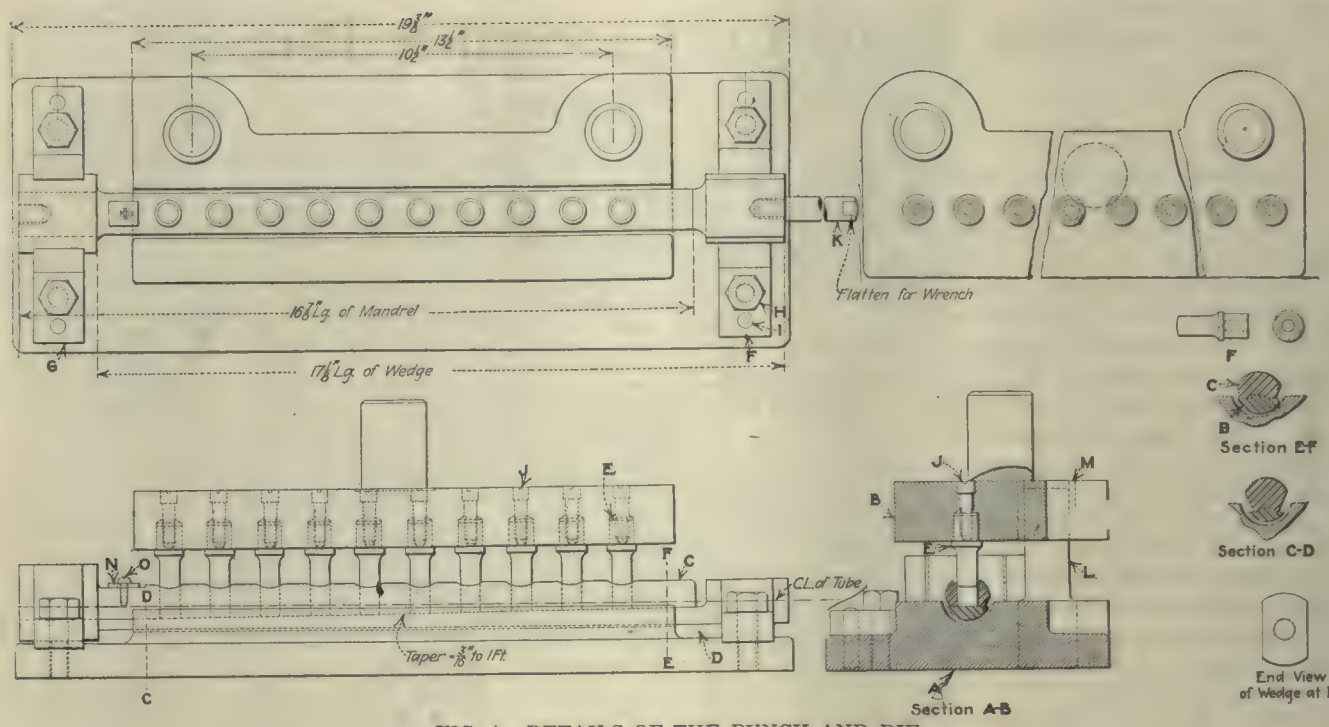


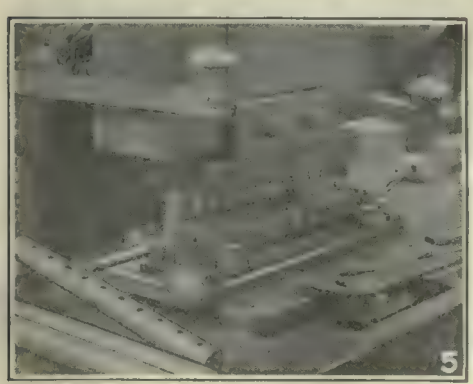
FIG. 4. DETAILS OF THE PUNCH AND DIE

die and its wedge are in the locating blocks *F* and *G* the entire device is securely held for the piercing operation. Withdrawal of the wedge by means of the handle at the right-hand end allows the die to release the work.

Note the shape of the punches, detail No. *E*, Fig. 4. Instead of flat ends with keen corners as with the usual piercing punches, they have rounded ends crowned to a height of $\frac{3}{64}$ in. This is because the punches act as combined drawing and piercing tools. They are in reality what is sometimes known as "pinch off" punches. After the punches strike the brass tube their first work is to draw the metal down into the counterbored chambers at the top of the die opening. Each chamber is the diameter of the piercing hole plus twice the thickness of the brass, in other words $\frac{1}{2}$ in. plus twice 0.072 in., or 0.644 in. in diameter. As the metal is drawn down into these counterbored recesses in the die it forms a shallow shell and continued descent of the punch cuts out the bottom of the metal, leaving a ring or flange around each pierced hole.

There is one detail connected with this set of tools which is not shown on the drawing referred to but which will be seen in Figs. 3 and 5. This is a form of stripper plate which is slipped into the die-shoe jaws above the work. In Fig. 3 the plate with its series of holes to clear the punches will be noticed in the foreground while in Fig. 5 the plate is shown in position over the die in the press. This plate is planed down along each edge to form guide surfaces which enter corresponding grooves in the long jaws attached to the face of the die shoe.

Another interesting set of dies is shown in Fig. 6. These dies are for piercing a long slot in a fiber tube to be used for a conduit. The die itself is in the form of a long arbor or mandrel over which the fiber tube is placed for slotting. The mandrel is slotted out as shown to give the right size of die hole and a clearance slot is cut out below in the bed which carries the die, to enable the punchings to drop out through the press bolster. The punch is an inserted blade in a holder as may be clearly seen to the right. The special feature of the punch is the method of forming a shearing cut from each end toward the center. This shear angle is about 5 or 6 deg. and is sufficient to enable the ends of the punch to strike the fiber surface and enter well into it before the length of the surface has been cut to any appreciable distance. The resulting action is an easy shearing cut which, starting from both ends simultaneously, pierces out the slot with uniform degree of smoothness and without tendency of crowding.



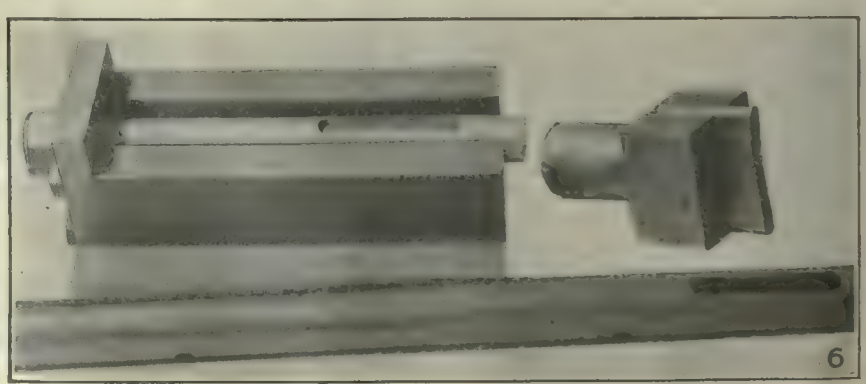


FIG. 5. DIE WITH STRIPPER PLATE IN POSITION. FIG. 6. TOOLS FOR SLOTTING FIBER TUBES

Common Sense in Engineering*

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This is a common-sense lecture on Common Sense in Engineering. The author follows what he refers to as the "case system"—developing principles by the examination of specific cases. This system is always a favorite with the party on the receiving end of a lecture, and the reader of this article will be in no way disappointed.

THE term "common sense" is used with great frequency, and yet, as you know, with different meanings. Indeed, it is sometimes said that common sense is really very uncommon. To avoid ambiguity we will attempt a definition as follows: "Common sense" is the application to the solution of problems of one's best experience and judgment without prepossession or prejudice. The qualifying clause is most important, because innumerable cases have occurred where an erroneous decision was reached by men of great ability just because they allowed their judgment and experience to be overruled and biased by prepossession or prejudice.

Possibly the most striking case of this kind, which is known to everybody, is that of the unwillingness of the Syrian general Naaman to take the advice of the prophet Elisha in order that his leprosy might be cured. You remember that the prophet told him to wash in the River Jordan. Naaman's prejudices, however, made him object to this extremely simple cure, and he wanted to know why the rivers of Damascus would not be better. His servant had more common sense than the master, for, as you remember, he said to him that if the prophet had directed him to do some great thing he would have done it at once, and why not follow out this perfectly simple injunction? The common sense of the servant prevailed and the general was cured of his leprosy.

Shrewdness Really Keen Observation

It should also be very thoroughly understood that far from excluding all the benefits of education and intellectual training, the true meaning of "common sense" assumes these as vital factors. In other words, to praise and emphasize the importance of common sense does not mean to disparage education, but, on the contrary, insists upon it most strongly. On account of the native shrewdness sometimes exhibited by uneducated men there is occasionally a tendency to think that common sense is a gift which can compensate for the lack of education. In fact, the shrewdness displayed by these uneducated men when analyzed will be found to agree entirely with our definition above. They are really keen observers, and have, within their limit, good experience, so that the sound judgment which they display is really a good illustration of common sense. It would be found, however, on test that the field within which their judgment could be exercised is very limited as compared with that of the highly-educated engineer.

*From the J. E. Aldred Lectures on Engineering Practice, of the Johns Hopkins University, Department of Engineering.

In discussing the subject of our lecture I propose to follow what is called in the law schools the "case system"; that is, to develop principles by the examination of specific cases. This is usually clearer, more interesting and more satisfactory than to announce abstract principles and then attempt to elucidate them.

Watt and the Steam Engine

A striking illustration of common sense in engineering is the revolution in the use of steam brought about by James Watt, inventor of the separate condenser. The steam engine as invented and developed by Newcomen was doing useful work, but it was very generally realized that it was exceedingly wasteful. As you will remember, the engine worked at atmospheric pressure, steam being admitted from the boiler underneath the piston, which was slightly overbalanced so that it would then ascend to the top of the stroke. A spray of cold water was injected inside the cylinder, which condensed the steam, producing a partial vacuum. The pressure of the atmosphere caused the descending stroke of the piston. It seems to us now that it ought to have been perfectly evident that, as the cylinder was necessarily chilled in causing the condensation of the steam, there would inevitably be great initial condensation of the newly-admitted steam before the temperature could be raised sufficiently to permit the steam to fill the cylinder, and that, in consequence, it was almost obvious that the condensation should take place in a separate vessel. It was, however, not until the Newcomen engine had been used for nearly seventy years that this revolutionary change was made by Watt, who was led to it when making repairs to the model of a Newcomen engine at the University of Glasgow. It must not be supposed because Watt was an instrument maker that he was not a scientific man. He was a friend and pupil of Professor Black of the University, who is, perhaps, best known as the discoverer of latent heat, and it is probable that this scientific knowledge led him to the careful study of conditions which resulted in the invention of the separate condenser.

Watt's Prejudice

As you know, Watt made other great inventions connected with the steam engine, so that, speaking generally, up to the time of the invention of the steam turbine the improvements made by later inventors were almost entirely in matters of detail rather than of principle. It is very interesting to note in this connection that, in spite of his shrewd common sense in his earlier inventions, Watt's prejudices led him to oppose very strongly the use of high pressure. Doubtless it was because the success of his early work was in connection with very low pressures that he was so prejudiced, but it illustrates the point that, notwithstanding his wonderful ability, he did not use common sense with respect to the higher pressures.

As we now look back over the further improvements in the steam engine, we are greatly surprised to find that it took so long to apply fully the principle which Watt had announced of endeavoring to keep the cylinder as hot as the entering steam. Of course, it is impos-

sible to do this completely when the cylinder head and passages have just been in communication with the exhaust at a much lower temperature than the incoming steam. Nevertheless, it should have occurred to a careful analyst of the conditions that division of the expansion into two or more stages in separate cylinders would make the temperature variation in each particular cylinder very much less and would thereby conduce to economy. Long after the compound engine, with the expansion in two stages, had become quite common this point was not fully appreciated. Indeed, as late as 1880 Rankine's Treatise on the Steam Engine, then considered the best work on the subject, distinctly stated that, so far as economy in the use of steam is concerned, it made no difference whether the expansion occurred in one, two or a dozen cylinders. After the principle was thoroughly appreciated and when improved materials permitted the construction of boilers for much higher pressures, the introduction of the triple expansion and quadruple expansion engines came almost as a matter of course.

Westinghouse and the Air Brake

For a number of years I had the pleasure of frequent association with that great mechanical genius George Westinghouse, the inventor of the air brake, while I was an officer of one of his companies, and on one occasion I heard him tell the story of the final step in his invention of the air brake, which is a splendid illustration of common sense. He was led to invent a power brake of some kind by his knowledge of the inadequacy of the means then employed, and his first idea was of one operated by steam. He fully realized the disadvantages due to condensation, but thought at first that these must be accepted. He had devised the brake cylinder and rigging under the car and was nearly ready to experiment. He was a reader of the *Scientific American*, and one day the new issue contained a description of the mechanical features of driving the Mont Cenis tunnel under the Alps. This described the rock drills driven by compressed air, and incidentally stated that, at the time the article was written, the heading of the tunnel where the drills were working was about a mile from the air-compressors outside the mouth, and that there had been no trouble on account of this distance between the generation and application of the compressed air. He at once realized that here was the ideal medium for transmitting his power. If it was satisfactory for the rapid-working pistons of rock drills at a distance of a mile from the compressor it certainly would be satisfactory in the brake cylinders under the cars at a distance measured by hundreds of feet. Thus was born the air brake, which, with its subsequent developments and improvements, has probably done more for the safety of high-speed railroading than any other single invention ever made.

The first great improvement was again a beautiful illustration of common sense. In the beginning the idea was to apply the brakes on all the cars practically at the same moment so as to stop all the cars at the same time. After this had been successfully accomplished and people began to rely thoroughly on the brake, an accident occurred when some cars broke from a train on an incline, which left nothing but the hand brakes to stop the descent of the detached cars. Up to that time, when it was desired to apply the brakes, pressure was admitted to the train pipe, and so to all the brake cylinders. Common sense suggested to Mr. Westinghouse that if it could be aranged to keep pressure on the train pipe as the normal condition, with the release of this pressure to set the brakes, then if any cars became detached the brakes on the cars would be automatically set. To carry out this idea he invented what is known as the "triple valve," which, in connection with a reservoir of compressed air under each car, fully accomplished this purpose of complete safety. The triple valve fulfills the three purposes of filling the reservoir under the cars, admitting the air from the reservoir under each car to the corresponding brake cylinder for the application of the brake, and exhausting the air from the brake cylinder when the brakes are to be released.

Nearly all of Mr. Westinghouse's many inventions were illustrations of his splendid common sense, and they evolved from existing methods to meet conditions which arose in the application of the mechanism. One of these inventions was made while I was with him, and I knew many of the details, so that the story will, I believe, interest you.

When Sir Charles Parsons had invented and developed the steam turbine, until it became reasonably economical, Mr. Westinghouse secured the patent rights for the United States and proceeded to develop it chiefly in connection with electric applications. As the power and size of the turbines increased it was found that there were difficulties due to the expansion of the material accompanying temperature changes in such long structures. As you are aware, the Parsons turbine is of the "reaction type." De Laval, a Swedish inventor, had developed a different kind of turbine, known as the "impulse type." In this latter the steam is expanded in special nozzles before entering the blades so as to reach them with a very high velocity and greatly reduced pressure. Familiar as you are with the properties of steam, you know that this reduction in pressure is accompanied also by a reduction in temperature. Mr. Westinghouse was familiar with both types of turbines, and it struck him that the way to obviate the difficulty due to this expansion of the material was a form of compounding the turbines somewhat analogous to what has been done in the steam engine. Consequently he bolted to the casing of the reaction turbine a small independent but connected casing containing a few rows of impulse blades and reduced the pressure from the initial figure of about 200 lb. to about 75 lb. when it entered the reaction blading. This smaller casing was free to expand without affecting the larger one. Along with this he introduced what he called the "double flow" principle by practically putting two reaction turbines in the same casing with the higher pressures in the center and the exhaust connection at the ends. This solved the difficulty, and this method in various forms is the one now used in all the large turbines of today.

The Diesel Engine

The Diesel engine is a most interesting subject for consideration by engineers on account of its remarkable thermal efficiency of some 30 per cent, which is about double that of good reciprocating steam engines. In fact, marine records of good average practice are ½ lb. of oil per brake-horsepower for the Diesel engine and about 1 lb. of oil per indicated-horsepower for a good reciprocating-engine plant.

More than twenty years ago Dr. Diesel believed he had perfected his engine, and many engineers who had studied his work went so far as to say that the steam engine would be obsolete in a few years and would only be found in museums. For a considerable interval thereafter little more was heard of it until about ten years ago. Possibly it was because the basic patent expired at that time and possibly because the engine had been worked out commercially; but at all events the technical papers were full of accounts of Diesel engines being fitted to numerous vessels, and again there was the same prediction that the steam engine would soon be displaced. As a matter of fact, the extent of the use of the Diesel engine has been a great disappointment to its advocates, and at the present time relatively few are being installed in new vessels.

As information was published of the details of these engines, it became apparent that they were all designed with a horsepower per cylinder which did not exceed 250 to 300. At first there were a great many vague statements that experiments were in progress with cylinders to give from 1,000 to 4,000 hp. per cylinder. In one such experiment there was an explosion with serious consequences. At all events, for some time there has been no talk of these more powerful cylinders. It will be realized at once that if any prime mover is to be used for large powers it must be capable of construction in large units. The reciprocating engines of the S. S. "Olympic" have cylinders of 4,000 hp. each, so that a single four-cylinder engine develops 16,000 hp. A Diesel engine developing only 250 hp. per cylinder would, of course, require sixty-four cylinders to give the same power. The enormous multiplicity of parts to be looked after and kept in adjustment, even if this were individually easy, would be sufficient to prevent such use, while, in fact, the Diesel engine requires unusual care and attention to keep it in good order.

The question naturally arises, "Why is it that the Diesel engine cannot be built in large sizes?" And here common sense gives us the answer quite simply. Like all other internal-combustion engines, the Diesel engine requires that the cylinders be water-jacketed so as to keep the barrel sufficiently cool to permit the proper working of the pistons. The pressures carried are quite high, from 700 to 1,000 lb. per square inch, requiring a thick cylinder even for a power of 250 to 300 hp. The fact is that this thickness is evidently about the maximum which will permit the interior cylinder wall to be kept of a sufficiently low temperature for satisfactory working. It happens that cast iron is by far the best material which has ever been found for the cylinders of quick-moving reciprocating engines. If a material could be found which has all the fine wearing qualities of cast iron with several times its thermal conductivity, then we might expect Diesel engine cylinders of greater power; but until that comes, or there is some other radical invention, the nature of which is not now apparent, the Diesel engine seems limited to small powers.

The Commercial Side of Engineering

There is another aspect of this case where that form of engineering common sense which we may call the "commercial side of engineering" comes in very prominently. Popular descriptions of Diesel engines have always laid stress on their elimination of the boilers, with a consequent saving in space. They have, so far as I know, carefully avoided a comparison of weights. Through the kindness of a friend who is chief engineer of a large shipbuilding company, and who had made a very careful comparative study of Diesel engines and steam turbines for certain vessels, I have been enabled to secure reliable data on this point of weight. You will perhaps be surprised to learn that for about 3,000 shaft-horsepower the Diesel engine installation weighs nearly double the steam plant, including turbines, boilers and auxiliaries. As might be expected, there is also a very great difference in the first cost, the Diesel engine exceeding the steam plant by over 50 per cent. My friend made up a very careful comparison of the operation of the two vessels, identical except machinery, extending over a year, with the net result that the earnings based on first cost worked out to almost the same.

This discussion emphasizes the importance of remembering that thermal economy in an engine is only one of the factors to be considered in determining whether it is the best to use. Indeed the matter may be put in this way: Every commercial engineering product must show a profit on the investment. This is just as important as high efficiency, adequate strength or admirable design. Failure to show a profit will offset the greatest merit in these other features.

Common Sense in Naval Engineering

A striking illustration of common sense in engineering came under my personal observation when I was in the naval service, and is worth careful study.

The early vessels of what was then called our "new navy," designed from, say, 1885 to 1890, were fitted with independent air pumps for the main engines. There were usually two air pumps driven by a small two-cylinder compound engine of the crank and flywheel type, the connecting rods of the pumps attaching to the same crankpins as the connecting rods of the engine. While an excellent design from the standpoint of a steam engine for ordinary purposes, there was a serious defect in these engines which was not realized until after they were put in use, due to assuming that an engine which would be satisfactory for ordinary purposes would be equally satisfactory for operating an air pump. In practice they proved very unsatisfactory. If they were given sufficient steam to handle a heavy load then they would run way with a light one. If they were adjusted for the light load, then they would stop when a heavier load came on them. In practice this required a man to give them almost constant attention, which was very undesirable.

As soon as this trouble was recognized, the designers at the Navy Department and in the various shipyards began to scheme methods of remedying the difficulty, and various methods were tried without success. Meanwhile the makers of standard pumps had developed a direct-acting, twin-cylinder air pump somewhat on the lines of their direct-driven water pumps, and this type of air pump has proved a great success. It could be run at any desired speed, depending on the output of the main engine, and required practically no attention. After this pump became available it was used exclusively, but the older ships remained with the unsatisfactory air pumps, and it was highly desirable, if possible, to correct the defect without replacing the air-pump engines. Finally Chief Engineer Bailey (now Admiral Bailey), then Chief Designer in the Bureau of Steam Engineering, took up the problem. I knew him intimately, and he gave me the details of his solution of the difficulty.

Recognizing that the direct-driven air pump was satisfactory, his first step was to find the points of difference between this type and the air-pump engines previously used. The compound engine had been designed with steam ports of the usual proportion, namely, 10 per cent of the piston area. In the direct-driven type the ports were only about 3 per cent of the piston area. In the direct-driven type the port opened wide at the very beginning of the stroke and stayed wide open until almost the very end. The valve gear of the compound engine was arranged, as is usual in such engines, to cut off at about three-quarters stroke; and, being driven by an eccentric, opened gradually and closed gradually, being wide open for only a short time. Mr. Bailey's conclusion was that the direct-driven pump builders had wisely decided to make the port so small that, if the load on the pump became very light and there was any tendency to run away, the steam would be wire-drawn by the small port, enough to prevent any excessive speed. On the other hand, if a very heavy load came on the pump, the port being wide open would permit the steam pressure to come in to its full extent so that the piston could not stop. With the existing conditions of the older plant he must continue to drive the valve by an eccentric, but he knew a valve seat could be fitted with ports about 4 per cent of the piston area, and a new eccentric and valve could be fitted to work without lap or lead so that the port would open at the beginning of the stroke and would be open to some extent at all times. This change was made, and the result was complete satisfaction, as I can testify by personal observation from having been on a vessel where the change was made during my service. I consider this one of the best illustrations of common sense in engineering that I know.

It was emphasized in the beginning of the lecture that common sense does not mean lack of education or absence of fine professional equipment. Indeed, these are vitally necessary, and the story which I am about to tell you will show that a well-equipped man is able to give an opinion which seems almost uncanny.

Judging Speed From Smoke-Stack Size

An accomplished naval engineer, who was one of my instructors at the Naval Academy, once told us of an amusing experience with reference to estimating the speed of a ship. He was attached to a vessel on the Asiatic Station, and during his service a new passenger vessel came out from England which was reputed to be very fast for those days. The two vesels happened to be in port together, and when passing the liner in one of the ship's boats one of a party of officers remarked that this vessel could make sixteen knots. My friend looked at the vessel a little while, and said: "That is impossible, and her speed is probably not over fourteen knots." He was at once asked how he could be so sure, and he replied: "I can tell by the size of the smokepipe." This led to jeers from some of the party, who really thought the answer was a joke. Those of you who have studied boiler design at all will probably know at once that there was a real foundation for his statement, and for the benefit of the rest I will give this analysis of the way in which he formed an opinion:

In a well-designed boiler installation there is a definite relation between the cross-sectional area of the smokepipe and the grate surface. It was before the days of forced draft, so that he knew the amount of coal that could be burned per square foot of grate surface, and, with the average economy of the machinery, the horsepower which would result. He was a man who had made a careful study of the propulsion of vessels, and knew roughly about what horsepower would be needed to drive a vessel of the size in question at a speed of sixteen knots. He could estimate fairly the diameter of the smokepipe, and with this as a basis a hasty mental calculation showed that the power which the machinery could develop was very much less than would have been necessary for sixteen knots. If any of you have had the opportunity to observe the transatlantic steamers you will appreciate this point about the smokepipe by the actual conditions of some of the great liners of today. The S. S. "Mauretania," which is a vessel of about 70,000 horsepower and twenty-five knots speed, has four huge funnels, while the White Star liners of nearly the same displacement have only two moderate-sized funnels, but they make only about sixteen knots. So you see that a man who is well posted professionally in marine matters could really form a fair judgment as to the speed of a vessel by the size of her smokepipe.

An Important Feature

A very important feature in your engineering education and experience is to discover in any specific case the general principle which is involved and which may often be utilized to advantage elsewhere with considerable differences of detail from the original case. A circumstance of this kind came under my observation and illustrates the point quite well.

It was customary in the engines of the navy up to about the beginning of the so-called "new navy" to make the eccentric straps of brass. Somewhat earlier than this, when steel castings had become available, designers for engines of the merchant service had made eccentric straps of steel castings lined with white metal, the idea being, of course, that the white metal furnished the suitable bearing surface, while the steel casting gave adequate strength. The steam launch on one of our vessels had the eccentric straps made of brass, as usual, ½ in. square in cross section, and one of them broke. It was the lower half, which was a half circle with lugs to bolt to the other part. The young engineer who was charged with the repairs did not know of this practice in the merchant service, and having always seen eccentric straps made of brass, tried to make a temporary repair by taking a couple of sheets of ¼ in. sheet brass, bending them to shape, riveting them together with a few copper rivets and bending over the ends to make lugs for attachments to the other part of the strap. Unfortunately, sheet brass is rather brittle, and, as might have been expected, this temporary strap broke off where the lug had been bent. After trying this a couple of times he was about to give up the attempt at repair and have a new strap made at a shop on shore. Another young engineer on board knew of the practice in the merchant service. It was out of the question, of course, to get a steel casting, and it would have been difficult to arrange for using white metal, but he remembered the principle of a proper bearing metal to go against the eccentric, backed up by a stronger one to stand the stress. Accordingly he took a piece of ½-in. square bar iron, had it bent to shape and faced it with one of the strips of ¼ in. sheet brass, securing it to the wrought-iron backing with the copper rivets. This was properly fitted to secure a good bearing, and, of course, worked with entire satisfaction. Later on a new brass strap was secured for use, if necessary, but the repair was so satisfactory that the new strap was never used.

From the circumstances existing in educational establishments it is practically a matter of necessity that in solving problems the data should be furnished you and your work should be chiefly the handling of these data. When you get out into actual practice an exceedingly important part of your work will be the securing of these data accurately, which means that the observations must be made with care and with the aim to be thoroughly correct and reliable. It is not always possible to devise simple checks on the observations which will tell at once whether the records are reasonably accurate, but there are many cases where such checks do exist, and you should endeavor, if possible, to ascertain what such checks are. Some will come from previous observation and experience, some from study, but a great many will be a matter of common sense. A striking case which came under my observation and where common sense was the check is worth telling.

Most of the Mediterranean ports are protected by breakwaters so that the water inside is smooth, and as a result when coal is brought off to vessels it is in rectangular piles on flat scows. Unfortunately, coal dealers in the Mediterranean have a rather bad reputation for trickery. Consequently, in naval vessels when coal is taken on board great care is used in measuring the coal piles so as to be sure of the amount received. I was attached to a vessel which coaled in the harbor of Algiers. A couple of our midshipmen were detailed to measure the coal piles, which were, roughly, 40 ft. long, 20 ft. wide and between 5 and 6 ft. high. At the end of the first day they handed in figures to show the amount received which came to 375 tons. The executive officer of the vessel had been attached to her for some two years, and so was familiar with the rate at which coal could be taken in. He said at once that some serious mistake had been made, for the reason that never before had more than 300 tons been received in one day, even when the conditions were better for rapidity than existed at Algiers.

Common Sense in Checking Up

The midshipmen were told to go over their work again to see if there was any mistake, and they examined their computations but could find no error. I was the possessor of a slide rule, and was, therefore, supposed to be something of an expert on figures, and was called in to see if I could find what was wrong. I had had nothing to do with the coaling, but was on board during the day, and happened on several occasions to notice the young men while they were making their measurements. I checked up some of their arithmetical work and found it was correct, so it seemed that the trouble must be in the measurements themselves. I remembered that when I saw them making the measurements the particular piles on which they were working did not come above their heads, while I noticed a great many heights recorded as being over 6 feet. The solution of the difficulty then occurred to me at once. They had used one of the tape measures from the engine room. If you do not know it now you will learn by experience that the ordinary linen tape measures are fitted with a brass ring in the end for convenience and to prevent the tape from slipping into the case. These rings are invariably torn off after a relatively short service, and the common practice is then to tie a knot in the end of the tape and to make all measurements from the 1 foot mark. I asked the midshipmen if they had used the linen tape, and found they had. It appeared on further investigation that the man who held the knot recorded the figures, which were called off by the man at the other end. The recorder assumed that the other man had deducted one foot before calling out the measurement, while the man at the other end called off what he saw, assuming that the recorder would deduct one foot. There would have been no easy way to check this on the measurements of 20 ft. and 40 ft., but obviously it was absurd to put down heights of 6 ft. 3 in. and 6 ft. 6 in. when, as a matter of fact, they were looking over the piles. Remembering that when I saw them the piles were below the top of their heads, I asked them if there were any piles which they could not look over. On reflection they said that there were none. I asked then where they got their heights of over 6 ft., and at once the error developed that every measurement they had made was one foot too great. When the correction was made the actual amount of coal received was only 275 tons instead of 375.

As you hear the story you may think that these young men were unusually stupid. As a matter of fact, this is not true at all, and both have since made enviable records in the navy. They simply failed to use common sense in applying the obvious check as to height when they could look over the piles of coal, which should at once have called their attention to the carelessness with which they were making the measurements.

Oil vs. Coal

While speaking of this subject of checks on observations you will in time acquire a great many of these from practice and experience, and it is well to do so as soon as possible. For example, with good average coal of, say, 14,500 B.t.u.'s per pound, if all the heat went into the formation of steam (that is, 100 per cent efficiency) you would have an evaporation from and at 212 deg. F. of about 15 pounds. Likewise, with good quality fuel oil of, say, 19,500 B.t.u.'s the corresponding evaporation would be about 20 pounds. These are figures easy to remember, and when you remember in addition that the best average results in good boilers are about 75 per cent efficiency with coal and from 80 to 82 per cent efficiency with oil, you will be in a position to discourage fairy tales about remarkable performances in the way of boiler efficiency. It is the custom now in all carefully-conducted boiler tests to tabulate what is known as a "heat balance," showing the way in which the heat in the fuel is distributed. Two elements of loss which are present in every fuel are the heat carried away in the dry chimney gases and the loss due to moisture formed by the burning of hydrogen. The sum of these two losses at moderate rates of combustion is, roughly, about 15 per cent in the case of coal, and about 14 per cent with oil fuel. You will see at once that if all the other losses are eliminated the possible efficiencies would be only roughly some 85 per cent. Consequently, if figures are shown you indicating an evaporation of 13 or 14 pounds of water per pound of coal, or 18 or 19 pounds of water per pound of oil, you will know at once that these results are impossible. Either there has been excessive priming of the boiler or there has been an error in the observation of the amounts of fuel and water.

Some years ago a friend of mine who is a very able engineer was discussing the matter of what is known as "surface combustion," where the gasified fuel passes through a porous earthen plate and burns on the surface. He asked if I had gone into the matter carefully, and I told him that while I had read something about it

I did not know very much. He then went on to say that it was a matter of the very greatest importance because the efficiency with this method of combustion was claimed to be five or six times as great as by any other method. I reminded him at once that this was absurd because a good average performance with oil fuel gave 80 per cent efficiency, and five times this would have been 400 per cent, which was, of course, ridiculous. He then concluded that the ratio of five or six times referred to the efficiency of an open grate or some other similar very inefficient method of burning coal.

While as engineers we always want our work to be accurate, common sense teaches us that there is a time for everything, and there are often occasions where you want to reach a decision quickly and where approximate data will be just as useful as those which are absolutely accurate. You will find as you go along that there are a number of "thumb rules" or "round figures" which are very convenient to carry in your memory for just such occasions. For example, a square foot of sheet steel 1 in. thick weighs approximately 40 lb., which gives you a "round figure" easy to remember and easy to divide for sizes which you are likely to need. The error is only about 2 per cent. Again, 1 ft. in length of a tube 4 in. in diameter gives one square foot of surface, and 2 ft. long of 2 in. diameter, and 4 ft. long of 1 in. diameter. Here the error is a little greater, being about 4 per cent.

There is another convenient figure to remember at the present time—when the question often comes up as to whether it will pay to change a coal-burning installation to one using oil. If you will take the relative thermal values of oil and coal and allow for the higher efficiency when using oil than coal, which is, roughly, about 10 per cent of the efficiency with coal, you will find that the cost for the same thermal value of fuel may be expressed as follows:

When the price of oil in cents per gallon is half the price of coal in dollars per ton (of 2,240 pounds) the cost for the fuel only is the same. In other words, two-cent oil costs the same as $4 coal. There are economies in using oil due to a smaller boiler-room staff, the absence of ashes and other things, which must be considered, but this "thumb rule" will often enable you to say whether the step is worth considering at all. For example, if oil is selling at five cents a gallon while coal can be obtained for $5 a ton, it is perfectly evident that the difference in the cost of the fuels is so great as to make it unwise to change. If, however, oil, say, is four cents a gallon and coal $7 a ton, the difference is then so small that it is possible the other savings would justify shifting over to oil, so that it is advisable to make a detailed investigation.

From one point of view the talk that I have given you may be regarded as rather disconnected, because so many subjects have been considered, and yet the same theme runs through them all—the application of common sense in the solution of engineering problems. Perhaps the very diversity of the subjects may impress you all the more with the great importance of common sense.

My aim has been to encourage you to develop and trust your own common sense by showing how it applies everywhere and is of the greatest service. Indeed, without it great mental ability is often helpless or goes wrong. One of the most brilliant engineers whom I know, who has designed some of our most important electrical machinery, and who is an accomplished scientist, once said "nine-tenths of good engineering is common sense." And, in closing, let me say again that common sense is not a special gift and does not replace careful study, but it does mean the application to the problem at hand of your best experience and judgment without prepossession or prejudice.

Large Gang Punch and Die

By Harry Johnson

To make the angle iron piece, partly shown in the foreground of Fig. 1 and also in detail in Fig. 2, the dies also shown in Fig. 1 were designed.

As the stock enters the die from right to left, the first stroke of the press cuts out an angular piece, this giving the notch on each end of the piece.

Before the second stroke of the press, the angle iron is pushed ahead under the notching punches. On this stroke the notches are cut, the round holes in the end are punched and the stock is cut apart. On the first end of the bar, a short piece of scrap is produced. After the second stroke, every stroke produces a completed piece.



FIG. 1. HEAVY NOTCHING AND PIERCING TOOL

The unique feature of this die is the slide which punches out the angular notches. This slide is inclined slightly from the horizontal, so that it clears the lower limb of the angle and cuts cleanly into the corner where the horizontal and vertical limbs join. The slide is carried forward on the cutting stroke by the long wedge which may be seen projecting from the end of the punch holder. The return stroke is accomplished by means of two heavy coil springs which are recessed inside the base casting.

The notching punches are plain flat strips of steel closely fitted to grooves in the punch holder, and held in place by clamps as shown. The groups at the far end of the punch holder consist of four round punches, with the cut-off punch between.

This punch and die performs at one stroke an amount of work which would call for the following single operations: Cut; notch two ends; cut nine square notches; punch four round holes.

It is used in a Long & Allstatter punching machine. The ends of the vertical notching punches were staggered as to height, so that the punches strike the stock at different times.

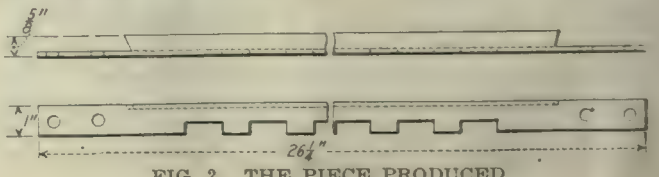
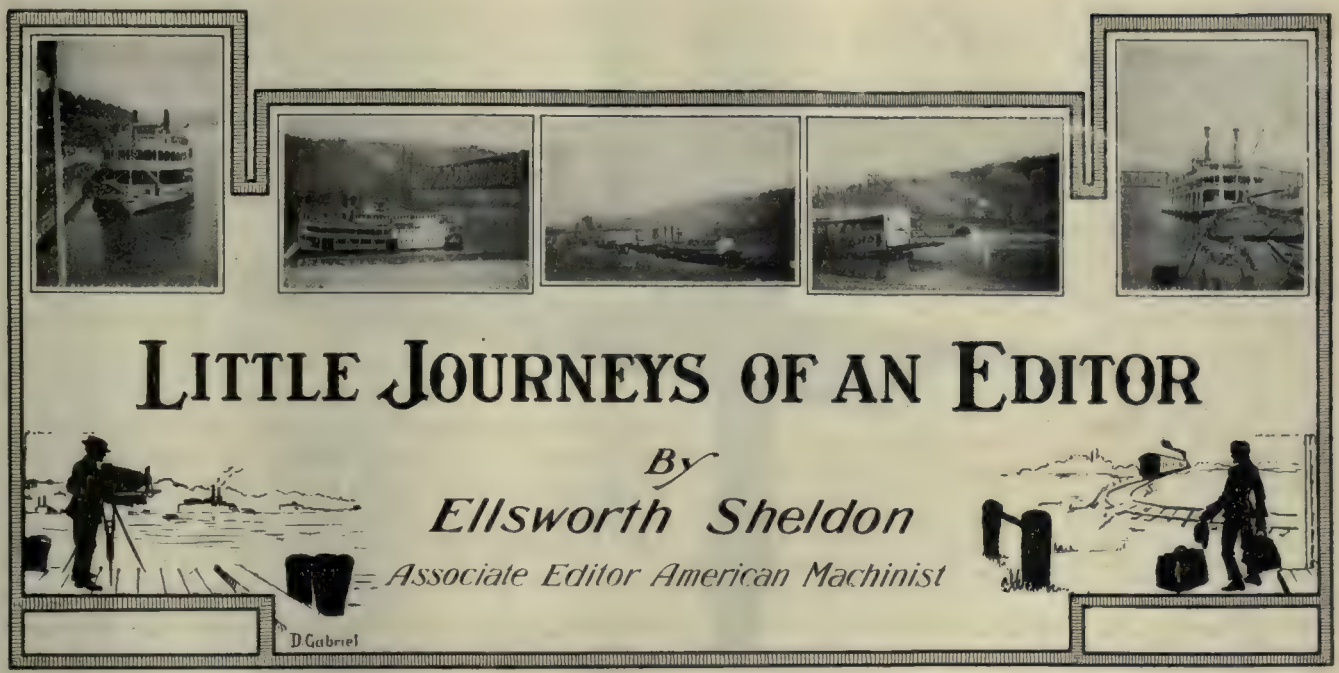


FIG. 2. THE PIECE PRODUCED



LITTLE JOURNEYS OF AN EDITOR

By
Ellsworth Sheldon
Associate Editor American Machinist

AN INTERESTING old machine shop whose windows have for seventy years looked out upon the turbid, iron-stained waters of the Monongahela River just above its junction with the Allegheny, is that founded in Pittsburgh in 1847 by William J. Renton and which, under the guidance of his sons Walter, George and John, is still doing business at the old stand.

In those far-off days, to towns situated as is Pittsburgh, the rivers were the highways of commerce and the business activities of the town were quite apt to be centered along the water front. Here were the important hotels, the larger stores, the open-air markets; and here, too, were the furnaces, the mills, the factories and the machine shops that were the exponents of American industrial life. Railroads, though not unknown, were few and far between, scantily equipped, and had not yet inspired the public with confidence in their future.

An editor on the road has no business hours. His time is subject to the convenience of others, and he is as likely to be doing real work at 3 a. m. as at 3 p. m. Nevertheless he must have his moments of relaxation. There are times when appointments fail, trains do not connect, or he just naturally has to wait for something or somebody. During these off moments he is not always asleep, and he will, under this heading, from time to time endeavor to interest the readers with accounts of things that he sees and hears aside from the main business of his trips.

Mountain roads, almost impassable in Winter and Spring, were about the only link of communication with inland towns, as was the horse or ox practically the only engine of transportation, leaving to the river steamboat, then in the heyday of its glory, the honor as well as the responsibility of keeping cities fortunate enough to be situated on Nature's highway, in touch with each other and with the outside world. It was a day that inspired the proverb to the effect that "large rivers run by large towns."

The Pittsburgh of 1847 was a large town as towns were then considered. It had not yet acquired either of the titles—"The Iron City" or the "Smoky City" by which it later became known throughout the world, and to a Pittsburgher of today it would have seemed but a country village. Yet its importance as a center of maritime commerce was relatively greater and its volume of river-borne traffic larger than it is now.

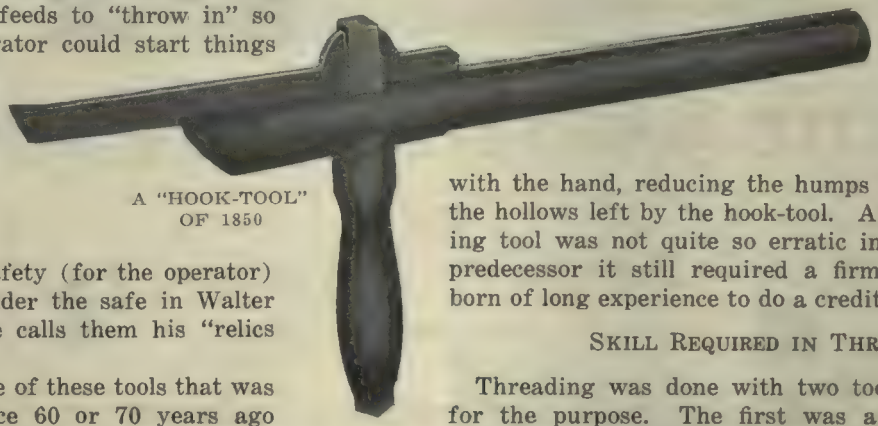
In early manhood the elder Renton, impelled by the genius for mechanics within him, sought service in the engine rooms of the river boats and soon acquired a reputation as an exceptionally skilled and resourceful engineer, and that in a day when an engineer was not only supposed to keep his engines at all times in readiness to move in response to the pilot's bell, but was likewise expected to repair or rebuild an engine in case of accident, or to install a new one should occasion arise. His skill in this direction being much in demand among boats other than the one upon which he was employed, Mr. Renton at length decided to break away from the routine of the river boatman's life and establish himself in the business of building and repairing steam engines. To this end he started a small shop upon the ground where the present shop stands at the corner of Water and Ferry Sts., a short distance from where the Allegheny and Monongahela Rivers unite to form the Ohio.

Machine shops and machine tools of three-quarters of a century ago were not the places and instruments of precision that they are now. Lathes were made largely of wood; planing was generally done with a hammer by the blacksmith before the forging got cold, while a favorite method of finishing flat surfaces of cast iron was by means of a hammer and chisel followed by a "dutch planer" otherwise known as a 14-in. coarse file. Mr. Renton, therefore, before going into the business of making machinery for others was obliged to become a machine-tool builder, with himself as the customer.

Not only was the machinery of the machine shop built partly of wood but so, also, was much of the

machinery turned out by it. The base or bed of an engine, particularly a steamboat engine, was a "timber"; the long unwieldy "pitmans" were (and still are) made from a single spar bound with iron; valve and reach-rods, levers, and other minor parts were jobs for the carpenter and ship builder rather than for him whom we now call machinist.

Running a lathe in those days was not the "cinch" that it afterward became; there were no slide rests and no feeds to "throw in" so that the lucky operator could start things moving and then go to sleep on a soap box. Turning was accomplished with the "hook-tool," two of which still occupy positions of safety (for the operator) if not of honor, under the safe in Walter Renton's office. He calls them his "relics of barbarism."



A "HOOK-TOOL" OF 1850

The picture of one of these tools that was doing valiant service 60 or 70 years ago appears on this page in Fig. 1. To use it the lathesman settled the point of the hook into the rough surface of the T rest, held the long end firmly upon his shoulder with one hand while with the other hand he tilted the downwardly projecting handle in such a way that the lip of the tool was moved forward in a direction parallel with the axis of the work.

If the piece being turned was good homogeneous iron, little difficulty would be experienced. With a properly ground lip the tool would almost feed itself forward until the angle of presentation became too great; when the heel or "hook" would have to be moved forward to get a fresh bite. The long end of the tool must be held tightly down on the shoulder so that the workman could at all times feel the pressure, and woe betide the unlucky wight who let his attention waver. George Renton told me a story in which a machinist whom he called "Charlie" was the hero and this particular tool the villian. It seems that Charlie was turning a piece of iron in a lathe that stood before an open window on the Ferry St. side of the building. Either there was a seam in the iron, or Charlie for an instant forgot his responsibilities, for the end of the tool suddenly flew up and fetched him a resounding thwack under the ear that nearly laid him out cold, after which it sailed merrily out of the window and landed among some kids that were playing in the street, scaring them into flight.



It took some moments and much sympathy and advice from his shopmates to restore Charlie's equilibrium but when his head had cleared sufficiently to allow him to navigate he went out into the street to retrieve the tool. As he stooped to pick it up a large lady of Hibernian extraction appeared suddenly from behind a nearby tree and commenced to belabor him unmercifully with a horsehide strap; calling him between blows a "dirty spalpeen that c'uldn't let the little childher play widout t'rowin' t'ings at 'um." It required the combined office and shop forces to effect an armistice.

After a job was roughed out with the hook-tool the latter was exchanged for a long-handled square-nosed tool which would be pushed along the top of the rest with the hand, reducing the humps to the diameter of the hollows left by the hook-tool. Although this finishing tool was not quite so erratic in disposition as its predecessor it still required a firm hand and a skill born of long experience to do a creditable job.

Skill Required in Threading

Threading was done with two tools made especially for the purpose. The first was a graver, having a single sharp point with which the lathesman would "start" the thread by a dexterous twist of the wrist, running up a turn or two on the work. Here, too, only the skill of the practiced artisan would suffice, for there was nothing but the movement of his hand guided by his eye to establish the lead.

When a partial thread of one or two turns had been cut, the "chaser" was brought into service. This would be a tool having several "teeth" of the exact shape and pitch of the required thread. The first turn or two cut by the graver served to start the forward movement of the chaser and it was up to the workman to continue the same relative rate of advance as he made pass after pass over the work until the teeth of the chaser had gotten sufficiently deep into the metal to guide itself. By the time the thread had been cut to half its depth the chaser would of course be guided by its own accurately pitched teeth, not only insuring the regularity of the threads but correct the slight inaccuracy of the starting threads cut by the graver. Capscrews, bolts, studs, etc., were not then available as a commercial product, therefore the making of these small but important items was a stock job to be followed up whenever work ran slack, or inclement weather kept the workers indoors.

Blacksmithing was a fine art and not a few parts came, all finished and ready to take their place in the machine, from the anvil. The good machinist was also blacksmith, carpenter, millwright and pattern maker; not infrequently foundryman as well. The broad axe or the sledge; the plane and the bit-brace, or the ham-

mer, cold-chisel and file; they were all his familiars and together with hook-tool and graver he was expected to handle them indiscriminately and with equal skill. It was emphatically the day of the "all-round man."

Crude Tools, but Accurate Work

Notwithstanding the crude tools, creditable jobs were the rule. The skilled craftsman would leave a journal as smooth and as parallel as would the average present-day mechanic; or would cut threads that looked as smooth and even, and served their purpose as well, though probably were not as accurately to pitch, as threads cut upon a modern engine lathe.

They did not talk about "splitting tenths" in those days; they split sixty-fourths instead, and a man who could turn a piece to "half a sixty-fourth was a good workman." Yet, when it came to making a fit with wire gage and caliper they worked as close in 1850 as they do in 1920; only they did not know it.

The principal line at the Renton shop in its earlier years was the building and repairing of steamboat engines, but with the rise of the steel and iron industry in Pittsburgh the work gradually changed to the new and heavier machinery required by the mills and furnaces.

Doing Jobs Outside of the Shop

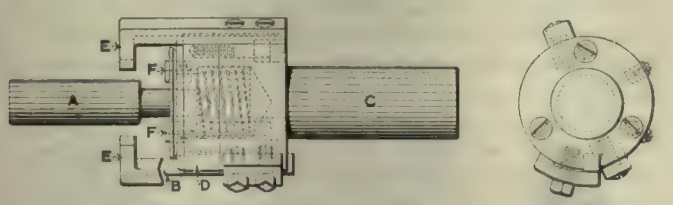
The size of a shop was no gage of the size of the work it could handle. Many a job that was too big to come in the front door was successfully accomplished upon improvised rigs mostly made of wood and set up outside. I was told of the boring of large cylinders set vertically in timber cribs in the street; a boring bar babbitted in place; boring head and cutter adjusted and a long pole made fast to the upper end of the bar. A mule attached to the free end of the pole furnished the motive power and a boy, riding on the pole near the center of activities, furnished the feed; varying the monotony from time to time by taking a whack at the mule with a long-handled ox-goad.

Chamfering Attachment for Hand Screw Machine

By Walter Symes

We had a quantity of punched washers to be chamfered, and the attachment here shown was designed to be used in a hand screw machine. It worked very successfully and we think it may be of interest to others.

The arbor *A* is made of tool steel, hardened and ground. It is held in a draw-in collet in the machine



THE CHAMFERING TOOL

spindle. The end is ground to a slight taper to allow it to enter the washer easily and still be tight enough to drive.

The cutter *B* is held in a shank *C* by a suitable clamp. The shank is made of machinery steel and carries the disk *D* which is made of machinery steel, casehardened and ground smooth on its face. The disk serves to hold the washer on the arbor by spring pressure and also acts to steady it while the tool is cutting.

The fingers *E* are for removing the washer from the arbor when the operation is completed.

The washer is dropped on the springs *F* which are fastened to the disk and which are made to suit the size of the washer. The turret is then brought forward so as to force the washer on the arbor and the forward movement, continuing after the washer has gone on as far as the taper will permit, forces the disk *D* back against its supporting spring, thus having the effect of projecting the tool to cutting position.

The turret is then withdrawn and the washer is engaged by the fingers *E* which remove it from the arbor whence it drops off into a suitable receptacle conveniently located.

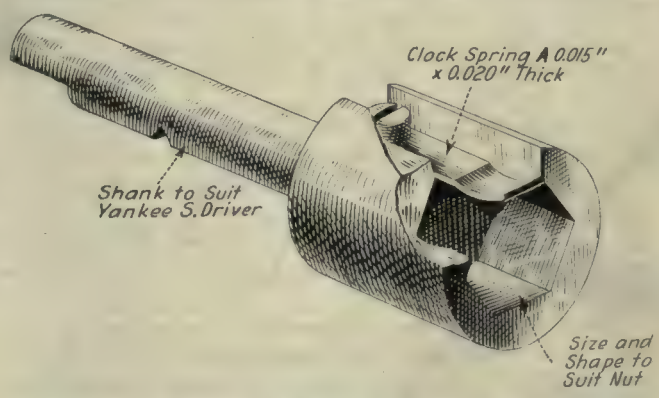
This attachment may be used for various sizes of washers by making arbors and springs to suit.

It is possible to chamfer 40 washers per minute.

Setting Small Nuts in Assembly Work

By H. S. Beeston
Notts, England

The writer noted with interest the article by Amos Ferber on page 739, vol. 52, of the *American Machinist*, describing the setting of small nuts in the assembling



TOOL FOR SETTING SMALL NUTS WITH A YANKEE SCREWDRIVER

of electrical devices by means of the sensitive drill-press and the tapping attachment. Having been directly connected with the assembly of electrical instruments for the past six years I can testify to the necessity for using tools of this class in order to keep abreast of the demand for production.

For the same purpose as outlined by Mr. Ferber in the above-mentioned article I have used the simple device herewith illustrated, fitted to the driver socket of a "Yankee" screwdriver, finding it quite as rapid as using a drilling machine and having the advantage of portability so that it may be used wherever convenient.

When used for setting small hexagon nuts the tool is made with a hexagon recess to fit the nut, and having one flat cut away to accommodate the spring (made from a piece of clock spring) that enables the operator to pick up and hold the nuts to be assembled. A downward push on the handle of the "Yankee" serves to spin the nut to place and set it up tight.

I have found this tool, used in this way, to be a production booster.

Your Liability for Concurrent Compensation

By CHESLA C. SHERLOCK

Not all of us—executives or workmen—fully understand the provisions of the workmen's compensation acts. The compensation allowable for various degrees of injury, resulting from the same accident, is explained in this article and the decisions of the courts of several states are furnished for reference.

THE other day a large employer of labor asked me this question: "For goodness sake, don't our liability ever end under the workmen's compensation acts? We always thought that when a workman was injured in his line of duty that we owed him compensation, but what happens when a workman receives two injuries from the same accident? Do we have to pay him double compensation?"

This is a question which has concerned not only the employers; it has greatly concerned the commissions and the courts administering the compensation laws.

The compensation acts have been unfortunate in their wording and in the plan used to provide for compensation to injured employees. It was the aim of the compensation acts, we will recall again, to take the place of the common-law theory of damages, and to remedy some of its evils.

And some of these evils which had worked the greatest dissatisfaction with the laboring classes were the uncertainty and the indefiniteness of recovery and the amount thereof. The compensation acts were to be certain and fixed in the fact that *some* recovery could be had, and definite in the *amount* to be recovered, so far as possible.

The framers of the acts provided a schedule to cover every kind of an injury they could think of. They then were faced with the conclusion that many workmen are injured and incapacitated who do not suffer any of these scheduled injuries. What were they to do with them?

In order to cover *all* cases they put in a provision which said in effect that anyone suffering an injury not listed should have compensation during the period of such disability not exceeding, however, a certain limit as to time and amount.

So we find that it is entirely possible for a workman to receive an injury arising out of the same accident which would raise a question as to whether he could force his employer to pay him as if he had, in effect, suffered two separate and distinct injuries arising from two separate accidents.

Law Does Not Allow Double Compensation

Does the compensation act in your state permit a double recovery for any given injury? It does not. Let that point be kept firmly in mind from the very beginning of this discussion. The law has never willingly permitted one person to collect the same debt twice, if it could help it. That is why, when the compensation acts were adopted, all recourse under the common law was cut off, and this provision made: That in case a workman should be injured under circumstances which gave him a right to both compensation and an action for damages under the common law, he was forced by the law to make a choice, to decide which branch of the law he wished to invoke, and having made his choice he had to abide by it.

If there is any employer who has been in doubt on this subject, let me bring to his mind at this time the fact that if he is operating under the workmen's compensation act that liability, in so far as his employees covered thereunder are concerned, does not extend to the old common law also. He need have no fear of suit at law for damages in addition to compensation. That right no longer is extended to his workmen. On the other hand, if there are workmen not covered by the compensation act in his employ who have a right to sue him for damages in case of injury, he cannot be called upon to pay them compensation also. The law is settled on this point and the employer's liability is single, not double.

The question we are discussing now is not with relation to a double liability as between the compensation acts and the old common law, but with reference to a double liability as under the compensation act alone.

Workmen are not to blame ordinarily if a single accident arising out of and in the course of the employment inflict several separate and distinct injuries upon them. If a workman loses a foot, for instance, he is entitled to a certain number of weeks' compensation under the schedule. He is entitled to it whether the disability in fact extends that far or not, for the law has presumed that such is the extent of the disability. Suppose, in addition, that the same accident causing the loss of the foot severely wrenched and lacerated his shoulder so that he can't stand erect or even sit up and must lie in bed on account of it.

The loss of the foot is a single injury and the incapacity resulting therefrom is partial and permanent. He will never have another foot. The injury to the shoulder is total but in time it will heal and the incapacity from such injury will pass away. So it is said to be a total temporary disability. It also is separate and distinct and is a compensable injury under the acts. Both, however, sprang from the same accident.

The employer complains when the workman moves for compensation for two injuries from the same accident. He claims that the workman is trying to recover double compensation for the same injury. He also states that he is charged to pay on the basis of accidents, not on the basis of every separate and distinct injury that the technicalities of the law or the genius of lawyers can discover for the claimant.

This is not an isolated or fanciful case which I have mentioned. It is one which has greatly concerned thousands of employers everywhere ever since the first compensation acts came into being ten years ago. Likewise it is one which has challenged the attention of the courts and commissions on many, many occasions. It is only within the past few months that any sort of definite conclusion has been reached by the authorities, and employers should feel gratified that at last some light is to be shed on the subject.

I have witnessed, while serving on an industrial commission, this question decided in several different ways, so I am not surprised to find that many of the states are still far apart on it. New York, for instance, decides the matter exactly the opposite of Connecticut and Indiana.

The Connecticut Law

In Connecticut, a case came up where a workman had sustained the loss of a leg and also an injury to a shoulder in the same accident. The headnote to the case states: "Under the Workmen's Compensation Act where a workman sustains the loss of a leg and also an injury to a shoulder in the same accident, resulting in partial incapacity, compensation may be awarded for such partial incapacity in addition to the specific indemnity provided for the loss of the leg."

Elsewhere, in the same decision, it is said: "Where an employee entitled to compensation under the Workmen's Compensation Act for partial incapacity to his shoulder and to specific indemnity for loss of a leg, sustained in the same accident, the trial court, inasmuch as the act does not permit double compensation, correctly made the awards consecutive, the award for total incapacity to precede in payment that for the partial incapacity."

Let us keep in mind this distinction made by the court between "concurrent" compensation and "consecutive" awards. The Connecticut court admits that the Connecticut act does not permit double compensation and seems to say by inference that to compensate two injuries *at the same time* would be to violate the law, but it sees no objection in paying for the two injuries at separate times.

Considered in a technical sense every workman suffers two injuries and the time limit imposed by the compensation act upon them must run concurrently, but the payment by the employer for them cannot run concurrently. This is a safeguard reacting to the benefit of the employer.

Let us be specific: Every injury results in a temporary disability. It may last but an hour, a week or a month, and this temporary disability is present whether a permanent injury is sustained or not. A workman is injured by the breaking of a belt in a shop. It strikes him in the side and wrenches an arm. He suffers a temporary disability because of the shock, the bruises and the wrenching. It may keep him in bed for three months. Suppose that in addition it causes him to lose the fourth finger of his hand. For such injury we will say that he is entitled to 40 weeks' compensation. The temporary disability due to the lacerated arm runs concurrently with the permanent disability suffered by reason of the loss of the finger. The employer pays first for the greater injury, the loss of the finger, and when the 40 weeks are up the temporary disability has disappared and he is, therefore, called upon to pay no compensation for it.

But suppose, and it was in a case of this kind that my friend made his protest, that the temporary disability exceeds the permanent disability in point of time, what then? Suppose the workman wants his awards paid concurrently? Under the law he cannot have them paid concurrently, but he can have an award made concurrently for both injuries, but the best he can hope for is to have them paid consecutively, and in some states, particularly New York, he cannot have them even paid consecutively.

In New York, it was shown that the workman's right hand had been injured, the second finger being cut off and the thumb and index finger severely lacerated. The commission found that "claimant was totally disabled for 10 weeks and awarded 8 weeks' compensation (minus waiting period) and then awarded 30 weeks' additional compensation for the loss of the second finger, to begin at the expiration of the 8-week period."

The supreme court reversed a decision of the appellate court upholding this award on the theory that the New York act was not indemnity for the loss of a member as such but compensation for disability to work on the basis of average weekly wages.

Said the court: "Concurrent awards and consecutive awards on separate items of physical impairment, disconnected from earning power, alike ignore the fundamental principle that the basis of compensation is a sum payable weekly for a fixed time during which the employee is actually or presumptively totally or partially disabled and nonproductive. All compensation acts have their foundation on the failure of the common law to provide a remedy for accidental injuries where the employer was not at fault, and both right and remedy thereunder are unknown to the common law. . . . While it may be urged that the law says that 'compensation . . . shall be payable for injuries sustained' and that injuries are recognized by law which do not necessarily impair earning power for any fixed period, such as 'serious facial or head disfigurement,' the schedule of compensation refers to disabilities only, and to compensation in case of disability only, and, so far as compensation is allowed for injuries which do not have any relation to disability for the full period for which such compensation is allowed, such allowances are the anomalies and not the characteristics of the statute. Any loss of physical function detracts potentially from earning power, and the Legislature is therefore justified in establishing a fixed period of compensation based on a specific injury such as the loss of a finger. If the injury detracts more or less from the earning power than the period fixed by the statute, it may at least be said that the rule is simple and the scale of compensation definite. The word 'disability' in the law as we read it, therefore, means 'impairment of earning capacity' and not 'loss of member.' . . . The entire matter is committed to the legislative discretion . . . which has not seen fit to provide for concurrent . . . or consecutive compensation. If the act is not sufficiently broad in view of the fact that it covers negligent as well as non-negligent injuries, we may not disregard its provisions to deal more scientifically or justly with the subject."

The Law in Other States

However, in Minnesota, a case arose where a workman lost a thumb and index finger of his right hand. For the thumb he was entitled to 60 weeks' compensation and 35 weeks for the index finger. The court made the payments run concurrently. The case was remanded by the supreme court for modification, the court pointing out that as the claimant had sustained two separate and distinct injuries if awards were made to run concurrently the amount payable weekly for 35 weeks would be $15, or a sum greater than that allowed under the statute.

Said the court: "This feature of the statute cannot be ignored, or the particular provisions brushed aside as unimportant. It must be recognized and effect given

thereto. But this can be done only by requiring payment for each injury separately during the period prescribed by the statute, one to follow the other. That would not violate the maximum either as to amount or the limitation of time."

Here, again, the court had no quarrel with the thought of a double award, but merely as to the manner of payment.

In Indiana, it was held that an employee who has sustained two or more injuries in the same accident, one of which is compensable under the specific schedule for permanent partial disability, and the other or others are compensable under another section, as for temporary total disability, compensation may be awarded under the specific schedule for permanent partial disability, and also as provided in other sections for temporary total disability, but that such awards should run consecutively and not concurrently, not, however, for a period to exceed 500 weeks as provided by the act, or for an amount exceeding $5,000 as provided by section 40 of the act.

The court said: "To determine that in cases such as are involved here the periods of compensation should run concurrently would, in our opinion, violate the spirit and the purpose of the act. It is therefore our judgment that in such cases compensation should be awarded at the 55 per cent rate, and that the periods should run consecutively, but not to extend beyond 500 weeks, and that the amount of the compensation should not exceed $5,000."

Again the Connecticut court has said: "An injury attended with blood poisoning might incapacitate for an entire year, and the injured person would be entitled to compensation for that period, provided no amputation were necessary; but if such injury was attended with the loss of a small toe or the phalanx of a fourth finger, compensation would be from six to thirteen weeks. Our act does not permit double compensation, and hence the trial court was correct in making these awards consecutive; the award for the total incapacity to precede in payment that for the partial incapacity."

It is useless to quote the courts further on this subject. The decisions based above are all from courts of last resort in the respective states mentioned and they are authoritative.

The courts, with one exception (New York), take the position that concurrent compensation cannot be awarded and no employer is liable therefor, but they see no objection to awards for separate injuries springing from the same accident, provided the employer is asked to pay for them in consecutive payments, the award for permanent partial disability, or scheduled injuries to be paid first.

The New York court, however, seems to consider "concurrent" and "consecutive" awards as one and the same thing; that if one is not permissible under the law the other should not be.

No matter what act you operate under, there is no room for the feeling that the compensation acts call upon you to pay for the same injury twice. Even in those states permitting "consecutive" payments you do not do that; you merely pay for the effects of the one accident, in its relation to the whole amount of disability actually caused the injured workman.

There is nothing unfair about it, under either construction. It is an attempt merely to harmonize the two diverse sections of the statute and to render unto each man—the workman and the employer—his due.

Is This a Punch Press Job?

By C. M. STARR

On page 372 of *American Machinist*, under the title "Is This a Punch Press Job?" is an article which offers a solution to the question previously raised by F. C. Hudson, on page 1267, Vol. 52.

I think a better and easier way to do this work would be by means of the little rolling mill shown in the illustration, which represents a device that I made several years ago for work similar in kind but different in section. This device was made for and used in an ordinary engine lathe of about 21-in. swing.

Referring to the drawing the letter *A* represents four boxes or bearings of cast iron, planed square in all directions, and bored through the center to take the 2¼-in. journals of the arbors which carry the rolls. The boxes are held together in pairs by two bolts to each pair; thus providing a means of adjustment to maintain the required pressure on the work.

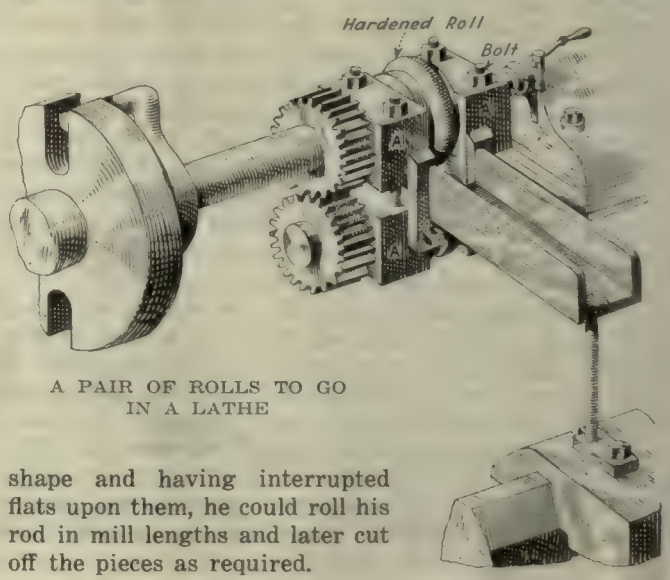
One arbor is made longer than the other and has generous centers, so that the device may be placed in the lathe, by which it is driven through the medium of the regulation lathe-dog. A pair of gears suitably mounted serves to drive the lower roll.

A spout or channel to guide the metal to be worked is firmly screwed to bearing blocks of the lower roll and a swinging strut pivoted under the spout fastens to the cross-slide of the lathe carriage and prevents the whole device from turning over with the lathe.

The rolls are of machinery steel, deeply carbonized, made glass hard, and must be polished to a mirror finish in order to make them do good work. They are threaded to the arbors, one right and one left hand, against a shoulder and should be plainly marked right and left so that there need be no guess-work when it becomes necesasry to remove them from the arbor, for they start hard.

It is a matter of a very few minutes to set up or dismount this device in a lathe and it can, therefore, be used to advantage in any lathe big enough to drive it at such times as the lathe is not needed for other work. With the backgears in, a very powerful drive is secured.

The shape of the rolls shown in the cut is not adapted to Mr. Hudson's work, but this is, of course, but a detail of construction. With rolls of suitable shape and having interrupted flats upon them, he could roll his rod in mill lengths and later cut off the pieces as required.



A PAIR OF ROLLS TO GO IN A LATHE



Franklin Transmission Case

By FRED H. COLVIN
Editor, *American Machinist*

The transmission case of the Franklin car is an aluminum casting, as can be seen from the various illustrations. The machining operations involve a number of interesting milling and boring operations, some of the fixtures being of particular interest on account of some of the features of their somewhat unusual design.

As in the machining methods of most pieces of this type, the first steps are to face-grind the top of the casting, drill the bolt holes and ream two of them to be used for locating points in all future operations. After this is done, the transmission cases go to the double-headed milling machine shown in Fig. 1, for the rough milling of the ends of the case.

The string fixture shown holds four of the cases at one setting, each case being located by two dowel pins, the face on the fixture squaring the castings with the faces which have been previously milled. These fixtures are very quick acting, the work being held down by five straps, one at each end and one between each of the castings. These straps are double ended but do not bear directly on the casting itself. Instead of this, the ends of the straps bear on the hook or angle plunger *A B*, the cam *C* locking them securely in position. For removing and replacing the work, the hooks can be swung out of the way, each being provided with a round body as can be seen. These, in connection with the quick acting cam *C*, enable the cases to be quickly handled on and off the fixtures.

The inside faces of the idler gear bosses are machined by means of the device shown in Fig. 2, the machine used being a substantial hand milling machine which is very convenient for work of this kind.

The cutter *A* is driven by gearing from the milling machine spindle, the gears being protected by the plates *B*. The transmission case is held against the angle plate *C*, by means of the strap *D* and the hand screw *E*. The stop *F* positions the strap *D*, and prevents it being swung up too far before locking in place. The case is positioned on the angle plate by dowel pins in the reamed holes.

An interesting combined boring and drilling machine is shown in Fig. 3, which takes care of all the holes in the ends of the case. Nearly all of the boring bars and drills can be plainly seen, the large boring bars being of the Davis expanding type while other holes are bored and drilled by the spindles and tools shown. It will be noted that the fixture holds two transmission cases, but that each set of spindles is at work at a different end of the case. The first set of spindles bore and drill one end and after the piece is removed, its po-



FIG. 1. MILLING ENDS OF CASE

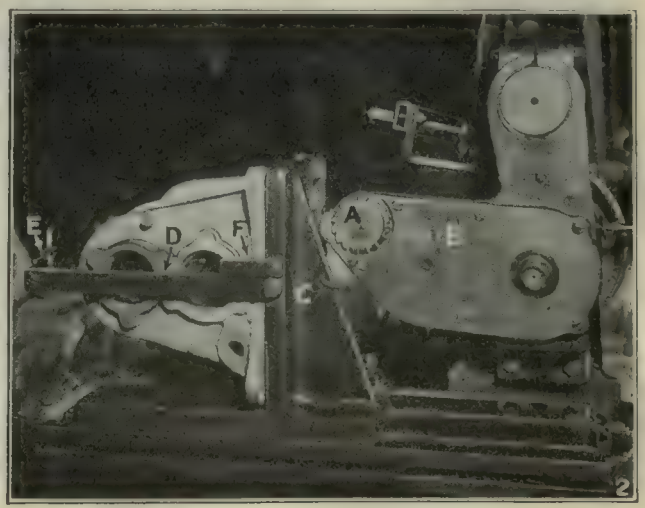


FIG. 2. INTERNAL MILLING DEVICE

AUTOMOTIVE CONSTRUCTION

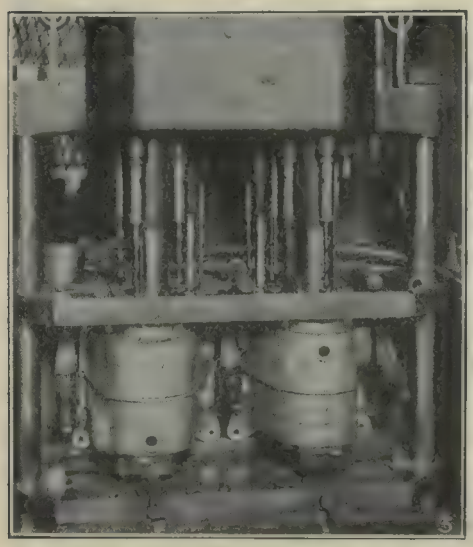


FIG. 3. BORING AND DRILLING CASE

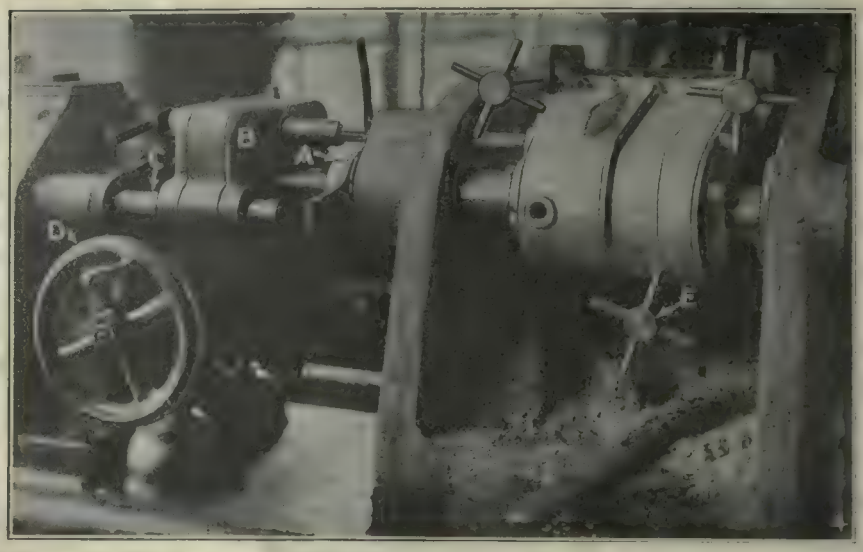


FIG. 4. FINISH BORING OPERATION

sition is reversed and placed in the second fixture, a new piece to be machined being ready to take its place.

This fixture uses a type of clamping fixture very similar to that shown in Fig. 1, where the lever can be seen between the cases.

After drilling and tapping the bottom of the case is milled to insure clearance of the transmission gear. Then the case goes to the fixture shown in Fig. 4 to have the four bearing holes reamed as well as to ream the hole for the shifter fork. The work is done on a special machine. The boring bars are driven from the central spindle *A*, which comes through the gear box *B*, the whole box sliding on two rods, one being shown at *C*. The boring bars are supported in the substantial fixture which holds the transmission case and suitably guided by removable bushings. The boring bars which impart motion to the gear case *B* are fed by the hand-wheel *D*.

The case is located by dowel pins in the usual manner, and held in place by the three clamping screws shown. The lower screw *E*, operates a regular strap clamp, while the two upper screws form part of special C-clamps.

Two other milling operations are shown in Figs. 5 and 6, each of which involves the use of a fixture of different type. The first operation is on a Kempsmith and the latter on a Becker vertical machine. In Fig. 5, the transmission case is located by the four corner holes and held in position by the arms *A* and *B*, which can be swung up into place or dropped entirely out of the way, as desired. The two hand-screws *C* and *D*, each provided with a large cap having a flat surface to

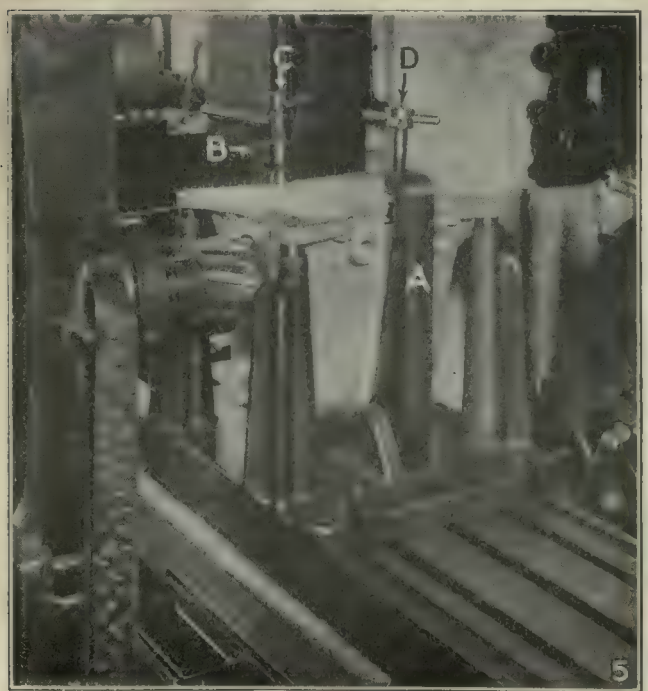


FIG. 5. FINISH MILLING ENDS

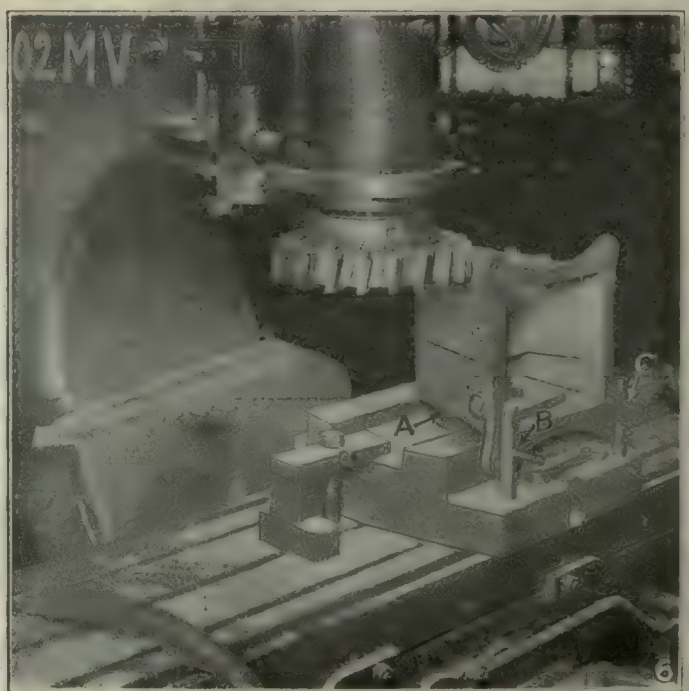


FIG. 6. VERTICAL MILLING OPERATION

AUTOMOTIVE CONSTRUCTION



FIG. 7. GRINDING THE COVERS

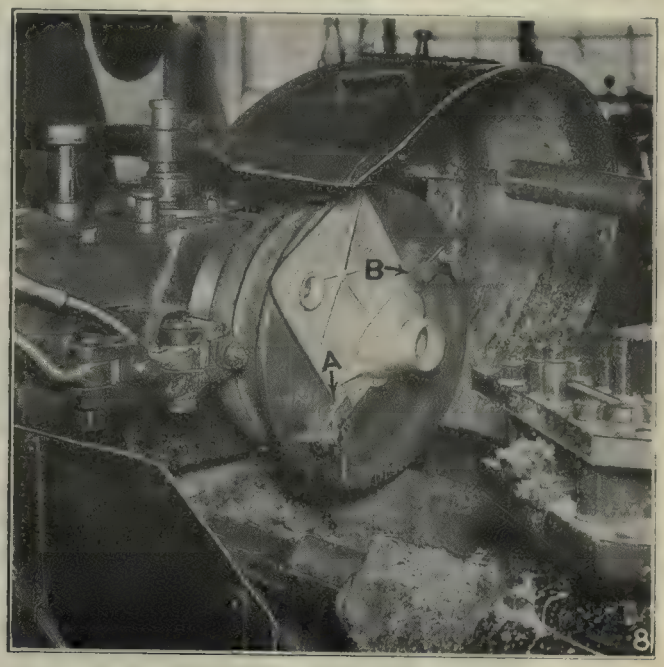


FIG. 8. BORING FOR THE LEVER

prevent marring, hold the case firmly in position during the milling operation.

In finish milling the side of the case, the casting is positioned by a stud at *A*, Fig 6, which enters the lower shaft hole, while the two post positioning screws, *B* and *C*, locate the case in the other direction.

Machining the transmission case cover, begins with grinding the bottom surface, on a Blanchard machine, as shown in Fig. 7. This view also shows the type of clamp used, it being necessary to have the clamp bite into the edge of the plate in order to hold it with sufficient firmness and, at the same time, keep the clamping jaw out of the way of the grinding wheel.

This view also shows how three covers are ground at one setting, by being placed around the revolving table. The fixtures are held in position by a magnetic chuck, which forms the working table.

Then comes the drilling of the bolt holes, spot facing the holes, and the operation shown in Fig. 8, which bores the hole forming the opening for the transmission gear shifting lever. This is a 2.25-in. hole with a tolerance of 0.002 in. while the outside is turned 2.625 in. and threaded sixteen per inch. The method of clamping the cover to the special faceplate is by means of the clamps *A* and *B*.

The under side of the cover has a slot $\frac{5}{8}$ in. wide by

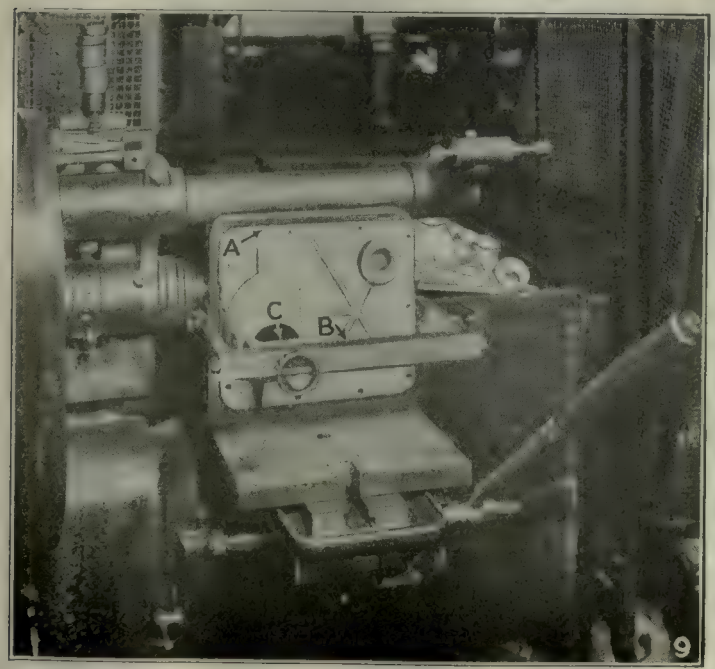


FIG. 9. MILLING RECESS IN COVER



FIG. 10. GRINDING THE EDGES

2 1/16 in. long, which is cut on the hand milling machine shown in Fig. 9. Here again, the cover is located by dowel, one being shown at *A;* and held in position by the swinging arm *B* and the clamp *C*. Then there is back facing, drilling and boring, after which the side is ground to size on a Gardner grinding machine as shown in Fig. 10. This finishes the operation, after which the cover is ready for the assembling department.

Solving Poland's Industrial Dilemma*

By HENRY ANIELEWSKI
American Representative of the Polish Mechanics' Co.

POLAND today is seeking to break the "vicious circle" of economic handicaps that is retarding industrial development. The nation needs money and raw materials in order to restore the full output of the mills and factories; the nations which possess the money and supplies are reluctant to make advances until the mills and factories are fully productive.

The most successful attempt so far made in solving this problem is through workmen's co-operation—the co-operation and full accord, not only of the workingmen of Poland, but of their Polish-American brothers as well. Under this plan the laborers in Poland will operate the factories, and their fellow workers on this side of the Atlantic will provide the initial capital and the necessary equipment.



MAIN ASSEMBLING ROOM AND MACHINE SHOP OF THE POREMBA PLANT

In carrying out this idea over 12,000 Polish-Americans have joined in an effort to assist Polish factory workers, and with them have organized the Polish Mechanics' Co. Though formed less than a year ago, this mutual benefit association is now operating two large machinery factories, one at Pruszkow, near Warsaw, ond the other at Poremba, in the heart of the Polish coal region.

This company is merely one of numerous co-operative organizations now functioning in Poland, but as it has most completely co-ordinated the efforts of Poles and Polish-Americans, a description of the progress made by this company may be taken as representative of the possibilities of mutual benefit establishments which avail themselves of the abilities of both the Polish workers and the small American investors.

The Polish Mechanics' Co. was incorporated in Ohio last year with a capital of one million dollars. American citizens living in 186 communities joined in financing the organization, and within a few months over 12,000 individuals had subscribed to the company's stock, the holdings varying in size from one to sixteen shares with a par value of $100. The truly representative character of the company is well indicated by this wide distribution of the capital holdings, no small group of individuals being in a position to manipulate the concern's affairs.

The actual direction of the company is in the hands of officers elected for one-year periods by the stockholders. In these elections both the Polish-American stockholders and the workers in the Polish factories are given representation according to the extent of their paid-up investments. To date the greater portion of the company's supporters are American residents, though the number of workers will be increased as rapidly as the business of the factories is expanded. All the workers in the two factories now in operation are interested in the company's finances, though a great number have not yet paid up in full the few shares of stock issued to them. There are now about one thousand employees on the company's payroll.

Nearly all the skilled workmen now employed in the Poremba and Pruszkow plants received their mechanical

*Reprinted from the October issue of the *Journal* of the American-Polish Chamber of Commerce and Industry.

training in American steel plants. The efficiency they acquired while in the United States has had a marked effect on the output of the factories. The adoption of American methods throughout the company's holdings in Poland is proceeding rapidly, the returned American workers being engaged in instructing the Poles in the most modern methods.

Shortly after the formation of the company and following the adoption of a definite plan of action, I was sent in February of this year to organize the proposed establishments in Poland. The first purchase for the account of the company was an industrial plant at Pruszkow. The immediate task presented was the restocking of the plant's equipment, much of the machinery having been carried off by the Germans during their period of occupation. Slightly over $250,000 worth of toolmaking machinery was purchased for this purpose in the United States and shipped at once to Poland, where early in the summer the preliminary installations were made in the newly acquired factory.

The disorganized state of the railroads proved to be a severe handicap to the factory because of its location in a region somewhat remote from the coal mines. To overcome this hardship, the company decided to acquire an additional plant located nearer the source of both the coal supplies and other mineral raw materials. At Poremba, near Zamiercie, in the southwestern section of Poland, a large and well-equipped industrial plant was purchased from a German-Jewish concern. Before the war this property had been valued at five million rubles, or two and one-half million dollars. This establishment, with its foundries, shops, Bessemer equipment, and other departments will accommodate 3,000 employees.

At the present time 850 workmen are employed. They are now engaged in the manufacture of war materials, but arrangements are being perfected for the making of tools and factory machinery as soon as Poland no longer requires munitions. Sixteen coal concessions are controlled by this plant, and the greater portion of them are now reaching normal production.

In acquiring this property, the Polish Mechanics' Co. fell heir to the town of Poremba, located on the company property and inhabited solely by the factory employees. The co-operative plan is thus in this case carried, not only to the production end of the business, but to the home life as well. All the town's stores are run on the mutual benefit plan. The homes are modern and sanitary and are turned over to the employees, who are in fact all partners, at very small rentals.

The co-operative idea in Poland is growing spontaneously among the peasants as well as among the industrial workers. Near the city of Krosno there is a factory under construction for the manufacture of linen goods. The entire project is in the hands of 8,000 peasants who live in the neighborhood and who have joined in an effort to control the finishing of the raw linens.

The Polish Government is giving aid to all essential industries, and has provided for priority in shipping rights to firms engaged in the manufacture of necessities. The department of commerce and industry which is now being formed will soon be in a position to cooperate extensively in improving transportation conditions, helping develop new markets, etc.

A letter which I received from the general staff of the Polish army further indicates the support that is to be expected from official sources in the re-establishment of Polish industry. The letter follows:

"The general staff gladly defines its standpoint with regard to the progress of domestic industries in Poland and asks you to communicate these views to our countrymen in America, and especially to all members of the 'Polish Mechanics' Co.'

"In view of the success attained through the complete co-operation of all units in the Polish state during the defense against the Bolshevik invasion, the supreme command, general staff, believes that thorough-going co-operation in industrial associations will result in the earliest possible restoration of the nation's production.

"Though the general staff is heartily in favor of official aid being given Polish industries, it yet believes that the slogan of the nation should be 'Private enterprise must initiate, the state must render aid.'

"With this idea in mind, the general staff is giving its support to the domestic industries which are based upon the sound democratic principle of workers' co-operation. In lending its aid to industrial establishments the general staff has in mind the development of a series of factory centers which in time of war could be quickly turned to the making of munitions and other supplies for the Polish army, and which in time of peace could first help restore those regions which suffered from the war and then in the general commercial upbuilding of the nation.

"The general staff is conscious of the fact that the co-operation of Polish-Americans with the workingmen of Poland may become a powerful means of opposing the invasion of Poland by German and Czech industries. The general staff believes that such a union will be one of Poland's most valuable foreign connections. The general staff will, therefore, support all honest efforts in that direction, and invites the Poles in America to an honest and sincere co-operation." (Signed),

By the order of the general staff,
MAJOR DOBRUCKI, construction chief.

Hardness Tests on White Metal Completed

Experimental work on determining the compression and hardness value of white-metal bearing alloys at temperatures up to 100 deg. C. has been completed by the Bureau of Standards, Washington, D. C. A paper has been prepared entitled, "Some properties of White-Metal Bearing Alloys at Elevated Temperatures," a summary of which is as follows:

An apparatus is described for determining the yield point and ultimate strength of white-metal bearing alloys at temperature up to 100 deg. C. A new design of heating apparatus is described for determining the Brinell hardness of such metals in the range of temperature indicated above. The results of compression tests and Brinell hardness tests at temperatures up to 100 deg. C. are given for five typical white-metal bearing alloys, including three tin base alloys, one lead base alloy and one intermediate alloy. These tests showed that the tin base alloys maintain their properties better at elevated temperatures than those containing lead. Results of tests are given which indicate that up to 3 per cent the lead in a high-grade babbit does not affect the yield point or ultimate strength at 25 deg C. or 75 deg. C. Tests are described which show that the yield point of tin base alloy is not affected by heating for six weeks at about 100 deg. C., but that the yield point is lowered in the lead base alloy by heating for only two weeks at this temperature.



Device for Handling Piston Rings in the Side Grinding Operation

By Amos Ferber

The rapid handling of piston rings in the side grinding operation on such machines as the Heald, involves a considerable degree of skill in accurately placing the ring on the chuck so that it will run true, and doing it in time to escape the advancing grinding wheel.

If the ring is badly centered the wheel may not cover the entire surface, or it may be swept out of place or broken; sometimes necessitating the stoppage of the machine to clear the chuck.

A device has been developed by the Heald Machine Co. to be applied to its machines which makes accurate centering a positive operation and machines can be operated continuously from the start by green operators, for nothing is left to the operator's skill or judgment.

The device is self contained and fastens to the standard machine by merely drilling and tapping a few holes in the splash guard to bolt on brackets, one of which is shown at *A*. The frame is supported by these brackets through the medium of elevating screws each fitted with a small handwheel *B* to provide for up-and-down adjustment.

The adjustment at this point is necessitated by the fact that the splash guard on a Heald machine does not move with the vertical adjustment of the work-holding chuck and, therefore, any change in thickness of work involves the extra adjustment of the device to meet the new level. The device is so adjusted that the disk *C* just clears the surface of the chuck.



FEEDING-IN DEVICE FOR USE IN GRINDING PISTON OR SIMILAR RINGS

The disk is revolved by means of the ratchet lever *D* which moves between permanent stops so arranged as to bring one of the openings in the disk concentric with the chuck. The operator lays a ring to be ground in the opening *E* and makes a movement, forward and back, of the lever, which carries the ring forward to position *F*. A second movement brings the work under the wheel.

The lever movements must of course be made in synchronism with the reciprocating movement of the wheelhead, which, as is usual in this class of work, makes and breaks the circuit to the magnetic chuck.

By means of this device the operator is relieved of any responsibility except that of laying a ring in the opening *E* and making the lever movement at the moment when the wheelhead is at the back end of its stroke. The disk centers the ring accurately on the magnetic chuck before the forward movement of the wheelhead turns on the current, and as the current is turned off as soon as the wheel clears the work on the reverse stroke there is nothing to prevent the moving disk from sweeping the ground ring off the chuck.

The operator has nothing to do with the removal of the work; the rings drop out upon reaching the position *G* and pass out through the chute *H* either to a box or to a rod arranged to receive them.

The holes in the disk are made large enough to take the largest diameter of work contemplated and are bushed for smaller sizes. The cut shows the machine set up in the service department of the Heald shop to grind ball-bearing rings considerably smaller than the holes in the disk. Bushings are therefore shown in place held by the small clamps *I*. The part *J* is a guard, attached to the fixed central stud of the device, and remains in the position shown, which is over the ring being ground. Its duty is to prevent the possible flying of pieces in case a ring breaks under the wheel.

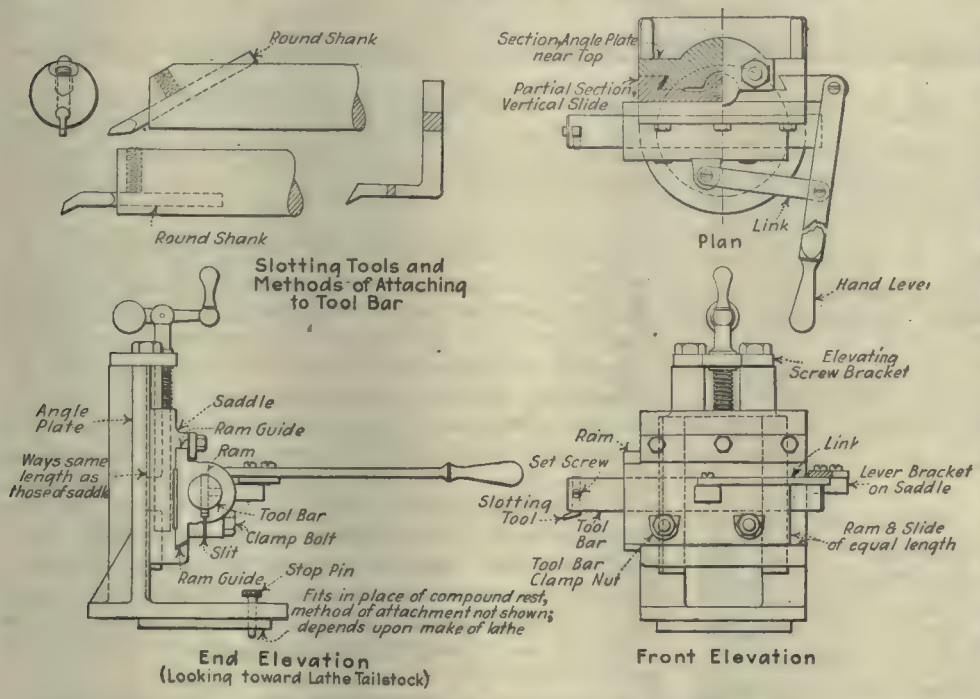
Slotting Attachment for the Lathe

By H. H. Parker

For general repair and experimental work, some means for cutting keyways in the hubs of gears and pulleys while they are still set up in the lathe after boring or machining would greatly facilitate the work. The illustration shows a small hand-power slotter which may be bolted to the cross-slide in place of the

compound rest, or, if practicable to cut the full width of the keyway at once, directly to the bed or ways of the lathe.

The attachment, while not of the "homemade" variety is of fairly simple construction and of substantial proportions. No dimensions have been given since these would depend upon the size of the lathe and upon the character of the work to be operated on.



SLOTTING DEVICE FOR USE IN A LATHE

First, there is an angle-plate casting which bolts to the cross-slide. It has a circular lower boss and this may be graduated similarly to the compound rest or else be provided only with a zero point, since in all probability the attachment would seldom be used for angular cutting. The vertical arm has sixty degree V-slides, cut away near the bottom to facilitate machining and to prevent the saddle from wearing a shoulder there. The vertically sliding saddle has horizontal ways similar to those of a planer cross-slide, the upper being flat and the lower a V-slide with gib. A boss to take the bronze or gun-metal feed screw-nut is cast on the back of the saddle and another on one side to act as the fulcrum for the operating lever.

A cast-iron ram, the same length as the saddle, which by the way has its slide the same length as that of the angle plate as called for by correct mechanical design, slides back and forth in the saddle when actuated by the lever. A round toolbar fits into a horizontal hole bored through the ram and is secured at any point by two clamp bolts which draw together the slotted casting. Thus for a short stroke the bar may be drawn well into the ram to take advantage of the greater stiffness. For use in a medium sized lathe, a maximum stroke of 2 in. would in most cases be sufficient combined with a vertical adjustment of about 4 in.

The transverse movement, when necessary, is furnished by the lathe crossfeed. As the device should be capable of being quickly and accurately lined up so that the ram movement will be parallel to the lathe bed, a hardened taper pin or other positive stop arrangement should be provided.

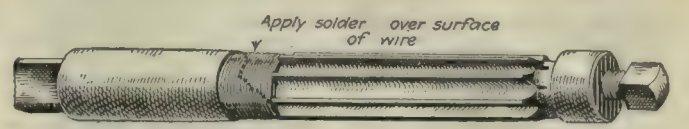
The operating lever works through a link and is fulcrumed on the saddle. Though it would be possible to arrange a power drive of some sort for such intermittent use as the attachment would ordinarily be put to, the hand lever is simple and satisfactory. Regular slotter type cutting tools are used; if there is room for the whole toolbar to enter the work, a tool held in a straight vertical slot in the end of the bar and clamped by a side setscrew is best. For a narrow keyway, a tool the full width of the cut will be used; otherwise the crossfeed will be operated to carry the cut the whole width. When the bore is smaller in diameter than the toolbar, the cutter can extend out from a hole drilled either horizontally or at an angle in the end of the bar, as shown in the sketches. Tools of drill rod forged to shape and hardened and drawn, with the shanks left round, will answer the purpose. Or a tool with a right-angle bend, clamped in the vertical slot, can be used for a short cut. One end of the toolbar can be made with a square vertical slot and the other end provided with the angular round one.

For satisfactory work all lost motion must be taken up by means of the gibs and a setscrew though other means for clamping the vertical slide might also be of value, but would hardly be necessary if the feed-screw makes an accurate fit in the nut and there is no play at the handle.

Repairing Broken Expansion Reamers

BY CHARLES HATTENBERGER

Some years ago while working in a small jobbing shop I noticed several expansion reamers that had been discarded because they were broken at the end of the slots. I repaired them all at small expense by winding over the broken section a layer of fine copper wire about



A REPAIRED REAMER

0.025 in. diameter. The reamers were put in the lathe, one end of the wire slightly bent and inserted in one of the slots, and the wire closely and tightly wound over the break.

Before relieving the tension on the wire a thin coating of solder was applied over the entire surface to hold it firmly in place.

The repaired reamers were then practically as good as new.

EDITORIALS

The Development of Aircraft

ENGINEERS returning from Europe tell us of the increasing activity in aircraft development on that continent which makes our own efforts seem of comparatively little consequence. True we have a few builders who are doing good work in the development of passenger carrying ships, but progress has been very slow for the nation in which the airplane first became a reality.

The British Government is giving considerable aid and encouragement to the development of aircraft, and the British Air Ministry is of real assistance by securing and placing at the disposal of British subjects all data regarding aircraft.

According to the British Air Ministry the last year saw 1,325 airplanes arrive in England from the continent. Of these machines 1,079 were British, 236 French, 9 Belgian and 1 was Swiss. The departing planes totaled 1,455, of which 1,206 were British, the difference denoting the planes flown over and sold.

These planes carried both passengers and freight (or express matter as we would call it), the latter amounting to $1,000,000 going out of Great Britain and $2,000,000 coming in. The planes carry this at a lower rate than the old method, small parcels costing ½ penny per pound as against 1¾ to 4 pence formerly.

It is gratifying to learn that the British Air Ministry credits the United States Air Mail Service as being the most successful air mail service in the world. But if we are to maintain this supremacy we must continue to design and build better and more efficient planes, as this has a marked effect on the economy of operation.

We must not let prejudice stand in the way of advancement. The so-called Larsen planes, which are the German-made Junker planes, have proved their economy and efficiency in many ways. The cross-country mail flight to San Francisco and return was a severe test, and they met it in a very creditable manner. The unfortunate accidents due to fire from leaking fuel pipes, are details which should have been remedied by providing for the vibration which occurs in all planes.

The absence of parasite resistance in these planes makes it possible to secure from their power plants a fuel economy as good as that of many makes of automobiles. A motor of 160 to 180 horsepower does almost the same useful work in one of these monoplanes as is done in our ships of regular design by a 400-horse-power motor. The noticeable difference is in taking off from the ground and in the ceiling of the plane.

With the knowledge of this performance the logical procedure would be to duplicate or improve it, abandoning if necessary the older designs of planes. Mere criticism of the origin of the design or of the agency by which it came to this country is neither logical, broad-minded nor good business.

We have the facilities for both laboratory and practical tests of all kinds. We have, or ought to have, engineers who thoroughly understand the problems. We have opportunities for development which few countries can enjoy. With these we ought to be leading the world in all aircraft matters instead of trailing along as we seem to be doing. F. H. C.

A Vindication of Private Ownership

THE remarkably quick come-back of the railroads in numerous ways, is a source of gratification to those who know the fallacy of government ownership.

Those who know human nature—who have had experience in handling bodies of men—know that the *average* person has a tendency to "loaf" or "lie down on the job" if placed in a position where he is practically immune from discharge, where his remuneration is fixed and where there is no means of real discipline to make him produce a minimum amount. Such conditions are enervating and take away ambition. Government ownership invariably produces such conditions. The morale of the working forces of the railroads, as it was at the end of government control, proved it.

It is an inexorable law of nature that the disuse of any limb or faculty shortly produces atrophy or a shrinkage of it. Limiting a worker's productive ability below his normal capacity comes under the same law, and results in loss of initiative and morale.

When the railroads were returned to their rightful owners, there were thousands more workers on the payrolls than ever before—thousands more than even war-time conditions warranted. These superfluous, pampered extras had to be eliminated in order to get back to anywhere near real efficiency. Prompt action by far-seeing railroad officials is now producing results that should effectually lay the ghost of government ownership, so ardently believed in by impractical dreamers and scheming politicians.

The number of tons of freight moved one mile in August, was 42,706,000,000, the largest amount ever moved in the same time in history. It exceeds, by nearly 2,000,000,000 tons, the largest amount moved in war time under government control and with the help of thousands more men than in the instance cited.

This is all the more remarkable in view of the great number of "bad order" cars and locomotives which the Railroad Administration dumped upon the present operators, and then boasted of how *economically* things had been handled under its direction!

From statistics available at present, it is highly probable that the figures for October will considerably exceed those given for August. E. V.

A Study of Working Fits

AN INTERESTING piece of work is being undertaken by the American Society of Mechanical Engineers through its Sectional Committee on Plain Limit Gages for General Engineering Work. This committee, formed at the request of the British Engineering Standards Association for co-operation in that

work, is including in its work not only the question of gages themselves but of tolerances for manufactured material, the methods of gaging manufactured material and the limits and manufacture of the gages themselves.

The members of this committee have been carefully selected so as to include practical men from a variety of industries. Several of these men were closely connected with the manufacture of ordnance, both in the service and out, and are keenly alive to the delays which were encountered, due to an utter lack of any sort of standardization, or even of understanding, of working allowances and tolerances.

Being practical men they have no illusions as to workable allowances and tolerances, and no desire to force any specific tolerances on designers in general. It is their desire to secure from as many sources as possible, the practice of the country with regard to fits of different kinds. Such information does not prevent anyone from experimenting with other tolerances for special cases, but it can hardly help preventing many costly and unworkable specifications being made.

Furthermore it makes available a source of data which can be used to show what the best manufacturers consider to be good, standard practice. Such information will go far to prevent foolish, if not impossible tolerances being specified in many cases, particularly in government work.

This committee asks and deserves your assistance in every way possible. It asks your consideration of the following kinds of fits:

1. Loose Fit Class
2. Medium Fit Class
   - A. Running fits for high speeds (say 600 r.p.m.)
   - B. Running fits for lower speeds, sliding fits, etc.
3. Snug Fit Class:
   - A. The closest fit which can be assembled interchangeably by hand
   - B. Wringing fits where parts must be selected or fitted
4. Tight Fit Class:
   - A. Drive fit for light sections
   - B. Force fit for heavy sections
   - C. Shrink fits

The committee would like your opinion of these classifications and to know how they cover your own work. Later, more specific questions will be placed before you, but suggestions from any source will be appreciated by the chairman of the committee, Col. E. C. Peck, General Superintendent, Cleveland Twist Drill Co., Cleveland, Ohio. F. H. C.

Motor-Flywheel Drive for Merchant Mill

By T. A. Bryson
Tolhurst Machine Works, Troy, N. Y.

Captain Varela's discussion under the above title, on page 660 of *American Machinist*, would have been considerably clearer, at least to the writer, if the characteristic torque-speed curve of the motor had been illustrated. From the data and specifications given in the body of the article this curve may be partially constructed. Such a curve indicates that the arbitrary rating placed upon the motor is low, considering the power that it is capable of developing. In fact, the motor is called upon to develop an average power output considerably above its rating.

Considering the cycle of operation:
Peak load, 6,534 hp., lasting 0.87 seconds.
Friction load, 360 hp.
Interval between peaks, 2 seconds.

$$\begin{array}{rrl} 6{,}534 \times 0.87 = & 5{,}685 & \text{hp.-seconds} \\ 360 \times 2.00 = & 720 & \text{hp.-seconds} \\ \hline 2.87 & 6{,}405 & \\ & 2{,}232 & \text{average hp.} \end{array}$$

The flywheel merely performs the function of storing power and smoothing down the peaks. It remains for the motor to supply 6,405 hp.-seconds of power during the 2.87 seconds, or an average output of 2,232 hp., although it is rated at only 1,800 hp.

Further, the author computes slip at overload as if the slip were proportional to the load. This is difficult to understand, since the specifications call for a slip of 2.8 per cent at full load and of 10 per cent of the full-load speed at 175 per cent overload. Or, converting both slips to per cent of synchronous speed, we have:

Load	Slip in % Syn. Speed.
100%	2.8
275%	12.5

This shows that at the higher load the motor is operating on that part of its torque-speed characteristic which is not an approximately straight line.

Near the bottom of page 661 it is stated that the motor recovers about 90 per cent of its speed. Does this mean 90 per cent of its friction-load speed or 90 per cent of its drop in speed? Further, it is not explained what effect this lack of total recovery will have upon the system in subsequent cycles.

It would seem to the writer that the proper method of attack upon this problem would be as follows:

Construct a curve showing the available energy stored in the rotating elements over the speed range through which the operation is to take place. Any speed drop would cause a loss in this energy of rotation and the time in which the loss takes place gives a measure of the power given up by the system.

From the speed-torque characteristic of the motor may be determined the additional power drawn from the motor due to a speed drop. The combination of these two curves will give a relation between the total power used and the drop in speed required to produce it.

By using sufficiently small time increments, a third curve may be computed and plotted, showing the change in speed necessary to produce the desired power during the given time range.

The recovery may be computed even more simply. The motor is now delivering more power than required for friction. All excess over friction is stored in the flywheel with the result that it is accelerated. At the same time the available excess power of the motor is gradually being reduced, due to a gain in speed. This part of the problem is comparable to the computation in hydraulics of the discharge of liquid under a falling head.

This is a very interesting subject. The writer has been prompted to this criticism of Captain Varela's article in the hope that some of the points may be made more clear, and to call particular attention to the necessity of considering the torque-speed characteristic of the motor, as well as the power requirements of the driven machine, in computations of this nature.

WHAT to READ —for the man in a hurry



Suggested by the Managing Editor

THANKSGIVING is a time for prayer as well as feasting and we couldn't resist the temptation of preaching a short editorial sermon on one of the serious business evils of today. The make-up man has placed it on the page opposite this one, and we sincerely hope you will real it carefully and take to heart the message it carries based on the text, "Give a square deal—and demand one." The last part of that text may not be good scripture but it is a great help in persuading the other fellow to observe the first part.

What to read was not a difficult matter to decide two hundred years ago when books were few and magazines unheard of. It is far different now when so much reading matter is offered to pass the time pleasantly or profitably as the reader chooses. We are doing our utmost to make the "American Machinist" not only profitable but indispensable as a clearing house of ideas and news of the machinery world. This page is the editors' advertisement of their section of the paper. It gives the high spots

A new machine-tool description has the position of honor this week, the big sectional planer built by Sellers for shipbuilding work. The lubrication and and control features are a little out of the ordinary and will repay your time in investigating them.

On page 977 is the second of Professor Bonis' articles on the determination of accelerations. Last week's contribution covered the calculations for the flyweight of a wheel governor, a subject not very near to the heart of the machine tool designer, but this time we have the author's methods applied to what he calls the quadric chain and what is really the basis of the Whitworth quick-return motion as used on many of our shapers.

For those interested in railroads and railroad shops we have, beginning on page 982, a description of the new shops of the state Railways of Chile at San Bernardo. Apparently the days of the llama, the mule and the burro as the principal means of transport are numbered, for the shops covered are up-to-date in every respect and quite sufficient to care for the rolling stock of a modern railway. The fact that all the machinery and electrical equipment was supplied by American firms adds importance to the installation from our point of view.

Frank Stanley has some notes on several of the press tools used in producing parts for caterpillar tractors in a California shop, on pages 987 and 988. They were designed to produce a finished part in one operation, thus doing away with preliminary drilling.

The common ground on which theory and practice can most easily meet is that of common sense. The importance of this homely virtue in the science of engineering cannot be overestimated. Its effect on the work of some of our great inventors is discussed at some length by Walter M. McFarland, of the Babcock & Wilcox Co., on page 989. He says in conclusion, "Common sense is not a special gift and does not replace careful study, but it does mean the application to the problem at hand of your best experience and judgment without prepossession or prejudice."

A somewhat novel story begins on page 995. Sheldon went to Pittsburgh a while back to get some material for serious articles and while there got acquainted with some of the river boatmen and repair men. He tells of some of the things he saw and heard in a shop that was doing business a decade before the Civil War.

Fred Colvin has more automotive data from the Franklin shop, beginning on page 1001. This time he describes the machining of the cast aluminum transmission case.

On page 1004 and 1005 we are reprinting an account of a co-operative workmen's organization in Poland which is being financed by Polish-American mechanics. The company is operating two factories in Poland, the methods adopted being those learned in America.

Mr. Chubb's letter on business conditions in England appears on page 1016. Among the more important points mentioned are the terms of the coal strike settlement and the losses occasioned by the strike; the British Automobile Show; the loss of a big British mill equipment order to the German A. E. G.; and the serious condition of the aircraft industry. If misery loves company our airplane builders should be glad to hear of the hard times that have overtaken their British contemporaries. Along this line we have an editorial on page 1008 to which we call your attention.

Editorial mention is also made of the work being done by the Committee on Plain Limit Gages for General Engineering Work of the American Society of Mechanical Engineers. Classifications for various kinds of working fits have been proposed and it is desired to get as wide an expression of opinion thereon as possible.

Thanksgiving—

A Time for Serious Thinking and Resolve

THANKSGIVING DAY is a typically American holiday. Underlying the spirit of feasting and good cheer that fills the land, is a more solemn disposition to look back over the past year and to count its blessings and its disappointments. But what man can reflect on the past without thought of the future?

We Americans are too little given to introspection and serious thinking. We live in a young country and really have not a very long past to think about compared to other nations. Events at any time on this side of the Atlantic move with breathless speed but since 1914 they have outdistanced even the best of us and left us somewhat dazed and in need of a chance to pause and consider.

In the rush of war preparation the usual safeguards surrounding business dealings were cast aside and the door was opened to all sorts of graft, profiteering and dishonest practices. Under normal conditions they would never have had a chance to get in, but once the attention of the country was fixed on the world struggle we had the disgusting spectacle of men who had had the reputation of being good Americans forgetting everything but personal gain and throwing moral standards to the winds.

The Shipping Board investigation and the work of the Lockwood Committee in New York are uncovering much of the badness in two separate fields and it is to be hoped that some few of the offenders will be brought to justice. Things are not as they should be in the coal industry. We can find reasons for such evils in the abnormal circumstances surrounding war preparation and its immediate aftermath.

There is no such excuse for the deplorable lowering of the high business moral standards of a few years back. We used to boast that American business was the cleanest in the world and that the American business man kept his given word as his bond. But can each of us make such a claim today?

The cancellation of honestly made contracts for the sale of goods is undoubtedly justified in some cases by the business policy of making certain sacrifices to avert a financial crash but there are too many cancellations that savor far more of expediency than they do of real necessity. Such an attitude on the part of business men, big or little, is not far removed from that of the late Imperial German government toward solemn treaties, and constitutes a very grave menace to the carefully built structure of business confidence.

On another page we print a word of warning as to the effect of the prevailing contempt of contracts on some of our foreign-trade connections. With the home market stagnant and the barrier of adverse foreign exchange facing us we can ill afford to endanger our chances for foreign trade still further by shady dealings of any sort. There is no doubt whatever that we are going to need a foreign outlet for the products of our mills and factories in the very near future and need it badly.

IT IS not a pleasant picture, this immediate business past of ours, and does not seem to offer a great deal to be thankful for except that it *is* past. It remains, therefore, for us to look to the future and to see to it that our bright prospects are not darkened by the shadow which now hangs over us. The future holds much for America if she has the wit to grasp it. No other nation is as sound financially, no other nation has the large and varied resources, no other nation has the skilled producing organization. For the immediate present we have a bumper crop, a real merchant marine, a banking system that works and a change, politically, from an administration that has been satisfactory to no one in its handling of our affairs, to one that bids fair to accomplish some of the many things we always hope to have an administration do.

But we never will get very far until we are able to restore the confidence in each other that has been so lacking. We must preach and teach and practice a new morality in business and in industry that will carry conviction not only to our associates here but to our friends in foreign lands. The Golden Rule works just as well now as it ever did and it says nothing about waiting for the other fellow to make a start in doing the right thing. It puts it right up to each man to play fair. When he does so he has a right to expect the same treatment from others and he is much more likely to get it.

Let this Thanksgiving be a turning point in American business life. Let each man of us deal squarely with his employees, his customers and his competitors, and he can then go a step farther and reach the second part of our slogan—

Give a Square Deal—and Demand One

SHOP EQUIPMENT NEWS

-Edited By-
S. A. HAND

SHOP EQUIPMENT • NEWS •
A weekly review of modern designs and • equipment •

Descriptions of shop equipment in this section constitute editorial service for which there is no charge. To be eligible for presentation, the article must not have been on the market more than six months and must not have been advertised in this or any previous issue. Owing to the news character of these descriptions it will be impossible to submit them to the manufacturer for approval.

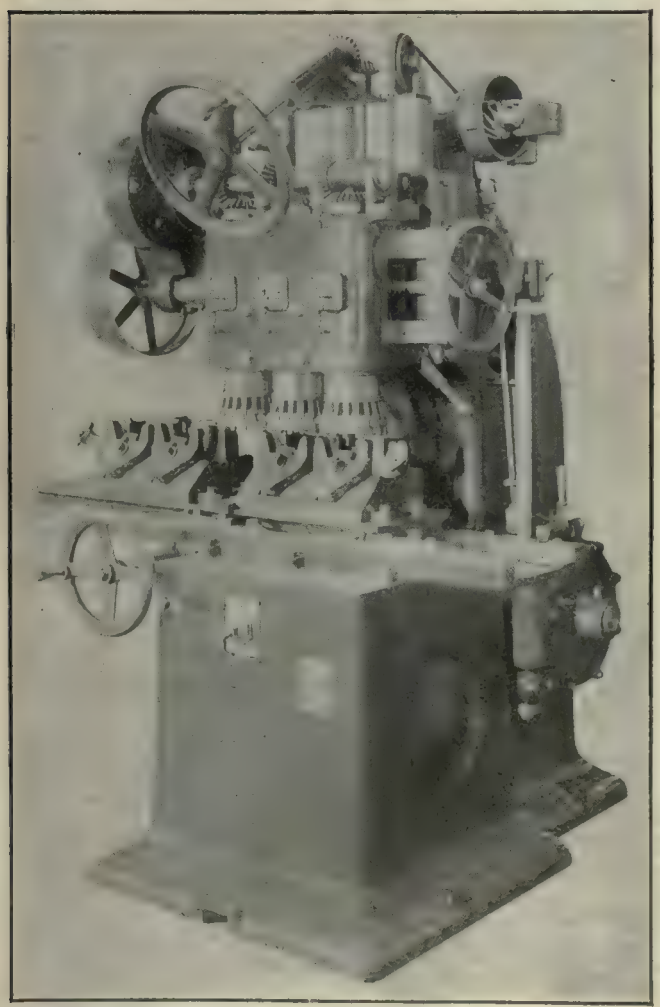
• CONDENSED • CLIPPING INDEX
A continuous record of modern designs • and equipment •

The Coulter Automatic Multiple-Spindle Profiling and Milling Machine

A recent modification of the Coulter automatic multiple-spindle profile milling machine has been brought out by the Automatic Machine Co., of Bridgeport, Conn. The machine has been equipped with a transfer table designed to permit the use of double or reciprocating fixtures so that a milling operation may be carried on with practical continuity by having one portion of the fixture in position for unloading and reloading while the cutters are at work upon pieces held in the other portion.

While this machine is essentially for single-purpose production it is adaptable to a wide range of work by reason of the adjustability of the spindle positions and the varied arrangements of the cams possible to suit the class of work under consideration.

Details of the original machine were published on page 1322, Vol. 52, of *American Machinist*.



COULTER AUTOMATIC MULTIPLE-SPINDLE PROFILE MILLING MACHINE

Sheffield Solid and Adjustable Snap Gages

The Sheffield Machine and Tool Co., Dayton, Ohio, has brought out the snap gages illustrated. In Fig. 1 is shown the solid, two-sided go and not-go length snap gage. The end-blocks, including anvils and anvil holders, are made up as units and are then assembled to strip-steel beams thus making it possible to secure any desired length. The cylindrical snap gage shown in Fig. 2 is assembled from unit end-blocks and castings in a series of sizes from $\frac{1}{4}$ in. upward. Anvils are either adjustable or renewable, and both external and internal gages can be furnished.

Advantages claimed for these gages are that the anvils are easily and cheaply replaced and that when a gage size becomes obsolete it is necessary to throw away only the beam, the end-blocks and pins being saved to use in making another gage.



FIG. 1. SOLID GO AND NOT-GO SNAP GAGE

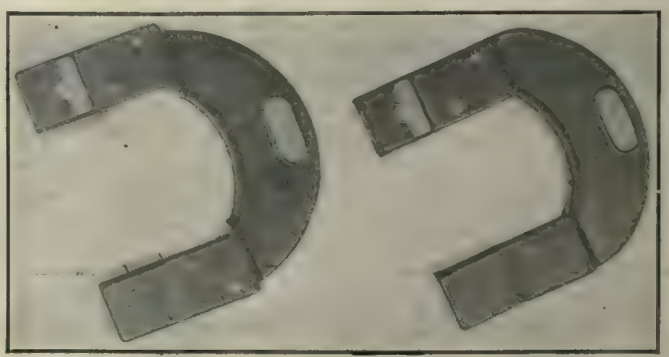
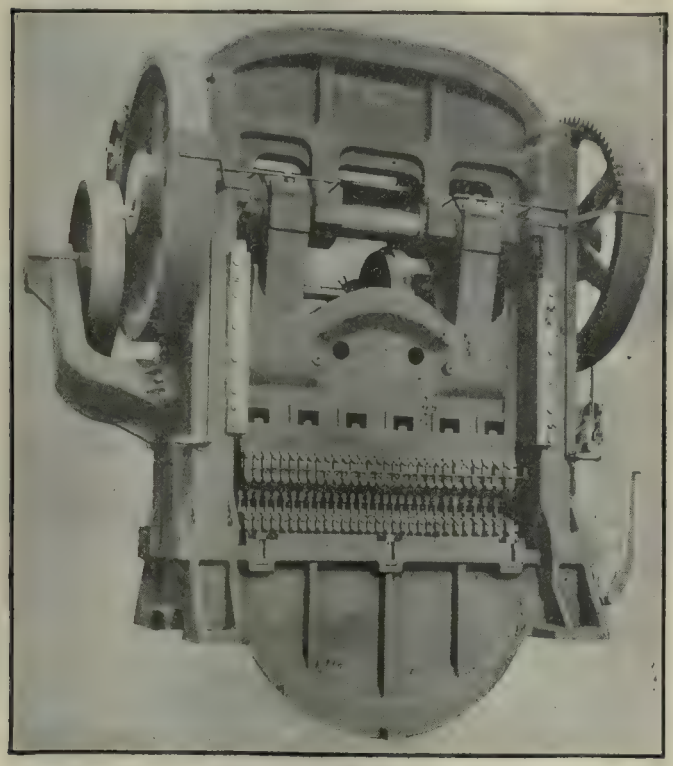


FIG. 2. CYLINDRICAL SNAP GAGES, ADJUSTABLE (LEFT) AND SOLID (RIGHT)

Toledo Multiple Punch Press

The accompanying illustration shows a large multiple punch press that has recently been built by the Toledo Machine and Tool Co., Toledo, Ohio. The press is of the double-crank type with twin-gear drive. As shown, it is fitted with sixty independently adjustable punches and dies for punching holes with varying distances between the centers. The punch holders are fitted with gags, so that by pulling out or pushing in the gags, holes may be punched or omitted as desired. The press is capable of punching 15 one-inch holes through $\frac{1}{8}$-in. steel.

The press is entirely self-contained and requires no outboard bearing, thereby reducing the floor space. It is controlled by a friction clutch having a positive stop, which automatically throws the clutch out at the top center. By changing the position of a small counterweight, the press can be run continuously, or else intermittently by operating the hand lever. The press is driven by a 30-hp. motor, which is supported on a bracket on the rear of the left-hand upright. It has a centralized forced-feed lubricating system, which permits the operator to lubricate all of the main bearings from the floor.



TOLEDO MULTIPLE PUNCH PRESS

The size of the press is shown by the following dimensions: Weight, about 165,000 lb. Width between uprights, 103 in. Area of bed, 36 x 102 in. Opening in bed, 4 x 98 in. Area of slide, 22 x 94 in. Diameter of crankpin, $13\frac{1}{2}$ in. Distance from bed to slide raised, 33 in.

"Electric" Arc-Welding Machine for Small Work

A hand-portable welding machine weighing approximately 100 lb. has been developed by the Electric Arc Cutting and Welding Co., 152-58 Jelliff Ave., Newark, N. J. The illustration shows a man holding the machine under one arm. The device is intended for light work, such as in a garage machine shop, and it can use electrodes from $\frac{1}{16}$ to $\frac{5}{32}$ in. in diameter. When using the smaller sizes of electrodes it can be operated continuously, but with the larger sizes the operation must be intermittent. Thus heavy work, such as on boilers or engines, can be done when necessity demands it; but the machine is intended especially for light welding, sheet-metal work, brazing, lead burning and the like. Building up worn parts can also be done.



SMALL PORTABLE ELECTRIC ARC-WELDING MACHINE

It is possible to operate the machine from a lamp socket on light loads, but it is intended that the supply wires of the device be attached to the panel board feeding the lights, provided that a current of 5 kva. is available. The machine will operate on any voltage between 90 and 130 and between 180 and 260. This is accomplished by the use of two coils, which can be placed either in multiple or series, and by providing means of regulation. The standard frequency is 60, but machines can be furnished for any frequency desired. It is said that there are no moving parts, so that troubles in the mechanism are not apt to occur.

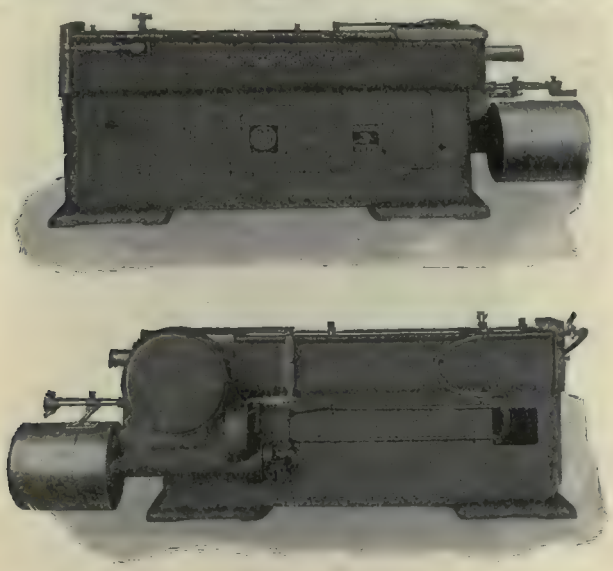
American Rack-Type Broaching Machine

The American Broach and Machine Co., Ann Arbor, Mich., has recently placed on the market a rack-type broaching machine in two sizes, Nos. $1\frac{1}{2}$ and 3, the difference being in the length of stroke and pulling capacity. The No. 3 machine is here illustrated, views of both the front and back being shown. The No. $1\frac{1}{2}$ machine is intended to handle broaches up to 40 in. in length, while the No. 3 can use broaches 58 in. long.

The drive is by belt, the speed reduction being made by means of an inclosed steel worm and phosphor-bronze worm-gear on the rear of the machine. The worm is hardened and provided with two roller thrust bearings to take up the end thrust. A hardened pinion on the shaft of the worm-gear drives the rack to which the broaches are attached by means of the sliding head. The section of the rack is D-shaped, the flat side with the teeth being on the bottom.

The reversal of motion of the rack is accomplished by shifting the belt at the ends of the stroke, the length of which can be adjusted by means of stops provided for that purpose. The return speed of the

rack is twice the cutting speed. A brake is automatically applied at the ends of the stroke, so as to absorb the momentum of the moving parts and to enable the travel of the sliding head to be accurately con-



FRONT AND REAR VIEWS OF THE NO. 3 AMERICAN RACK-TYPE BROACHING MACHINE

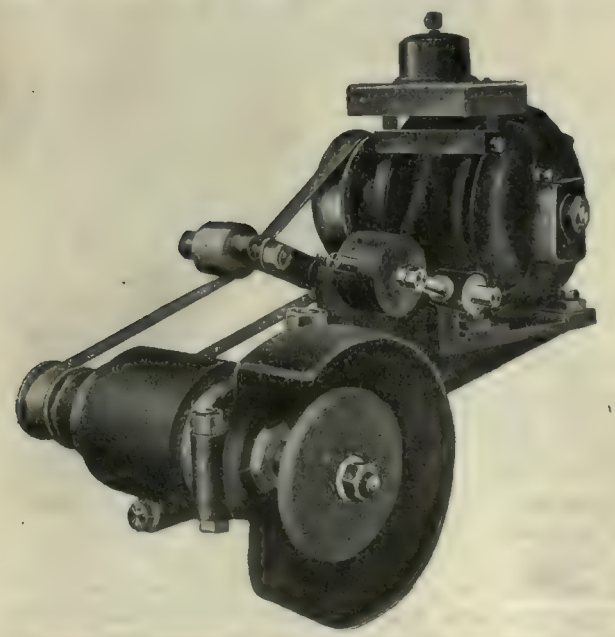
Specifications: Maximum capacity; length of broach, 58 in.; will square or spline hole, 3½ in.; will cut keyways, 1⅜ in. Height to center of bore, 32⅜ in. Face, 15 x 14⅜ in. Bore, 5-in. diameter. Weight, crated with countershaft, 4,300 lb.

trolled. It is stated that there is no tendency to cause a twisting action in the starting head, such as occurs with a screw-type drive.

The base of the machine is of the cabinet type, and is fitted with shelves for holding broaches. One end of the base is finished and provided with T-slots, so that special fixtures or an oil trough can be attached. An oil pump, served from a trough in the base, is provided.

Grinding Attachment for Lathe

A portable grinding attachment for a lathe is manufactured by the Société pour l'Industrie Mécanique, Basel, Switzerland, which organization is represented in this country by François Chappuis, Room 2632, 120 Broadway, New York City. It is intended for internal and external cylindrical grinding. Either motor drive, as shown in the illustration, or countershaft drive can be used; the former is preferable, owing to its ability to operate in any position desired.

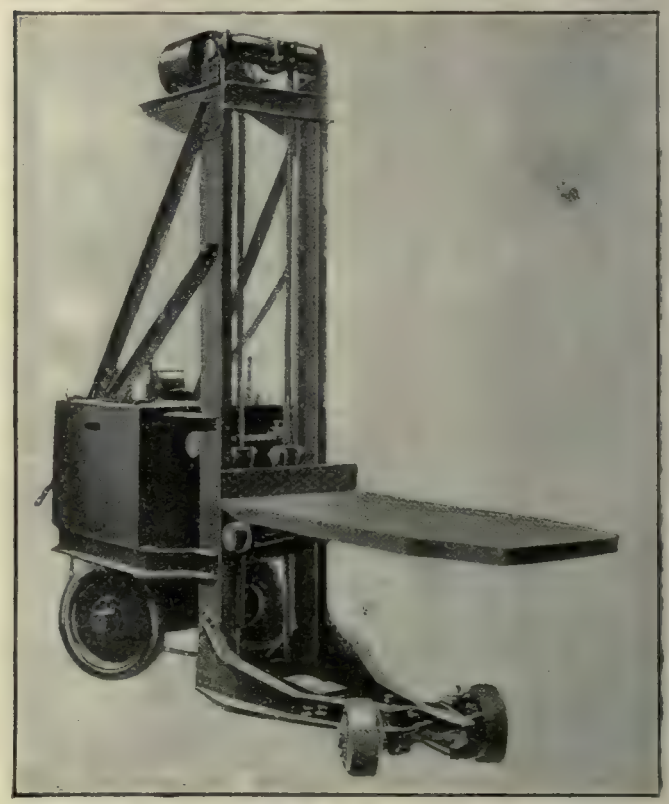


A SWISS GRINDING ATTACHMENT FOR LATHE USE

A high degree of precision is claimed for the machine. The spindle runs in three sets of ball bearings, mounted in an eccentric case, so that the height of the spindle can be regulated. Since the speed of the machine is from 12,000 to 18,000 revolutions per minute, a belt-tightening device is used. A small pulley and a splinter guard are furnished with the machine.

Lakewood No. 703-A Tier-Lift Truck

The Lakewood Engineering Co., Cleveland, Ohio, has added to its line of electrically-operated Tier-Lift trucks the one shown in the illustration and designated as Model 703-A. The general characteristics of the



LAKEWOOD MODEL 703-A TIER-LIFT TRUCK

machine are similar to those of the Model 703 truck described in the *American Machinist* on page 52, vol. 52.

Both models are built in four sizes with lifts of 42, 60, 76 and 96 in., respectively. The difference is that the Model 703-A machine has an elevating speed nearly twice as great as the other machine, its maximum load being 2,000 lb., while that of the 703 truck is 4,000. The new model is intended especially for the handling of rather light, bulky packages.

Ross "Two-Way" Centrifugal Pump

The Ross Manufacturing Co., 3160 West 106th St., Cleveland, O., has placed upon the market a coolant pump that can be run in either direction. The liquid is delivered from the same orifice no matter in which direction the impeller is rotated, and reversal of the

direction of rotation, as on a screw machine, does not hinder the action.

As can be seen in the illustration, the pump is belt-driven, the pulley having an internal gear on its rim. This gear drives a gear on the impeller shaft, the

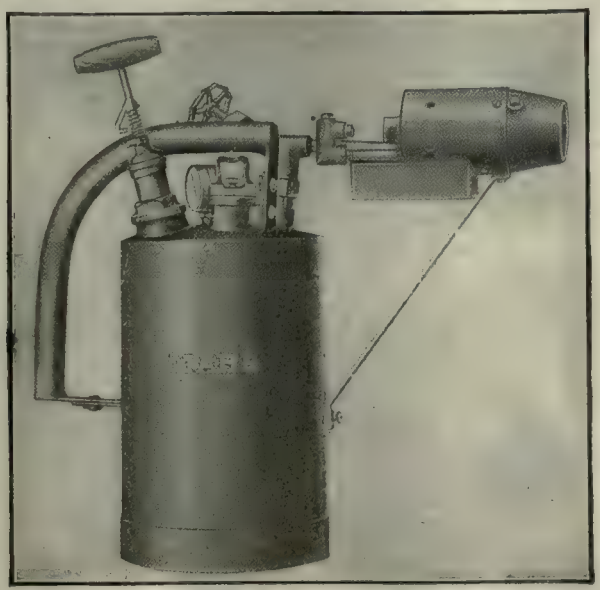


ROSS "TWO-WAY" CENTRIFUGAL COOLANT PUMP

speed ratio being 1 to 4. An oil-less bearing is used; a graphite asbestos packing keeps the liquid from reaching the bearing or the gears. The four-bladed impeller is made of spring steel. It is claimed that, because the inlet is at the top, the impeller is always submerged and consequently primed. The pump delivers a large volume of coolant and can be used to serve a battery of small machines, by running it at high speed. It can also operate with a slight suction lift.

Mahr Style "T" Kerosene Torch

A self-contained kerosene torch, shown in the illustration and known as Style "T," has recently been placed on the market by the Mahr Manufacturing Co., Minneapolis, Minn. It is intended for use in foundries, tin shops, machine shops, or wherever a small heating appliance is required.



MAHR STYLE "T" KEROSENE TORCH

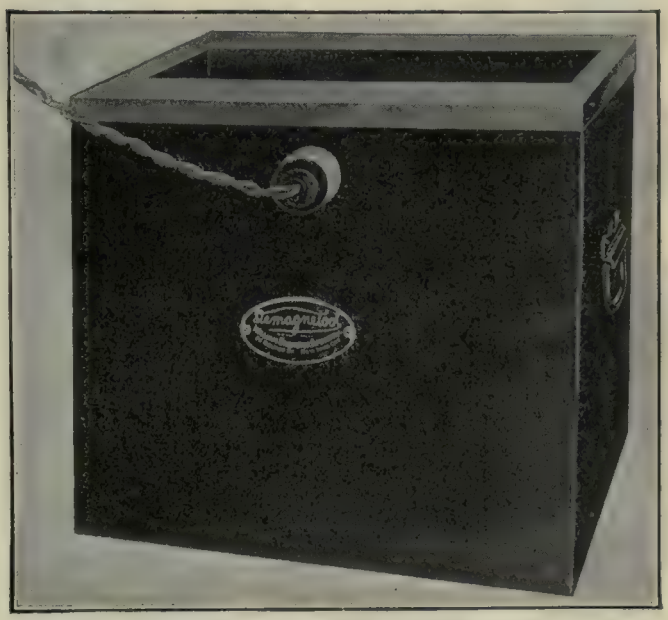
It is stated that the torch operates under a wide range of pressure, so that a few strokes of the pump will provide sufficient pressure to last for an hour. The entire head is made of brass, the high heat-conductivity of which is said to make for ease in generating and for steady operation. Starting the torch requires about 4 minutes. The gas plug screws down against a copper gasket, pipe threads not being used, thus insuring the proper distance between the plug and the nozzle. It is said that the flame cannot blow out, because the gases issue from the jet at very high velocity.

A cleaning tool is provided to remove carbon which might clog the torch.

The torch is made in three sizes, ½, 1 and 1½ gal., the oil consumptions being, respectively, 1, 2 and 3 quarts per hour. The net weights are 6½, 8½ and 10½ lb.; the boxed weights, 12½, 15½ and 18½ lb.; and the volumes when boxed are 1, 1.5 and 2 cu.ft. respectively.

Brewster "Demagnetool" No. 2

A type of demagnetizer suitable for production work, and with which it is not necessary either to rub or to place the work on the plate of the device, has been



BREWSTER "DEMAGNETOOL" NO. 2

placed upon the market by the William Brewster Co., Inc., 30 Church St., New York City. As shown in the illustration, there is an opening extending vertically through the demagnetizer, which is made in box form. It is only necessary to drop or pour the work through the opening in order to demagnetize it.

It is claimed that, due to the design of the transformer, the magnetic flux crosses at right angles the opening through which the work is passed, so that the action extends equally to all points of the working space.

The No. 2 "Demagnetool" has an opening 6 x 12 in., but other sizes of the machine can be furnished, if desired.

Business Conditions in England

By OUR LONDON CORRESPONDENT

LONDON, Nov. 5, 1920.

ALTHOUGH the miners rejected the terms of settlement reached between the government and the executive of the miners' federation it is expected that in a few days all the mines will be working. Votes cast for the terms numbered 338,045, and votes against totaled 346,504. As two-thirds of the members taking part in the voting did not vote in favor of the continuation of the strike it was declared off, but only after a considerable discussion and then simply by a "substantial majority" of the delegates assembled to consider the figures. The two districts that really voted against the proposal were the Lancashire, where the majority was 55,509, and South Wales, where the majority against was 46,405. Nearly all the other districts voted for acceptance of the terms.

What the Terms Are

These terms provide for the co-operation of the mine owners and workers to obtain increased output. For this purpose district committees and a national committee are to be organized. Further, the parties are to prepare a scheme, to be ready not later than by Mar. 31 next, for the regulation of wages in the coal mining industry "having regard, among other considerations, to the profits of the industry and principles upon which any surplus profits are to be dealt with." Until then wages are to be regulated on the following plan, without prejudice to the decision of the wages board:

(a) An advance of 2s. a shift to persons of 18 years of age and over; 1s. to persons of 16 and 17, and 9d. to persons under 16; will be paid from the date of resumption of work to the classes of colliery workers entitled to Sankey wage and subject to the conditions under which Sankey wage is payable.

(b) For the purposes of this temporary arrangement the advance referred to shall be automatically adjusted on the basis set out below from Jan. 3, 1921, in the light of the results of the five weeks ending Dec. 18, 1920, and similarly from Jan. 31 and thereafter every four weeks on the results of the four weeks immediately following the last preceding test period — but the Christmas holiday week shall not be counted in any such period, and an adjustment will be made in those cases where the holiday period falls wholly or partly within the New Year week.

The basis on which the advance shall be adjusted is as follows: If the weekly average of the proceeds of export coal during the test period are maintained at the weekly average of the proceeds of export coal during the September quarter the advance will be 1s., 6d., and 4½d. respectively. If (after deduction of the cost of extra output) they exceed the September figure an additional 6d., 3d., and 2¼d. respectively will be paid for every complete £288,000 of the excess.

(c) For this purpose the amount of export coal in each period shall be assumed to be the excess of the tonnage produced over the rate of 219,000,000 tons annually; the proceeds shall be calculated by multiplying that excess tonnage by the average f.o.b. price as shown in the Trade and Navigation Accounts for the quarter ended Sept. 30, 1920, and the cost of extra output shall be taken as 15s. a ton for each ton produced in excess of the rate of output for the quarter ended Sept. 30, 1920.

(d) As part of the settlement hereby concluded the government undertakes to make an order under section (3) of the mining industry act which will provide for the variation of the one-tenth share of the excess profits of the industry payable to the owners under the coal mines (emergency) act by the deduction therefrom or addition thereto of one-quarter of the said tenth part for each 6d. by which the men's advance is reduced or increased.

(e) The certificate of the secretary for mines as to the amount of the proceeds and the advances payable shall be accepted as final.

Export Profits the Deciding Factor

Thus until Jan. 3 next the miners will receive an advance of 2s. a shift. After the date mentioned the sum of 2s. may be added to or diminished according to the output, export profits being the deciding factor. For the purpose of regulation both home consumption and export prices are apparently to be assumed as constant, so that the actual advance will depend on the putput as measured at yearly rates: Thus with the total output at the rate of 244,000,000 tons per annum the advance will be 3s. But this scheme of course is to operate only until the national wages board for the industry goes into operation. This board is regarded by many of the leaders as the first step toward public ownership of some sort of the mines. On the other hand the working miners are more concerned with the wages they will receive, and recognize that these will, at least to some extent, necessarily vary with the actual output, a position they definitely rejected when voting on the datum line proposals. The general disposition is to regard the terms accepted as purely of a temporary character. It seems probable that the whole problem will be raised when the wage board meets, for that body will apparently have to devise permanent means of settling wage rates; a matter about which, disregarding large views on the subject, there are many differences of practice throughout the country. The output committees to be immediately selected may perhaps help to clear the course for consideration of the larger problem, as employer and employed will have to work together for the time being for mutual advantage, and this may lead to a greater measure of co-operation later.

Loss Resulting from Strike

As to the loss entailed, measured in output of coal this is something like 15,000,000 tons. About £15,000,000 has been lost in wages, and some £2,000,000 in strike pay. The estimate has been made that in all two and one-fourth million workpeople were idle as the result of the strike.

Official figures for 1920 show that the coal output for the first quarter of the year was 62,103,000 tons with an average of 1,188,500 persons employed; for the second quarter, 58,166,000 tons with 1,200,300 persons; and for the third quarter, 59,467,000 tons with 1,207,800 persons.

The Machine Tool Market

In the machine-tool world orders have undoubtedly been scarce, and some small tools, for instance, twist drills, are drugs. Optimists are under the impression that as soon as the coal-strike dislocation has been put right trade will revive; but the troubles are probably deeper-rooted than that. During the last few days rumors relating to motor car firms have been less frequent. For one thing the motor show opens today and with it of course there is at least the hope that firms who have doubts will be able to resolve them as the result of exhibiting. Not that an exhibition is an infallible remedy, for one of the smaller firms that made a really serious effort at the recent machine-tool exhibition has had to close down within the past few days.

The technical journals during the war entered into a self-denying ordinance, not altogether voluntary in character, to omit all advertisements of German products. Various periods were suggested. But it is now being thought that the British manufacturer has had almost sufficient time to put his house in order and it is possible that by the beginning of next year German advertisements will be accepted. Then, competing frankly with the annual anachronism, the Lord Mayor's show, advertising men will run a procession in which "famous advertising characters and trade-mark figures will march through the main streets of London," and, again to quote their announcement, this will be "one of the big 'stunts' which will capture public imagination and compel attention to the International Advertising Exhibition" being held at the White City, Shepherd's Bush, W., from Nov. 29 to Dec. 4.

The Motor Show

The motor show is, on account of the large number of exhibitors (about 500), being held in two halls widely separated, namely, Olympia, W., and the White City, Shepherd's Bush, W., and the price of admission permits a visit to both shows and also provides for motor-coach service between the two halls. No German cars are shown, but the exhibits include French, Italian, Swiss and Belgian, not of course to mention American. The French firms have made a special effort; having decided that the Paris automobile salon should be dropped for this year they are, according to some reports, regretting the decision already. It is suggested that the cars from overseas are rather cheaper than those of British make. The industry has been expecting a general reduction in prices, the position being exactly the opposite of that prevailing at the same time last year when premiums were

demanded for cars with immediate possession. But it is not thought that a very marked general decline in price will show itself until next year is well advanced, if then. Everything will depend on the demand, that of course varying to no small extent with the general condition of trade. British firms seem to be dropping their ladylike practice of introducing fashions at the show, and are making changes or improvements as and when they are needed or are advisable. A new eight-cylinder car has been introduced, the cylinders being in line. Once more attempts have been made to popularize hydraulic and electro-magnetic methods of transmission and regulation of speed.

The Austin Motor Co. has recently equipped a new foundry to cast about 60 tons of steel a week on one shift only, and has installed also a press plant for producing some 500 bodies a week. The tractor side has been extended; according to program, early next year the weekly output in this section will be about 200.

Export-Credit Scheme Modified

The government has modified its scheme of export credits, and the percentage of the cost of the goods to be advanced to the exporter may be increased to 100; previously it was 80 per cent. But there will be recourse against the exporter as regards 20 per cent. Some exporters have been claiming that, while the whole 100 per cent of the cost should be advanced to the exporter, no claim should be made in the case of default, his risk being simply that of his profits. Whether the 100 per cent advance shall be granted is to be decided by the export credits department of the Board of Trade.

The Airplane Industry

The enormous expansion of the aircraft industry during the war, particularly toward its end, naturally brought about a period of stress when military operations ceased and demand dropped. Several firms have been shut down and some have broken down. Now it is clear that the Aircraft Manufacturing Co., Ltd., is in difficulties and recently an informal meeting was held of various shareholders, etc. The accounts are not available, but it has been publicly stated that the results up to the end of March last will show a heavy loss and that the dozen or so subsidiary companies are also producing nothing in the way of profits. A bank overdraft has been accumulated amounting to £660,000 and a call has been made on the company to repay. Apparently therefore the assets are to be realized. According to proposals, the Daimler Motor Co., which is of course associated with the Birmingham Small Arms Co., will take a five years' lease of the factories at Hendon, with the option to purchase for four years. A debenture issue of £330,000 is proposed, in order to provide half the sum for which the Birmingham Small Arms Co. has made itself responsible in connection with the bank overdraft. The only alternative is a forced sale, which might not provide sufficient to pay off the overdraft. The estimated value of the factory and premises is put at £500,000 and other assets at £2,200,000; this is the book value, the realizable value being estimated at half that sum.

Germans Obtain Large British Order

The announcement that the A. E. G. of Berlin had secured a British order for electrical plant to the value of £150,000 had the effect of a bombshell on the electrical industry of Great Britain a week or so ago. The plant to be supplied is rolling-mill equipment for the Partington Steel and Iron Co., near Manchester. The German firm, which was asked to tender, submitted fixed prices; this course could not be followed by its British competitors. A turn of comedy has been given to the affair by the announcement that one of the directors of the firm concerned is president of a leading organization for the furtherance of British industries, and that another director is a public man well known for his advocacy of tariff reform (British royalty) protection.

A New System of Measurement

Messrs. Brooks and Sears, two officials of the National Physical Laboratory, Teddington, have devised a new system for producing slip gages of the well-known form and, it is claimed, a new system of measurement by which they can plot the contour of the gages to limits of considerably less than 0.000001 in. Stabilization of the steel employed has also received attention; it is something that has been overlooked by certain people, at any rate in Great Britain, who have attempted the production of these gages. The new gages are stated to be actually generated, all sizes being referred back from a standard foot that is an extremely accurate division of the standard yard. The blocks are not polished but are straight grained on the surface, polishing, as is well-known, producing a hard outer skin which is under stress and therefore tending to change the size and form of the gage. The hardness is 100 Shore. The set comprises 81 pieces, ranging from 0.1001 in. to 4 in. These gages are being made by Pitters Ventilating and Engineering Co., Ltd., London, S. E., and are being distributed by Alfred Herbert, Ltd., Coventry.

The High Cost of Metric Measurements

By W. Burr Bennett
President, Wayne Engineering Co.

Near us is a knitting mill making sweaters and other wool knit goods. It was established several years ago and it is possible that nothing but German made machines built to metric measurements could be obtained at that time. At any rate they have continued to buy similar machines, except during the late war. While we are not a tool shop or jobbing shop, nevertheless they often call on us to make repairs and parts in which case we endeavor to serve them. The writer has continuously suggested, however, that as far as posible, all new parts and repairs be made to standard English measurements in order to keep the cost down and to insure quick service. It so happens, however, that the sweater factory management is not in favor of this and we are compelled to work to metric sizes. Recently we had an example which shows the absurdity of conflicting the metric system with our own and which convinced us that we do not want any metric machinery.

Four small hardened-steel pawls were wanted in our shop; they weighed about two ounces each and contained two drilled and reamed holes and two tapped holes. To make up the four, using all metric measurements, cost $100. This of course included the making of one of the taps and the purchasing of the other, as well as the full use of metric measurements with which our toolroom was not over-familiar.

As an experiment, the writer made up a piece to serve the purpose employing all British or U. S. Standard dimensions, including taps and even making the necessary standard screws to fit the U. S. Standard thread. The piece worked perfectly and the total cost of one was about $10, or $60 less for four than it cost to make them in metric sizes.

The less we have to do with the metric system the better. If European and South American countries want U. S. goods let them take them with good old U. S. measurements.

Smoothing Up a Defective Thread By Means of a Castellated Nut

By C. Nye

Many times a planer bolt or similar piece gets a jam in the threads that makes it a source of annoyance. If a set of dies does not happen to be available, put the bolt in a vise, invert a hardened castellated nut and screw it down on the thread with a wrench. The castellated nut, being harder than the bolt, serves as a cutter and the slots afford a recess for metal cuttings.

SPARKS FROM THE WORK

Valentine Francis

Machine-Shop and Design Sections of A. S. M. E. Meeting

The machine-shop session at the annual meeting of the A. S. M. E. in New York, Dec. 7-10, 1920, will be given over to the presentation of three papers.

Earle Buckingham of the Pratt & Whitney Co. will present the results of a mathematical investigation on the side-cutting action of a hob when milling threads. The paper will deal with both externally and internally threaded parts and will indicate the corrections that can be applied to the form of hob to prepare a correct thread.

The paper by W. H. Chapman of the Norton Grinding Co. records the new developments in grinding practice in the present year and points out the importance of these developments.

Joseph F. Keller, general manager of the Keller Mechanical Engraving Co., will present a slide lecture giving important information concerning a new die sinking mechanism which he developed.

It is anticipated that this newly formed professional section session on machine shop will be a rallying point for machine-shop men throughout the country and that future intensive action in machine-shop development will be the result from this meeting.

Design Sessions

Data of great interest to designers of machines will be recorded in the papers to be presented before the design sessions.

Louis Illmer, oil-engine expert, Southwark Foundry and Machine Co., in his paper entitled, "Disastrous Experiences with Large Center Crankshafts," will point out the essential principles to be followed in the design of this type of shaft. Mr. Illmer's conclusions were obtained after a careful analysis of a failure of a large center crankshaft.

In his paper, "Tests on Rear-Axle Worm Drives for Trucks," K. Heindlhofer, research engineer of the SKF Industries, has tabulated data on the efficiency of motor-truck drives and will give information on the tests to destruction of several worms.

N. W. Akimoff, manufacturer of balancing machinery in Philadelphia, who has developed a successful balancing machine, will present an entirely new point of view on the design of foundations for machinery. Mr. Akimoff's device relates to the reduction of vibration by a study of the gyroscopic laws. It is believed that the principles he has evolved will be of particular value to the designer of high-speed rotating machinery on land and shipboard.

Acquiescing to the demand of hoisting-drum manufacturers, Professor E. O. Waters of Sheffield Scientific School, Yale University, worked out the formula for the rational design of hoisting drums. Professor Waters will present the results of his investigation and study to the meeting.

The designer of flywheels for reciprocating machinery connected to generators and motors will have at his disposal accurate information as to the methods to be followed and results to be attained in the design of this important adjunct of constant-speed mechanism. Messrs. Doherty and Franklin of the General Electric Co. will show in their paper wherein the procedure of design can be bettered and give principles to be used.

A Research Information Bureau

The National Research Council has established a research information service as a general clearing-house and informational bureau for scientific and industrial research. This "service" on request supplies information concerning research problems, progress, laboratories, equipment, methods, publications, personnel, funds, etc.

Ordinarily inquiries are answered without charge. When this is impossible because of unusual difficulty in securing information, the inquirer is notified and supplied with an estimate of cost.

Much of the information assembled by this bureau is published promptly in the "Bulletin" or the "Reprint and Circular Series" of the National Research Council, but the purpose is to maintain complete up-to-date files in the general office of the Council.

Requests for information should be addressed, Research Information Service, National Research Council, 1701 Massachusetts Avenue, Washington, D. C.

Welding Patents Association

At a meeting of the Welding Patents Investigating Committee, composed of nearly 500 members, held at the Hollenden Hotel, Cleveland, Nov. 9, it was decided to form a permanent organization which will be known as the Welding Patents Association. The committee was originally formed in 1917 to conduct litigation testing the validity of patents on the process of spot welding. Henry C. Milligan, president of the Republic Stamping and Enameling Co., Canton, Ohio, who has been chairman of the committee, was elected as chairman of the association.

Cancellations—Legal Liabilities of Buyer and Seller

In these days when cancellations of orders are so frequent, a word regarding the legal liabilities of the buyer and seller may prove of value.

It should be understood first that a contract comes into existence when an offer to buy is made by one party and accepted by the other and that such a contract is not subject to revision or cancellation, except by mutual consent. A legally enforceable obligation to pay arises when the buyer orders a quantity of goods shipped and the seller either promises to ship them or actually ships them upon receipt of the order. The law does not impose an obligation upon the buyer to receive goods which he has purchased, but if the buyer elects to refuse to carry out his part of the bargain he must pay to the seller whatever damages the seller has sustained.

But let us suppose that the buyer orders a quantity of goods which are to be specially manufactured for him, and thereafter, while the goods are in the process of manufacture, notifies the seller that he repudiates the contract and will not accept the goods, the law thereupon places upon the seller the duty of refraining from taking any further steps which would increase the amount of damages for which the buyer has made himself liable. The seller cannot continue to manufacture if to do so will pile up damages against the buyer.

Where goods have been specially manufactured for the buyer and are not suitable for sale to any one else, the seller may hold the buyer for the full value of the manufactured articles. But if the goods are suitable for sale to another and can be disposed of, the amount of damages which the seller can collect is limited by the amount of loss which he has sustained after disposing of the goods at their fair market value at the time the contract was to have been performed.

Attention has been called to a situation arising from loose business methods resulting in a state of facts somewhat as follows: A salesman takes an order from a buyer, using the seller's form of order blank. This blank, duly signed by the buyer, is forwarded to the seller's office and the order accepted and the buyer notified. Thereafter the buyer comfirms the order, using his own order blank, which sets forth terms differing from those contained in the original order. Subsequently the goods are shipped. What are the rights and liabilities of the parties? The answer is clear that the original order,

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having been accepted, is not subject to variation by the action of the buyer in forwarding his own confirmation. The seller has a right to insist upon the enforcement of the contract in accordance with its original terms; but if the confirmation differs so materially from the original order that it amounts to a repudiation thereof, the seller is clearly put upon notice that the buyer elects not to accept the goods on the terms originally agreed upon, and while the seller may still insist upon the performance of the contract under its original terms, he is nevertheless bound to refrain from taking any steps which will increase the damages to be paid by the buyer. Under such circumstances the only safe course for the seller to pursue is to notify immediately the buyer that the contract must be fulfilled as originally made or not at all, and that the terms of the confirmation are not acceptable, and that the seller will hold the buyer liable for breach of contract. —By W. Randolph Montgomery, Counsel, National Association of Credit Men, in the *Supply Manufacturer*.

W. R. Moore Gives Lecture on Grinding

A lecture on grinding, illustrated by stereopticon views, was the feature of the November meeting of the New York chapter of the American Society for Steel Treating. The lecture was given by W. R. Moore, sales engineer of the Norton Co., Worcester, Mass., and was held at the Machinery Club, Hudson Terminal Building, New York.

The meeting was preceded by a dinner at the club, after which the lecture was given, the diners retaining their seats. Mr. Moore commenced with a brief history of grinding, then going through the evolution of abrasive wheels from the mines to the finished products. Practically every type of grinding machine was illustrated, those made by concerns other than the Norton Co. being included.

A discussion on grinding followed, during which Mr. Moore satisfactorily answered all questions put to him

Thanksgiving Dinner at the Chicago Machinery Club

One of the annual customs of the Machinery Club of Chicago is the turkey dinner and general jollification held on Thanksgiving Day. This will be held again this year and not only will dinner be served for the price of $2.50 per couple, but cold lunch in the evening is included. The plans also include a musical program for the afternoon with music and dancing.

National Founders' Association Holds Annual Convention

Opening its twenty-fourth annual convention in the Hotel Astor, New York City, on Wednesday, Nov. 17, with a powerful speech by President William H. Barr, the National Founders' Association wrote another chapter into the history of the fight for the "open-shop" method of employment. All through the two days of the convention this issue was paramount and nearly every one of the speakers touched on some particular phase of the subject.

Mr. Barr has long been identified with this movemeent for the open shop and he covered the matter thoroughly. He stated that the opposition of the American Federation of Labor to the open-shop movement is evidenced by the plan of that organization to raise a huge sum to be spent in combating this growing menace to its control of the American workingman.

The speaker also touched on the labor clause as contained in Article 13 of the Covenant of the League of Nations. He had the following to say on this subject:

> During the campaign you heard much about the League of Nations, and various articles contained in the Covenant. But I refer to it only for the purpose of discussing Article 13, which creates an international labor office and which, if the Treaty were ratified, would put labor in the United States under its control. The first meeting of this annual international labor conference was held in Washington in October, 1919, at which the United States could not officially participate. But should the League of Nationals, or some similar agreement, ever become effective there must be not merely a reservation as to the international labor clauses, but their complete elimination. This existing labor office is largely dominated by its radical members, and the American Federation of Labor is cordially co-operating with these socialists in trying to entangle our country in the labor meshes of the League of Nations. For I emphasize the fact that there are in the proposed Covenant certain labor clauses which were apparently included at the request of our labor unions, and with the consent of our representatives, for the purpose of hindering our industries.

Mr. Barr is also associated with the Inter-Racial Council of New York and spoke as follows on the immigration problem as affecting our industrial life:

> This country needs immigrants, and will continue to need them. It is the industrial university of the world, and it requires a freshman class every year. The question is, whether we are to admit and distribute our immigrants according to a well-thought out consistent plan, or whether we are to continue to leave things to the mercies of chance and to politicians.
>
> We ought also to recognize a few fundamental facts on immigration. The immigrant comes here for his benefit, and we take him here for ours. If we accept him, we cannot at the same time exploit him or make him the universal goat when anything goes wrong. There are radicals who are foreign born, and most of them are misguided. There are, too, Americans of the same stripe, and they have less excuse. The very great majority of our immigrants are decent, law-abiding, intelligent, respectable, worthy people, and they will become good and enthusiastic citizens if given a square deal. In the fundamental things men and women are much the same the world over.
>
> It is time, therefore, that these problems of admission, distribution, assimilation and stabilization should be taken out of the hands of sentimentalists and politicians, and that they should be placed where they belong, in the hands of intelligent, impartial thinkers who know enough of American history to realize that we need these people for our own development and that, on the other hand, they need the wisdom and sympathy of unprejudiced Americans.

Emery on "Mistaken Philosophy"

James A. Emery, counsel of the National Industrial Council, and only recently chosen chief counsel for the National Founders' Association, spoke on the "Progress of the Open Shop."

Few men are better qualified to discuss this subject than is Mr. Emery. As a student of industrial problems and a lawyer of no mean talent, he has given much thought to this "mistaken philosophy"—as he termed the doctrine of the closed shop.

Mr. Emery started off by showing the evils of the closed shop and declared there was too little public appreciation of the influence of organized labor on production. He said that the idea of organization for legitimate benefit was ancient, but that it had grown in the wrong direction till now it was "an alien movement in our midst which threatened to undermine our economic structure and destroy the peace of society."

He declared that during the eighteen months in which the United States was engaged in the great war over 6,000 strikes in essential industries were participated in by union labor, with the resulting loss of time and money, besides the inconvenience to the public and those in conduct of our military establishment, and general confusion in the industrial life of the country.

In conclusion Mr. Emery said: "The growth of the open-shop movement is a natural consequence of the rising of the communities to a greater sense of justice, and a combined effort to throw back this false doctrine which is detrimental to its life.

"The defeat of the candidates, sponsored by the labor leaders in the recent election, shows the feeling of the public against this altogether mistaken philosophy. And so long as the American Federation of Labor sponsors that philosophy it cannot be a force for good in this country."

Colonel T. C. Dickson, commanding officer of the Watertown Arsenal, Watertown, Mass., took up the subject of "Industrial Relations in Arsenals of the Ordnance Department, United States Army." Of course, being an army officer, he was not at liberty to

say very much, but he intimated that it was time the public, and particularly the manufacturers of the country, looked into the growth of labor unionism in government circles.

In driving home this point Colonel Dickson quoted many War Department orders and other official documents to show the influence which labor officials must have at Washington.

C. C. Pettijohn, of New York, a pioneer in the movement of stamping out radicalism by means of the moving picture, was heard in an interesting talk on "Americanization on the Screen." Mr. Pettijohn accompanied his remarks with several reels of film, picturing the ways in which soveitism is spread among the ignorant and ill-informed.

The Open Shop in Texas

On Thursday W. S. Mosher, of Dallas, Texas, presented a paper on "The Open-Shop Movement in the Southwest." Mr. Mosher traced the events, mostly strikes and labor troubles, which led to the formation of open-shop associations at Dallas and other industrial centers of Texas. He said the movement had the support of the public and the merchants and was a booming success, but was ever on its guard against the bitter opposition of labor unions.

A particularly noteworthy phase of this address was the suggestion offered by the speaker to the employers, to "sell their company to the employees." He urged a policy of better working conditions, consideration and constructive management as a means of bringing the employees into closer co-operation and thus establishing a bulwark against the ever present danger of radicalism.

Other papers presented at the convention were: "The Relationship of the Stock Exchange to Industry," by J. Edward Meeker, of New York, and "Modern Foundry Equipment," by Joseph J. Wilson, of the General Motors Corporation, Saginaw, Mich.

The convention discussed and unanimously passed a resolution congratulating the United States Chamber of Commerce in its stand against the closed shop in this country.

Barr Re-elected

At the conclusion of this part of the program the election of officers took place. William H. Barr was unanimously re-elected president, and he carried all the other officers in with him.

The others elected were Julius Goslin, of Birmingham, Ala., vice-president; Arthur E. McClintock, Chicago, Ill., commissioner; Jeffrey M. Taylor, Chicago, Ill., secretary.

Society Changes Headquarters

The American Society for Steel Treating has changed its headquarters to 4600 Prospect Ave., Cleveland, Ohio. This change was made on Nov. 20 and all future correspondence should be mailed to the new address.

A Record for Freight Traffic

The highest recorded volume of freight traffic ever transported in the history of the Pennsylvania Railroad System was handled during the month of October. Reports from all divisions, which have just reached the general offices in Philadelphia, show that during the month an average of nearly 24,000 loaded cars per day, or 167,461 per week, were forwarded to their respective destinations. This represents more than 870,000 tons of freight a day, or over 6,000,000 tons a week, loaded on the Pennsylvania Railroad, or accepted by it from connecting lines.

The nearest approach to the figures for October of this year were those of the corresponding month of 1919, when the daily average of loaded cars handled was 23,700. As compared with midsummer, the freight traffic handled has been increased by an average of 3,300 cars per day, or approximately 120,000 tons.

New Publications

Advertising the Technical Product. By Clifford Alexander Sloan and David James Mooney. 365 pp., 6 x 9, illustrated. Published by McGraw-Hill Book Co., Inc., 239 West 39th St., New York City.

A real advertising manual for the man with a technical product to sell, manufacturer, advertising manager or copy writer. The subject is well presented and there are ideas for every man connected with the advertising business. The book is divided into five parts as follows: I, The General Problem and Its Economic Elements II, The Instruments Available for Advertising the Technical Product; III, Technical Advertisements; IV, Advertising Organizations; V, Appendix.

One of the most interesting features of the book is the section of the appendix in which sample advertisements taken from various sources are criticized by the purchasing engineer, the sales manager, the advertising manager and the sales engineer. There is also a good bibliography in the appendix.

Material for the book has been contributed by the following well-known men in the industry. J. C. McQuiston, manager, Westinghouse Department of Publicity; Robert Porter, vice-president, Jaxon-Steel Products Co.; F. M. Feiker, vice-president, McGraw-Hill Co., Inc.; J. A. Harlan, purchasing agent, Delco-Light Co.; M. F. Lawrence, sales promotion manager, Hyatt Roller Bearing Co.; P. C. Gunion, advertising manager, Industrial Division, General Motors Corp.; O. W. Crawshaw, president, Crawshaw Service; S. Sidney Neu; E. E. Eby, American director, Delco-Remy, Ltd.., T. P. Cunningham, vice-president, Lincoln Products Corp.; D. L. Darnell, assistant sales manager, Baker Industrial Truck Co.; C. A Trapper, president International Trade Press Association; F. D. Wood, advertising department, *Good Housekeeping;* R. Bigelow Lockwood, manager, Advertising Service Department, McGraw-Hill Co., Inc., Jesse H. Neal, executive secretary, Associated Business Papers; J. Frank Eddy, The Dando Co.; J. D. McGuire, president, McGuire Printing Co.

Export Register of the Federation of British Industries. Three hundred and twelve 7 x 9½-in. pages including advertisements and indexes. Published for the federation by the Industrial Publishing Service, Ltd., 4-7 Red Lion Court, London, E. C. 4.

The book is divided into the following sections, with cross references: Products; Companies, Firms and Their Agents; Associations, Arranged in industrial groups; Advertisements. In the section on Companies, Firms and Their Agents, which is a list of the members of the federation, each member's name is followed by the name of his overseas agents.

Business Items

The corporate name of the Dawson-Rouillard Tool Corporation has been changed to the Dawson Tool Corporation. The address of the company is 51st St. and Lancaster Ave., Philadelphia, Pa.

The board of directors of the T. H. Symington Co., manufacturer of railway specialties and special machinery at Lincoln Park, at a meeting in New York City on Oct. 27, elected Donald S. Barrows, heretofore works manager and chief engineer, as vice-president in charge of operations.

The Chicago offices of the Tacony Steel Co., Philadelphia, have been removed from the Marquette Building and are now situated at 427 Reaper Block. F. B. Hillwick, former district sales representative in this district, has been succeeded by A. H. Ackerman.

The Lafayette Tool and Equipment Co., Lafayette, Ind., manufacturer of universal grinding machines, has appointed Russell, Holbrook & Henderson, Inc., with sales offices at 30 Church St., New York and 548 Leader News Building, Cleveland, Ohio, its sole United States representative.

The Baltimore Tool Corporation, 921 Sterrett St., Baltimore, Md., has been recently incorporated. Charles A. Schmidt, secretary and treasurer, says that the company expects to have one of the best equipped tool manufacturing plants in the East, in conjunction with which blacksmith, forging and machine work and commercial heat treating will be solicited.

The Bowers & Bartlett Co., Inc., Baltimore, Md., manufacturer of washing machines, has leased a building at 1201 South Sharp St. as a plant.

The Syracuse Washing Machine Corporation, Syracuse, N. Y., which now makes only laundry apparatus, plans to extend its field to include other labor-saving devices, such as ironing machines and dishwashers. G. C. Wilkinson, a vice president of the company, is to have charge of this development work.

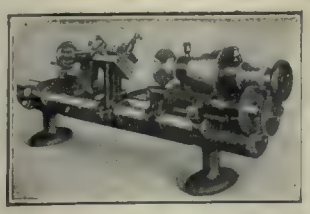
The Reed & Prince Manufacturing Co., Worcester, Mass., manufacturer of machine screws, etc., held a three days' salesmen's conference at its plant recently. It brought together twelve of its men from the principal distributing centers of the country and each day a set of speakers talked on various problems of interest relating to the work of the men in the field, etc.

The Hardware City Manufacturing Co., New Britain, Conn., has changed the name of the company to the Plainville Manufacturing Co., and has also removed the plant of the company from Elm and Seymour Sts., New Britain, to Plainville, Conn., where it has a modern equipped plant.

Condensed-Clipping Index of Equipment

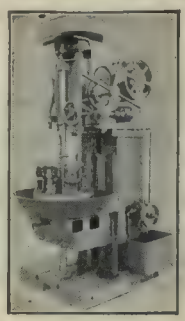
Patented Aug. 20, 1918

Attachment, Lathe, Bench, Thread-Chasing
S. A. Potter Tool and Machine Co., 77 East 130th St., New York.
"American Machinist," Oct. 28, 1920



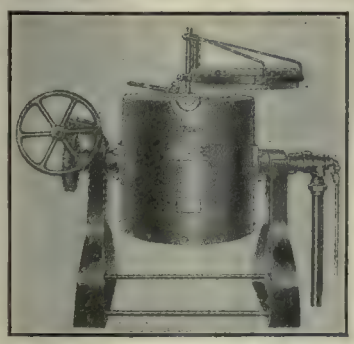
This fixture can be readily attached to the company's Nos. 5 and 7 lathes. It will cut threads up to 5 in. long with leads from 4 to 84 threads per inch. The lead screw is mounted on a shaft carried in brackets at the rear of the headstock, a short section of the screw being fluted to form a hob for cutting the bronze lead-nut when necessary. The tool-holder is mounted on a slide which is provided with screw adjustment and a graduated feed dial. The slide swings on a frame mounted on the chasing bar back of the bed.

Drilling Machine, Two-Spindle, No. 220
Baker Bros., Toledo, Ohio.
"American Machinist," Oct. 28, 1920



This machine is built as a single-purpose production tool for successive operations and can be used for drilling, boring, counterboring, reaming, facing, etc. The indexing table affords two work stations and a loading station. The rated capacity of the machine is 2-in. diameter for high-speed drilling. The spindle centers are 10½ in. apart. The length of downfeed is 12 in. Changes of spindle speed can be had by changing slip gears in the gear box on the side of the machine. Specifications: Speeds and feeds built to suit job. Weight, 5,200 lb. Floor space, belt drive, 31 x 42 in.; motor drive, 31 x 66 in. Motor, 10 to 15 hp. Height, 8½ ft.

Furnace, Tilting, Crucible Type, Oil-Burning, No. 3015
Wayne Oil Tank and Pump Co., Fort Wayne, Ind.
"American Machinist," Oct. 28, 1920



The furnace stands entirely above ground, is self-contained and is ready for connection to the oil and air supply lines. Specifications: Three sizes, Nos. 3, 6 and 9. Respective capacities, 200, 350 and 750 lb. Average heats per day, 6 to 10, 5 to 9, 3 to 5. Floor space, 36 x 66 in., 39 x 68 in., 42 x 70 in. Height to cover, 3 ft. 8 in., 3 ft. 10 in. and 4 ft. Air pipe connections, 2, 2½ and 3 in. Oil pipe connections, ¾ in. Air volume required, 200, 250 and 400 cu. ft. per minute. Shipping weights, complete, 2,000, 2,500 and 3,000 lb. The burner is designed for air at a pressure of from 1 to 2 lb. and oil at pressure of 5 lb. or more.

Bandsaw, Bench, "Junior"
West Side Iron Works, Grand Rapids, Mich.
"American Machinist," Oct. 28, 1920



This machine can be used as a portable machine or mounted on a bench when not furnished with the pedestal. It is furnished either for belt or motor drive. The belt drive pulley is 5½ x 1½ in. The frame is a one-piece cored casting, carrying self-oiling bearings for the shafts. The wheels are 14 in. in diameter with 1 in. face and are covered with rubber bands. The shaft of the upper wheel runs in a double yoke-box and has a tilting device for shifting the saw-blade to the desired path. The table is 16½ x 19 in., is finish-planed and can be tilted to any angle up to 45 deg. The overall height without pedestal is 3 ft. 6 in.

Heater, Ladle, No. 3085
Wayne Oil Tank and Pump Co., Fort Wayne, Ind.
"American Machinist," Oct. 28, 1920



This heater is for use in connection with tilting crucible and non-crucible melting furnaces. It consists of a frame upon which the ladle may be supported at various heights. There is mounted on the top plate of the frame, an inverted burner with a cone-shaped hood to blow the flame into the ladle. The burner is designed for connection to the regular oil or gas supply lines and uses oil at 5 lb. or more pressure and air at 1½ lb.

Welding Machine, Electric, A.-C., "Weldrite"
Electric Welding Machine Co., 500 East Larned St., Detroit, Mich.
"American Machinist," Oct. 28, 1920



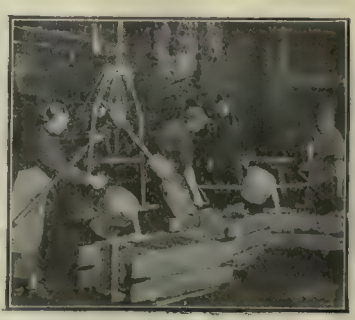
The company recommends this device for welding cast-iron and repair work. The device uses a short drawn arc, eliminating the necessity of preheating. It is built without moving parts and is so designed that the delivery of voltage and amperage to the work remains substantially constant. The machines are built to be operated on 110-, 220- or 440-volt alternating-current, indoors or out, where access can be had to an electric circuit of 75 amp. capacity. They are portable, the largest type weighing about 300 lb. All are mounted on ball-bearing casters.

Slotting Machine, No. 25
Racine Tool and Machine Co., Racine, Wis.
"American Machinist," Oct. 28, 1920



The base contains the main working parts of the mechanism and the reservoir for the coolant. The table has a slotted hole lengthwise through its center for about one-half its length which permits the table to be fed for that distance into the cutting tool. Specifications: Table, 12 x 27 in. Strokes per minute, 60. Length of stroke, 7 in. Drive pulley, 3 x 10 in. Pulley speed, 750 r.p.m. Net weight, 2,000 lb. Floor space, 26½ x 57 in. Height overall, 58 in. Power required, 2 hp. The machine is furnished either with tight and loose pulleys for belt-drive or with a tight pulley only for motor drive.

Pouring Device, Mechanical
E. J. Woodison Co., Detroit, Mich.
"American Machinist," Oct. 28, 1920



The illustration herewith shows the relative advantages of this pouring device over the old-style method. The pouring is said to be more accurate, with fewer spills and accidents. Adjustable levers and a counterweight enable ladle capacities of over 400 lb. to be lifted 18 inches.

Clip, paste on 3 x 5-in. cards and file as desired

Personals

LUTHER A. DAVIS, formerly production superintendent of the Standard Screw Co., Corry, Pa., and more recently with the Hydraulic Pressed Steel Co., Cleveland, Ohio, is now connected with the lamp equipment division of the National Lamp Works, General Electric Co., Cleveland, Ohio.

PETER H. GODA, who until recently was general foreman of the Lorain, Ashland & Co. R.R., Ashland, Ohio, is now with the Pennsylvania R.R., Pitcairn, Pa.

W. S. QUIGLEY, president of the Quigley Furnace Specialties Co., New York City, has just returned from Europe after an extensive trip made in connection with installations of the Quigley powdered-coal system in Italy and Belgium.

W. H. DEWOLFE has been appointed district manager of the New Britain Machine Co., with headquarters at 294 Washington St.. Boston.

CLIFFORD F. MESSINGER has been appointed general sales manager of the Chain Belt Co., Milwaukee, to succeed L. C. Wilson who has resigned to become secretary of the Federal Malleable Co., closely associated with the Chain Belt Co. Other promotions announced are C. E. STONE, assistant to the vice president, and J. A. MONAHAN, purchasing agent.

C. C. BRADFORD has changed the name of the selling organization which he has recently formed, from the Manufacturers' Sales Co. to the Bradford Sales Co. The offices of this company, which will represent not more than two manufacturers as a district sales office of each, are located at 340 Leader-News Building, Cleveland, Ohio.

MISS GRETCHEN RASELY, for several years connected with the advertising department of the Norton Co., of Worcester, Mass., and later assistant editor of the *Norton Spirit*, the factory paper of the company, has resigned her position to accept one as editor of the shop paper of the Westinghouse Lamp company's plant in Bloomfield, N. J. Miss Rasely will be one of the few woman editors of such papers in the country.

JAMES E. MCKENNE, superintendent of the National Manufacturing Co. division of the Wickwire-Spencer Steel Corporation, at Worcester, Mass., has resigned his position. He has accepted a position in the production department of the Republic Rubber Co., Youngstown, Ohio.

ROBERT G. ASHMAN has resigned as superintendent of the Worcester Pressed Steel Co., Worcester, Mass., to become general manager of the J. D. Crosby Co., Pawtucket, R. I., manufacturer of cold-rolled strip steel, flat wire, etc.

E. KENT SWIFT, treasurer of the Whiton Machine Works, of Whitinsville, Mass., was recently chosen a member of the chief executive commission of the Associated Industries of Massachusetts.

CHARLES E. HILDRETH, president of the Whitcomb-Blaisdell Machine Tool Co., Worcester, Mass., has been appointed receiver of the Standard Plunger Elevator Co., of Worcester, which was recently petitioned into bankruptcy by creditors of the company.

JOHN H. COLLIER, superintendent of the Bridgeport, Conn., plants of the Crane Co., of Chicago, has been elected as president of the Bridgeport Manufacturers' Association. Mr. Collier succeeds Clarence E. Bilton, who is the president of the Bilton Machine Tool Co., of Bridgeport.

CHARLES L. LANGLOTZ is now assistant manager of the export division of H. H. Robertson Co., New York. He was formerly assistant regional manager of the Allied Machinery Co. of America, New York.

Obituary

JOSEPH H. BAIRD, founder of the Baird Machine Co., Bridgeport, Conn., died on Nov. 14 in Cheshire, Conn. He was president of the above company until 1913, when, at his own request, he made way for a younger man; however, he acted in advisory capacity to the last. As an inventor Mr. Baird's reputation was world-wide. He was the first man in the United States to manufacture pins and invented many of the machines and methods used throughout the world in making them. He invented a pin-sticking machine which puts the pins into papers, and a safety-pin machine which takes a coil of wire and drops out complete pins ready for the cleaning or plating operation. Mr. Baird was the inventor of many automatic machines that are used for making every-day products in large quantity. One of his early inventions was the machine that fastened the hoops in hoop skirts. He sold this invention for thirty dollars and the man who bought it resold it for fifty thousand dollars. Mr. Baird was associated with many of the men who developed the manufacturing industries of New England and was generally recognized as a pioneer in the manufacturing of machines for the automatic making of small wares and notions.

A. J. BABCOCK, formerly president of Manning, Maxwell & Moore, Inc., New York, died in London, England, Oct. 30, after a short illness. Mr. Babcock was born in Brookfield, N. Y., in 1850. He served in the regular army during the Civil War, after which he studied a tool law course and practiced law in Denver, Colo., from 1882 to 1884. Mr. Babcock entered the machinery business in Chicago with Fay & Egan Co., and later was in the employ of Manning, Maxwell & Moore, Inc., as the Chicago branch manager. Seven years ago he came to New York as assistant to the president and finally was made president of the company, retiring in May, 1920, because of ill health.

SAMUEL H. WHEELER, of Bridgeport, Conn., prominent in several manufacturing plants of that city, died in Chicago on Nov. 14 after an illness of but two weeks. Mr. Wheeler, who was one of Connecticut's wealthiest citizens, was for a number of years president of the Wheeler & Wilson Manufacturing Co. of Bridgeport, which company was absorbed by the Singer Manufacturing Co. some years ago.

JOHN M. LYNCH, vice president of the American Hardware Co., Bridgeport, Conn., died very suddenly at his home on Sunday, Oct. 31. Mr. Lynch was at his office the day previous, and was apparently in the best of health. He was fifty-one years old, and had been in the hardware business in Bridgeport for the past thirty-two years.

Export Opportunities

The Bureau of Foreign and Domestic Commerce, Department of Commerce, Washington, D. C., has inquiries for the agencies of machinery and machine tools. Any information desired regarding these opportunities can be secured from the above address by referring to the number following each item.

An American engineer who is about to go to China desires to secure the representation of firms for the sale of machinery, tools, hardware, and technical and engineering lines. References. No. 33,991.

An engineering equipment company in Wales desires to purchase electrical accessories, such as conduit pipes, ceiling roses, cutouts, lamp holders, switches, and to secure an agency for the sale of mechanical latches, drilling machines, shaping, milling, and slotting machines, engineer's small tools, leather and balata belting, and iron and steel. Quotations should be given c.i.f. Welsh port. Reference. No. 34,013.

A mill owners' association in India desires to secure an agency and purchase rice-mill machinery, including steam engines, boilers, and crude-oil engines, horizontal and vertical boilers, electrical plants for bungalows and factories, agricultural machinery, etc. Quotations should be given c.i.f. Madras. Payment to be made against documents through bank in India. Reference. No. 33,994.

A producer and wholesaler of oxygen in Denmark desires to secure an agency and purchase oxygen-welding and cutting equipment for metals, all kinds of tools and apparatus for the ship-building industry, iron and steel, and automobiles. Reference. No. 33,994.

Forthcoming Meetings

The 1920 annual meeting of the American Society of Mechanical Engineers will be held in the Engineering Societies Building, 29 West 39th Street, New York City, from Dec. 7 to Dec. 10.

The American Institute of Weights and Measures will hold its annual meeting at 2.30 p.m. in the United Engineering Societies Building, 29 West 39th St., New York, Dec. 10, 1920.

The Society of Automotive Engineers will hold its annual meeting on Jan. 11 to 13 inclusive at New York.

Condensed-Clipping Index of Equipment

Patented Aug. 20, 1918

Drill, Portable, Electric, Type "C"
Arnold Electric Tool Co., Inc., New London, Conn., and 114 Liberty St., New York.
"American Machinist," Oct. 28, 1920



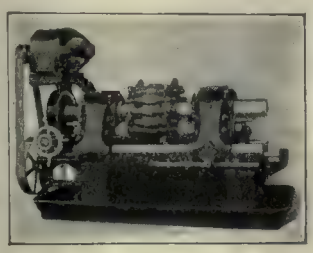
This drill has a ½-hp. motor and an idle speed of 480 r.p.m. It is claimed to have a capacity for drilling ½ in. in steel and ⅝ in. in wood or brass. The motor operates on both a.c. and d.c. current of 110 to 120 volts, although machines can be furnished for other voltages. Each section of the tool can be removed as a unit. The breast-plate and the spade handle are interchangeable. The overall length of the tool is 16½ in., and the weight 13½ lb.

Wood Trimmer, Revolving Knife
A. E. Bauer & Son, 7021 S. Racine Ave., Chicago, Ill.
"American Machinist," Oct. 28, 1920



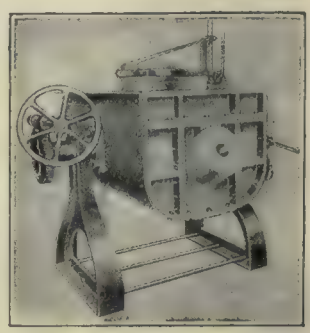
It is claimed that the revolving knife cuts instead of crushes off the wood, making a straight, smooth cut with a polished surface effect on any kind of wood. The total cutting edge of the knife is 16½ in. The guides at the ends can be set at any angle up to 45 deg. and 45, 60 and 90 deg. angles are marked on the base of the machine. There is an attachment to be used when grinding the knife. Specifications: Length overall, 17½ in. Width overall, 11 in. Height (without handle), 9 in. Maximum length of cut, 7½ in. Maximum height of cut, 2⅝ in. Diameter of knife, 5¼ in. Weight, 40 lb.

Milling Machine, Four-Spindle, Continuous, Duplex, No. 1
Davis & Thompson Co., 251 Reed St., Milwaukee, Wis.
"American Machinist," Oct. 28, 1920



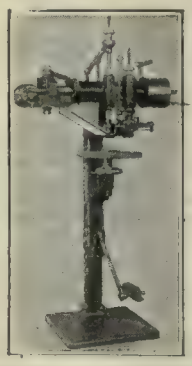
This machine is intended for continuous end milling and milling to length. In each head are two cutter spindles having an endwise micrometer adjustment of 2 in. and provision for locking them in place after adjustment. The right-hand head is adjustable on the bed, permitting milling various lengths up to the capacity of the machine. The work is held in a revolving fixture as shown and the cutters are so located that the front ones do the roughing and the back ones the finishing. The work mandrel is supported in both heads and is rotated by worm gearing. The various feeds are by change gears.

Furnace, Tilting, Non-Crucible Type, Oil-Burning
Wayne Oil Tank and Pump Co., Fort Wayne, Ind.
"American Machinist," Nov. 4, 1920



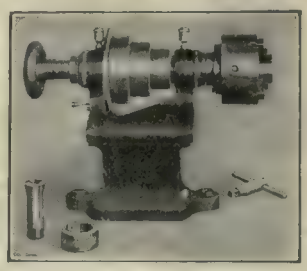
This type of furnace melts brass, copper, aluminum, etc. The furnace is charged through a 10-in. hole in the center of the top. The shell of the furnace is of ¼-in. steel plate with reinforcements of angle iron. The firebrick lining is 7 in. thick with a layer of insulating material between it and the furnace shell. Specifications—Built in two sizes, Nos. 3 and 6. Respective capacities, 350 to 550 and 550 to 800 lb. Average heats per day, 6 to 10 and 5 to 9. Floor space, 56 x 80 in., 66 x 80 in. Height to cover, 51 in. Pipe connections, air, 3 in.; oil, ¾ in. Air volume, 400 and 500 cu.ft. per minute at 1½-lb. pressure. Oil pressure, 5 lb. or more. Shipping weights complete, 5,500 lb. and 6,500 lb.

Screwdriving Machine, Automatic, Magazine-Feed
Reynolds Machine Co. Massillon, Ohio.
"American Machinist," Nov. 4, 1920



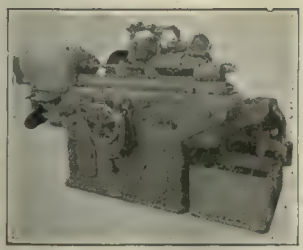
Not only screws of ordinary length but even those having a length shorter than the diameter of their heads can be driven by this machine. The screws are dumped at random into the magazine where they are automatically delivered, with heads upward, to an inclined track. At the lower end of the track a finger receives a screw and holds it in line with the spindle. The spindle, carrying a screwdriver bit, is brought down by a treadle.

Headstock, Mounted for Bench Use
S. A. Potter Tool and Machine Works, 77 East 130th St., New York.
"American Machinist," Nov. 4, 1920



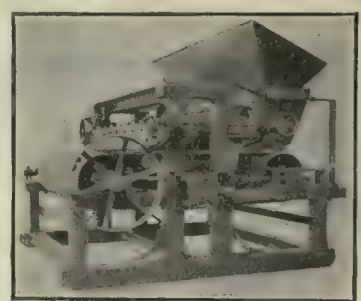
The device can be employed for filing, polishing and lapping, being adapted to performing speed-lathe work where no tailstock is required. The headstock is essentially the same as that used on the bench lathes made by the concern. It can be fitted with jaw chucks, spring chucks and lever chuck-openers. The device is driven by belt and fastened to the bench by means of two bolts.

Attachment, Cam-Grinding
Landis Tool Co. Waynesboro, Pa.
"American Machinist," Nov. 4, 1920



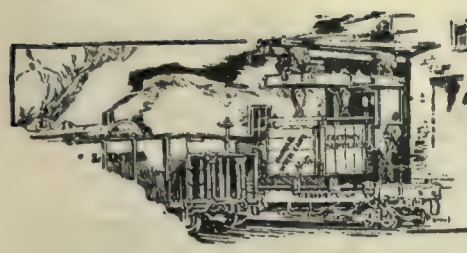
Intended for grinding cams for internal-combustion engines. The master cams are mounted directly on the work spindle inside the headstock. It is claimed that in generating master cams from models, the roller used is of the same diameter as the grinding wheel to be used for reproduction and that with this method, together with the pivotal position of the attachment, cams in duplicate of the models can be reproduced with the minimum of error. The live spindle is worm driven. The attachment can be furnished in the following sizes: 5½ x 26½ in., 5½ x 36 in. and 5½ x 52 inches.

Separator, Magnetic, Type "B"
Dings Magnetic Separator Co., Milwaukee, Wis.
"American Machinist," Nov. 4, 1920



This machine extracts iron from brass, aluminum borings and turnings, abrasive materials, rubber buffings, etc. It has an electro-magnet with poles above two cross-belts which travel above a wide belt containing the materials to be separated. The materials are placed in the hopper from which they are distributed evenly on the wide belt. The cross-belts carry the particles which are raised by the magnetic poles to the side of the machine from which they drop into receptacles. These machines are built in five sizes, with conveyor belts from 18 to 60 in. in width.

Clip, paste on 3 x 5-in. cards and file as desired



THE WEEKLY PRICE GUIDE

IRON AND STEEL

PIG IRON—Quotations compiled by The Matthew Addy Co.:

CINCINNATI	Current	One Year Ago
No. 2 Southern	$46.50	$30.35
Northern Basic	42.80	27.55
Southern Ohio No. 2	48.50	28.55
NEW YORK—TIDEWATER DELIVERY		
2X Virginia (Silicon 2.25 to 2.75)	54.50	32.40
Southern No. 2 (Silicon 2.25 to 2.75)	49.16	35.20
BIRMINGHAM		
No. 2 Foundry	42.00	29.25
PHILADELPHIA		
Eastern Pa., No. 2x, 2.25-2.75 sil.	47.25	29.00-30.00
Virginia No. 2	47.00	33.10
Basic	46.50	26.75
Grey Forge	46.50	26.75
CHICAGO		
No. 2 Foundry local	47.00	26.75
No. 2 Foundry, Southern	48.67	28.00
PITTSBURGH, INCLUDING FREIGHT CHARGE FROM VALLEY		
No. 2 Foundry	47.56	28.15
Basic	43.96	27.15
Bessemer	50.96	29.35

* F.o.b. furnace. † Delivered.

STEEL SHAPES—The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses at the cities named:

	New York			Cleveland		Chicago	
	Current	One Month Ago	One Year Ago	Current	One Year Ago	Current	One Year Ago
Structural shapes	$4.15	$4.30	$3.47	$3.58	$3.37	$3.58	$3.47
Soft steel bars	4.15	4.50	3.37	3.48	3.27	3.48	3.37
Soft steel bar shapes	4.15	4.50	3.37	3.48	3.27	3.48	3.37
Soft steel bands	5.50	6.43	4.07	6.25	.....	.....	.....
Plates, ¼ to 1 in. thick	4.15	4.75	3.67	3.78	3.57	3.78	3.67

BAR IRON—Prices per 100 lb. at the places named are as follows:

	Current	One Year Ago
Mill, Pittsburgh	$4.25	$2.77
Warehouse, New York	4.75	3.37
Warehouse, Cleveland	3.52	3.27
Warehouse, Chicago	4.12	3.37

SHEETS—Quotations are in cents per pound in various cities from warehouse; also the base quotations from mill:

Blue Annealed	Large Mill Lots Pittsburgh	New York Current	New York One Year Ago	Cleveland	Chicago
No. 10	3.55-5.80	6.15@7.25	4.57	6.25	6.13
No. 12	3.60-5.85	6.20@7.30	4.62	6.30	6.18
No. 14	3.65-5.90	6.25@7.35	4.67	6.35	6.23
No. 16	3.75-6.00	6.35@7.45	4.77	6.45	6.33
Black					
Nos. 18 and 20	4.20-5.85	7.90@8.80	5.30	7.55	6.90
Nos. 22 and 24	4.25-5.90	7.95@8.85	5.35	7.60	6.95
No. 26	4.30-5.95	8.50@8.90	5.40	7.65	7.00
No. 28	4.35-6.00	8.10@9.00	5.50	7.75	7.10
Galvanized					
No. 10	4.70-6.00	8.65@10.00	5.75	8.00	7.25
No. 12	4.80-6.10	8.75@10.00	5.85	8.10	7.30
No. 14	4.80-6.10	8.75@10.10	5.85	8.10	7.45
Nos. 18 and 20	5.10-6.40	9.00@10.40	6.15	8.40	7.75
Nos. 22 and 24	5.25-6.55	9.15@10.55	6.30	8.55	8.15
No. 26	5.40-6.70	9.30@10.70	6.45	8.70	8.30
No. 28	5.70-7.00	9.60@11.00	6.75	9.00	8.60

Acute scarcity in sheets, particularly black, galvanized and No. 16 blue enameled.

Automobile sheets are unavailable except in fugitive instances, when prices are 9.45c per lb. for No. 16; 9.50 for Nos. 18 and 20, and 9.55c for Nos. 22 and 24.

COLD FINISHED STEEL—Warehouse prices are as follows:

	New York	Chicago	Cleveland
Round shafting or screw stock, per 100 lb. base	$6.15	$5.80	$5.50
Flats, square and hexagons, per 100 lb. base	6.65	6.30	6.00

DRILL ROD—Discounts from list price are as follows at the places named:

	Per Cent.
New York	50
Cleveland	50
Chicago	50

NICKEL AND MONEL METAL — Base prices in cents per pound F.O.B. Bayonne, N. J.

Nickel	
Ingot and shot	43
Electrolytic	45

Monel Metal			
Shot and blocks	35	Hot rolled rods (base)	42
Ingots	38	Cold rolled rods (base)	56
Sheet bars	40	Hot rolled sheets (base)	55
Special Nickel and Alloys			
Malleable nickel ingots			45
Malleable nickel sheet bars			47
Hot rolled rods, Grades "A" and "C" (base)			60
Cold drawn rods, grades "A" and "C" (base)			72
Copper nickel ingots			42
Hot rolled copper nickel rods (base)			52
Manganese nickel hot rolled (base) rods "D" — low manganese			64
Manganese nickel hot rolled (base) rods "D" — high manganese			67

Domestic Welding Material (Swedish Analysis)—Welding wire in 100-lb lots sells as follows, f. o. b. New York: 5/32, 8½c. per lb.; ¼, 8c.; 5/16 to ½, 7½c Domestic iron sells at 12c. per lb.

MISCELLANEOUS STEEL—The following quotations in cents per pound are from warehouse at the places named:

	New York Current	Cleveland Current	Chicago Current
Openhearth spring steel (heavy)	7.00	8.00	9.00
Spring steel (light)	10.00	11.00	12.00
Coppered bessemer rods	9.00	8.00	6.75
Hoop steel	6.00	5.79	5.32
Cold-rolled strip steel	12.50	8.25	10.75
Floor plates	6.40	4.00	6.63

WROUGHT PIPE—The following discounts are to jobbers for carload lots on the Pittsburgh basing card:

BUTT WELD

Steel Inches	Steel Black	Steel Galvanized	Iron Inches	Iron Black	Iron Galvanized
⅛ to 3	54–57½%	41½–44%	⅛	15½–25½%	+1½–11½%
			¼	19½–29½%	1½–11½%
			⅜ to 1¼	24½–34½%	8 –18½%

LAP WELD

2	47 –50½%	34½–38%	1¼		
2½ to 6	50 –53½%	37½–41%	1½		
7 to 12	47 –50½%	33½–37%	2	20½–28½%	6½–14½%
13 to 14	37½–41 %		2½ to 6	22½–30½%	9½–17½%
15	35 –38½%		7 to 12	19½–27½%	6½–14½%

BUTT WELD, EXTRA STRONG PLAIN ENDS

⅛ to 1½	52 –55½%	39½–43%	⅛ to 1½	24½–34½%	9½–19½%
2 to 3	53 –56½%	40½–44%			

LAP WELD, EXTRA STRONG PLAIN ENDS

2	45 –48½%	33½–37%	1¼		
2½ to 4	48 –51½%	36½–40%	1½		
4½ to 6	47 –50½%	35½–39%	2	21½–29½%	8½–16½%
7 to 8	43 –46½%	29½–33%	2½ to 4	23½–31½%	11½–19½%
9 to 12	38 –41½%	24½–28%	4½ to 6	22½–30½%	10½–18½%
			7 to 8	14½–22½%	2½–10½%
			9 to 12	9½–17½%	5½–+2½%

	New York Black	New York Galv.	Cleveland Black	Cleveland Galv.	Chicago Black	Chicago Galv.
⅛ to 3 in. steel butt welded	38%	22%	39%	30%	54%40%	40½@30 %
2½ to 6 in. steel lap welded	33%	18%	41%	26%	50@40%	37½@27½%

Malleable fittings. Classes B and C, banded, from New York stock sell at plus 45%. Cast iron, standard sizes, plus 5%.

METALS

MISCELLANEOUS METALS—Present and past New York jobbers' quotations in cents per pound, in quantities up to car lots:

	Current	Month Ago	Year Ago
Copper, electrolytic	15.75	18.50	22.50
Tin in 5-ton lots	38.75	44.50	56.50
Lead	7.25	8.50	6.25
Zinc	7.00	8.50	7.60
ST. LOUIS			
Lead	7.25	8.00	6.00
Zinc	6.75	7.70@8.05	7.15

At the places named, the following prices in cents per pound prevail, for 1 ton or more:

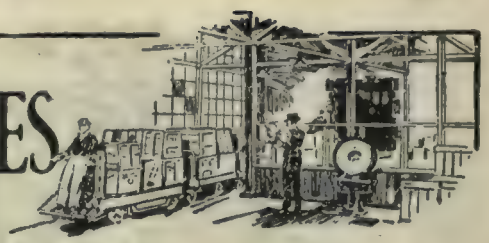
	New York Current	New York Month Ago	New York Year Ago	Cleveland Current	Cleveland Year Ago	Chicago Current	Chicago Year Ago
Copper sheets, base	23.50	29.50	33.50	26.50@29.00	35.50	36.00	36.50
Copper wire (carload lots)	20.00	20.00	30.75	24.00	30.50	29.00	26.00
Brass sheets	28.50	28.50	32.00	25.00	33.00	27.00	28.00
Brass pipe	28.00	33.00	36.00	30.00	39.00	34.00	37.00
Solder (half and half) (case lots)	31.00	35.00	45.00	29.00	41.00	38.00	38.50

Copper sheets quoted above hot rolled 24 oz., cold rolled 14 oz. and heavier, add 2c.; polished takes 5c. per sq.ft. extra for 20-in. widths and under; over 20 in., 7½c.

BRASS RODS—The following quotations are for large lots, mill. 100 lb. and over, warehouse; net extra:

	Current	One Year Ago
Mill	25.00	24.00
New York	27.00	28.00@29.75
Cleveland	25.00	29.00
Chicago	30.00	27.00

SHOP MATERIALS AND SUPPLIES



ZINC SHEETS—The following prices in cents per pound are f.o.b. mill + less 8% for carload lots..... 11.50

	Warehouse			
	—In Casks—		— Broken Lots —	
	Current	One Year Ago	Current	One Year Ago
Cleveland	15.30	12.50	14.70	13.00
New York	14.00	11.50	14.50	12.50
Chicago	14.50	16.50	14.95	16.00

ANTIMONY—Chinese and Japanese brands in cents per pound, in ton lots for spot delivery, duty paid:

	Current	One Year Ago
New York	7.25	9.50
Chicago	7.25	9.75
Cleveland	8.00	9.75

OLD METALS—The following are the dealers' purchasing prices in cents per pound:

	*New York			
	Current	One Year Ago	Cleveland	Chicago
Copper, heavy, and crucible	12.50	17.00	12.00	11.50
Copper, heavy, and wire	12.00	16.00	11.75	11.00
Copper, light, and bottoms	10.00	14.00	10.00	10.00
Lead, heavy	5.00	4.75	5.50	5.25
Lead, tea	4.00	3.75	3.75	4.00
Brass, heavy	7.00	10.50	8.00	11.25
Brass, light	5.50	7.50	5.00	6.00
No. 1 yellow brass turnings	7.00	10.00	6.00	6.00
Zinc	4.50	5.00	3.75	4.50

*These prices nominal because of dull market

ALUMINUM—The following prices are from warehouse at places named:

	New York	Cleveland	Chicago
No. 1 aluminum, 98 to 99% pure, in ingots for remelting (1-15 ton lots), per lb	$33.00	$30.00	$33.50

COPPER BARS—From warehouse sell as follows in cents per pound, for ton lots and over:

	Current	One Year Ago
New York (round)	38.00	32.00
Chicago	29.00	31.00
Cleveland	27.00	35.00

BABBITT METAL—Warehouse price per pound:

	—New York—		—Cleveland—		— Chicago —	
	Current	One Year Ago	Current	One Year Ago	Current	One Year Ago
Best grade	70.00	90.00	47.00	70.00	45.00	60.00
Commercial	30.00	50.00	18.00	16.50	11.00	13.00

NOTE—Price of babbitt metal is governed largely by formula, no two manufacturers quoting the same prices. For example, in New York we quote the best two grades, although lower grades may be obtained at from $16 to $20.

SHOP SUPPLIES

NUTS—From warehouse at the places named, on fair-sized orders, the following amount is deducted from list:

	—New York—		— Cleveland —		— Chicago —	
	Current	One Year Ago	Current	One Year Ago	Current	One Year Ago
Hot pressed square	+$1.25	$1.50	List net	$2.25	+1.15	1.85
Hot pressed hexagon	+ 1.25	1.50	List net	2.25	+1.15	1.85
Cold punched hexagon	+ 1.25	1.50	List net	2 25	+1.15	1.30
Cold punched square	+ 1.25	1.50	List net	2 25	+1.15	1.30

Semi-finished nuts, $\frac{7}{16}$ and smaller, sell at the following discounts from list price:

	Current	One Year Ago
New York	30%	50–10%
Chicago	40%	50%
Cleveland	50%	55%

MACHINE BOLTS—Warehouse discounts in the following cities:

	New York	Cleveland	Chicago
½ by 4 in. and smaller	+10%	30%	20%
Larger and longer up to 1½ in. by 30 in.	Net list	30%	10%

WASHERS—From warehouses at the places named the following amount is deducted from list price:

For wrought-iron washers:
New York..... list Cleveland..... $2.50 Chicago..... $1.90

For cast-iron washers, ½ and larger, the base price per 100 lb. is as follows:
New York..... $7.00 Cleveland..... $4.50 Chicago..... $5.50

CARRIAGE BOLTS—From warehouses at the places named the following discounts from list are in effect:

	New York	Cleveland	Chicago
½ by 6 in. and smaller	+20%	30%	20%
Larger and longer up to 1 in. by 30 in.	+20%	25%	15%

COPPER RIVETS AND BURS sell at the following rate from warehouse:

	Rivets		Burs	
	Current	One Year Ago	Current	One Year Ago
Cleveland	20%	20%	10%	10%
Chicago	net	20%	net	20%
New York	30%	40%	net	20%

RIVETS—The following quotations are allowed for fair-sized orders from warehouse:

	New York	Cleveland	Chicago
Steel ⅞ and smaller	20%	40–5%	30%
Tinned	20%	40–5%	30%

Boiler, ½, ⅝, 1 in. diameter by 2 to 5 in. sell as follows per 100 lb.:
New York..... $6.00 Chicago..... $5.73 Pittsburgh..... $4.5

Structural, same sizes:
New York..... $7.10 Chicago..... $5.83 Pittsburgh..... $4.60

MISCELLANEOUS

SEAMLESS DRAWN TUBING—The base price in cents per pound from warehouse in 100-lb. lots is as follows:

	New York	Cleveland	Chicago
Copper	28.00	33.00	35.00
Brass	27.00	30.00	34.00

The prices, of course, vary with the quantity purchased. For lots of less than 100 lb., but not less than 75 lb., the advance is 1 c.; for lots of less than 75 lb., but not less than 50 lb., 2½c. over base (100-lb. lots); less than 50 lb., but not less than 25 lb., 5c. should be added to base price; quantities from 10-25 lb., extra is 10c.; less than 10 lb., add .15–20c.

Double above extras will be charged for angles, channels and sheet metal mouldings if ordered in above quantities. Above extras also apply to brass rod other than standard stock sizes—stock sizes being considered as ¼-2 in. inclusive in rounds, and ¼-1½ in., inclusive, in square and hexagon—all varying by thirty seconds up to 1 in. by sixteenths over 1 in. On shipments aggregating less than 100 lb., there is usually a boxing charge of $1.50.

LONG TERNE PLATE—In Chicago No. 28 primes from stock sell, nominally, for $9.85 per 100 lbs.

In Cleveland—$10 per 100 lbs.

COTTON WASTE—The following prices are in cents per pound:

	—— New York ——			
	Current	One Year Ago	Cleveland	Chicago
White	15.00@17.00	13.00	15.00	15.00@17.00
Colored mixed	9.00@14.00	9.00–12.00	11.00	11.00@13.00

WIPING CLOTHS—Jobbers' price per 1000 is as follows:

	13½x13½	13½x20½
Cleveland	55.00	65.00
Chicago	41.00	43.50

SAL SODA sells as follows per 100 lb.:

	Current	One Month Ago	One Year Ago
New York	$2.00	$2.00	$1.75
Philadelphia	2.75	2 75	1.75
Cleveland	3.00	3.00	2.50
Chicago	2.00	2.75	2.00

ROLL SULPHUR in 360-lb. bbl. sells as follows per 100 lb.:

	Current	One Month Ago	One Year Ago
New York	$3.50	$3.90	$3.65
Philadelphia	3.65	3.65	3.87
Chicago	4.10	5.00	4.12½

COKE—The following are prices per net ton at ovens, Connellsville:

	November 22	November 15	November 8
Prompt furnace	$ 8.00@$10.00	$11.50@$12.00	$16.00@$16.50
Prompt foundry	10.00@ 12.00	12.50@ 13.00	17.00@ 18.50

FIRE CLAY—The following prices prevail:

		Current
Ottawa, bulk in carloads	Per Ton	$8.00
Cleveland	100-lb. bag	1.00

LINSEED OIL—These prices are per gallon:

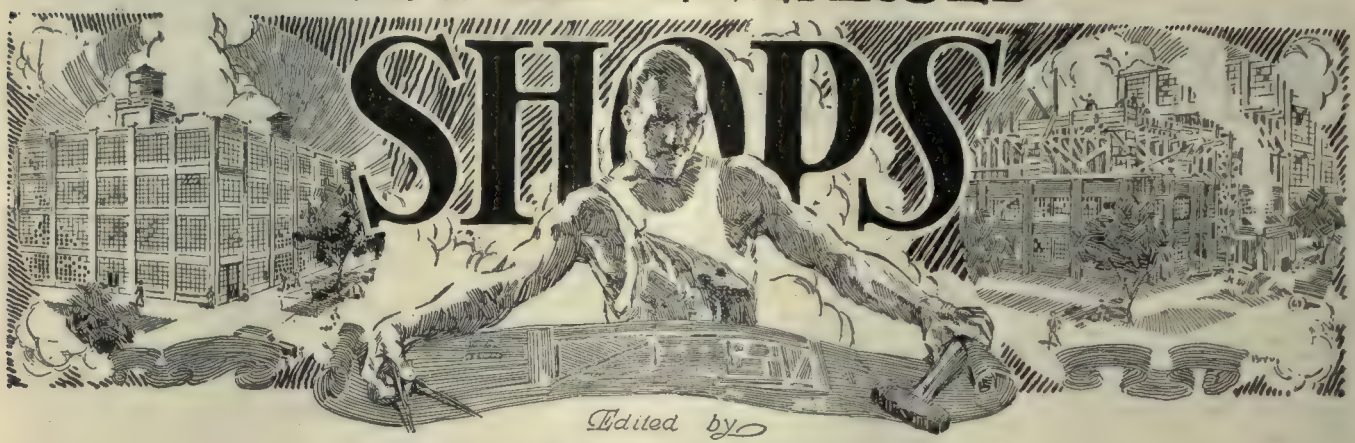
	—New York—		—Cleveland—		—Chicago—	
	Current	One Year Ago	Current	One Year Ago	Current	One Year Ago
Raw in barrels, (5 bbl. lots)	$1.00	$2.15	$1.25	$2.50	$1.08	$2.37
5-gal cans	1.15	2.30	1.50	2.75	1.33	2.57
1-gal cans (6 to case)	1.25	....	....	....	....	....

WHITE AND RED LEAD—Base price per pound:

	Red				White	
	Current		One Year Ago		Current	One Year Ago
	Dry	In Oil	Dry	In Oil	Dry and In Oil	Dry and In Oil
100 lb. keg	14.25	15.75	13.00	14.50	14.25	13.00
25 and 50-lb. kegs	14.50	16.00	13.25	14.75	14.50	13.25
12½-lb. keg	14.75	16.25	13.50	15.00	14.75	13.50
5-lb. cans	16.25	17.75	15.00	16.50	16.25	15.00
1-lb. cans	17.25	18.75	16 00	17.50	17.25	16.00

500 lb. lots less 1% discount. 2000 lb. lots less 10–20½% discount.

NEW *and* ENLARGED



Edited by
L-V-FLETCHER

Machine Tools Wanted

If in need of machine tools send us a list for publication in this column

Conn., Shelton—The E. W. Iles Mfg. Co., Hull St., manufacturer of tools and gages—several turret lathes and other machine tools.

N. Y., New York (Borough of Manhattan)—The Copic Service Co., 473 Broome St.—one Universal press.

N. Y., New York (Borough of Manhattan)—Rojo, Fabian & Co., 350 Bway.—one 2½ ft. radial drill with 6 change speed box for motor drive, complete with tapping attachments, round table, swinging knee, etc.

N. Y., Rochester—The Alent Machine Tool Co., 419 St. Paul St., N. Alent, Purch. Agt.—general machine tools including special surface grinder.

N. Y., Rochester—L. Freedman, mechanical engr., c/o Selden Truck Corp., Probert St.—boring mill, drill press and arbor press.

N. Y., Rochester—B. Goetz, 110 Central Bldg., manufacturer of jewelry—metal rolling machine.

N. Y., Rochester—The Harrison Machine Co., 146 Platt St., machine builders and repairers, J. Harrison, Purch. Agt.—general machine tools.

N. Y., Rochester—The L. L. L. & D. Mfg. Co., 203 State St., manufacturer of reflectors for head lights, F. B. Shannahan, Purch. Agt.—broaching and brazing machines.

N. Y., Summerville (Rochester P. O.)—J. Pollock, Stop 24 (machinist)—Standard tapping machines.

Pa., Philadelphia—The Mueller Electric Co., 222 North 11th St.—engine lathes.

Pa., Philadelphia—The Precision & Thread Grinder Mfg. Co., 1932 Arch St., F. R. Imhoff, Mgr.—several surface grinders, similar to the Brown & Sharpe No. 2.

Ill., Chicago—The Atchison, Topeka & Santa Fe Ry. Co., Ry. Exch. Bldg., M. J. Collins, Purch. Agt.—
One 6 spindle nut tapper, capacity up to 2½ in., belt drive.
One 4 spindle bolt turning machine, capacity up to 2¼ in., Easkester type, belt drive.
One 6 spindle turning and threading machine for crown and side staybolts, belt drive.
Two 20 in. x 7 ft. cabinet turret lathes for brass locomotive parts, similar to Manning Maxwell & Moore No. 1.
One No. 9 Niles, Bement & Ponds vertical milling machine, or similar; 230 volt, d.c. motor drive, alternate on No. 10 and No. 12.
One 100 in. heavy duty boring mill with 2 heads on cross rail and 4 chuck jaws, 230 volt, d.c. motor drive.
One 96 in. x 96 in. x 16 ft. heavy duty cylinder planer for locomotive cylinders with 2 heads on cross rail and 2 side heads, 230 volt, d.c. motor drive.
One double head slotter for locomotive frames, with bed 40 ft. long, 66 in. wide and with 24 in. stoker stroke; each head individually motor driven, 230 volt, d.c.
One 100 in. heavy duty tire boring mill for locomotive drive wheel tires, 230 volt, d.c. motor drive.
Two 24 in. heavy duty slotters with compound table and cross feed in 2 directions, belt drive or 230 volt, d.c. motor drive.
Four 24 in. x 12 ft. heavy duty engine lathes, 230 volt d.c. motor drive.
Four 6 ft. radial drills, 230 volt. d.c. motor drive.
One 8 ft. radial drill, 230 volt, d.c. motor drive.
Two 60 in. heavy duty vertical boring mills with 2 heads on cross rail, 230 volt, d.c. motor drive.
One 48 in. x 14 ft. heavy duty engine lathe, belt drive or 230 volt, d.c. motor drive.
One 30 in. stroke draw-out-shaping machine, Morton or equivalent, alternate on 32 or 36 in. stroke.
One 28 in. x 14 ft. double head shaping machine, belt drive or 230 volt, d.c. motor drive.

Ill., Chicago—Ellis Drier Co., 332 South La Salle St.—No. 3 plain miller, single pulley drive, double crank press with bolster plate about 15 x 60 in. equal to No. 206 Toledo, gap shear 60 in. blade to cut ¼ to ⅜ in. stock (used).

Ill., Quincy—The Wall Pump & Compressor Co.—radial drills.

Ind., Marion—The Marion Machine Fdry. & Supply Co.—one 1¾ in. hand screw machine; one 18 in. or 20 in. x 8 ft. bed lathe with backing off attachments, one 42 in. back geared engine lathe, with 30 in. over carriage, 12 ft. between centers.

Mich., Detroit—The Detroit Precision Tool Co., 521 Lincoln Ave.—miscellaneous machine tool equipment.

Mich., Detroit—R. E. German, Statler Hotel—lathes, shapers, milling machines, drill presses, planers, boring mills, turret lathes, gear cutters, grinders (used equipment in good condition).

Mich., Detroit—The Modern Die & Plate Press Mfg. Co., 122 Sherman St.—die making equipment.

Mich., Detroit—The Rund Sales Corp., 833 Woodward Ave.—garage equipment.

Mich., Mt. Clemens—The Sauzedde Mfg. Corp., Evans and Rose Sts.—equipment for the manufacture and enameling of wire wheels.

O., Columbus—The Tifft Martin Machine Co., 9 West Poplar Ave., R. W. Martin, Purch. Agt.—one milling machine No. 2, one French fly wheel press, and one 16 in. turret lathe (used).

O., Orrville—The Will Burt Co.—Attachments for Garvan screw machines.

Wis., Ft. Atkinson—The Bull Milking Machine Co., North Main St., L. Bull, Purch. Agt.—3 drill presses, sizes 14 in., 20 in. and 26 in.

Wis., Gleason—J. Houle—machinery for garage repair work.

Wis., Mineral Point—The Fiedler Motor Co.—garage repair machinery.

Wis., New London—The New London Machine Shops—Universal miller and Universal shaper.

Wis., Oshkosh—The Challoner Co., 29 Osceola St., manufacturer of saw mill machinery, etc.—one trimming press and one forming press.

Wis., Milwaukee—The Andrew Mfg. Co., 533 30th St., manufacturer of motors, W. Andrew, Purch. Agt.—one ½ in. to 3 in. internal grinder.

Wis., Ripon—E. J. Peschke—lathe and other equipment for garage repair work.

Ala., Birmingham—A. G. Glass, 1322 Glen Iris Ave.—sheet metal working and riveting machines for making ovens of sheet steel.

Machinery Wanted

N. Y., Rochester—The Bartholmay Brewing Co., 555 St. Paul St., S. B. Foster, Pres.—$100,000 worth of machinery for its crude oil refinery.

Pa., Philadelphia—The Amer. Ice Co., 6th and Arch Sts.—machinery for the manufacture of ice.

Mich., Battle Creek—The Bd. Educ., F. Harvey, Secy.—monorail crane.

Mich., Saginaw—The Bd. Educ.—shop equipment to include metal and woodworking machinery.

Wis., Fond du Lac—The Fond du Lac Paper Co., 298 Forest Ave—special paper machinery.

Wis., Jefferson—The Jefferson Rubber Co.—rubber working machinery.

Wis., Kewaunee—The Kewaunee Mfg. Co., manufacturer of laboratory furniture—woodworking machinery.

Wis., Milwaukee—The Hercules Knitting Co., 1097 Greenbush St.—special knitting machines, etc.

Wis., Milwaukee—The Blochowiak Dairy Co., 1364 4th Ave.—new creamery equipment for proposed plant at Helenville.

Mo., St. Louis—The T. J. Moss Tie Co., Security Bldg.—treating machinery for its proposed creosoting plant at East St. Louis, Ill.

Que., Montreal—The Royal Duke Refining Co., 157 St. James St.—$50,000 worth of equipment for its proposed plant in East Montreal.

Metal Working

NEW ENGLAND STATES

Conn., New Britain—Landers, Frary & Clark, Commercial St., manufacturers of hardware and cutlery, will build a 1 story, 50 x 150 ft. and 50 x 160 ft. additions to its plant, on East Main and Lake Sts. Estimated cost, $25,000.

Me., Auburn—The Darling Auto Co., 15 Turner St., will build a 1 story, 80 x 100 ft. garage, etc., on Franklin St. Estimated cost, $40,000. Noted Nov. 4.

Me., Augusta—Bunker & Savage, Augusta Trust Bldg., have awarded the contract for the construction of a 1 story, 50 x 106 ft. garage and service station on Main St. Estimated cost, $20,000.

Me., Augusta—P. M. Lawrence Co., 320 Water St., has awarded the contract for the construction of a 1 story garage on State St. Estimated cost, $25,000.

Mass., Everett—J. E. Sheppard, 198 Elm St., plans to build a 1 story, 50 x 50 ft. garage on Chelsea St. Estimated cost, $10,000. Private plans.

Mass., Gloucester—M. S. Katz, 46 Poplar St., will build a 1 story garage on Maplewood Ave. Estimated cost, $25,000.

Mass., Holyoke—The Worthington Pump & Mchy. Corp., 37 Appleton St., will remodel old schoolhouse on North Bridge and East Dwight Sts. into pattern shop building. Estimated cost, $30,000. Noted Nov. 11.

Mass., New Bedford—F. W. Greene, Jr., 252 Union St., is having plans prepared for the construction of a 1 story garage on Emerson St. Estimated cost, $25,000. La Brode & Bullard, 251 Union St., Archts.

Mass., Springfield—The Ridgewood Community Trust Co., c/o Kirkham & Parlett, Archts., 25 Harrison St., has awarded the contract for the construction of a 1 story, 40 x 60 x 70 ft. garage on Mulberry and Union Sts. Estimated cost, $15,000.

Mass., Worcester—The Morgan Constr. Co., 15 Belmont St., has awarded the contract for altering and building a 1 story, 50 x 50 ft. addition to its machine shop, on Crescent St. Estimated cost, $30,000.

MIDDLE ATLANTIC STATES

N. J., Newark—Cohen & Katchen, 201 Norfolk St., will build a 1 story, 50 x 100 ft. garage on Stanton St. and Sherman Ave. Estimated cost, $20,000.

N. Y., Glendale (Brooklyn P. O.)—The Eastern Eng. & Constr. Co., c/o Gilbert & Ashfield, Archts. and Engrs., 350 Fulton St., Brooklyn, has awarded the contract for the construction of a 1 story, 120 x 300 ft. pipe fitting shop. Estimated cost, $80,000.

N. Y., New York (Borough of Bronx)—A. L. Guidone, 52 Vanderbilt Ave., Manhattan, will build a 2 story, 50 x 100 ft. garage on Jerome Ave. and Bedford Park Blvd. Estimated cost, $85,000.

N. Y., New York (Borough of Bronx)—The Kissler Realty Co., Inc., c/o J. DeHart, Archt., 1041 Fox St., will build a 1 story, 100 x 110 ft. garage on East 167th St. Estimated cost, $30,000.

N. Y., New York (Borough of Brooklyn)—B. Clayman, 37 Van Buren St., will build a 1 story, 100 x 150 ft. garage on De Kalb Ave. near Tompkins Ave. Estimated cost, $40,000.

N. Y., New York (Borough of Manhattan)—G. H. Aspland, c/o DeRose & Cavalieri, Archts., 370 East 149th St., will build a 1 story, 50 x 210 ft. garage on Park Ave. and Gouverneur Pl. Estimated cost, $25,000.

N. Y., New York (Borough of Manhattan)—The Ferncliff Garage Inc., c/o DeRose & Cavalieri, Archts., 370 East 149th St., will build a 1 story, 121 x 123 ft. garage on 3d Ave. near Franklin St. Estimated cost, $75,000.

Pa., Coraopolis—The Keystone Garage Co. has plans prepared for the construction of a 1 story, 50 x 110 ft. garage. Estimated cost, $25,000. T. E. Cornelius, House Bldg., Pittsburgh, Archt.

Pa., Philadelphia—A. Pestcoe, 1625 South 6th St., has awarded the contract for the construction of a 2 story, 50 x 120 ft. garage, at 707 Tasker St. Estimated cost, $20,000. Noted Nov. 11.

Pa., Philadelphia—A. M. Russel, 1327 Dickinson St., has awarded the contract for the construction of a 2 story, 47 x 70 ft. addition to his garage at 1339 South Jupiter St. Estimated cost, $13,000.

SOUTHERN STATES

N. C., Raleigh—The State Highway Comn. plans to build mechanical equipment sheds and repair shop. Estimated cost, $75,000. W. S. Fallis, State Highway Engr.

W. Va., Huntington—The Fordlette Engine Co. plans to build a plant, which will probably include a foundry, machine shop and assembly plant. Estimated cost, $100,000.

MIDDLE WEST STATES

Ill., Chicago—M. Block & Son, 1123 Newberry Ave., will soon award the contract for the construction of a 3 story, 48 x 100 ft. sheet metal factory at 1120-25 Newberry Ave. Estimated cost, $50,000. Dubin & Eisenberg, 139 North Clark St., Archts.

Ill., Chicago—The Independent Packing Co., 41st and Halstead Sts., has awarded the contract for the construction of a 1 story, 75 x 125 ft. garage at 4119 Emerald Ave. Estimated cost, $50,000.

Ill., Chicago—The Joseph Bros. Lumber Co., 3393 Archer Ave., plans to build a 1 story, 75 x 150 ft. garage. Estimated cost, $50,000.

Ill., Chicago—The Oppenheimer Casing Co., 1020 West 36th St., has awarded the contract for the construction of a 1 story, 26 x 70 ft. garage and an 80 x 147 ft. factory, on West 38th St. and Auburn Ave. Estimated cost, $35,000.

Ill., Chicago—The Parmalee Transfer Co., 202 South Clark St., will soon award the contract for the construction of a 150 x 180 ft. garage on Monroe and Racine Aves. W. E. Perry, 64 East Van Buren St., Archt.

Ill., Chicago—The Union Stock Yards Casting Co., 834 West 49th Pl., is having plans prepared for the construction of a 1 and 2 story, 60 x 125 ft. foundry at 4843 South Morgan St. Estimated cost, $28,000. A. Ritter, 140 South Dearborn St., Archt.

Mich., Detroit—The Rund Sales Corp. has awarded the contract for the construction of a 1 story, 50 x 140 ft. garage at 833 Woodward Ave. Estimated cost, $20,000.

Mich., Kalamazoo—The Clarage Fan Co., North and Porter Sts., is building an addition to its foundry. F. M. Murdie, Supt.

Mich., Mt. Clemens—The Sauzedde Mfg. Corp., Evans and Rose Sts., is having plans prepared for the construction of a 2 story factory for the manufacture of auto parts and wire wheels. Estimated cost, $75,000. H. T. Millar, Lightner Bldg., Detroit, Archt.

O., Cleveland—The Bellstein Young Co., 7508 Carnegie Ave., has awarded the contract for the construction of a 1 story, 22 x 34 ft. garage at 1795 Crawford Rd. Estimated cost, $10,000.

O., Cleveland—The Belmore Co., Society for Savings Bldg., will soon award the contract for the construction of a 2 story, 75 x 150 ft. garage and commercial building at 731 Vincent St. Estimated cost, $50,000. A. Garfield, Natl. City Bldg., Archt.

O., Cleveland—The Hess Auto Body Co., 15008 Aspinwall Ave., will build a 1 story, 50 x 60 ft. workshop at East 152d St. and Aspinwall Ave. Estimated cost, $10,000.

O., Cleveland—C. J. Howley, 10305 Clifton Blvd., is building a 1 story, 65 x 150 ft. Garage at 11000 Clifton Blvd. Estimated cost, $25,000.

O., Cleveland—Teufel Bros., (packers,) c/o C. E. Tousley, Archt., 4500 Euclid Ave., had plans prepared for the construction of a 1 story, 40 x 130 ft. garage on West 65th St. Estimated cost, $40,000.

O., Conneaut—The Conneaut Telephone Co. has awarded the contract for the construction of a 2 story, 40 x 80 ft. telephone exchange building and garage. Estimated cost, $75,000. Noted Oct. 21.

O., Mt. Vernon—The C. and G. Cooper Co., 11 Bway., New York City, has awarded the contract for the construction of a 1 and 2 story foundry and machine shop, etc. Cost about $400,000.

O., Warren—Brier Hill Steel Co., Youngstown, has taken an option on a 480 acre site north of here, for the purpose of constructing a steel mill. Estimated cost, $1,500,000. E. L. Ford, Chn. of the Advisory Com.

Wis., Kaukauna—The Kaukauna Motor Service Co. had plans prepared for the construction of a 4 story, 50 x 100 ft. garage and show room on 3d and Main Sts. Estimated cost, $75,000. Juul & Smith, Imig Bldg., Sheboygan, Archts.

Wis., Kewaunee—The Kewaunee Mfg. Co. is having plans prepared for the construction of a 4 story, 24 x 102 ft. factory on Main St., for the manufacture of chemical laboratory furniture. Estimated cost, $50,000.

Wis., Oshkosh—R. Lutz, 1270 Knapp St., is having plans prepared for the construction of a 2 story, 40 x 80 ft. and 40 x 78 ft. garage on Knapp St. Estimated cost, $30,000. Auler & Jensen, F. R. A. Bldg., Archts.

WEST OF THE MISSISSIPPI

Col., Denver—The Denver & Salt Lake R.R., Ideal Bldg., will rebuild and equip its 90 x 250 ft. shops which were recently destroyed by fire. Estimated cost, $800,000. A. L. Cochran, Purch. Agt.

Minn., St. Paul—The Northern Pacific R. R., 507 Marquette Ave., plans to expend $644,121 for shop buildings, engine houses and appliances, $475,542 for shop machinery and tools, and $500,000 for pile drivers, cranes and like equipment.

CANADA

Man., Winnipeg—The Consolidated Motors Ltd., 397 Portage Ave., plans to build a garage. Estimated cost, $80,000.

Que., Montreal—The Canada Heaters Ltd., St. Laurent, plans to build a 1 story plant, here. Estimated cost, $250,000.

Que., Montreal—The Canadian Natl. Ry., Moncton, N. B., has awarded the contract for the construction of a 1 story, 100 x 250 ft. round house on Sherbrooke St., here. Estimated cost, $20,000.

General Manufacturing

NEW ENGLAND STATES

Conn., Bridgeport—Dober & Klein, 693 Hallet St., have awarded the contract for the construction of a 1 story, 30 x 120 ft. bakery and 20 x 35 ft. garage, on Garden St. Estimated cost, $25,000.

Conn., South Glastonbury—The Wasuc Mills Co. plans to rebuild its paper plant which was recently destroyed by fire. Estimated cost, $50,000.

Conn., Versailles—The Federal Paper Board Co. has awarded the contract for altering and building a 2 story addition to its plant. Estimated cost, $250,000.

Mass., Boston—The Boston Herald, 171 Tremont St., has awarded the contract for the construction of a 4 story addition to its publishing plant on Avery St. Estimated cost, $125,000. Noted Oct. 28.

Mass., Boston—S. Simons, 21 Bromfield St., is having plans prepared for the construction of a 2 story, 30 x 50 ft. printing plant on Massachusetts Ave. Estimated cost, $25,000. M. J. Mastrangelo, 2 North Square, Archt.

Mass., Northampton—Tait Bros., Cass St., Springfield, plan to build a 1 story ice cream plant, here. Estimated cost, $25,000. B. E. Geckler, 335 St. James Ave., Archt.

Mass., Worcester—The J. F. Bicknell Lumber Co., 16 Mulberry St., has awarded the contract for the construction of a 2 story planing mill. Cost between $15,000 and $18,000.

Mass., Worcester—The P. W. Wood Lumber Corp., 7 Garden St., has awarded the contract for the construction of a 1 story, 36 x 48 ft. addition to its mill on Garden St. Estimated cost, $10,000.

R. I., Providence—The Rumford Chemical Wks., 231 South Main St., has awarded the contract for the construction of a 3 story, 58 x 125 ft. baking powder plant. Estimated cost, $100,000.

MIDDLE ATLANTIC STATES

Md., Baltimore—The Red "C" Oil Mfg. Co., 410 Keyser Bldg., plans to build a refinery and tanks on Key Highway. Estimated cost, $250,000. W. W. Pagon, Lexington Bldg., Engr.

Md., Baltimore—The Horn Ice Cream Co., 446 Aisquith St., has awarded the contract for the construction of an ice cream and ice manufacturing plant on Low and Aisquith Sts. Estimated cost, $300,000. Noted Nov. 4.

N. Y., New York (Borough of Brooklyn)—The Hub Knitting Mills, 1007 Buchman Ave., will build a 1 story top addition and a 2 story side addition to its factory. Estimated cost, $50,000.

N. Y., New York (Borough of Queens)—J. H. Rhodes & Co., 115 Fulton St., New York City, has awarded the contract for the construction of a factory in Long Island City, for the manufacture of abrasives and polishing materials. Estimated cost, $200,000.

Pa., Philadelphia—The Amer. Ice Co., 6th and Arch Sts., has awarded the contract for the construction of a 2 story, 75 x 100 ft. ice factory on 10th and Callowhill Sts. Estimated cost, $120,000.

Pa., Philadelphia—L. Martin Co., Milnor St. south of Bleigh St., will build a 1 story, 27 x 47 x 55 ft. addition to its factory, for the manufacture of lampblack. Estimated cost, $25,000.

Pa., Philadelphia—The Westmoreland Color and Chemical Co., 22nd and Allegheny Sts., has awarded the contract for altering its factory. Estimated cost, $10,000.

Pa., Pittsburgh—The Methodist Episcopal Church, 6th and Smithfield Sts., had plans prepared for the construction of a 4 story, 50 x 100 ft. good will industrial building, on 28th St. and Liberty Ave. Cost, between $90,000 and $100,000. T. B. and L. Wolf, Century Bldg., Archts.

SOUTHERN STATES

La., New Orleans—The Linde Air Products Co., 30 East 42d St., New York City, will build a 1 story, 125 x 125 ft. oxygen factory, here. Estimated cost, $300,000.

MIDDLE WEST

Ill., Chicago—The Burns Craft Co., Como Bldg., has awarded the contract for the construction of a 1 story, 100 x 124 ft. factory at 2225-39 Hurden St. Estimated cost, $55,000.

Ill., Chicago—The New Way Laundry, Montrose and Francisco Sts., has awarded the contract for the construction of a 2 story, 64 x 152 ft. steam laundry. Estimated cost, $100,000. Noted Nov. 11.

Ill., Chicago—J. Press Sons, 300 North Halstead St., have awarded the contract for the construction of a 1 story, 125 x 140 ft. wagon factory at 3338-60 Normal Ave. Estimated cost, $150,000.

Mich., Saginaw—The Bd. Educ. is having plans prepared for the construction of a 3 story, 173 x 282 ft. school on Woodock and Park Sts. Plans include shops, etc. Estimated cost, $1,000,000. Cowles & Mutscheller, Chase Blk., Archts.

O., Cleveland—The Frank Dry Cleaning Co., 1361 East 55th St., plans to build a 2 story, 44 x 76 ft. factory at 6000 Bonna Ave. Estimated cost, $40,000. F. J. Cochlan, 709 Union Bldg., Archt.

O., Cleveland—F. Streiber, 10307 St. Clair Ave., has awarded the contract for the construction of a 1 story, 23 x 40 ft. bakery at 13707 St. Clair Ave. Estimated cost, $15,000.

O., Dayton—The Bd. Educ. plans to construct a 3 story, high school on Summit St. Plans include shops, etc. Estimated cost, $750,000. Schenk & Williams, Mutual Home Bldg., Archts.

O., Elyria—The Lakeshore Rubber Co., c/o H. L. Miller, Natl. City Bldg., Cleveland, has awarded the contract for the construction of a 2 story factory. Estimated cost, $150,000.

O., Willoughby—The Thor Tire Rubber Co., c/o R. C. Gary, 802 Society for Savings Bldg., Cleveland, plans to build a 1 and 3 story, 60 x 250 ft. factory and power plant. Estimated cost, $300,000. Private plans.

Wis., Fond du Lac—The Fond du Lac Paper Co., 298 Forest Ave., is having plans prepared for the construction of a 1 and 2 story, 100 x 300 ft. factory, for the manufacture of paper board. F. Stepnoski, 144 Marquette St., Archt. Noted Oct. 28.

Wis., Granville—The T. J. Moss Tie Co., Security Bldg., St. Louis, Mo., plans to construct a tie treating plant here, to include 3 buildings. Estimated cost, $100,000. J. Penny, c/o owner, Engr.

Wis., Hartford—The Storm King Mfg. Co. has acquired a site on North Main St., and plans to build a 2 story, 60 x 150 ft. factory, for the manufacture of side curtains for Ford cars. Estimated cost, $100,000.

Wis., Helenville—The Blochowiak Dairy Co., 1364 4th Ave., Milwaukee, plans to build a 2 story, 80 x 140 ft. dairy products factory on Main St., here. Estimated cost, $75,000.

Wis., Jefferson—The Jefferson Rubber Co. will build a 1 story, 80 x 300 ft. tire factory. Noted Oct. 28.

Wis., Madison—The Sheboygan Dairy Products Co., 936 North Water St., will soon award the contract for the construction of a 2 story, 70 x 140 ft. dairy products factory on West Wilson St., to replace the one which was recently destroyed by fire. Estimated cost, $75,000. Noted Oct. 28.

Wis., Manitowoc—The Drost Box Mfg. Co. 1116 South 9th St., has awarded the contract for the construction of the second unit of its plant on South 9th St., to be 3 story, 80 x 160 ft. Estimated cost, $75,000.

Wis., Milwaukee—The Hercules Knitting Co., 1097 Greenbush St., has awarded the contract for the construction of a 1 story, 30 x 80 ft. and 30 x 40 ft. addition to its factory. Estimated cost, $45,000.

Wis., Prentice—S. Millar Cold Storage Co., Marshfield, plans to build a 3 story, 50 x 80 ft. branch warehouse here. Estimated cost, $30,000.

Wis., Racine—The Bd. of Industrial Educ., City Hall, is having plans prepared for the construction of a 3 story, 85 x 186 ft. industrial school to include a manual training department, on Geneva St. Estimated cost, $250,000. A. A. Guilbert, Robinson Blk., Archt.

WEST OF THE MISSISSIPPI

Kan., Belleville—The Chicago, Rock Island & Pacific R.R., 139 West Van Buren St., Chicago, is having plans prepared for the construction of a 1 story, 32 x 80 ft. ice house here, to have a capacity of 1,500 tons. Estimated cost, $80,000. A. T. Hawk, c/o owner, Archt.

Mo., St. Louis—The Perfection Mfg. Co., Montgomery and Leffingwell Sts., will build a 1 story, 60 x 60 ft. enameling plant, at 2701 Leffingwell St. Estimated cost, $7,000. J. A. Eberle, Pres.

Mo., St. Louis—Smith & Davis Mfg. Co., 1925 Locust St., plans to build a furniture factory on Goodfellow Ave. Estimated cost, $1,000,000.

S. D., Watertown—The South Dakota Packing & Shipping Co. plans to build a 4 story packing house, to cover 80,000 cu.ft. of floor space. Estimated cost, $300,000. F. R. Hewitt, Pres.

Tex., Corpus Christi—W. A. Chambers will build an oil refinery, to have a capacity of 1,500 bbl. refined oil and gasoline per day. Estimated cost, $100,000.

CANADA

B. C., Powell River—The Powell River Co., Ltd., plans to build a saw mill, to have a daily capacity of 250,000 ft. Private plans.

B. C., Ruskin—The Ruskin Operations, Ltd., plans to build a second shingle unit to have a daily capacity of 1,000,000 shingles.

N. B., Glen Falls—Clarke Bros., Ltd., Bear River, plan to build a plant here for the manufacture of fibre shipping cases. Estimated cost, $50,000. Private plans.

N. F., Grand Falls—A. Rothermere will soon award the contract for the construction of an addition to his pulp and paper mill. Estimated cost, $180,000.

Ont., Coburg—The Rice Lake Canoe Co., Gore's Landing has awarded the contract for the construction of a factory here.

Ont., Hamilton—The United Gas & Fuel Co., 72 James St., N., plans to build a coke oven gas plant in the northeastern part of the city, near Stipe's Inlet. Estimated cost, $3,000,000.

Ont., Kingston—S. Kelley and S. Driver plan to build a moulding factory on Montreal St. Estimated cost, $35,000.

Ont., Mimico—The Sterling Action & Piano Key Co. has purchased a site on Church and Newcastle Sts. and plans to build a factory for the manufacture of musical accessories.

Que., Montreal—The Berliner Gramaphone Co. Ltd., 33 Lenoir St., has awarded the contract for the construction of a 1 story, 53 x 88 ft. gramaphone manufacturing plant on Lacarse St. Estimated cost, $75,000.

Que., Montreal—The Royal Duke Refining Co., 157 St. James St., plans to build a plant in Montreal East. Estimated cost, $200,000.

Que., Sherbrooke—The Sherbrooke Record Co., (printers and publishers), plans to build a 3 story, 50 x 75 ft. plant.

MEN——EQUIPMENT——SUPPLIES

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December 2, 1920 American Machinist Vol. 53, No. 23

Hamilton Double Carriage Production Lathe

By J. V. HUNTER
Western Editor, *American Machinist*

The demand for high production naturally results in the development of new styles of machine tools. Each year sees more new designs placed upon the market as standard products, since the industry has advanced to the point where it will accept and can utilize them to advantage.

A LATHE equipped with two independent carriages has recently been placed on the market by the Hamilton Machine Co., Hamilton, Ohio. The object of the two carriages is to enable the turning and facing operations to be performed at the same time, the front carriage, shown best in Fig. 1, holding the turning tools, while the rear one, seen in Fig. 2, carries the facing tools.

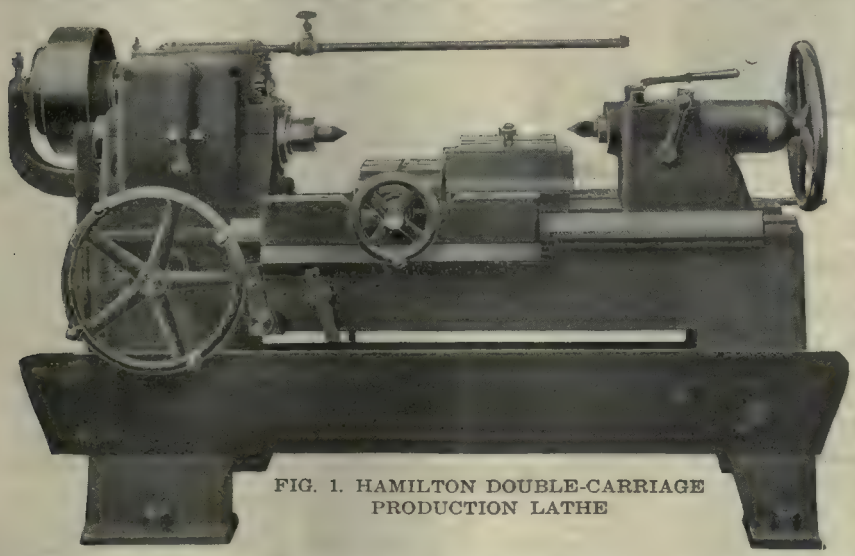


FIG. 1. HAMILTON DOUBLE-CARRIAGE PRODUCTION LATHE

The machine is intended for production work on such parts of steering knuckles for automobiles and tractors, small shafts, axle parts and gears of different types. It is stated that, when the lathe is properly tooled for a given job, it may be run by a comparatively unskilled operator and yet give speedy production and accurate work. The machine is quite simply, yet sturdily, constructed. The bed of the lathe is rather complicated, consisting practically of two narrow beds tied together by crossbraces at frequent intervals. Each of the beds bears a carriage and has two ways on its top surface. The front carriage runs on one V-way and one flat way, while both of the ways of the rear carriage are of the V-type, the inner one being smaller. The headstock and the tailstock are mounted on the two middle ways, the front one being flat and the back one a small V-way. The front carriage has a long bearing surface on its ways. It can be traversed by power, although the toolslide with which it is provided is hand-operated only, by means of the handwheel shown in Fig. 1. For ease in operation, the slide is equipped with a ball-bearing crossfeed screw and a large micrometer dial. The rear carriage can be traversed along the bed by hand and then clamped in position. The cross-slide is provided with a power feed, so that the turning and facing tools can be cutting at the same time. Both of the carriages and the toolslides are fitted with adjustable taper gibs.

The drive is through a constant-speed pulley mounted on the side of the headstock. If desired, silent chain drive can be furnished, the motor being mounted on the top of the headstock and the driving chain inclosed in a suitable guard. The spindle is driven from the drive shaft through inclosed wide-faced herringbone gears. It is made of chrome-nickel steel, runs in bronze bearings and has a large ball bearing to take up end thrust. In order to stop the spindle quickly after the clutch has been disengaged, an automatically operated brake with an asbestos lining is provided.

The same mechanism is used to feed both the front carriage and the rear toolslide. It is driven from the headstock spindle by an inclosed silent chain. The motion is transmitted through detachable change gears to an inclosed worm and a large worm-wheel to be seen on the rear of the bed in Fig. 2. The shaft of the worm-gear carries two pinions, which engage racks so as

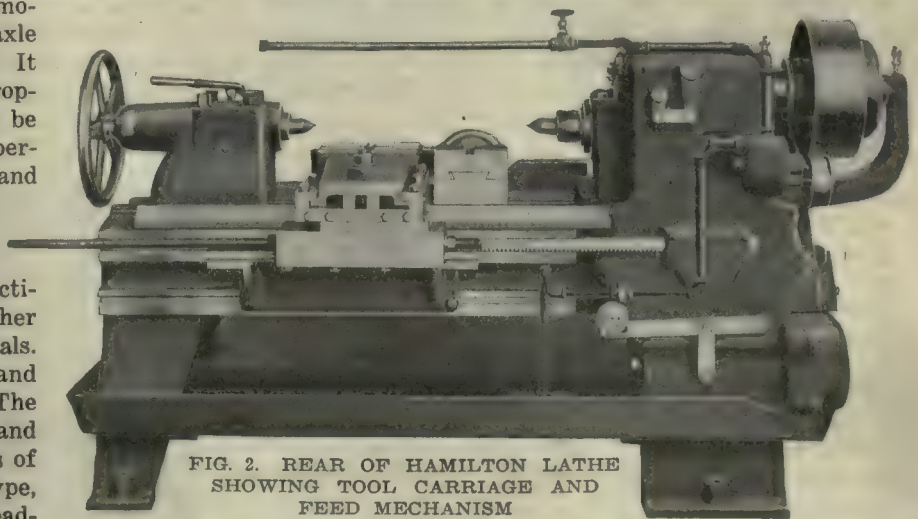


FIG. 2. REAR OF HAMILTON LATHE SHOWING TOOL CARRIAGE AND FEED MECHANISM

to transmit the feed motion to the front carriage and to the toolslide on the rear carriage.

Since the rack driving the facing tool can be seen in the illustration, it will be dealt with first. It is made in one piece with a long screw on which a flat, grooved cam

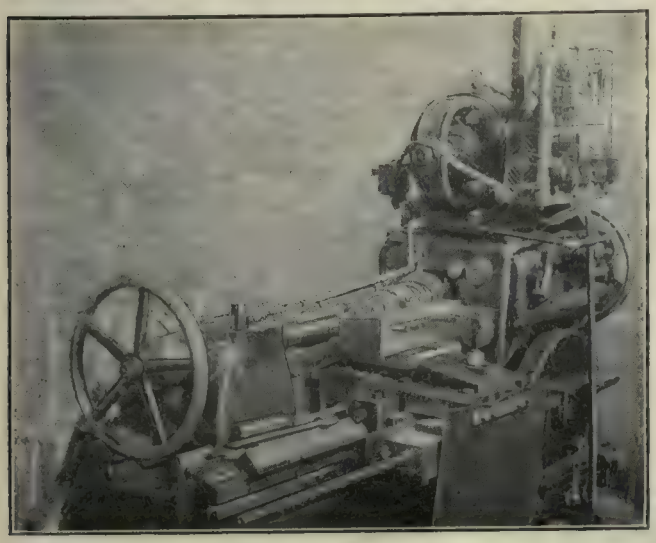


FIG. 3. THE LATHE, TOOLED UP FOR PRODUCTION WORK ON TRACTOR AXLES

is adjustably fastened. A roller fastened to the toolslide runs in the groove of the cam, so that a longitudinal motion of the rack produces a transverse movement of the toolslide. The cam slides on and is held in place by a bracket bolted to the rear of the bed on a finished surface provided with T-slots, so that the bracket can be shifted to correspond to the position of the carriage. The rear tool can be arranged to cut tapers, if desired.

The front carriage is moved longitudinally by the rack to which it is adjustably fastened inside the bed. It is fitted with a dog, the position of which can be adjusted to connect with a knock-out mechanism, and thus release the drive to the worm-gear when it is desired to stop the feed.

At the front of the machine under the headstock and on one side of the shaft of the worm-gear, is located a large handwheel by which both tools can be moved. This wheel not only provides a means of obtaining a quick return after finishing a cut, but also serves for setting the tools to the desired positions.

A Tooling Arrangement

Fig. 3 shows the lathe as set up for a shaft-turning job, the arrangement being that used in a large tractor plant for turning an axle shaft of the sort seen at the left. The heavy tool-holding blocks should be noted, as well as the arrangement of setscrews for adjusting independently the positions of the toolbits. It is stated that a total of 14 tools are cutting on this job at the same time, a feature that means rapid production. The view of the machine shows well the general construction of the rear carriage with the groove in the cam. The machine is equipped with an individual motor drive for this work.

A steel chip pan and coolant pump are regular equipment. The piping is arranged so that the flow of coolant can be adjusted to give a single stream or a number of small streams to cover the entire length of the work between the centers

A Method of Indexing Drawings

By M. Kurth

Chief Draftsman, Oil Well Supply Co.

In various branches of industry, particularly in those where a large variety of articles are manufactured, it is often difficult to follow general rules for establishing a system of indexing and filing records, and especially drawings to which reference must be made at a moment's notice.

In one of the largest manufacturing concerns of its kind, where thousands of articles are made which have no immediate relationship to each other, the following plan has been adopted, and during the past five years has proven entirely adequate to the purpose and superior to methods previously employed.

A large general catalog, in which is described and illustrated every article manufactured by the company, is made the key to the filing system, which operates in the following manner: The catalog is subdivided into a number of sections, each comprising about two hundred pages. The corresponding index card drawers bear the marking, page 1 to 200, 200 to 400, etc., and the filing of the cards is done in exactly the same order as the article appears listed in the catalog. Each index card bears the description and an outline of the article conforming with nomenclature and cut in the catalog which makes identification almost positive. The drawings themselves are also marked, referring to the catalog number as well as the page number on which the article appears, and they are filed in numerical order irrespective of size. Whenever new machinery is developed, entries are made in the catalog in that section where these parts will be permanently recorded later on in subsequent editions.

Milling the Radius on the End of a Rod

By E. A. Thanton

A method of milling the radius on the end of a rod is shown in the illustration. This scheme may be used for work on link rods, certain kinds of connecting rods or any similar work. A flanged center-pin is bolted to the revolving table of a vertical milling machine as shown at *A*. A spiral milling cutter is used as at *B*.

On heavy work, it is necessary to clamp the piece securely to the table and use the circular table feed. On light work it is sometimes possible to pull the rod around by hand. In the latter case the work can be done on any vertical milling machine.



MILLING THE RADIUS ON THE END OF A ROD

Some Experiences in Deep-hole Drilling

By CHARLES J. STARR
Planning Engineer, The New Britain Machine Co.

The drilling of deep holes presents problems not met in ordinary drilling work. This article was written by a man who has had practical experience in this line; and the points treated should prove of value in shops where deep-hole drilling is encountered, the drill which was found by the author to be the most satisfactory being fully described.

WHY is it that so many reference books on subjects of vital importance fail to give to the searching reader the exact bit of knowledge that he is looking for? This may not be in harmony with the title of this article, but nevertheless it is the thought which has prompted its writing.

Some time ago the writer had quite a varied experience in the drilling of long holes, and the problems encountered caused him to search, but with little success, through various books and papers for some hint that would help him at a time when he thought that he was up against it and when any suggestion was gladly considered. Looking back over those days, it seems only fair to pass on to the other fellow my experience, with the hope that he may find a few pointers that may be of use to him.

It seems to be an accepted fact that, no matter to whom you talk on this subject, when you commence to speak about the fine points of deep-hole drilling and the why and how of a single-lipped drill, the one of whom you ask questions will shut up like a clam and practically refuse to give you any information. I have talked with a number of men who are working continually along this line, yet I have met only one man who would impart any information whatsoever. This man was only too glad to tell anything that he knew, and to him I am greatly indebted for the success I have had with single-lipped drills.

An Unsatisfactory Drill

When I came in contact with this particular problem, forged steel spindles of 0.35 to 0.50 per cent carbon were being drilled with more or less success on a well-known make of deep-hole drilling machine on which the work revolved and the drill fed horizontally. The drill used was of the single-lipped type and furnished by the manufacturer of the machine. The single flute was helical instead of straight, and the cutting edge had several steps for breaking up the chips. It is not concerning this drill that I wish to speak, except to say that after numerous trials it was found wanting and our attention was turned to other types in an endeavor to find a solution for our problems.

Of deep-hole drills there are numerous designs, but they resolve themselves into practically two classes; namely, single- and double-lipped drills. Of course, it is well known that the two-lipped drill is superior to the single-lipped when speed is desired and not accuracy of diameter, and that is one of the things which we ascertained for ourselves on this job. The problem originally was to get a hole through the spindle, and it was considered that a single-lipped drill was the correct tool to use. After sufficient experimentation the hole was drilled with a two-lipped drill and then reamed, that process taking about one-third of the time required when working with a single-lipped drill.

Experimentation with Drills

The steps taken in testing different drills are worthy of investigation. The type of drill shown in Fig. 1 was decided on and tried out with considerable success until the carbon content of the spindle was increased from the 0.35—0.50 range to 0.75—0.80. With high-carbon steel, forged and annealed, it was found that the drill with the inserted blade failed to live up to what was expected of it, and so a new design of drill was sought for, which resulted in using the solid single-lipped drill shown in Fig. 2.

It is the design of this drill that I wish to speak of, in order to compare it with others and to endeavor to show why it seems to me much simpler and easier to make, and also why, if made and sharpened correctly, it will live up to what is expected of it.

On high-carbon steel, the drill shown in Fig. 1 seemed to fail because of lack of support at the cutting point. By lack of support I mean support in two ways: First, in order that the drill will clear itself, the cutting edge must create a greater diameter than the size of the drill body, consequently the body could

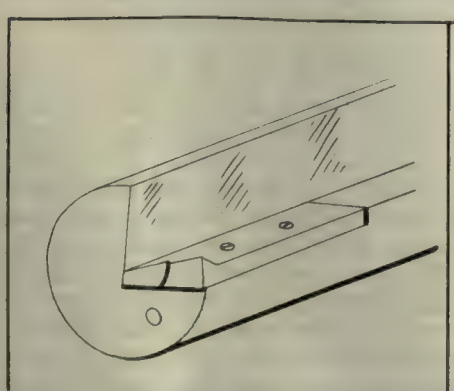


FIG. 1. INSERTED-BLADE, SINGLE-LIPPED, STRAIGHT-FLUTED DRILL

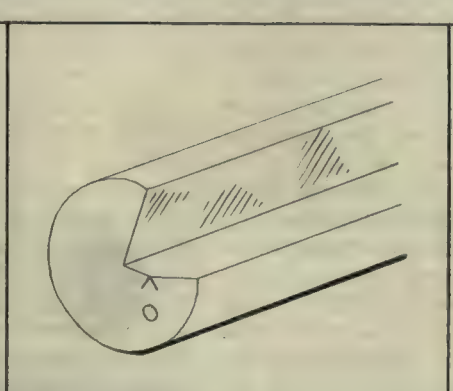


FIG. 2. SOLID, SINGLE-LIPPED, STRAIGHT-FLUTED DRILL

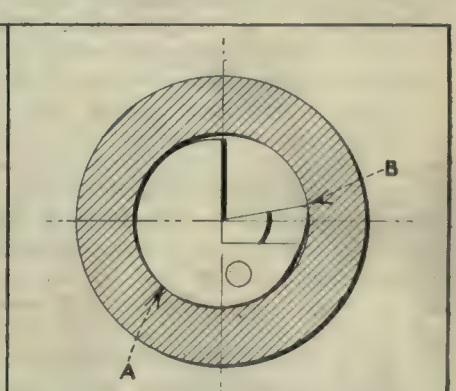


FIG. 3. CLEARANCE OF THE INSERTED-BLADE DRILL

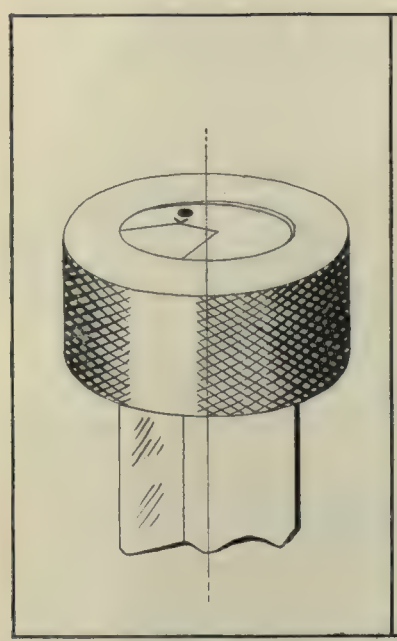


FIG. 4. USE OF THE RING-GAGE ON THE SOLID-END DRILL

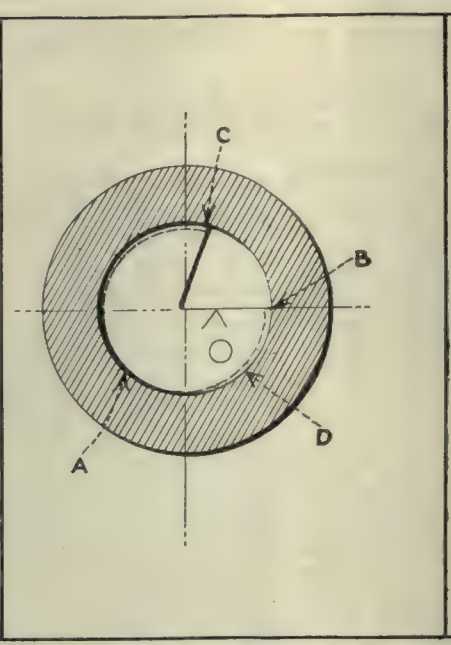


FIG. 5. CLEARANCE ACTION OF THE 70-DEG. FLUTE DRILL

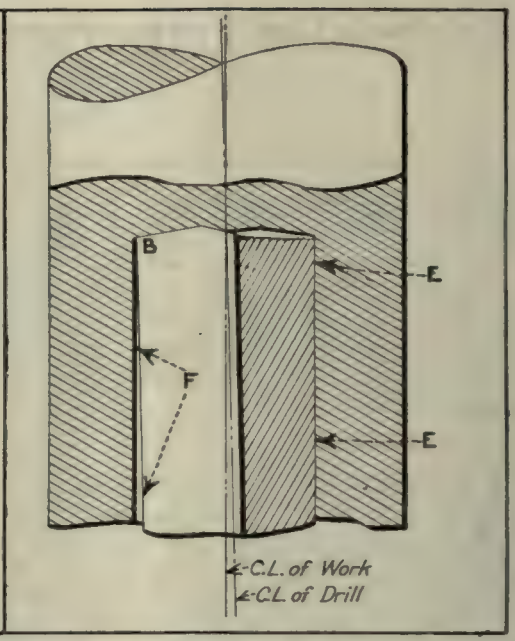


FIG. 6. BENDING OF DRILL SHANK

bear on the hole in only two places, as shown at *A* and *B* in Fig. 3; and second, in order to make regrinding of the inserted blade possible it was made to project ahead of the drill body, which resulted in making it weaker and more liable to snap off.

With the solid drill, shown in Fig. 2, the conditions might be considered as being similar as to clearance and bearing points, except that they are not as exaggerated as with the inserted blade. The form of the cutting edge can be governed when sharpening, and after the correct formation is found it can be kept at each succeeding grinding till the drill is completely worn out. As to the clearance of the drill in the hole, that is, having the drill cut large enough to free itself, that may be governed in two ways, first, by giving the drill a back taper through its entire length of about one-thousandth inch per inch of length, and second, by the relative length and degree of angle of the two flats comprising the cutting edge.

Cutting Edge of the Solid Drill

When we first started using these drills the points were ground by hand and the amount of clearance determined by the use of a 6-in. scale and a ring gage of the correct diameter to fit the end of the drill. This gage was used to show the relative position of the several parts on the periphery with relation to the point of the cutting edge which is on the periphery and which determines the bore of the hole. See Fig. 4. By trying the point in this way it could be easily seen whether or not the several parts on the periphery were behind the cutting point and how much.

At first the flute of the drill was cut with a straight milling cutter, thus making it 90 deg.; but later on it was found advisable to cut this down to 70 deg. The reason for this was that it was found that the point *C*, in Fig. 5, opposite point *B* was inclined to bear on the hole and help steady point *B*. This action was found to vary when the lengths of the flats of the cutting edge varied from what was later found to be proper, and also, when the clearance angle below the cutting lip varied. It was found that the variations of these quantities governed the size of the hole. If the drill cut too large, it was found that *A* had moved toward *B*; and not being properly supported at *C*, the drill would chatter, this chatter causing the keen cutting edge at point *B* to break down so that the drill must be resharpened.

If the drill cut too small, because of the improper proportioning of the two angles of the cutting edge, then undue wear would be noticed at point *C*, and also, wear could be seen over quite an area at *A*, and sometimes clear around the periphery. After sharpening the drill, it was always coated with copper sulphate before using it again in the hole, for only by doing this were we able to tell where the bearing came and what was the action of the drill.

The question will doubtless arise concerning clearance around the periphery, as at *D* in Fig. 5. It was found that the axis of the drill did not follow the axis of the work but was inclined at a slight angle to it, due to the pressure of the feed springing the drill shank and causing it to bear against the side of the hole, as shown at *E* in Fig. 6. The result was that the taper of the drill for its entire length came all on one side, as at *F*, giving the necessary clearance behind the point *B*. Referring again to Fig. 5, a good idea of the three bearing points on the periphery can be obtained, *B* and *C* being on the end of the drill and *A* extending up the shank from the bottom.

Design of Flute

The question arose as to the design of the flute, that is, the width of the opening and also the advisability of using the straight or spiral flute. The width of opening has been spoken of before, and some reasons for changing it from 90 deg. to less have been given. Furthermore, it was found that by making the flute narrower, the chip was not allowed to curl up as much and choke the drill, particularly when cutting soft stock. The spiral flute was tried out with the idea in view of giving a shearing cut, but it was found that the point was not properly supported under these conditions and would wear away rapidly. This wearing away process was found to take place practically in a straight line, parallel with the axis of the drill. Noting that, we

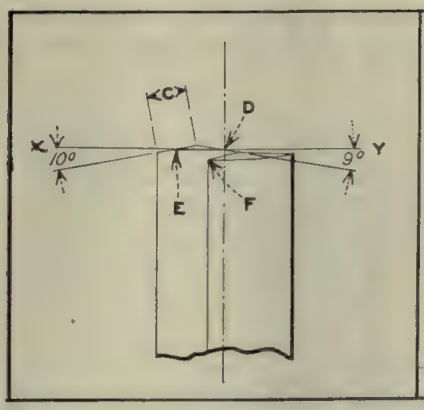


FIG. 7. PROFILE OF END OF SINGLE-LIPPED DRILL

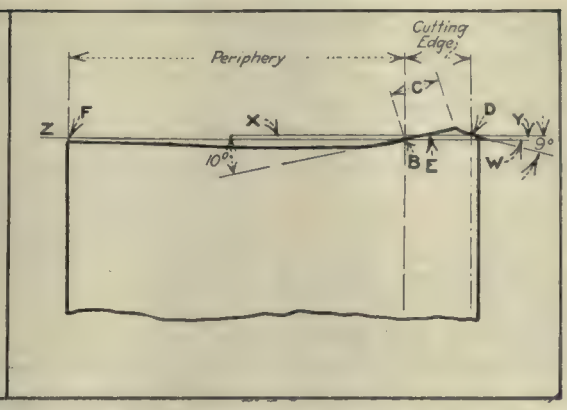


FIG. 8. DEVELOPED PROFILE OF SINGLE-LIPPED DRILL

ground the flute out straight for a short distance back and found under this new condition that the point stood up very well. Another point in favor of the straight flute was that, when necessary, the cutting face in the flute could be reground to give a sharp edge the entire length of the flute.

The Cutting Edge

The proper proportion of the two cutting edges comprising the lip was found to be about the same regardless of the drill diameter; that is, the length of the outer edge should be one-third of the diameter of the drill, as shown at *C* in Fig. 7. Then, too, the angles must be in such a relation to each other that if a scale, as through line *XY*, were laid across, starting from the center *D* and held at right angles with the center line of the drill, it would cut the lip *C* into two equal parts at *E*. This proportion was found to hold true on all sizes of drills from ¾-in. up to 3-in. diameter.

The form of the end of the drill around its periphery cannot be too strongly emphasized, for this was found to influence the cutting action and also to help in governing the size of the hole. The development of the point of the single-lipped drill is shown in Fig. 8, the letters corresponding to those in Fig. 7. The proportions as here shown are adaptable to almost all sizes of drills, these being taken from a 1½-in. drill. Line *Z-W* denotes the circumference of the bottom of the hole as cut by point *B*, the developed periphery of the drill out to point *F* lying behind it.

One other point which must be considered in the sharpening of this type of drill is the clearance under the cutting lips, both inner and outer. The outer lip, being wider and exerting a greater pressure, tends to make the drill cut small; therefore, the clearance under the cutting edge must be large, so as to allow the edge to cut freely. The inner lip, being narrower, must have a blunter cutting edge to offset the pressure of the outer lip and make the drill cut large enough to free itself.

Doubtless the foregoing explanation is such as to cause anyone to consider this drill as a rather difficult proposition to grind and keep in proper condition, but on the contrary it was found by the writer to be quite easily cared for. With the use of the proper grinding machine and correctly formed cams for sharpening, a good drill point could be assured at all times.

As to speeds and feeds to be used, these were found to vary according to the diameter of the drill and hardness of the metal. Spindles of 0.60 per cent carbon steel, forged and properly annealed, have been drilled with a 1-in. diameter drill at the rate of 30 in. an hour; also, chrome-nickel steel spindles, forged and properly heat-treated, were drilled with a 1½-in. drill at the rate of 22 in. an hour. The standard adopted for drilling for all sizes was a surface speed of 100 ft. per min. and all the feed that the drill would stand, though it was found that a very light feed gave the most satisfactory results. In the case of the 1½-in. diameter drill, we ran that at a speed of 295 r.p.m., which equaled 117.5 ft. per min., with a feed of 0.00125 in. per revolution. Because of the closeness of the points of support in this drill it is believed that it can be run at a high surface speed with more safety than drills with excessive relief ground on them, and also, that it is far superior to the inserted-blade type.

The writer has seen deep hole drills of such design as to make it necessary to tool up quite elaborately in order to grind the relief. For one drill a master cam was milled with a drop on its circumference of from 0.005 to 0.025 in., according to the diameter of the drill. By using these cams when grinding, a three point bearing was produced on the periphery of the drill, with the idea of steadying the cutting edge. This I consider unnecessary, as I have already shown when treating of the design of the drill shown in Fig. 2. The form of the point, coupled with the taper on the drill, will give ample clearance to the cutting edge and distribute the wear more evenly over the circumference of the drill.

Single- and Double-Lipped Drills

Of course, we all know that a two-lipped drill will cut much faster, but the size of the bore will not be held as accurately as with the single-lipped drill. The reasons for all this are well known and need no further reference.

The whole of my experience with deep hole drilling has been with drills ranging from ¾ to 3½ in. in diameter, yet I believe that this drill is applicable to sizes below ¾ in. As to the larger sizes, I will say that the drill works correctly, yet from the standpoint of production it is not practical. For large sizes the two-lipped drill is the best; but with the smaller sizes, due to the consequent lightness and frailty of the cutting tool, the single-lip is by far superior.

The foregoing information I believe to be of greatest

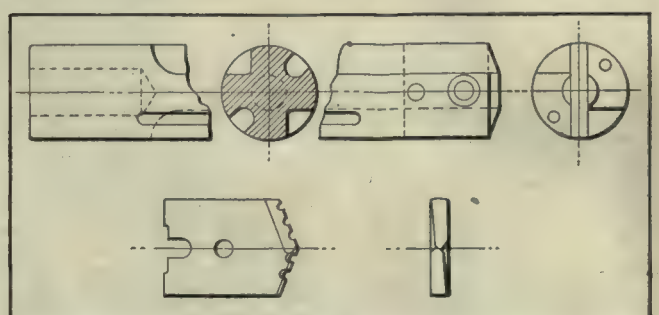


FIG. 9. BLADE AND BAR OF DOUBLE-LIPPED STRAIGHT-FLUTED DRILL

value to those who drill small holes, ¾ in. in diameter and under, as in rifles and shot guns, and for these sizes I believe this drill to be very satisfactory. On larger sizes, that is, 1 in. in diameter and over, I believe that this drill, or any other single-lipped drill, can be beaten by the two-lipped drill, finish of course not considered.

A Fast Two-Lipped Drill

I have seen some pretty good time made when drilling deep holes with a two-lipped drill. In this case, a drill of the type illustrated in Fig. 9 was used. The flutes of the drill are straight, and the inserted blade has broken cutting edges.

Cost Keeping in the Small Shop

By T. P. Schustek

The article by Mr. Colvin in the Sept. 2 issue of *American Machinist*, entitled "Cost Keeping in the Small Shop," is very interesting and prompted the writer, who designed the system described below and which is in successful operation in the shop of the S. A. Rhodes Manufacturing Co., Chicago, to offer his ideas to readers of the *American Machinist*.

TICKET No. 1448 DATE Sept 10

7 8 9 10 11 12 1 2 3 4 5 6 7

NAME Albert Jones ORDER No. 6745

HOURS OVERTIME TOTAL HOURS 8½

CHECK HERE	OPERATION	NO PCS	CHECK HERE	OPERATION	NO PCS	CHECK HERE	OPERATION	NO PCS
✓	LATHE	4		BENCH WORK				
	MILLING			POLISHING				
	SHAPER			PAINTING				
	PUNCH PRESS			FORGE AND HARD				
	DRILL PRESS			ENGRAVING				
	GRINDING			BOX AND PACKING				

FIG. 3. TIME CARD

This system has worked out satisfactorily in every respect, enabling us to keep quite accurate costs on all jobs, the necessary precautions, of course, being taken to see that all material used is properly listed and the time cards properly filled out. This being done, we have found no place where the system is not perfect for a small shop with one girl to do the bookkeeping, cost-keeping, correspondence, etc.

In addition to keeping accurate costs, we have the advantage of knowing, by 9 o'clock each morning, just how many hours and how much money in time have been put on every job up to the night before, this point alone being particularly valuable, inasmuch as the office always knows just what has been done in the shop.

Our girl makes out our orders in duplicate, one for the shop, Fig. 1, printed on blue paper, and one for the office, Fig. 2, both on 6 x 9½-in. forms to fit a standard binder, space being provided for any special instructions that may be necessary. The material used is listed on the shop order and when the job is completed the shop order is turned into the office and the material transferred to the office copy and priced.

The sample copy should explain itself. If the job consumes more time than the office form provides for, we simply use a second sheet. On the shop copy, if the material list is a long one, we list it on the back.

Our time cards, Fig. 3, are all numbered consecutively, starting from No. 1 on Jan. 1 of each year and are filed numerically. The man working on the job simply draws a line on the scale along the top of the card (which indicates the time of day) at the time he starts and finishes the job, and fills in his name, date, order number and operation. He does not have to figure up the number of hours on each job.

A new card is taken each morning and for each different job.

SHOP ORDER No. 6745 DATE Sept. 8 '20

FOR Geneva Order # F248 DATE PROMISED Oct. 15 SURE

75 Disk holders as per B. P. # G 243

Be sure to hold the 1. 125 in. dimension to size.

The tolerance is plus or minus 0.0015 in. although not shown on B. P

LBS	DESCRIPTION OF MATERIAL	DATE	NO. FIN.	DATE	NO. FIN.
67½	Brass Castings	9-10	4		
3¼	Brass Rod 5/8 dia.	9-11	4		
		9-13	4		
		9-14	12		
		9-15	16		
		9-16	20		
		9-17	15		
			75		

FIG. 1. SHOP ORDER

ORDER No. 6745 DATE Sept. 8 '20

FOR Geneva Order # F 248 DATE PROMISED Oct. 15 SURE

75 Disk holders as per B. P. # G 243

Be sure to hold the 1.125 in. dimension to size. The tolerance is plus or minus 0.0015 in. although not shown on B. P.

LBS OR PCS	DESCRIPTION OF MATERIAL	@			TICKET NO.	DATE	HRS.	RATE	AMOUNT	TOTAL HRS	TOTAL AMOUNT
67½	Brass Castings	32	21	60	1448	9-10	8½	75	6 38		
3¼	5/8 ϕ Brass Rod.	29½		96	1451	9-11	7½	75	5 63	16	12 01
					1452	9-13	6	75	4 50	22	16 51
					1454	9-14	4	85	3 40	26	19 91
					1455	9-14	5¼	75	3 94	31¼	23 85
					1460	9-15	5¼	85	4 46	36½	28 31
					1461	9-15	8½	75	6 38	45	34 69
					1462	9-16	8½	85	7 23	53½	41 92
					1463	9-16	8½	75	6 38	62	48 30
					1470	9-17	8½	85	7 23	70½	55 53
					1471	9-17	3¼	75	2 81	74¼	58 34
TOTAL MATERIAL			22	56							
NO. OF HOURS 74¼		TIME	58	34							
TIME AND MATERIAL			80	90							
OVERHEAD FIGURED @ 95 %			49	59							
COST EACH $1.74		TOTAL COST	130	49							

FIG. 2. OFFICE ORDER

The man who always retains his head can usually retain a goodly share of other things.—*Forbes Magazine.*

Acceleration Determinations—II

BY HENRY N. BONIS, B. S., M. E.
Assistant Professor of Mechanical Engineering, Purdue University

In the author's previous article on this subject he made use of several theorems and constructions which were assumed to be correct. Here he gives proofs of these constructions and goes on to other short cuts without using higher mathematics.

(Part I appeared in the last issue.)

IN PART I of this article, which appeared last week, the writer evolved means for the solution of the quadric chain when a sliding joint was one of the elements. In so doing reference was made to $\mu\omega$, the acceleration of the instantaneous center, and to Bobillier's Construction for finding the tangent to the centrode at the instantaneous center. The writer will endeavor in the following lines to give simple proofs and demonstrations of the above references together

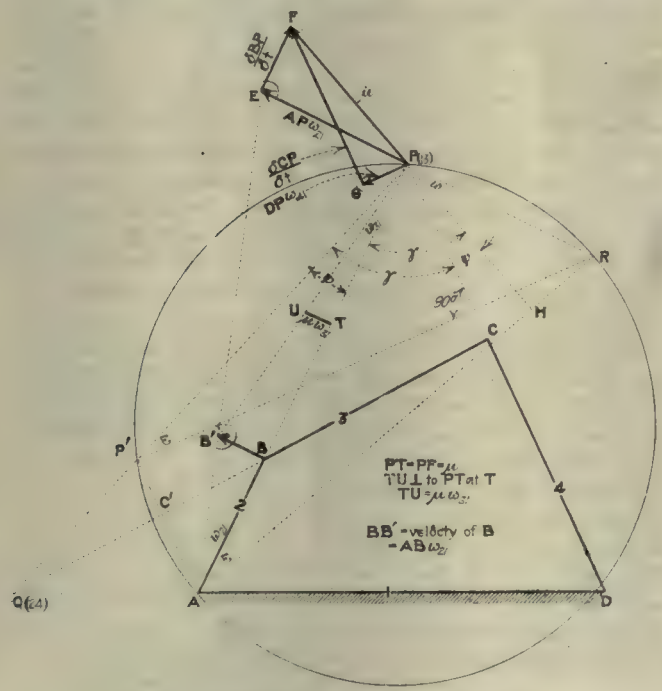


FIG. 1. DIAGRAM OF QUADRIC CHAIN

with a few other theorems which the machine designer or student of kinematics will be able to understand and use without resorting to higher mathematics.

Before proceeding with the above proofs I will develop a construction whereby the angular acceleration of the coupler can be determined when the acceleration of any point of the driver is known. The proofs already mentioned will follow very simply.

Referring to Fig. 1, we have the quadric chain *ABCD*. Locate the instantaneous centers $P(13)$ and $Q(24)$ by prolonging the sides 2 and 4 and 1 and 3 respectively. Now we have

$$\frac{\omega_{31}}{\omega_{21}} = \frac{23 - 21}{23 - 31} = -\frac{BA}{BP}$$

Differentiation will give

$$\frac{\omega_{21} A_{31} - \omega_{31} A_{21}}{\omega_{21}^2} = \frac{BA}{BP^2} \cdot \frac{\delta BP}{\delta t} \text{ where } A = \frac{\delta \omega}{\delta t}$$

$$\frac{\delta BA}{\delta t} = O, \text{ since } BA \text{ is constant.}$$

In order to determine $\frac{\delta BP}{\delta t}$ we proceed to find the velocity of the point of intersection P of both lines AP and DP about their fixed centers A and D respectively. Point P as a point on link 2 has a velocity $PE = AP\omega_{21}$ which is normal to AP, and a sliding component $EF = \frac{\delta BP}{\delta t}$ parallel to AP. Similarly point P as a point on link 4 has a velocity $PG = DP\omega_{41}$ which is normal to DP, and a sliding component $GF = \frac{\delta CP}{\delta t}$ which is parallel to CP. We thus determine the velocity $PF = \mu$ of the point of intersection P, which is the velocity of the instantaneous center (13). Join P with Q and draw $AC'P'$ parallel to link 4. Draw $P'R$ and PR perpendicular to AP' and AP respectively and join A with R.

Now triangles $AP'R$ and PGF and APR and PEF are respectively similar, and the ratio of proportionality of the sides is ω_{21} to 1, which is evident since $PE = AP\omega_{21}$. Or by Professor Rosebrugh's phorograph $AP'\omega_{21} = DP\omega_{41} = PG$, and hence $\frac{\delta BP}{\delta t} = PR\omega_{21}$.

Let angle $PAR = \varepsilon$ and angle $QPD = \gamma$. Now since the right-angled triangles $AP'R$ and APR have the same hypothenuse AR we can pass a circle through the points A, P', P and R on AR as a diameter and we see that angle $PAR = \varepsilon = PP'R = 90° - \gamma$. Prolong PF to intersect AR at H. Then we have

$$\text{angle } HPC = \psi = HPA - CPA = \gamma - CPA$$

$$\text{also angle } QPA = \psi = QPD - CPA = \gamma - CPA$$

Hence $HPC = QPA$, and since HP is the direction of velocity μ of the instantaneous center $P(13)$ we have the proof of construction for Bobillier's Construction.

Now we have $PR = PA \tan \varepsilon = PA \cot \gamma$, and substituting $\frac{\delta BP}{\delta t} = PR\omega_{21} = PA\omega_{21} \cot \gamma$ in our original equation we get

$$\frac{A_{31}}{\omega_{21}} - \omega_{31} \frac{A_{21}}{\omega_{21}^2} = \frac{BA}{BP^2} PA\omega_{21} \cot \gamma$$

$$A_{31} = \frac{BA}{BP^2} PA\omega_{21}^2 \cot \gamma + \omega_{21}\omega_{21} A \frac{A_{21}}{\omega_{21}^2}.$$

Dividing by ω_{21}^2 we get, after substituting $\frac{\omega_{31}}{\omega_{21}} = -\frac{BA}{BP}$,

$$\frac{A_{31}}{\omega_{21}^2} = \frac{AP \cot \gamma - BP \frac{A_{21}}{\omega_{21}^2}}{BA} \qquad (1)$$

Let $\frac{A_{31}}{\omega_{31}^2} = \tan X$ and $\frac{A_{21}}{\omega_{21}^2} = \tan G$, where X and G are the angles made by the relative acceleration vectors with the line joining any two points on links 3 and 2 respectively. Equation 1 permits a similar graphical construction to the one shown in the previous article and may perhaps afford in certain cases a shorter one.

In order to take care of the signs of the various quantities entering I have formulated the following procedure. (See Fig. 2.) Draw perpendiculars to AP

at A and P respectively. Prolong MB, the acceleration vector of B, to intersect the perpendicular at P (say at E). Consider angle γ as generated by turning PQ to PD and lay off angle FEH at E in the same direction from the perpendicular at P and equal to γ. Prolong HE to intersect the perpendicular at A (say J). Join J and B and prolong indefinitely to K. Then angle $KBP = X$ when $MBA = G$. Taking P as a center the direction of BK (since angle PBK cannot be greater than 90 deg.) will show the direction of the angular acceleration of link 3. Also since the relative

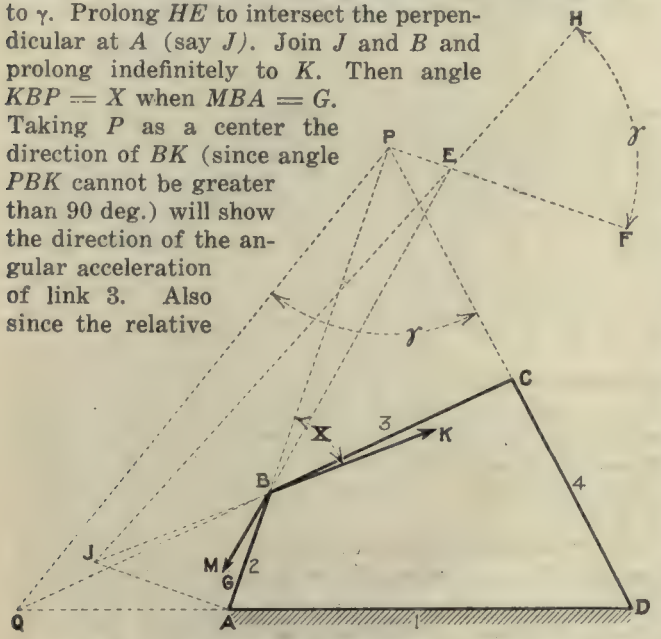


FIG. 2. DIRECTION OF ROTATION DIAGRAM FOR DETERMINING SIGNS

centripetal acceleration of C about B can be easily determined, i.e., $BC\omega^2_{32}$, the tangential acceleration of C relative to B is obtained from the ratio given by tan X, and hence the total acceleration of C can be obtained directly by the addition of the two vectors representing the absolute acceleration of B and the relative acceleration of C to B.

Meaning of the Angle X

A little consideration of the meaning of the angle X will afford a simple means of determining the center of acceleration when we are given the accelerations of any two points of a plane figure, or when the directions and the ratio of the accelerations are given. It also furnishes simple proof of the acceleration image.

Referring to Fig. 3 we are given the acceleration of P and G completely, and if we can find a point H whose relative acceleration is opposite in direction but equal in magnitude respectively to the absolute acceleration of P or G we have determined a point whose absolute acceleration is zero, and hence the point found will be the center of acceleration. Let PA and GB be the accelerations of points P and G respectively. Draw BC equal and opposite to PA. Then GC is the relative acceleration of point G to P. Join P and C. Lay off $CD = BC = PA$. Draw DE parallel to PC. With P as a center and the radius PE draw the circle EH. Make angle APH equal to the angle CGP. Also make angle HGB equal to angle CGP. Then the lines HP and HG and the circle HE all intersect at H, the center of acceleration. For the actual determination of H any two of these three loci could be used. A fourth locus could be obtained by passing a circle through G, P and the intersection of GB and PA. (See two-circle method—Klein's "Kinematics of Machinery," page 121, or Introduction—Weisbach-Hermann, "Mechanics of Engineering and Machinery," page 44—art. 21.)

Since GC is the relative acceleration of G to P, the relative acceleration of any point on the line PG, such as E, would bear to the relative acceleration of G the ratio of PE to PG, and hence EF drawn parallel to GC and limited by the line PC is the relative acceleration of E to P. The magnitude of EF is determined graphically by means of the similar triangles PEF and PGC. The angles PEF and PGC are also equal. In fact the angle between the relative acceleration vector of any point K in the plane of lamina and the line joining K to P would also be equal to PEF or PGC. As regards the magnitude, any point on the circle HE would have the same magnitude of relative acceleration as point E, namely the length of EF.

Now taking the particular point H we have by construction $APH = PGC = PEF = PHM$. Hence the relative acceleration vector of point H is parallel and opposite to the absolute acceleration vector PA, and since the magnitudes of the relative accelerations to point P of points E and H are equal (because $PE = PH$), and since $HM = EF = DC = BC = AP$ by construction, the relative acceleration of H to P is equal and opposite to the absolute acceleration of point P, and therefore the absolute acceleration of point H is zero. We have thus determined the locus PH and the circle EH whose intersection gives us the center of acceleration. Had the point G been used as a point of reference we would have found the other locus GH and another circle with G as center and radius GH that would have intersected also at H. But since we know that all the angles marked X are equal we arrive at a very simple construction, because all we need to do is to find the value of X, which is given at once at G by the angle PGC, and draw lines HG and HP making the angle X with the absolute acceleration vectors PA and GB.

Although this method gives a construction some of the lines of which coincide with the method of images, the writer believes the statement of procedure to be new and shorter, and likewise the proof. The method described above of using one line and a circle gives a new construction. Inasmuch as we need only know the value of X we need only be given the directions and the ratio of the magnitudes of

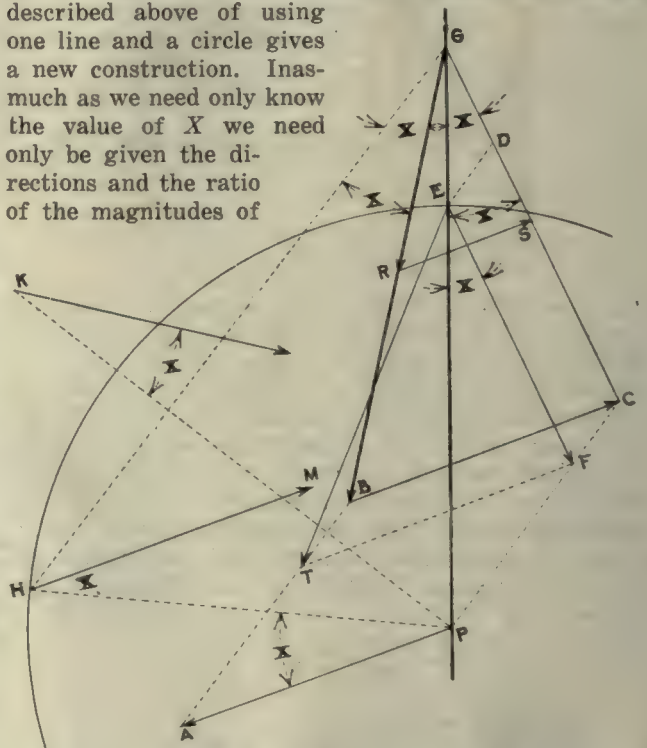


FIG. 3. DIAGRAM TO ILLUSTRATE MEANING OF ANGLE X

the accelerations of P and G. To determine X draw GR and RS to scale to represent the accelerations of G and P (reversed) and join G to S and we get $SGP = X$ as before. This construction is much simpler than the two-circle method.

In the two-circle method when one of the accelerations happens to lie along the line PG joining the two points we have a failing case. It is evident, however, that this case can be solved by a combination of the two-circle and the image method. But by using the relative acceleration method as above and obtaining the angle X we never have a failing case.

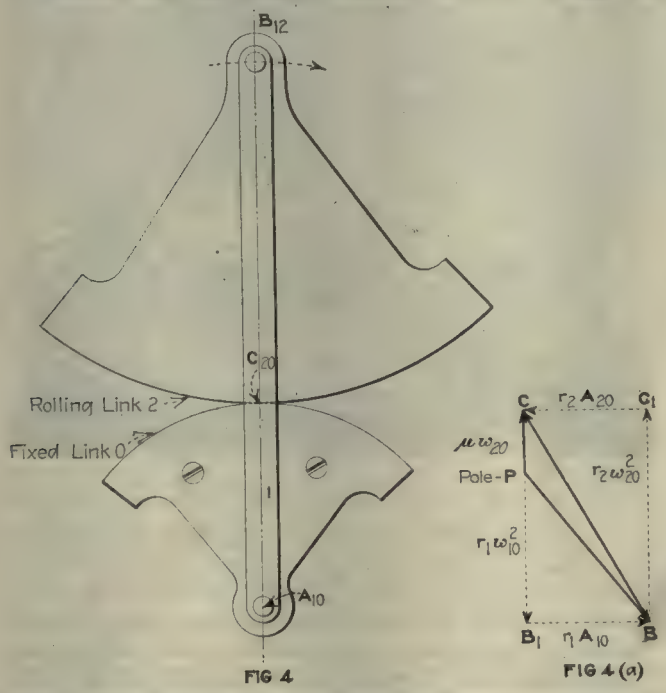


FIG. 4. BAR AND CIRCULAR LINK MECHANISM DIAGRAM

Again referring to Fig. 3. Join A and B and draw FT parallel to AP. Consider E as any point on line PG. Since EF is the relative acceleration of E to P, and FT is the absolute acceleration of P, we have ET as the absolute acceleration of point E. Since triangles PEF and PGC are similar we have $PF : PC = PE : PG$. But $AT = PF$ and $AB = PC$. Hence $AT : AB = PE : PG$, which proves the principle of the acceleration image.

The same reasoning as above gives us a simple proof of the principle of the velocity image.

If we apply our method of reasoning to determine the instantaneous center of velocity we will find that the angle X is 90 deg. (as it should be since the relative velocity of one point to another is always perpendicular to the line joining them) and we therefore have the rule of drawing normals to the directions of the two respective velocities. We could also find the instantaneous center of velocities by the two-circle method as a means of checking the accuracy of the drawing, but there are other simpler methods.

The theorems connected with rolling curves and usually applied to finding the velocity μ and acceleration $\mu\omega$ of the point of contact or instantaneous center can be very easily obtained by referring to Fig. 4, where we have two circular links 0 and 2 whose centers are connected by the bar link 1. Link 0 is fixed and link 1 is assumed as the driver with an angular velocity ω_{10} and angular acceleration A_{10}. Now as link 1 rotates with angular velocity ω_{10} the point of contact $C(20)$ will move along both curves with a velocity $\mu = r_0\omega_{10}$ where r_0 is the radius of link 0. We also have the following angular velocity ratio $\frac{\omega_{20}}{\omega_{10}} = \frac{12 - 10}{12 - 20} = \frac{r_2 + r_0}{r_2}$ where r_2 is the radius of link 2. Substituting the value of ω_{10} we have

$$\frac{\omega_{20}}{\mu} = \frac{r_2 + r_0}{r_2 r_0} = \frac{1}{r_0} + \frac{1}{r_2} \qquad (2)$$

It is to be noted that if the curvature of the circles were in the same direction one of the signs would have to be changed.

As regards the acceleration of point C on link 2, we have to add together the vectors representing the total acceleration of $B(12)$ and the relative acceleration of $C(20)$ to $B(12)$. Referring to Fig. 4(a) we have an acceleration diagram with P as pole. Draw $PB_1 = r_1\omega_{10}^2$ = centripetal acceleration of B to A. Draw $B_1B = r_1A_{10}$ = tangential acceleration of B to A. (r_1 = length of link $1 = r_2 + r_0$.) Then we have PB as the total acceleration of B. Draw $BC_1 = r_2\omega_{20}^2$ = centripetal acceleration of $C(20)$ to $B(12)$, and $C_1C = r_2A_{20}$ = tangential acceleration of $C(20)$ to $B(12)$. Then BC is the relative acceleration of C to B, and hence PC is the total acceleration of $C(20)$. It will be noted that in the figure $B_1B = CC_1$. Since we have above the ratio of angular velocities $\frac{\omega_{20}}{\omega_{10}} = \frac{r_2 + r_0}{r_2} = \frac{r_1}{r_2}$ = a constant, the ratio of the angular accelerations is also equal to this same constant, and hence

$$\frac{A_{20}}{A_{10}} = \frac{r_2 + r_0}{r_2} = \frac{r_1}{r_2} \text{ or, } r_2A_{20} = r_1A_{10}.$$

The total acceleration PC of the instantaneous center is therefore only along the normal, the tangential component having just been shown to be zero. The magnitude of PC is the difference of the two centripetal accelerations BC_1 and PB_1, that is, $PC = r_2\omega_{20}^2 - r_1\omega_{10}^2 = r_2\omega_{20}^2\left[1 - \frac{r_1}{r_2}\left(\frac{\omega_{10}}{\omega_{20}}\right)^2\right]$.

Substituting the value $\frac{\omega_{10}}{\omega_{20}} = \frac{r_2}{r_1}$ we get $PC = r_2\omega_{20}^2\left(1 - \frac{r_2}{r_1}\right)$ or $PC = \frac{r_2r_0}{r_1}\omega_{20}^2$. But from equation 2, $\mu = \frac{r_2r_0}{r_1}\omega_{20}$, and therefore $PC = \mu\omega_{20}$. (3)

We have derived equations 2 and 3 from the consideration of circular arcs. But no generality is lost, for if for the instant two rolling plane curves are placed in tangency at point C equations 2 and 3 may be extended to cover these curves, provided the circles used are the osculating circles and A and B therefore the centers of curvature of the rolling curves.

Errata

Two typographical errors occurred in the article, "Strengths of Shafts and Beams," by John S. Watts in the issue of Nov. 11.

At the top of the second column on page 910 the total stress should have been $\frac{f}{2} + \sqrt{fr^2 + \frac{1}{4}f^2}$, and below the center of the same column the latter part of the formula for calculating the shaft diameter should have been $D = \sqrt[3]{\frac{T_1}{0.196 \times f}}$

We are indebted to Frank W. Salmon, Richmond, Va., for calling our attention to the errors.

Building Saw Mill Machinery

By FRED H. COLVIN
Editor, *American Machinist*

The past five years have shown great increases and improvements in the machine-tool equipment of some of the better plants in the Pacific Coast States. These improvements have meant more modern methods and better production in every way. Some of the results are shown herewith.

AMONG the shops in Portland, Oregon, the plant of the Willamette Iron Works stands out in many ways. Two of the prominent features are the large number of logging outfits which it has installed in various sections of the West and Northwest, and also its record as a builder of marine boilers during the war. Leaving the latter, for another article, this article will show some of the methods which have been developed for the more economical production of saw mill engines and other machinery. It will also be noted that the machine equipment contains many modern tools and of a size which are not common in this section of the country.

Steam engines for saw mills were formerly about as crude as could be built, the question of fuel economy not being a factor owing to the large amount of waste lumber which could be used for firing the boiler. This condition, however, no longer exists as the power now required to run saw mill engines is so large, that slabs and trimmings cannot be fired fast enough to maintain the desired steam pressure.

When it becomes necessary, as is now the case, to burn perfectly good timber to produce steam, saw mill engines with a low steam consumption are in demand and the engine of today is much more refined in every way, than that of the past. The fuel has become such a problem in some sections that oil engines are being installed in place of steam.

The machining of the steam cylinder of one of the more modern saw mill engines is shown in Fig. 1, a four-headed Ingersoll milling machine being used for

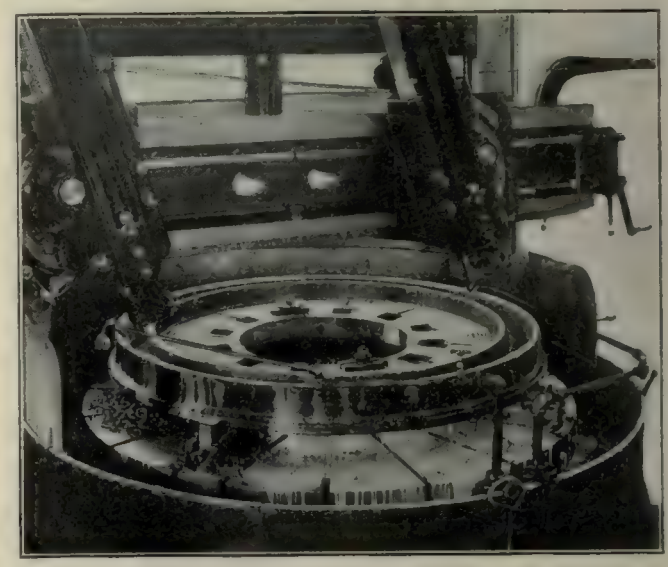


FIG. 3. TURNING A LARGE RING

this purpose. The method of mounting the cylinder, which has first been bored, can be clearly seen. The supporting mandrel *A* carries spools *B*, centering the cylinder and holding it in the V-block shown. The thrust of the left-hand vertical cutter head is taken by the substantial jack *C*. It will also be noted that the right-hand head on the cross-rail can be swung into any desired position, making it particularly useful for angular work of any kind.

A Universal Boring Job

A somewhat unusual horizontal boring machine job is shown in Fig. 2. This is the combined cylinder and guides of a logging engine and has the cylinder and guides bored and both ends faced at the one setting. The illustration shows how the work is fastened to the table of the Lucas boring machine, and the way in which the cylinder and guides are bored by cutters *A* and *B* on the boring bar which is supported by the

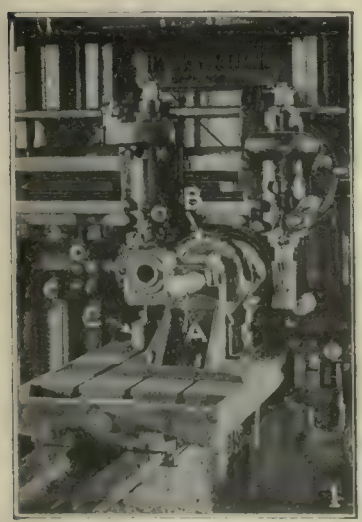


FIG. 1. MILLING CYLINDERS

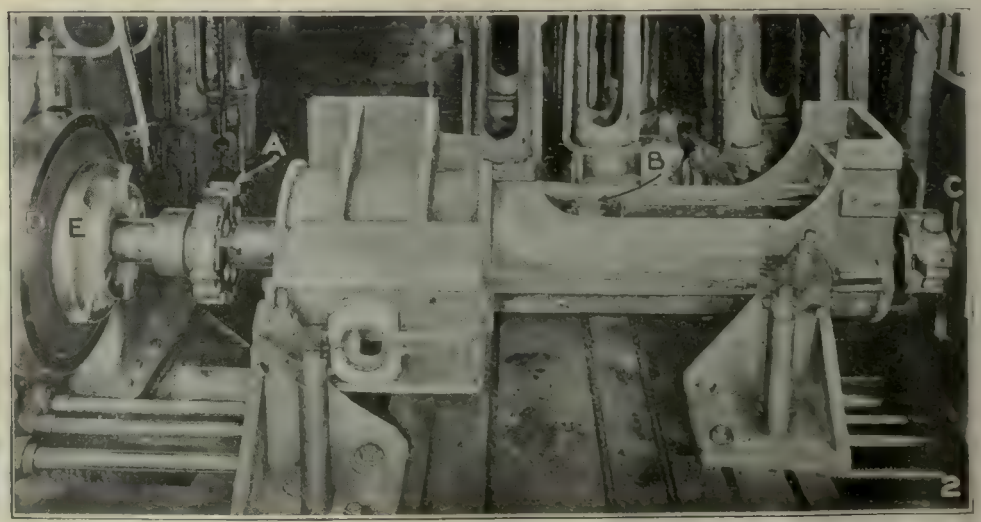


FIG. 2. BORING CYLINDER AND GUIDES

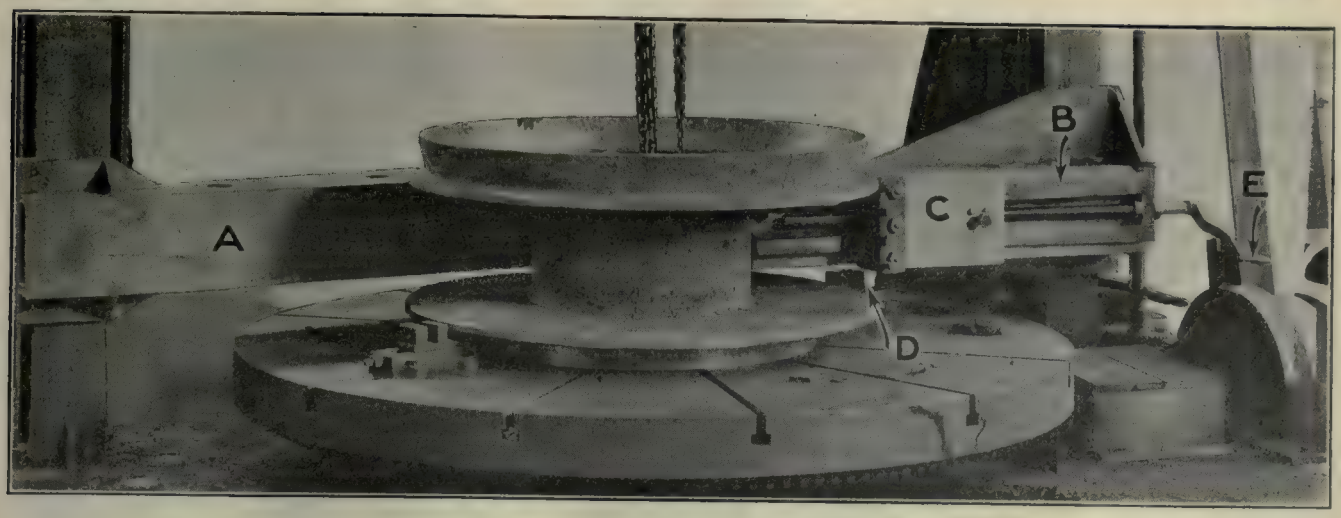


FIG. 4. TURNING DRUM FLANGES

outer bearing at *C*. The outer end of the bar carries the facing cutter shown, while the faceplate *D* carries the combined counterboring and facing cutter shown at *E*.

Another operation, and one which also shows a modern machine, is the job shown in Fig. 3, being bored on a Gisholt double-head vertical boring mill. This is a part of the logging outfit and the size of the chips being taken by both tools indicates very clearly that this work is on a production basis.

Turning on a Boring Mill

Fig. 4 shows the drum of one of the logging outfits and also the way in which a large boring mill has been rigged up for handling this kind of work. The operation is to face down the side surfaces of the drum. The casting *A* goes from one housing to the other, and is so shaped as to pass behind the drum being turned. The right end of this machine has a dovetailed tool slide at *B*, on which the carriage *C* travels. This carriage supports two tools, one being shown at *D*. This arrangement allows the tools to be fed into the work by means of the handle *E* and the sides are thus faced without difficulty.

The turning of the engine crossheads is shown in Fig. 5, the job being done on a large turret lathe. The work is driven by the plate *A* which also centers it on the driving end, while the first center is supported at *B* in one of the corner holes of the turret. Lathes of this kind are not at all plentiful in this section of the country.

An interesting grinding machine, which was built because at the time it was impossible to secure one of standard make, is shown in Fig. 6. The simple con-

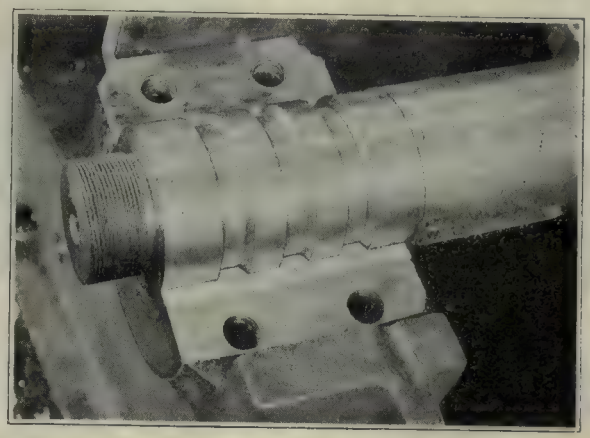


FIG. 7. THE THRUST BEARING

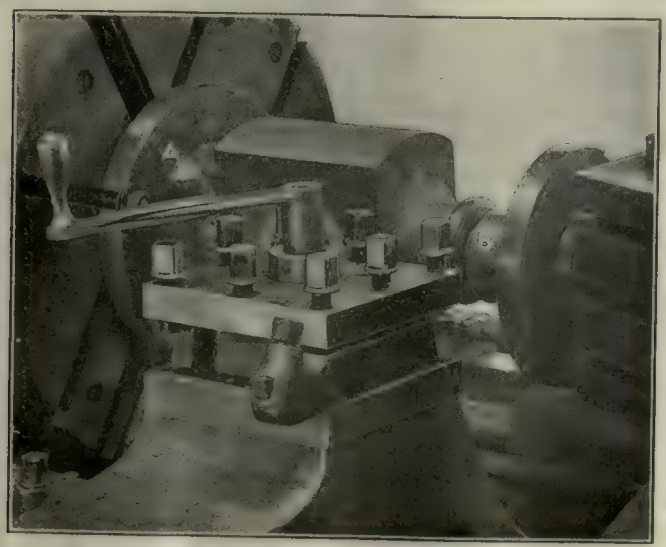


FIG. 5. TURNING THE CROSSHEAD

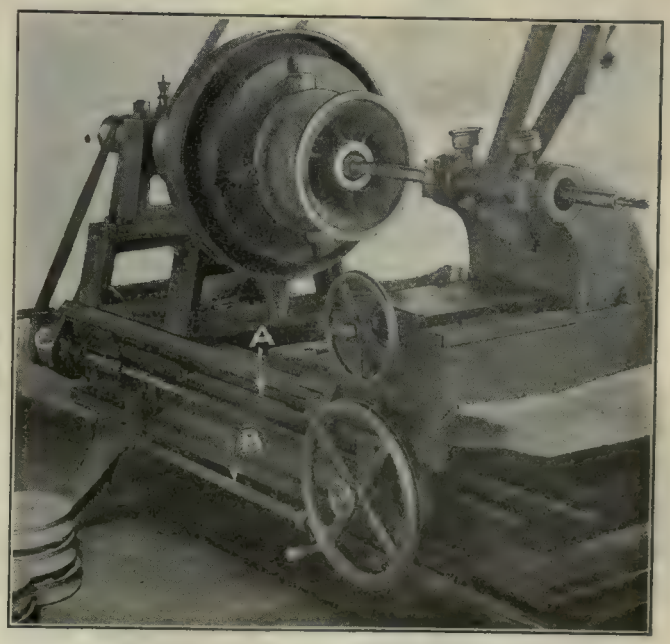


FIG. 6. A LARGE INTERNAL GRINDER

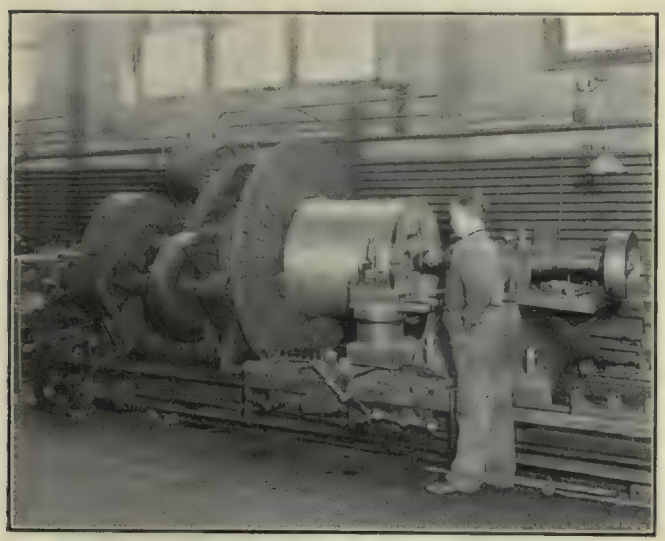
struction of the headstock and the solid way in which the grinding spindle bearings are mounted, attract attention at once. The feed is automatically reversed by means of the shifter rods *A* and *B* which control the shifting of the belt on the pulleys *C*.

The last illustration, Fig. 7, shows the form of thrust bearing used on the hoisting drum shafts in order to prevent end motion. The thrust rings are turned on the shaft and the babbitt poured in position as shown.

A Veteran of Three Wars

By Frank R. Calkins

During a recent visit to the machine shops of the Otis Elevator Co., at Yonkers, N. Y., the writer happened on the venerable lathe shown in the illustration. This machine, of unknown origin, has a history.



A VETERAN—STILL IN SERVICE

At the outbreak of the Civil War, the Star Arms Co., located in Yonkers, N. Y., were awarded large contracts for supplying the Union forces with revolvers. It was a large industry for those days, as more than 1,000 men were on the payrolls.

At the close of the war the firm accepted further contracts for supplying pistols and revolvers to parties connected with the Mexican Government. When the French evacuated Mexico the Mexican Government failed to live up to its agreements and the Star Arms Co. was forced into bankruptcy. The plant equipment was disposed of to manufacturers in different sections of the country.

The lathe here shown was purchased by the Otis Elevator Co. for machining some of the heavier parts of their product. The exact date of purchase is not known as no records now appear on the company's books.

The operator of this lathe, Patrick Harding, has served the Otis Co. for nearly half a century and he states that the lathe was in the plant at the time he entered their employ. Harding has been running this machine for over sixteen years and it is still daily employed in turning and grooving elevator cable drums.

The large ring gear on the back of the faceplate requires renewal about every fifteenth year and the bronze lead-screw-nut demands frequent replacement. The length of the lead-screw and its consequent weight causes a slight sag and the nut rapidly wears out of round. A motor drive has been attached to the lathe but otherwise this survivor of several wars stands in its original form and is still capable of continuous service.

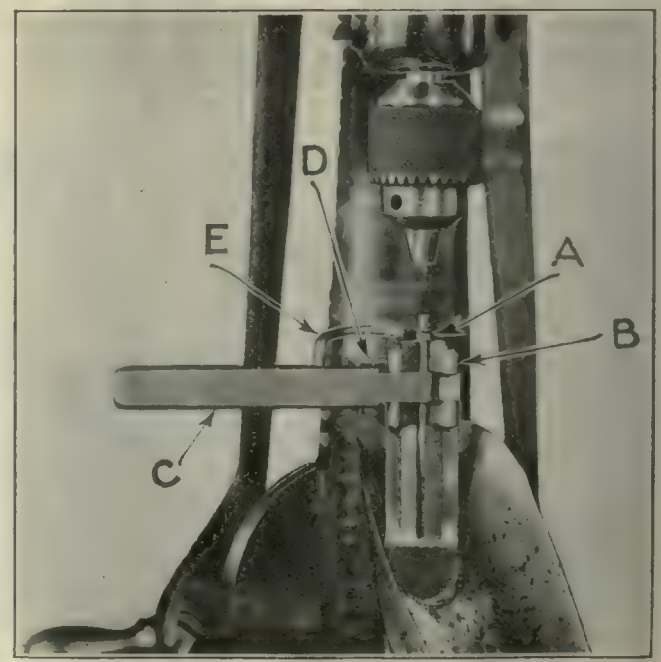
In the endeavor to trace the makers of this lathe, the search ended with C. & G. Place, Pearl St., New York City, machine-tool dealers who have long since ceased activities. Perhaps some machinist may recognize ear marks about this "old-timer" and be able to throw light on its origin.

[There were comparatively few builders of large lathes prior to the Civil War, and nearly if not quite all of them built into their machines certain characteristics by which they were easily recognizable. By process of elimination of other makers because of certain features known to belong to them, our guess is that the lathe in question was built by the Putnam Machine Co. of Fitchburg, Mass. Will any of our older readers venture an opinion?—Editor.]

Drilling Ignition-Point Holes in Spark Plug Spindles

By E. V. Allen

In making a spark-plug center or spindle, it is necessary to drill a small hole in the lower end for the insertion of a short piece of wire which forms the central ignition point. As these spindles are made in large quantities they must be rapidly handled. For this purpose we have made the simple jig shown ir the illustration. A spark-plug spindle is shown at *A*, resting in the vertical V-block *B*. The shoulder on the piece rests on top of the V-block, and keeps it from slipping down. While drilling the hole, the spindle is kept from turning by the operator pulling outward on the end of lever *C*. As soon as the hole is drilled and the drill backed out, the operator releases lever *C*, which is immediately pulled back by the small spring *D*. When the lever flies back the end of the curved rod *E* hits the work and knocks it into the chute below. The speed of this device will be readily seen by anyone who takes the trouble to study out the cycle of movement for a piece of work.



DRILLING JIG FOR SPARK-PLUG SPINDLES

SEVEN CENTURIES of BRASS MAKING



By O. A. KENYON
ENGINEER RAY D LILLIBRIDGE, Inc.,
NEW YORK*

IV. Phono-Electric Wire—Brass and Copper Tubes

The making of phono-electric wire is described. There is information on rolling, joining and drawing. The author specifies that the advantages of phono-electric wire are great toughness, high tensile strength, favorable arcing characteristics and the permanency of these properties under service conditions. Brass and copper seamless tube manufacture is gone into—data on the piercing, cast shell and cupping processes are given.

(Part III appeared in the Nov. 18 issue)

SOME twenty odd years ago, phono-electric trolley wire was developed and placed on the market by the Bridgeport Brass Co. in response to a demand for a contact wire that would withstand the conditions of severe service better than hard-drawn copper. The greatest advantages of phono-electric wire from the railway man's point of view are: Toughness, high tensile strength, favorable arcing characteristics, and best of all, these various characteristics are permanent—the wire does not alter its properties under service conditions, which is one of the most serious disadvantages of hard-drawn copper. These properties of phono-electric wire are due first to the composition of the wire; second, to the uniformity and homogeneity of this composition; third, to the carefully controlled process of manufacture. Phono-electric billets are delivered from the electric casting shop to the rolling mill where they are introduced into a heating furnace, the entrance to one of which is shown in Fig. 27. After having reached the desired temperature, the billet is withdrawn from the furnace by sliding onto a two-wheel car as shown in Fig. 28. It is then wheeled to one of the rolling mills and passed back and forth until it is sufficiently reduced in diameter, when it is coiled up and delivered to the wire mill. Figs. 29 and 30 show the billet at two stages of the rolling process. The coiled rod before going to the draw benches is joined into long lengths by soldering. The joint is prepared by sawing the ends at an acute angle, clean-

*Booklet published by the Bridgeport Brass Co., Bridgeport, Conn.

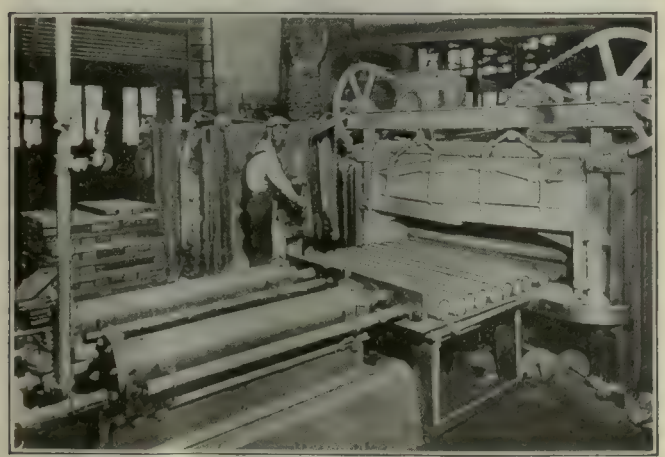


FIG. 27. PHONO-ELECTRIC BILLETS ENTERING THE HEATING FURNACE



FIG. 28. REMOVING A PHONO-ELECTRO BILLET FROM THE HEATING FURNACE PREPARATORY TO INSERTING IT IN THE ROLLS

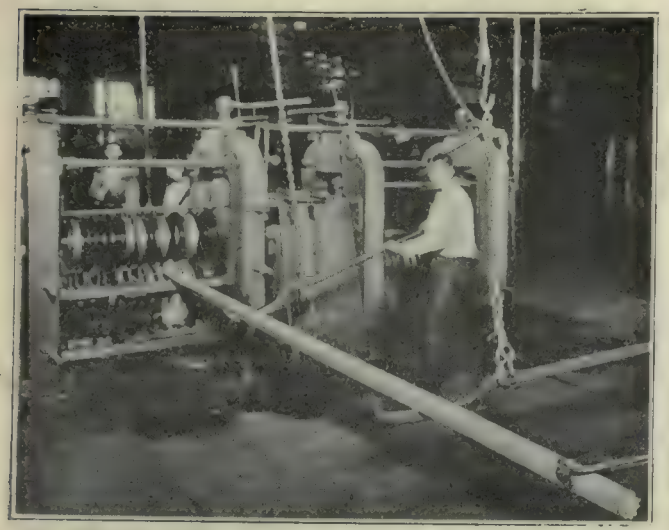


FIG. 29. THE SAME BILLET AS SHOWN IN FIG. 28 AFTER THE THIRD PASS THROUGH THE ROLLS



FIG. 30. THE SAME BILLET AS SHOWN IN FIG. 28 JUST BEFORE THE LAST PASS THROUGH THE ROLLS

ing the adjacent surfaces with acid and inserting between them a sheet of silver solder. They are next bound together with wire and a brazing furnace swung into position to enclose the joint. After heating to the proper temperature the operator applies more silver to the joint and works it in thoroughly. Having completed the operation, the furnace is dropped down, the wires removed and the joint smoothed up with a file. In Fig. 31 is shown the soldering equipment for two men. The joint in the foreground has just been completed, while the other one is being heated in the furnace.

The drawing of phono-electric takes place in the usual way except that extraordinary care is exercised to maintain accurate dimensions. The die itself is special. It is so designed and manipulated that strains are equalized and any unbalanced wear prevented. Fig. 32 shows the soldered rod undergoing the first draw. It passes from the rod reel through the die to the drum of the drawing machine and after making several turns around the drum it is wound up on a reel ready for the next operation.

The Bridgeport Brass Co. has been making seamless brass and copper tubing for over thirty years, being one of the pioneers in the making of this product. The processes employed in making seamless tubing impose extremely severe conditions on the brass maker if success is to be attained. To begin with, it is all-important that the quality of the metal be definitely known and uniformly maintained for any given result. Years of study in the research laboratories and even more years of practice in the mill have taught this company what conditions are necessary to the making of seamless brass and copper tubes for any given purpose, and equipment has been provided to realize these conditions on a manufacturing basis.



FIG. 31. PHONO-ELECTRIC RODS ARE SOLDERED INTO LONG LENGTHS WITH SILVER



FIG. 32. PHONO-ELECTRIC ROD PASSING THROUGH THE DIE FOR THE FIRST DRAW



FIG. 33. TAKING CUT OFF BRONZE BILLET OF SPECIAL TURBINE BLADING METAL

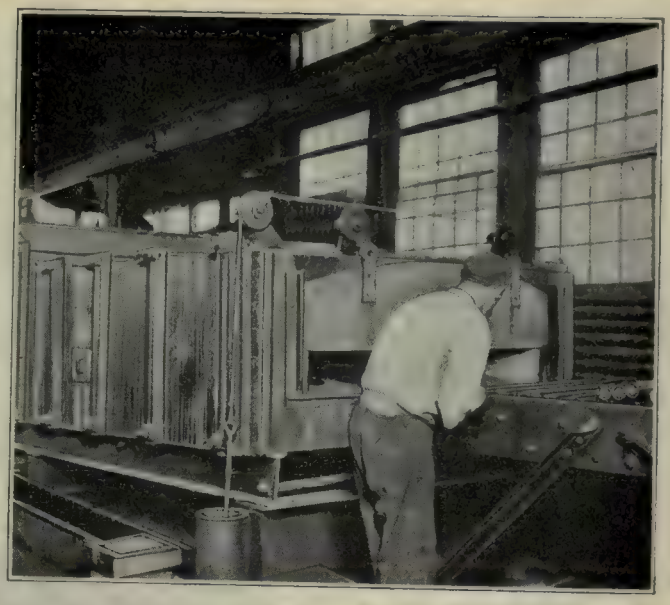


FIG. 35. BILLETS ENTERING THE HEATING FURNACE PRELIMINARY TO ENTERING THE PIERCING MACHINE

Although there are several different methods of making seamless tubing, practically all tubing made by the Bridgeport company falls under three processes, namely: the piercing process; the cast shell process; and the cupping process. The choice of these three is determined by the character of the tube to be produced. Taking up the piercing process first, cast billets.

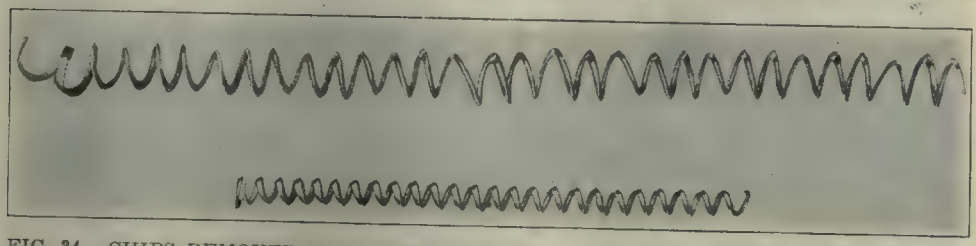


FIG. 34. CHIPS REMOVED FROM THE SURFACE OF THE BILLET SHOWN IN FIG. 33

slightly cupped at the end and of suitable diameter, are delivered to the piercing mill from the electric casting shop.

Billets used in this process are turned so as to remove surface impurities and mechanical imperfections, and in this way insure greater perfection in the surface of the tube. Fig. 33 shows the turning of a billet. Fig. 34 shows chips removed from the surface of the billet. When it is considered that these chips are taken from the surface of a cast billet, it is evident that the casting itself closely approaches physical perfection.

In Fig. 35 we see these billets on their way into a heating furnace. In this furnace they are brought to the proper temperature and discharged at the proper moment into the intake end of the piercing machine as shown in Fig. 36.

The operator of the piercing mill by means of a motor controller causes the billet to be inserted into the piercing machine by rotating the rollers upon which it rides.

Once in the machine, it is subjected to a cross rolling action, the result of which is to cause the billet to travel through the rolls. Just as it leaves the rolls it encounters a projectile-like steel point carried on a long rod over which it is forced, rotating the meanwhile between the rolls just ahead of the point. The working parts of this very interesting machine consist of two

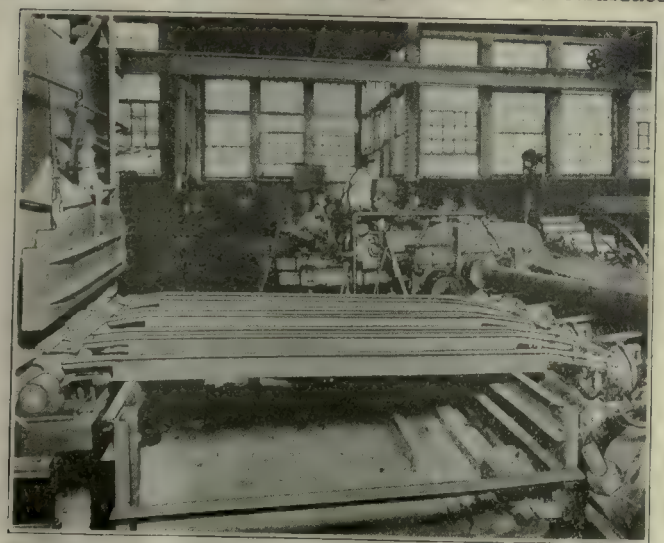


FIG. 36. A HOT BILLET, AFTER LEAVING THE HEATING FURNACE SHOWN IN FIG. 35, ABOUT TO ENTER THE PIERCING MACHINE

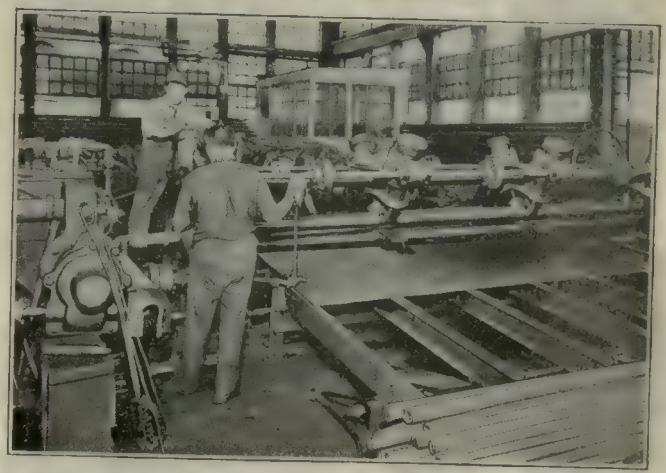


FIG. 37. THE PIERCED TUBE, EMERGING FROM THE ROLLS AND PASSING OVER THE ROD WHICH CARRIES THE PIERCING POINT



FIG. 38. POINTING TUBING PRELIMINARY TO DRAWING

tirely through the machine the rod is withdrawn by a traveling workhead. The ends of tubes produced by this process are shown in the foreground.

From the piercing mill the tubes go to the draw benches, where they are pointed and drawn. The pointing operation is shown in Figs. 38 and 39. It consists simply of smashing down the end of the tube sufficiently to allow its insertion through the die and into the grip.

The openings into one of which the tube is about to be inserted are split and are opened and closed continually under the action of the driving mechanism. The holes just below the pointing dies serve as gages into which the pointed tube must fit.

In Fig. 40 is shown a general view of the main tube plant. Practically all the equipment in this plant is special. One type of tube draw-bench alone contains ninety-three elements that are covered by patent claims. Before this mill was built, an experimental mill was set up and every detail of the process worked out experimentally and theoretically before the final decision as to design to be used in the plant was made. Fig. 41 shows a group of tube draw benches. At the right is seen a tube partially through the die. The rod here shown carries the plug or triblet, which is held inside of the tube at the point where it passes throught the die and maintains the internal diameter as well as preventing deformation of the circle. In the outer end of the tube is seen a bushing which serves as a bearing and guide for the rod. The tube itself is drawn by the action of an hydraulic plunger, located on the other side of the die. These machines are so long that photographing is extremely difficult.

power driven rolls, mounted at an angle to one another and having their cylindrical surfaces made up of the frustums of two cones. Just below and between these two driven rolls, is a small idler. The billet passes between the three and is drawn in by the spiral travel of the three rolls, the angles being such that the point of contact travels on the same spiral on all three rolls, giving the billet a powerful forward motion. Fig. 37 shows a tube issuing from the machine. The rod with the piercing point is inside. The points have to be changed from time to time in order to maintain the proper contour. A point that has just been removed from the machine is shown resting on a block in the left foreground. When the billet has been forced en-



FIG. 40. A GENERAL VIEW OF THE MAIN TUBE PLANT



FIG. 39. VERTICAL POINTING MACHINE FOR LARGE SIZE TUBES. THE OPERATORS ARE JUST REMOVING A TUBE FROM THE MACHINE

After each draw the tubes are delivered to continuous annealing furnaces which are maintained at constant temperature, the tubes traveling at a definite speed through the furnaces. In Fig. 42 is seen a set of tubes

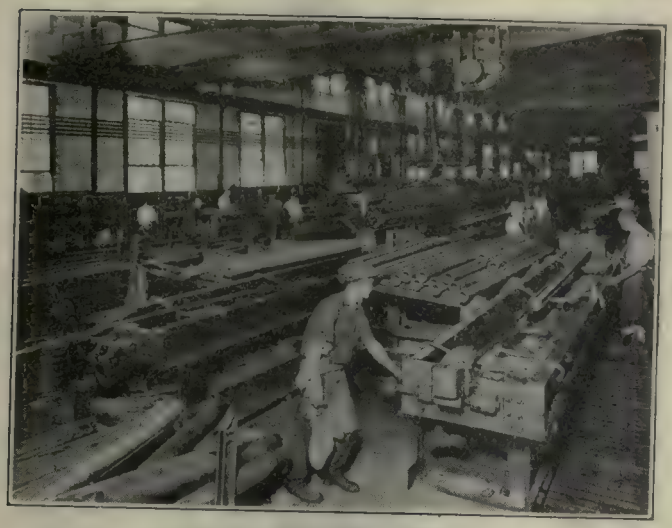


FIG. 41. DRAWING TUBING

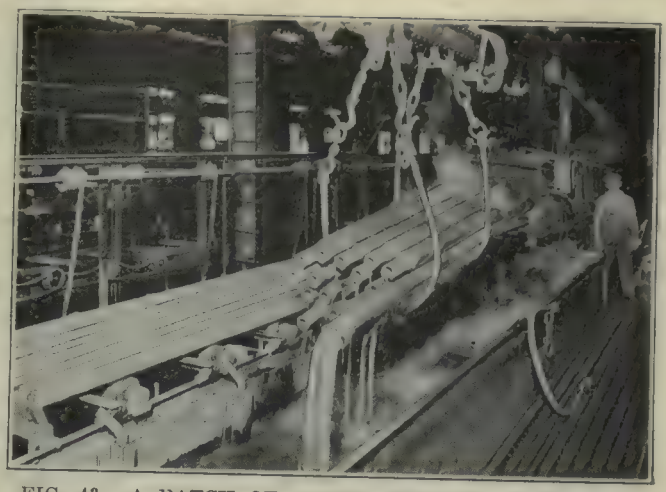


FIG. 43. A BATCH OF TUBES REMOVED FROM THE PICKLE TO BE RETURNED TO THE DRAWBENCHES FOR THE NEXT DRAW

on the conveyor which have just emerged from the furnace and are ready to dump into the pickle. The method by which the conveying rolls are driven is plainly shown in the machine just back of the one in the foreground. The tubes here shown are just about to be dumped into the pickle which is accomplished by the operator in the background. The temperature of the furnaces and the speed of travel through them is so chosen, that the mechanical strains from the drawing operation are equalized without detriment to the physical properties of the tube. Fig. 43 shows a bunch of tubes being lifted from the pickle to be carried back to the draw benches for the next operation. This operation of annealing is of the greatest importance since it has a marked effect on the distribution of stresses in the walls of the tube and acts to prevent what is known as "season cracking."

The importance of proper annealing cannot be over emphasized. The Bridgeport Brass Co. has studied the annealing operation with respect to temperature, rate of heating and cooling, and as a result of these studies has formulated exact specifications covering both these factors for every quality of metal turned out by the mills. In Fig. 44 the results of experiments on a certain alloy are shown graphically. From this diagram it is seen that the annealing temperatures affect vitally all the physical properties of the metal, and when properly

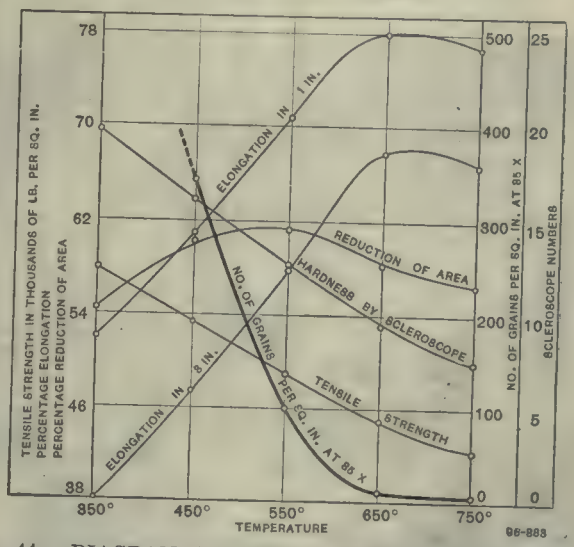


FIG. 44. DIAGRAM SHOWING EFFECT OF ANNEALING TEMPERATURE UPON PHYSICAL PROPERTIES FOR BRASS OF A GIVEN COMPOSITION

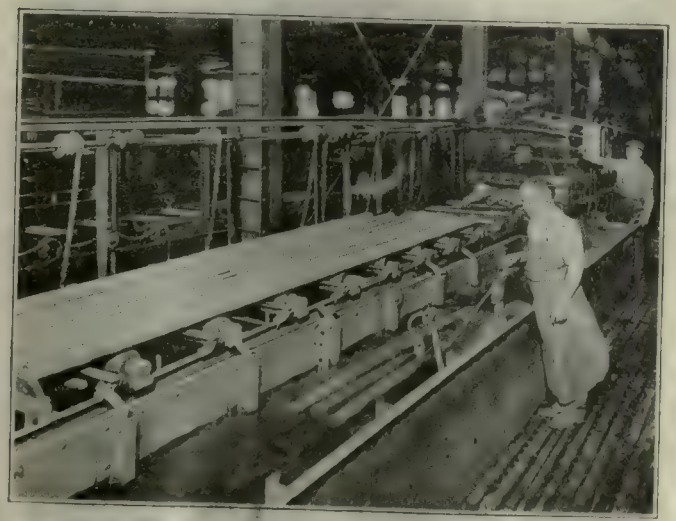


FIG. 42. A BATCH OF TUBES ISSUING FROM A CONTINUOUS ANNEALING FURNACE



FIG. 45. RECORDING PYROMETER

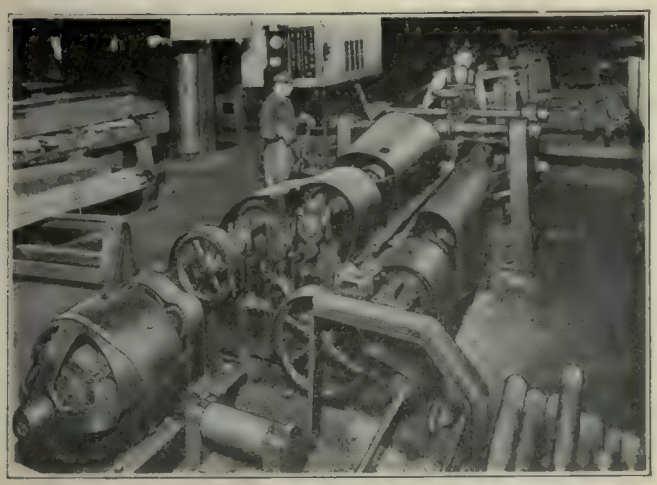


FIG. 46. A TUBE PASSING THROUGH THE SPIRAL ROLLS OF A STRAIGHTENING MACHINE



FIG. 47. STRAIGHTENING CONDENSER TUBES

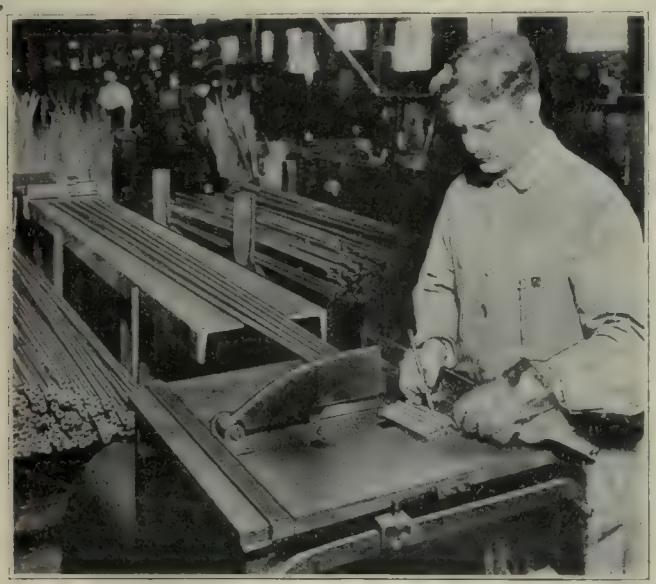


FIG. 48. SAMPLING CONDENSER TUBES FOR INSPECTION TESTS

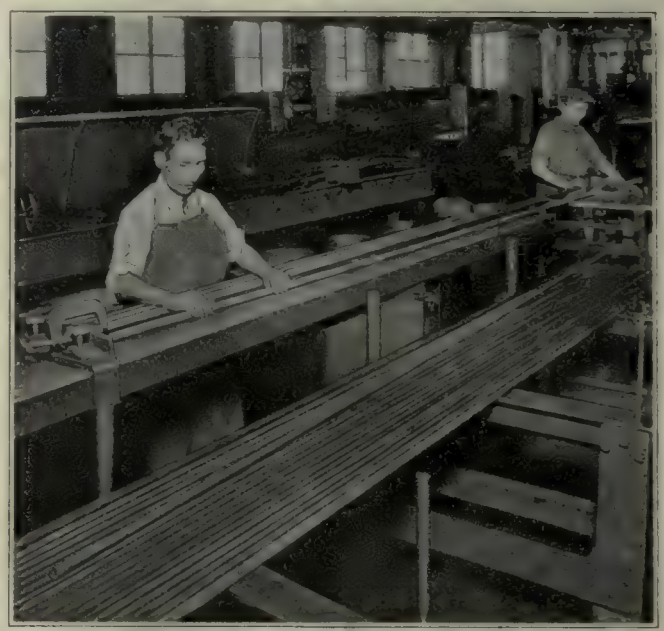


FIG. 49. CUTTING STRAIGHTENED CONDENSER TUBES TO STANDARD LENGTH

understood can be used to obtain certain desired properties.

The temperature of the annealing furnaces is measured with electric pyrometers, the indicating instruments being used by the operators for making heat adjustments, and the recording instruments used for information of the engineers as well as for the operators, so that the exact history of any given batch of metal can be recorded. In Fig. 45 is shown one of the recording instruments.



FIG. 50. HYDRAULIC TEST OF CONDENSER TUBES

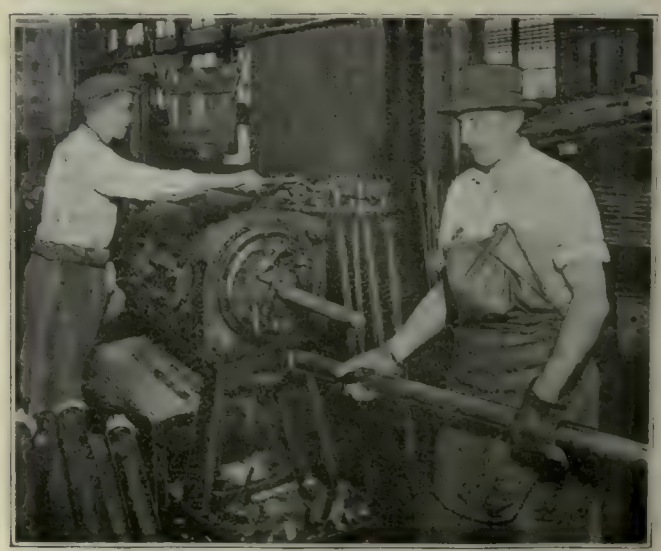


FIG. 51. DRAWING TUBES BY THE CUPPING PROCESS

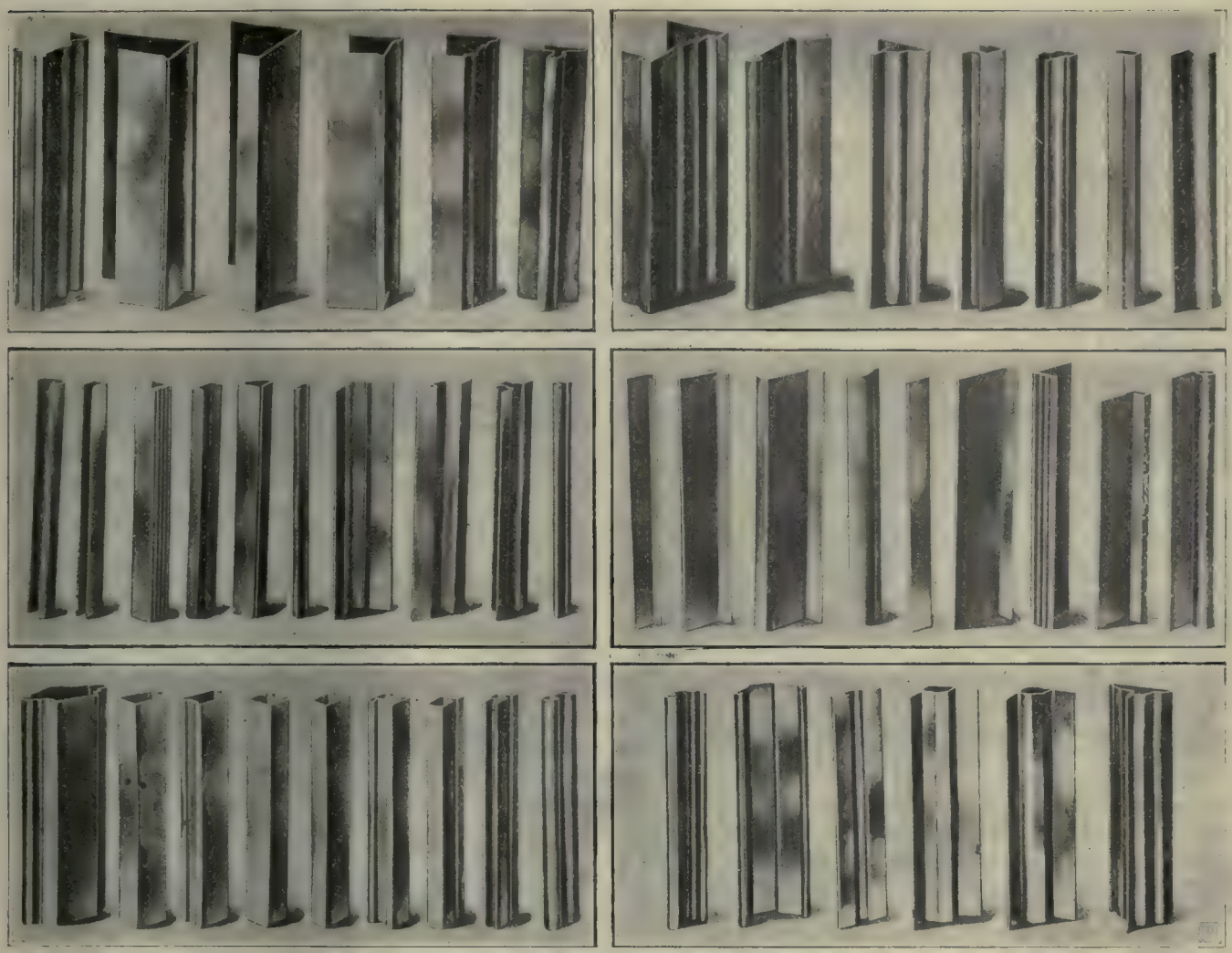


FIG. 52. SECTIONS OF DRAWN TUBING

When the tubes have been drawn to the proper diameter and gage, they are straightened by passing them through a set of rollers. The large diameter tubes are passed through rollers which travel in a spiral around the tube as shown in Fig. 46, while the small tubes such as those used for condensers are straightened by passing through a series of rolls in two different planes as shown in Fig. 47. Both of these straightening machines spring the tube in such a way as to tend to equalize any unbalanced mechanical strains that exist and thereby improve the service qualities of the tubing.

In order to control the quality of the product, samples are subjected to whatever tests are necessary to establish the properties of the tube required for the particular service they are to perform. In Fig. 48 is shown an inspector marking samples to be delivered to the laboratories. A certain percentage of all tubes manufactured are thus sampled for analyses and tests in the laboratory.

After straightening the tubes are sawed to standard lengths and each one is subjected to an hydraulic pressure test. These various operations are shown in Figs. 49 and 50.

In addition to pressure tests, each tube is examined by an expert and checked for dimensions and general quality before it is delivered to the shipping department for packing and shipment.

The cupping process, although used only to a small extent, is preferred for certain kinds of tubing. In this process, the metal is pushed through a die by a round nosed punch. An operation of this kind is shown in Fig. 51. In the liquid bath under the machine may be seen several tubes ready for the drawing operation. The operator at the right is holding a similar tube after the drawing operation. This tube is now ready for an annealing and pickling, after which it will be returned for the next draw and so on until the finished size is attained.

Although the bulk of the tubes are circular in section, other sections are also drawn. Fig. 52 shows a number of special sections and serves simply to indicate the possibilities of the processes.



Backlash Standards for Spur Gears

By CHARLES H. LOGUE
Brown-Lipe-Chapin Co., Syracuse, N. Y.

Standardization of gear characteristics is gradually coming about. The author suggests a formula for determining the proper backlash for spur gears, and tables, computed from the formula, are given. The article paves the way for discussion on the subject.

IT IS well known that spur gears cut with the involute form of tooth may be assembled at any desired center distance, and, as long as the teeth are in engagement, they still operate correctly. Perhaps this is too well known, as it has led to a general misunderstanding of an essential point in the cutting of spur gears. Simply because the depth of the tooth engagement may be varied as desired, it does not follow that the depth to which the teeth are cut may be varied either in order to secure any desired amount of backlash or for a modification of the center distance at which the gears operate.

The pitch diameters of spur gears automatically increase or decrease as a corresponding change is made in the center distance, but, it should be noted that the base circle from which the teeth in the gears derive their formation remains constant and does not change with any position in which the gears may be placed. Thus, in Fig. 1, the only change is in the pitch diameters and obliquity of action.

Therefore, to produce a correct tooth form, the base line of the gear being cut and the base line from which the cutter is formed must be brought into agreement—that is, the cutter must be located at a definite distance from the center of the gear in order to assure a correct tooth profile. In case an attempt is made to cut deeper or shallower than this, the involute curve will be distorted and an incorrect form of tooth will result. For large numbers of teeth the amount of damage done is relatively small, but for small pinions the proper location of the cutter is vital.

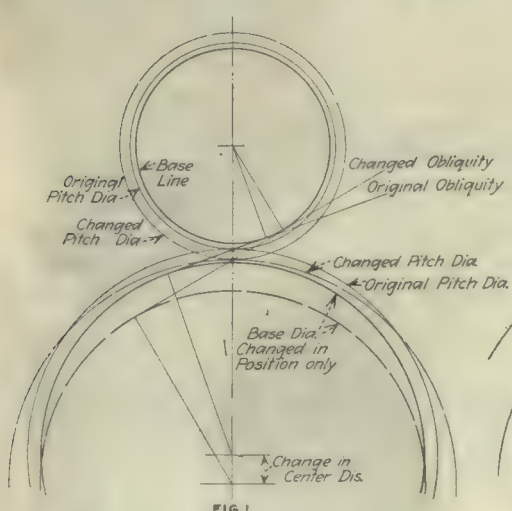


FIG. 1. EFFECT OF CHANGE IN DISTANCE BETWEEN GEAR CENTERS

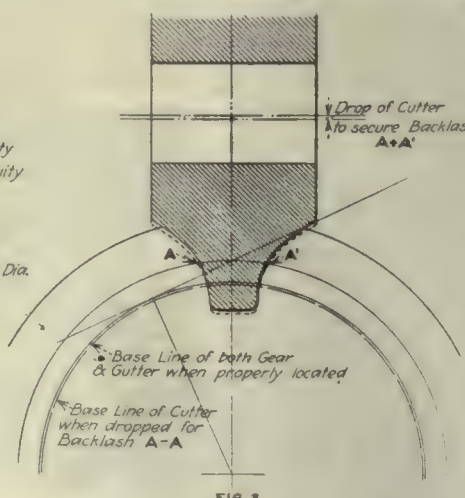


FIG. 2. EFFECT OF CUTTING TOO DEEPLY IN GEAR BLANK

In Fig. 2 is shown the effect of cutting too deeply. The solid lines represent true involute form, when the base line of both the cutter and the gear being cut are in agreement. Dotted lines show the cutter dropped to secure backlash, as indicated by the distances *A*. A comparison of the two constructions will make evident the resulting error.

It is evident, therefore, that all spur and helical gear cutters must be made so as to cut a given amount of side clearance, or backlash, and this necessarily means standardizing the amount which is proper for various pitches. To this end the writer suggests an allowance based upon the square root of the pitch, as follows:

$$\text{Average Backlash} = \frac{0.018}{\sqrt{D}}, \text{ or } 0.01\sqrt{C}.$$

$$\text{Minimum Backlash} = \frac{0.0135}{\sqrt{D}}, \text{ or } 0.0076\sqrt{C}.$$

The "average" allowance is recommended for all gears which are to be heat treated, the run-out which results from such treatment causing a need for more backlash than would ordinarily be recommended. The "minimum" allowance is recommended for general purposes when the center distance can be depended upon and is accurately known. In cases where the center distance has any great minus value, the average allowance is recommended.

In case cutters are made without any allowance for backlash, the calculated center distance must be increased, as it is then necessary to cut the teeth standard—that is, the circular thickness must then equal one-half the circular pitch. Also, in case a certain amount of backlash has been allowed for in making the cutter and it becomes necessary to increase this amount, the only proper solution is to increase the distance between centers. The only manner in which this increase can be avoided is to take side cuts, that is, rolling the gear against the cutter.

The logical solution would be to reduce the thickness of the teeth of the gear to give the full amount of backlash desired—there being a surplus of strength in the gear teeth—and to cut the pinion teeth standard, that is, one-half the circular pitch. But, it is very often necessary to engage two pinions, as gears having small numbers of teeth are commonly called, so that it would appear that the backlash for an interchangeable standard must be divided equally between the gear and the pinion teeth.

Table I gives calculated values for "average" backlash, based upon $\frac{0.018}{\sqrt{D}}$, or $0.010\sqrt{C}$. These values should, of course, be grouped, as it is unnecessary to follow the exact value as

TABLE I. RELATION BETWEEN PITCH AND BACKLASH FROM THE FORMULA: AV. BACKLASH = $\frac{0.018}{\sqrt{D}}$, or $0.01\sqrt{C}$

D	C Inches	Backlash, Inches	D	C Inches	Backlash, Inches
...	10	0.0320	3½	..	0.0097
...	9	0.0305	..	⅞	0.0094
...	8	0.0290	4	..	0.0090
...	7	0.0270	...	¾	0.0084
⅜	..	0.0260	5	..	0.0080
...	6	0.0250	...	⅝	0.0076
...	5	0.0230	6	..	0.0073
¼	..	0.0215	...	½	0.0070
...	4	0.0203	7	..	0.0067
...	3½	0.0190	8	..	0.0063
...	3¼	0.0184	...	⅜	0.0061
1	..	0.0180	9	..	0.0060
...	3	0.0179	10	..	0.0057
...	2¾	0.0169	11	..	0.0054
1¼	..	0.0162	12	..	0.0052
...	2½	0.0161	...	¼	0.0050
...	2¼	0.0153	14	..	0.0049
1½	..	0.0148	16	..	0.0045
...	2	0.0142	18	..	0.0041
1¾	..	0.0139	20	..	0.0039
...	1¾	0.0135	22	..	0.0038
...	1⅝	0.0130	24	..	0.0037
2	..	0.0127	26	..	0.0036
...	1½	0.0125	28	..	0.0034
2¼	..	0.0123	30	..	0.0033
...	1⅜	0.0121	32	..	0.0032
2½	..	0.0120	34	..	0.0031
...	1¼	0.0114	36	..	0.0030
2¾	..	0.0110	60	..	0.0029
...	1⅛	0.0107	80	..	0.0020
3	..	0.0103	100	..	0.0018
...	1	0.0100	120	..	0.0012

given there. The arrangement shown in Table II might be recommended as a standard.

TABLE II. APPROXIMATE RELATIONS BETWEEN PITCH AND AVERAGE BACKLASH

Circular Pitch, Inches	Backlash, Inches	Diametral Pitch, Inches	Backlash, Inches
10 and over	0.032	0.5	0.026
8 to 9½	0.030	0.75	0.020
7 to 7½	0.028	1.0	0.018
6½ to 6¾	0.026	1¼	0.016
5½ to 5¾	0.024	1½	0.015
4¾ to 5	0.022	1¾	0.014
3¾ to 4½	0.020	2	0.013
3 to 3½	0.018	2½	0.012
2½ to 2¾	0.016	2¾	0.011
2½	0.015	3–3½	0.010
2	0.014	4	0.009
1¾ to 1⅞	0.013	5–6	0.008
1⅝ to 1½	0.012	7–8	0.007
1¼	0.011	9–10	0.006
1 to 1⅛	0.010	11–16	0.005
¾ to ⅞	0.009	18—26	0.004
⅝	0.008	28–60	0.003
½	0.007	80–100	0.002
⅜	0.006	Over 120	0.012
¼	0.005		

The distance from the pitch line to the outside diameter of the cutters being held correct, we might depend upon the bottom diameter of the gear for correct cutter location. In setting up the gear-cutting machine, we could then measure from the center of the work spindle to the outside diameter of the cutter.

Dropping the cutter into the gear until the desired tooth thickness is secured is poor practice, unless the amount of tooth space desired is embodied in the design of the cutter. It is, therefore, suggested that the amount of backlash for various pitches be standardized and all form cutters made in strict accordance with this allowance.

Is This a Punch-Press Job?

By Hugo F. Pusep

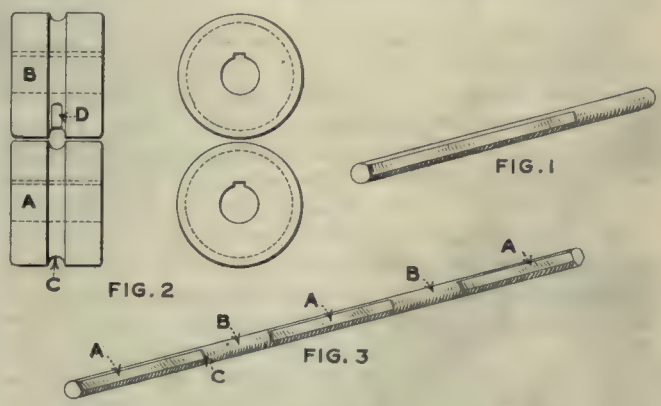
The rod with a flat on it described by F. C. Hudson on page 1267, vol. 52, of the *American Machinist* and supplemented on page 372, vol. 53, of the same journal by Joran Kyn, can be manufactured very cheaply in large quantities.

If I remember right, the rods in question were made of cold rolled steel about ⅝ in. in diameter with the flat extending over about two-thirds of their length, somewhat similar to Fig. 1.

This flat can be rolled very easily, it being comparatively shallow in comparison to the diameter of the rods. The rolling equipment would consist principally of two rolls *A* and *B*, as shown in Fig. 2. Roll *A* would have a perfect semicircular groove *C* cut around its perimeter, while the roll *B* must have the semicircular groove on only a certain length of its perimeter; the rest of the groove having a flat bottom as at *D*. These rolls can be mounted in a substantial fixture having provision made for adjustment. Driving power for the rolls can be obtained from various sources, depending on the quantity of rods to be produced. For a medium production the rolling fixture can easily be mounted on a milling machine table or on a horizontal boring machine of sufficient power, and driven direct from the machine spindle through a suitable connection.

Should the production warrant it, an individual electric motor and reduction gearing, installed as a unit with the fixture, will supply an ideal drive. Under these conditions, however, the fixture would become a special machine. Some other improvements could be made in a case of very large production, such as separate feeding rolls, cutting off mechanism, etc.

Now using mill length cold rolled rods ⅝ in. in diameter as the raw material and passing them through the rolls such as shown in Fig. 2, at every revolution of the



FIGS. 1, 2 AND 3. THE WORK AND THE ROLLS

rolls we would have a flat part *A* and the original round rod *B* alternately for the entire length of the rod, as shown in Fig. 3. Our next step would be to shear this long rod up into several shorter lengths. This can be accomplished very cheaply in an ordinary rod shearing die under a punch press locating from the small shoulders *C*, Fig. 3.

There are a few modifications of the rolls, which would be largely determined by the quantity of rods to be made and the quality and accuracy of finish at each end of same; such as making the rolls large enough so that several flat and round lengths could be rolled at one revolution of the rolls; or having the round and flat bottomed groove slightly longer around the perimeter of the forming roll than is actually necessary, so as to allow for facing operation at both ends after shearing off the rods.

This method of rolling flats on round rods is the cheapest and best way where the quantity is considerable, and it has proven very satisfactory to me on several occasions. I hope that it will help to solve the problem referred to at the beginning of this article.

Modern Aviation Engines—VI

By K. H. CONDIT
Managing Editor, *American Machinist*

THE four engines shown on the opposite page are representative of American designs for commercial aviation. The Thomas and Sturtevant engines are essentially alike, both being V-type eights with reduction gearing between the crankshaft and the propeller. They differ in carburetor location, the Thomas carburetor being overhead between the cylinder blocks while the Sturtevant carburetor is carried on a level with the base of the engine; and, in valve arrangement, the Thomas cylinders are of the L-head type, an unusual design for an aviation engine, while the Sturtevant valves are overhead and operated by rockers and long push-rods from the camshaft which is located in the crankcase.

The Packard engine shows the effects of the information made available by the war of the details of both allied and enemy airplane engines. Valve action and cylinder construction are similar to the Liberty motor designs for those parts, while the cylinder angle has also been reduced from the normal 90 deg. to 60 deg. The carburetor location and intake-manifold design are original but show the effect of German practice. The water pump location is the same as on the Hispano-Suiza.

The Curtiss six shown is practically a half portion of the twelve mentioned in the first installment and has been designed to replace the old reliable, but obsolete, model OX with which most of our army pilots learned to fly. In this motor also, the effects of foreign practice are discernible. The aluminum cylinder casting with threaded steel liners points to the Hispano-Suiza arrangement but the combination of cylinder casting and crankcase upper half is different. Hispano practice is also followed in the elimination of push-rods and rocker-arms for the valve-operating mechanism, but the cams, instead of acting directly on the valve stems, bear on yokes which connect the two inlet or exhaust valves of each cylinder. Two camshafts are fitted, one for the inlet and the other for the exhaust valves.

The problem of making a living in peace times under present conditions is a difficult one for the American airplane manufacturer to solve. The art of flying has not as yet been sufficiently developed to stand alone without governmental aid and those in authority seem to have learned little from the experience of the aircraft program. Much time would have been saved and our part in the war in the air would have been much more valuable than it was if the starved little airplane manufacturing companies that existed before the war had been given a little encouragement in the way of Government orders. There is a world of difference between intelligent economy and stupid parsimony.

The work of the few Army and Navy officers assigned to aviation duty has been very commendable in view of the handicaps under which they have labored, but it could have been so much more effective if sufficient funds had been provided to carry on the work. During the war efficient expert organizations were built up at the scientific and experimental fields and much valuable machinery and testing apparatus were installed. The equipment remains but most of the men have returned to civil life, according to figures given out Oct. 1, which show a reduction in the Air Service of 92 per cent. In England, on the contrary, the testing and experimental forces are to be kept at full war strength to carry on the work of research and development hardly possible by private concerns.

What is left of our Air Service is doing valuable missionary work in educating the people to the possibilities of commercial aviation by the recruiting, demonstrating and photographic tours that are being carried out. Their participation in the Mineola-Toronto race and the transcontinental race have done much to prove the reliability of aërial transportation.

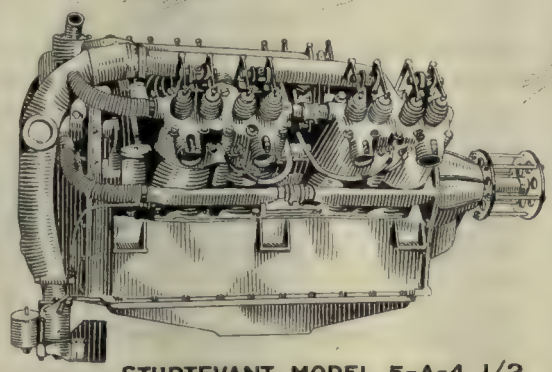
The work of the Navy in the successful transatlantic flight of the NC-4 is beyond praise and from a practical point of view was of far more value than the more daring and spectacular non-stop trip made by Brown and Alcock in the British Vickers-Vimy bomber.

That the British are wide awake to the importance of demonstrations of the sort is evident by the exhibition trip of a flying-boat over the various Scandinavian countries where aviation progress has lagged but where interest is keen.

It will not be long before trips of this sort will be greatly extended. A prize has been offered for the first transpacific flight. British planes have flown from England by way of Cairo to India. An aërial pathway from Europe to Australia has been traversed. Plans are under way for a round-the-world race and a committee has started to lay out the route, pick out landing-places and referees and make the other necessary arrangements for such a venture.

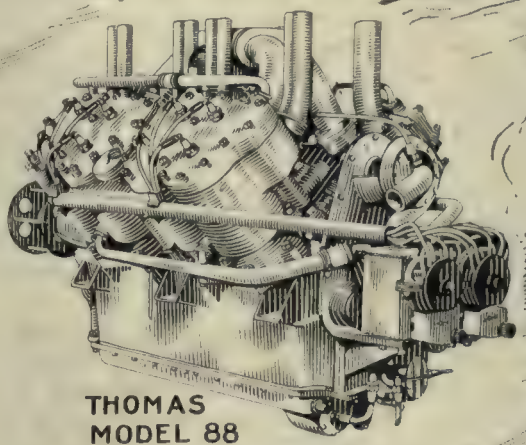
It is interesting to compare the results of the New York-Toronto air race with the automobile race held at Sheepshead Bay a few weeks later. In the first case the conditions were just about as bad as they could possibly be. Severe storms were encountered and two of the landing-fields, besides being small, were in bad condition. At Sheepshead Bay, on the contrary, the weather was perfect, the track the equal of any in the world and the cars on edge after days of careful tuning. But look at the results. The airplanes made better speed over a longer distance; there were no serious accidents except a broken arm sustained by a pilot who wrecked his machine to prevent running into a crowd which had broken the police lines, and nearly 60 per cent of the contestants finished the race. By contrast, one car broke a steering connection and rolled over, its occupants escaping by a miracle, and another caught fire and was only stopped after the driver and mechanic had been severely burned. The percentage of finishers was less than 50. Considering the relative age of the two sports, if one chooses to call them sports, the comparison seems more favorable to the airplane than ever.

Reliability is further demonstrated by several hundred-per cent months in the records of the New York-Washington aërial mail service which has been in satisfactory operation over a year. If all our mail were handled as promptly, some of us would begin to believe



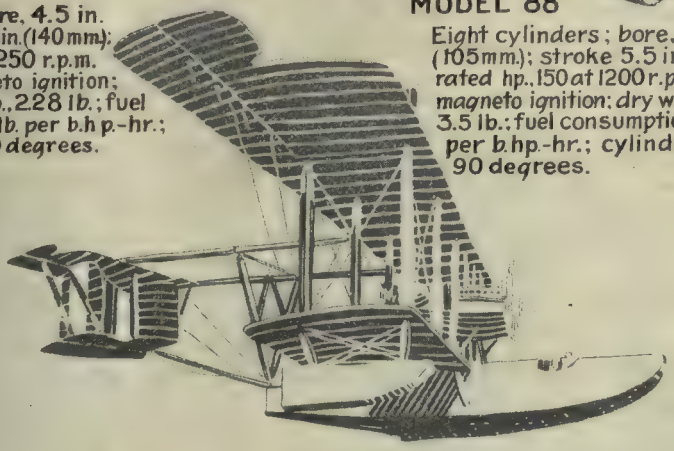
STURTEVANT MODEL 5-A-4 1/2

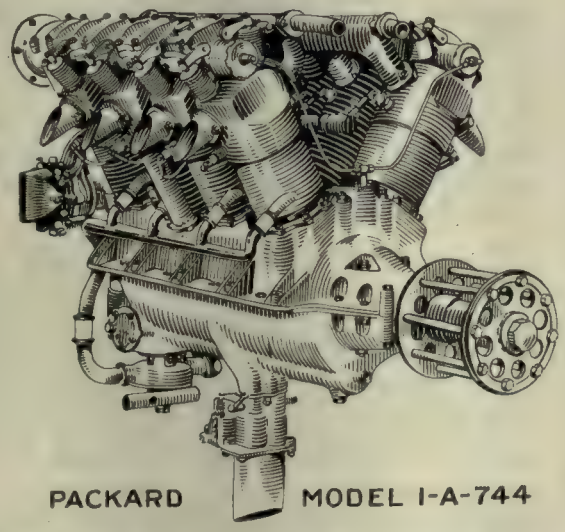
Eight cylinders: bore, 4.5 in. (114mm); stroke 5.5 in. (140 mm); rated hp. 210 at 2250 r.p.m. (crankshaft); magneto ignition; dry weight per hp., 2.28 lb.; fuel consumption, 0.55 lb. per b.h.p.-hr.; cylinder angle, 90 degrees.



THOMAS MODEL 88

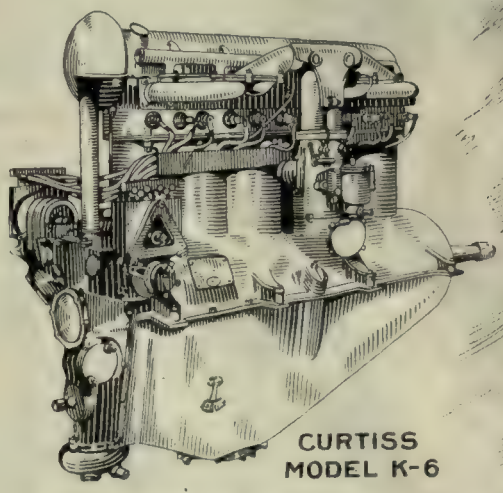
Eight cylinders; bore, 4.125 in. (105mm.); stroke 5.5 in. (140mm.); rated hp., 150 at 1200 r.p.m. (propeller); magneto ignition; dry weight per hp., 3.5 lb.; fuel consumption, 0.59 lb. per b.hp.-hr.; cylinder angle, 90 degrees.





PACKARD MODEL I-A-744

Eight cylinders; bore, 4.75 in. (121 mm.); stroke, 5.25 in. (133 mm.); rated h.p., 160 at 1525 r.p.m.; battery ignition; dry weight per hp., 3.5 lb.; fuel consumption, 0.52 lb. per b. hp.-hr.; cylinder angle, 60 degrees.



CURTISS MODEL K-6

Six cylinders; bore, 4.5 in. (114mm.); stroke. 6 in. (152 mm.); rated hp., 200 at 1600 r.p.m.; magneto ignition; dry weight per hp., 2.1 lb.; fuel consumption, 0.55 lb. per b. hp.-hr.



By-B.Z Reiter

in the imminence of the millennium. The newer branches of the aërial mail have not quite reached this standard but they are rapidly approaching it.

Freight-carrying by airplane does not look very practical as yet, and perhaps never will, but, speaking generally, we are not in so much of a hurry for freight as we are for some other things. Passenger carrying is undoubtedly coming. During the war British statesmen made many safe and speedy trips between London and Paris in a De Haviland plane with an inclosed body. This special de luxe service has been succeeded by a regular passenger-carrying line operating on schedule between the two cities. The Germans are doing the same thing with Zeppelins which even carry the passengers' baggage, while other lines in England, Germany and France will soon be in operation.

In America we lag behind as usual, but one big passenger carrier has made a successful flight from west of the Mississippi River to New York and Washington and many others will probably have been made before this article is published. The greatest handicap just now seems to be the lack of suitable landing-fields in all parts of the country.

The recent offer of a big engineering concern to the British Government of huge rigid dirigibles with a 70-ton carrying capacity and a 6,000-mile cruising radius makes one wonder how soon the fanciful transatlantic trip described in Kipling's story, "With the Night Mail," will be commonplace realities. They may come sooner than we think and prove Kipling and Jules Verne more prophets than visionaries.

The Field for Employment Management

By Entropy

During the height of the war almost every manufacturer of any considerable size opened an office which he called the "Employment Office." In some cases it was a real and important part of the organization, but in too many it was merely a hiring office established in imitation of the real thing but performing very few of its functions. Very naturally, however, all the men engaged in this work called themselves employment managers. Many of them would be glad to take on their old jobs today if they could get them. That is, there are many more men who have had the title than there are filling such jobs today.

Does that mean that employment management is a bubble that has burst? Is there any object in a young man trying to make it his life work? My guess to the second question is: Yes. Almost every thing has its ups and downs, and nearly every good thing has been hurt at some time by people who were trying to be helpful. Scientific management was one that suffered from people who saw a chance to coin money but who did not grasp the fundamentals of the profession. It has weathered the storm and a great deal of very good scientific management is being done under the name of industrial engineering, which name really describes the work better than the one with which it was christened. In the same way employment management is suffering today for the sins of imitators who do not see the kernel in the thing they imitate.

The rush is over to all appearances. Scouting for help is not likely to again be an appreciable part of the employment function for some time. Polite stealing of help, big advertisements and all that goes with it have sunk out of sight. From now on it looks as though the function of employment management is the legitimate one of a more or less scientific selection of help and their careful and thorough training for the jobs they are to do and then making them content with the jobs, but not content to make little of them. It really seems as though the future holds out more that is worth while in employment management than the past. That is, it seems as though the work of industrial relations, of which employment management is a part, might become a very important factor in the cost of production and it certainly looks as though cost of production was again to become a very important part of business, where perhaps sales was the most important for a time and where getting materials and workmen was the most vital for another period. That is, we are likely to run into a period of competition in which every effort to produce efficiency is going to be of importance.

Need of "Esprit de Corps"

No one who has been around shops much can doubt for a moment that there is a great difference in the productivity of different shops and he is also impressed with the fact that the same men do vastly more work in some shops than they do in others. Some of this difference is in engineering, in methods of manufacture, in methods of handling, but more of it is in *esprit de corps*, and it is with that that the employee relations department is most keenly interested. This begins with the selection of men who have a fighting chance of making good in each job, then training them so as to bring out the best there is in them. It continues with seeing that they are placed under foremen who will make profitable use of the investment which has been put into them and so managing their relations to the firm that they will see that from a business point of view it is to their advantage to stick to it, and that from a social point of view they will want to stay. This is a rather large and comprehensive program but it takes the whole program to make an employment department which it is worth while to start at all. It is of course not necessary to do everything at once. In fact if it is put into effect too hurriedly there is danger that workmen will believe that it is some sort of a scheme to exploit them and they are likely to hold off and not co-operate as they would if it were put in gradually.

Must Attract Good Workman

Thus it is made necessary that the employment manager be able to organize his work so as to make reasonably good selections where for the past few years he has merely had to attract a sufficient number of applicants. From now on he will probably get applicants enough so far as mere members go but he may have to artificially stimulate a flow of the quality he requires. Of course under competitive conditions it is very much worth while to man the shop with men who can and will gladly produce the largest amount of well-made goods. Such men are attracted by stability of employment, by a safe shop, by pleasant surroundings, by good wages, or wages proportionate to production and by association with their own kind of people.

Of course it is going to be necessary for each employment man to sell this idea to his superiors unless it happens to originate higher up, but it is certain that a great deal of the profit to be made in the future is going to be made in just this way and that is what most business is run for.

Small Machines for Building Optical Instruments

By J. V. HUNTER
Western Editor, *American Machinist*

The publicity given to the present-day tendency toward mass production with heavy machines is apt to cause us to overlook many items of interest in metal working of a different nature. The following article describes some miniature machines which have been built for use in the manufacture of delicate instruments.

AN INSTRUMENT which the occulist uses when he gazes into the interior of your eye is known as the ophthalmoscope or retinoscope. One of the makers of these instruments is the S. A. Rhodes Manufacturing Co., Chicago, Ill., in whose shop the interesting small machine tools which are here illustrated are to be found.



FIG. 1. SALT SHAKER AS CONTAINER FOR SMALL SCREWS

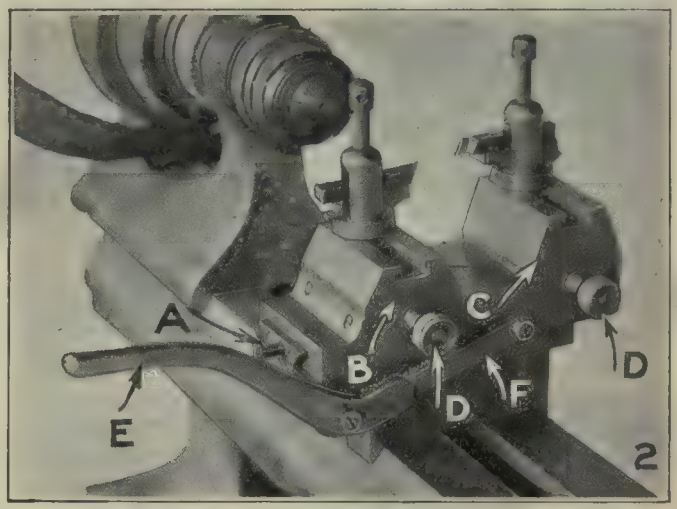


FIG. 2. CUT-OFF SLIDE FOR JEWELER'S LATHE

Some of the work done in the construction of these machines is similar to that done on small clocks, and one of the best evidences of the minute character of some parts is shown by the fact that a salt shaker is used for the storage of one size of small screws. The illustration, Fig. 1, shows it lying on its side with a few of the screws shaken out through the perforations. This method of handling is very convenient for the workman.

Mr. Rhodes has designed many small tools which better fit his shop for the character of work with which it is occupied. One of them is the cut-off slide, Fig. 2, which is provided as the tool carriage on a standard jewelers' lathe. Screw stops *A* that may be set for the depth of the cut are provided on both ends of the slide. Longitudinal adjustment of the two tools is provided by the compound slides *B* and *C*, which are adjusted by means of the thumb nuts *D*. In making a cut, the main slide is operated forward and back by means of the small hand lever *E* through the toggle link *F*.

A lens container to hold lenses of varying power in each of the openings around its rim is shown at *A* in Fig. 3. Outside of these openings a very narrow groove has been previously cut nearly through the entire thickness of the plate, leaving a thin flange of metal surrounding the hole. After putting a lens in place, the container disk is placed in the machine, as shown by the illustration, and the spinning head *B*, operated by the handle *C*, sets down the thin flange of metal, firmly holding the lens in the disk. At the same time the disk is pressed up against the spinning head by means of the hand lever D. The entire machine, including its base, is approximately 10¾ in. high and weighs 4½ pounds.

The bench hand-press, Fig. 4, is one of the smaller machines constructed in the shop under consideration. It is used for punching out little parts, different dies being set in the bolster plate for different jobs. In the illustration, the machine is equipped with a riveting head for forcing small studs *A* into the flat steel springs *B*. The studs go in opposite sides of the two ends of the springs, and the recess *C* in the top of the extra bolster plate permits the spring in which one stud has already been inserted to lie flat. A small ejector is operated by the lever *D* to force the riveted stud out of the hole in the die. The body of the press is a single casting, the crankshaft bearings at the top being solid. The slide is dovetailed into the face of the column, and is provided with a gib which can be adjusted by setscrews. The link connecting the crankshaft with the slide is held by a screw on the eccentric stud turned on the end of the crankshaft, and it is attached to the slide by a stud riveted in place. The entire machine is 10¼ in. high and weighs 12 pounds.

A Milling Machine Weighing 6 Pounds

If the description of the masterpiece of this collection has been left for the last, it loses nothing of interest by contrast with that which has gone before.

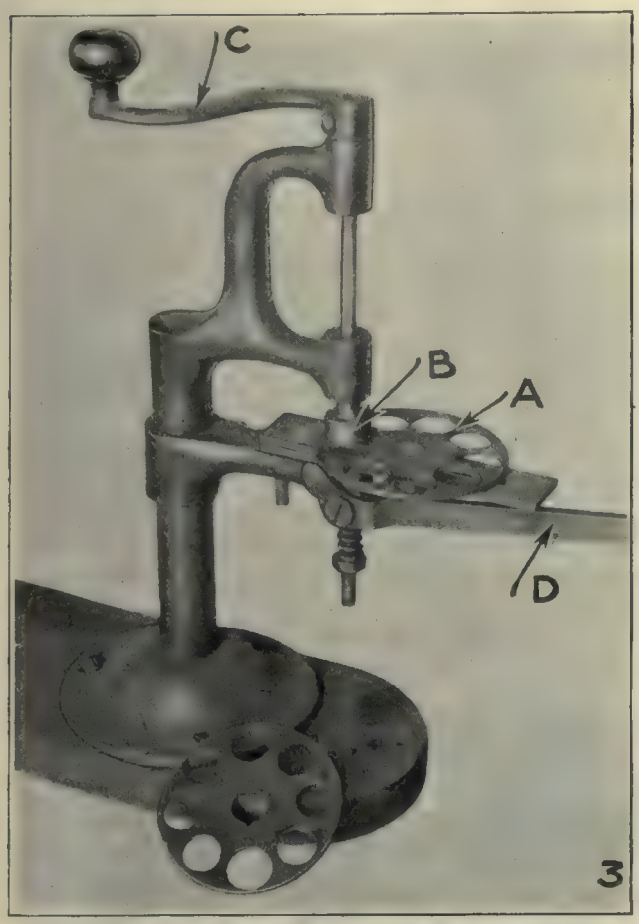


FIG. 3. SMALL SPINNING DEVICE FOR SECURING LENSES IN THEIR CONTAINERS

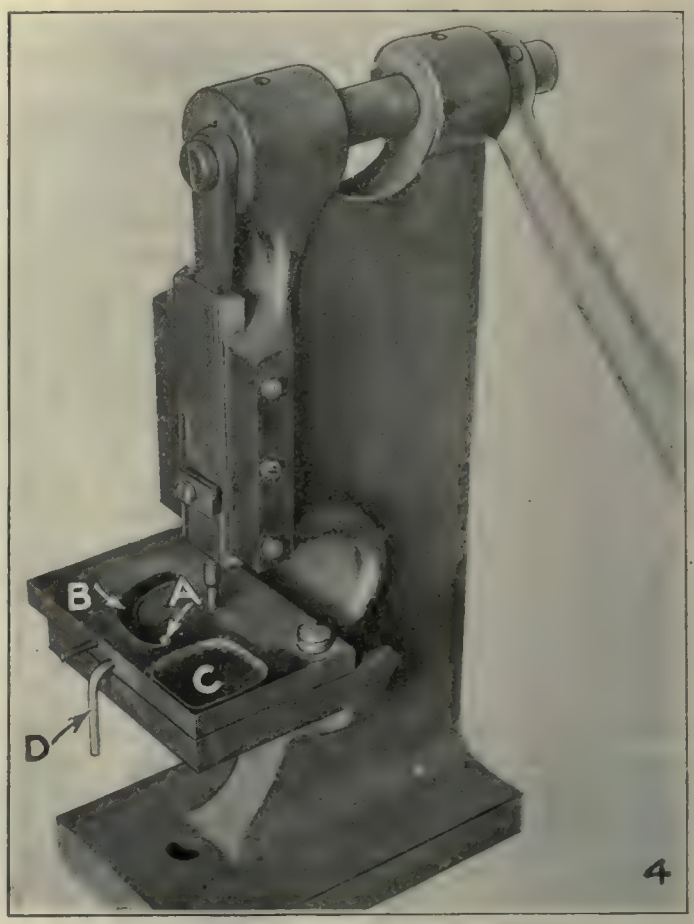


FIG. 4. 12-LB. PUNCH PRESS SET UP FOR A RIVETING JOB

The milling machine illustrated in Fig. 5 was designed and built for machining small parts that can be held in a chuck. At the rear of the machine stands a 6-in. scale *A*, indicating the height of the machine from its base to the center of the spindle. The complete machine,

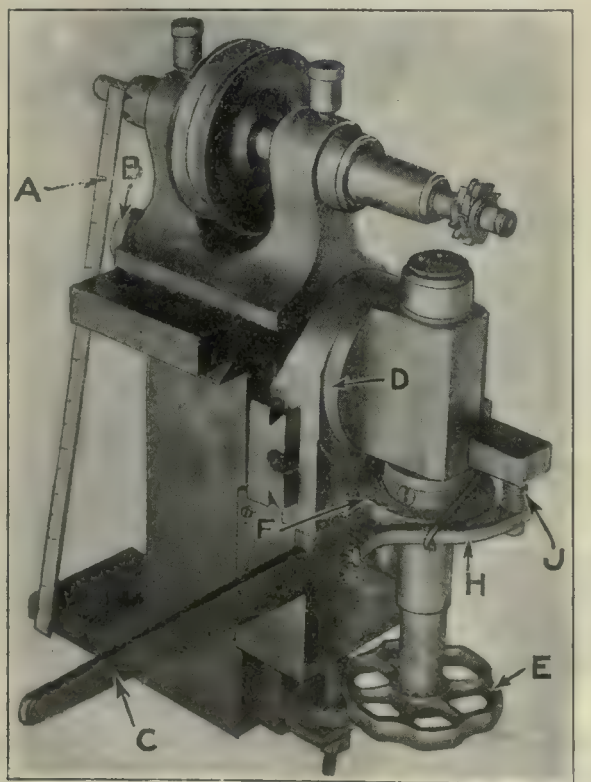


FIG. 5. LEFT-HAND SIDE OF 6-LB. MILLING MACHINE

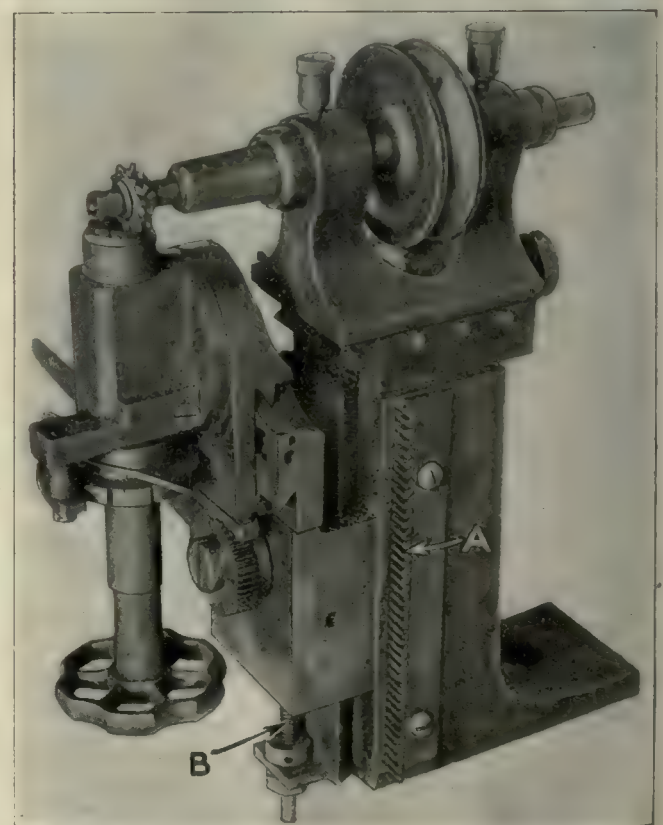


FIG. 6. VERTICAL FEED RACK ON RIGHT SIDE OF MILLING MACHINE

as shown here, weighs an even 6 pounds. Its column is provided with a foot by which it can be bolted to a table, and it carries a spindle head which can be adjusted in or out by means of a thumb nut *B* on its rear side in order to position the cutter with respect to the work. The spindle is driven by a round belt on a single grooved pulley. It is mounted in steel bearings, and the rear bearing is tapered and may be adjusted by means of the nut on the rear of the spindle to take up end play. Small cup oilers are located on the top of each bearing.

The knee slides vertically on ways on the face of the column and has an adjustable gib. It was originally provided with a vertical feed, with a hand lever operating a pinion in the rack *A*, Fig. 6, but this has been temporarily removed while the machine is in service on its present job. A screw stop *B*, provided with adjusting nuts, is arranged so that the knee can be set at any desired height.

The saddle slides horizontally on the ways of the knee. It is provided with a rack-and-pinion feed operated by the lever *C*, Fig. 5, for moving the work under the cutter.

The rise on the saddle may be swiveled in a vertical plane, and the graduations can be noted on the circular portion *D* of the base. By means of a nut on the back of the saddle, the vise is clamped in position after it has been set at the desired angle. The vise is fitted with a spring collet that is drawn down by the handle *E*. The spindle of the collet can be rotated for indexing the work when multiple slotting the heads of screws. For this purpose it is provided with an index flange *F*, in which notches have been cut. The flange is indexed by the trigger *H*, which normally is held firmly against the flange by means of a spring *J*.

To enumerate and describe the different parts on this milling machine makes it seem almost as large and complicated as a full sized machine, such as a No. 3, but the difference in size can be illustrated no more strikingly than by saying that the crown of a man's hat placed over the little machine will entirely cover and hide it.

Marking Tools by Etching

By E. A. Dixie

About the only way to mark hardened tools satisfactorily is by the etching process. They can be marked by an electric instrument which fuses the surface but the marks made by this instrument are irregular, with little blobs of metal along the lines, and on very fine tools there is a possibility that the intense heat, at least 3,000 deg. F. at the point where the etching is done, may cause a distortion. By the chemical process of etching, the steel is eroded by an acid, the lines are as uniform as the lines drawn on the work by the etcher, there are no blobs of metal at the sides of the lines and the amount of heat generated by the chemical action is so slight that it cannot injure the most delicate instrument. Further, with the exception of the eyeglass, the entire outfit can be bought for less than half a dollar.

In Fig. 1 all the essentials for etching are shown. They comprise a *glass stoppered* bottle of 25 per cent nitric acid; a small can of Asphaltum varnish; a fountain pen or medicine dropper; a coil of wax fillet such as patternmakers use; an etching point; and an ordinary toolmaker's eyeglass. Besides the outfit shown the etcher should have two or three small brushes, such as one



FIG. 1. THE ESSENTIALS FOR ETCHING

can even now buy at the druggist's for five cents each, and a squirt can of kerosene or gasoline. The etching point shown was made from a small darning needle, and is for small work. The etcher should have several points if his work is varied. Fig. 2 shows three types. Note the bent end of the thin point. This is one of the handiest points, and not well known. If it is made from a thin needle, so that it is springy, very fine script can be written with it in the etching resist.

The steel to be etched should be clean and bright, although this is not absolutely necessary. It is coated with a thin coat of the asphalt varnish. If the varnish in the can is too thick it can be thinned with a very little gasoline or kerosene, of which gasoline is the better because it dries more quickly. The tool can then be left to dry slowly or drying of the varnish may be accelerated by warming the tool slightly. From time to time the etcher should test the dryness of the varnish with the tip of his finger, applied at some point on the surface where he does not intend to scratch with the etching point. When the varnish has become dry enough so that it will not stick to the finger, that is to say, *beyond* the "tacky" stage, it is ready for the next operation.

With the tip of the finger, powdered chalk, talcum or any other white powder is smeared in a very thin coat over the varnish. This forms a "ground" for the etcher's *pencil* sketch of what he wishes on the tool. He then takes a soft lead pencil and sketches in the words or figures *very lightly*, being exceedingly careful *not to cut through the soft varnish* which protects the steel. for every part of the steel which is exposed will be attacked by the acid.



FIG. 2. THREE TYPES OF ETCHING POINTS

The various steps are shown in Fig. 3, beginning at the left. The samples shown were prepared especially for this article and were purposely etched large for reproduction. They are patternmakers' chisels, the left one 1½ in. and the others 1¼ in. wide. *A* shows the chisel coated with varnish, dusted with chalk and the letters H.R. sketched in with a "B" pencil.

The etcher now takes the most suitable etching point and scratches the outlines of the letters or design right through the varnish so that the steel is exposed as shown by the letter H on chisel *B*. He then, with the glass, examines the outline carefully to see whether or not it needs correcting anywhere. Correction can usually be done better before the letters are fully blocked out as one can often make the whole job look all right by "doctoring" two or three of the letters next the one on which the slip has been made. Having decided that the outline is to his liking he proceeds to block the letters out as shown by the letter R and the vinculum of the H on chisel *B*. The work is again examined for mistakes and corrections made.

Being satisfied with the work the etcher takes a soft cloth or one of the small brushes and dusts off all the chalk. If this is left on it causes the acid to boil and much of its strength is wasted on eating the chalk instead of the steel. Having removed the chalk the etcher takes a piece of the wax fillet long enough to surround the words or diagram and presses it firmly down onto the face of the work, being careful that it makes a tight dam around the scratched part so that the acid will not run beyond the varnished surface. This stage of the work is shown by chisel *C*. The work is now ready for the application of the nitric acid.

The work is adjusted in a level position, with the face up. With the medicine dropper the etcher drops a little of the acid on the scratched part of the tool within the wax dam, being careful to see that all of the exposed surface of the steel is wet with the acid. Almost immediately small bubbles will form in the acid along the lines scratched on the steel. Where the lines are very fine the bubbles will be very small and close together. As they prevent more acid from reaching the scratched lines they should be removed. This is easily done by sucking up the acid with the dropper and then dropping it again, being very careful not to scratch away any of the varnish. On work which has very fine lines it will be necesasry to repeat this operation several times during the etching process. The acid will eat in several thousandths deep in a few minutes, the depth and time depending upon the strength of the acid and the steel being etched. The etcher should remember that for this work concentrated acid does not work so rapidly as diluted acid. I have no data at present covering nitric acid, but with sulphuric the mixture which acts quickest is about 11 or 12 per cent. The same is also true of hydrochloric.

Having "bitten in" the design to a sufficient depth the etcher removes the excess acid with the dropper and then takes the job to the sink to wash the remaining acid out. He should be careful not to allow any of the acid to drip or run over other bright work or other bright portions of the job as it will at once make a black stain wherever it touches.

After washing the work thoroughly with water the wax is removed and the varnish washed off with a rag wet with gasoline or kerosene. Work which cannot be washed in water (for example a fine toolmakers' protractor) for fear of rusting its parts should be washed

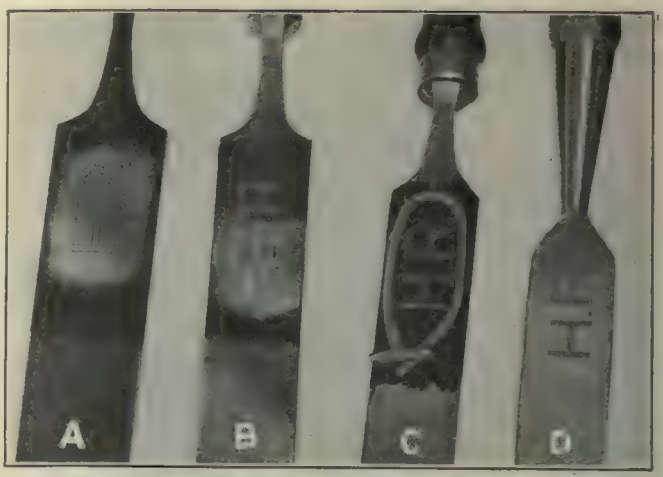


FIG. 3. SUCCESSIVE OPERATIONS IN ETCHING

with the medicine dropper, using strong sal soda water, as the sal soda neutralizes the acid. The finished job is shown by *D*.

There are a few things that the beginner should remember: Do not attempt to etch nickelplated tools with nitric acid as it has little effect on nickel. If you want to etch nickel, get the druggist to mix you some "aqua regia" which is a mixture of nitric and hydrochloric acids.

Be careful not to scratch the varnish off anywhere except where you wish to etch, but if you do, or your etching point slips, cover the defect with a little varnish and let it dry as described, before going on with the work. Never let the varnish harden dead hard before starting to scratch the design, because hard dry varnish has a most unpleasant habit of jumping off in flakes, leaving a line which will etch unevenly.

The varnish should be spread on *thinly* but *evenly*, and if very fine lines are to be etched, the varnish should be *especially thin.*

Phonograph needles make good etching points for some work, but are too stiff for other kinds. The needle shown in Fig. 1 has the extreme tip bent over at about a right angle, the point extending about ⅛ in. from the body of the needle and works well on script.

Besides etching designs on work the writer has used the process for cutting out springs of varied shapes from hardened flat spring steel stock, and for "drilling" holes in hard stock such as old hacksaw blades. When either of these jobs is in hand the shape of the spring or the location and size of the hole is laid out on *both* sides of the stock which has previously been *varnished all over.* The work is then put in a shallow glass, earthenware or lead (nitric acid does not attack lead) receptacle with the acid covering it. The etcher should see that the job is so placed that the acid can get at the design on both sides. The beginner should experiment on pieces of old hacksaws until he becomes familiar with the work and the depths of etch he gets with various lengths of exposure to the erosive action of the acid. At the start do not allow the acid to remain longer than say five minutes on the work. It can be examined with the glass after washing in clean water and if not deep enough it can be subjected to the acid again *if the varnish is not injured.*

Do not have fine bright tools close to an etching operation as the gas bubbles formed on the work often throw microscopic drops of acid when they burst, and these, falling on bright work, will make little black spots like fly specks.

Developing and Holding Foreign Trade

For some time prior to the war, the foreign trade of the United States showed a healthy increase; but the great conflict, in converging the thought and energies of Europe upon war and its necessities, gradually converted the American nation into the temporary workshop and supply house of the world. In an endeavor to meet this unprecedented demand for its products and manufactures of every description, with the added strain of becoming in 1917 an active belligerent in the conflict, there have been invested in the United States since 1914, in new productive enterprises and machinery, more than six billions of dollars. If these new forces, in addition to those in operation before the war, are now to be kept in productive activity, it becomes incumbent upon the United States to develop foreign outlets to take over the surplus to be expected from this production.

THE POSITION of this country during the war was an extremely difficult one. Not only had we become for the time being the banker and supply house of the world, but the cataclysm of a world war with its imperative and immediate demands had placed almost insuperable obstacles in the way of our adequately answering this universal demand upon us.

Now, however, that peace is again established the country appears to be slowly awakening to a realization that no nation of the world has ever had thrust upon it the foreign trade possibilities which are now opened up before us. Before the world conflict Germany and England were impelled by economic forces to develop external markets for their surplus products, inasmuch as their productive machinery was producing a surplus above that required for home consumption. The United States, on the other hand, to the time of the outbreak of the war had been growing with such tremendous strides that any preparation for foreign trade was soon overtaken by the home demand.

Now, however, with the termination of the war the productive capacity of all Europe will again be diverted to the interests of peace and competition for world markets must of necessity become keen. In this crisis if this country is to keep in productive activity the vast new forces which were created during the war to enable us to answer the demand of the world upon us for our products we have no alternative but to enter actively into this competition in an endeavor to develop permanent markets for the surplus which these forces must inevitably create.

With a view to meeting this competition the highest intelligence that can be spared from our various lines of business interested in foreign development should visit South America. This preliminary survey should not be left to salesmen. It must be remembered that in South America there are today approximately sixty-five millions of people. The field is a vast one and has heretofore been intensively cultivated by Europe.

An axiom in foreign trade is that "Business follows Investment." The vast foreign commerce transacted before the war between Europe and South America was based primarily upon Europe's investment in South American bonds and public utilities of every description. The opportunities for such further investment are extensive and should now be taken advantage of by American capital.

Within the past few years the great packing interests in this country have established large plants in Brazil, in Uruguay and in the Argentine, and American mining companies are constantly augmenting their holdings in Chile and along the West Coast. Practically every line of American business effort is now represented in the various South American countries and the constant inquiries we receive indicate an ever-increasing interest on the part of American business men, not only in South American trade development, but likewise in the possibilities of the southern continent for the investment of capital. The measure of our ability, therefore, to retain the foreign business which abnormal world conditions have temporarily diverted to this country will be the extent to which we intelligently cultivate the trade of our new acquaintances. If we will now bring to bear upon our efforts at reconstruction and the development of a permanent foreign trade that same intelligence and energy which we devoted intensively to the prosecution of the war our efforts in this direction should meet with a like measure of success. We must remember, however, that the confidence of foreign merchants can be inspired only by properly pricing our goods for export; by according time where the credit standing of foreign client so warrants; by scrupulously adhering to instructions regarding packing and billing; by avoiding substitution without securing the consent of client thereto, and in general through endeavoring to impress upon our foreign friends by the manner in which we fill their orders our desire to develop a permanent foreign trade by applying to the business with which they favor us those same high principles of scrupulous business probity which have built up the vast domestic commerce of this country.

How to Hold Foreign Trade

The development of a permanent foreign trade requires as much care and attention to holding business once secured as it does to its original development, and as competition increases the truth of this assertion becomes more apparent. As an aid to the development and retention of foreign business the following suggestions are offered:

First. That correspondence be in the language of the country in which client is located; that is, if the customer is a subject or citizen of that country, and if it is not known that he is familiar with English.

There is likewise a prevalent complaint throughout South America as to apparent laxity in our methods of correspondence. It must be remembered that South American clients are many thousands of miles from their sources of supply, and inquiries should be answered immediately and in detail. If an order is received and conditions render impossible immediate

manufacture this information should be communicated immediately to foreign client, and if delay in shipping is occasioned for any reason, notice to this effect by cable or letter will be appreciated. In other words, it is advisable to keep foreign clients constantly advised as to the progress that is being made with their orders. In fact, the opportunity of corresponding in this manner should be taken advantage of, as in addition to placating a customer by keeping him informed there is an element of courtesy involved which is appreciated.

SECOND. In selling endeavor to give the foreign client what he wants, and not just what you wish to sell him. The application of this principle is the basis upon which was constructed the vast foreign trade of England, France and Germany before the war.

THIRD. Conform strictly to the instructions of customers as to packing, billing and the preparation of documents. It is well to assume that the foreign merchant is probably more familiar with the requirements of his own government and the customs or habits of his own trade than we can possibly be.

FOURTH. Investigate the credit standing of those with whom you contemplate establishing relations.

PACKING

A subject calling for close and intelligent study in foreign trade is the packing of shipments. On the kind and manner of packing depends the arrival of shipment at destination, the amount of rail and ocean freight charged for transportation and the amount of customs duties imposed. Duties are frequently affected, sometimes quite seriously, by faulty packing or by the use of a container or a covering which brings the contents under a classification of tariff higher than would be the case were a different kind or method of packing used.

Packing should be considered with three different aspects in view: the preservation of the merchandise, economy in duties to be imposed by the foreign custom house, and economy in the space occupied by the packed shipment. In connection with this subject it should be remembered that in addition to the severe and varied handlings of shipments incident to being placed aboard vessel in this country they are subjected to considerable additional handling in the foreign port, and to interior points in many of the South American countries transportation from the coast is by means of river steamer, raft and mule. Generally speaking, bulky packages should be avoided when this is possible, it being far better to divide the shipment into two or perhaps three parts.

Packing should be as light as possible, consistent, however, with the strength necessary to carry to destination, intact and in proper condition, the particular class of merchandise shipped, having in mind the numerous exceedingly rough handlings and many changes to which all foreign shipments are subjected.

If, to answer this purpose, a heavier case with metal straps and bands is necessary, then by all means the packing should be done in this manner.

When a foreign buyer suggests that his order be packed in a certain way, it is possible that his request is based upon the rules of the custom house regarding the imposition of duties. As an illustration of this point, shovels when imported into Chile pay no duty if they come into the country complete. If, however, the handles and the metal bases come packed separately duties are imposed upon each. It is evident that a shipment of shovels sent forward in this divided manner will entail upon the part of foreign purchaser the payment of the duties imposed resulting in dissatisfaction and complaint.

When merchandise is forwarded to a distributing agent, goods for different consignees should not be placed in the same case unless instructions have been received to this effect, because, when so packed, delivery to any one consignee renders necessary the payment of all duties and the release from the customs of the entire shipment.

Where various packages make up a shipment to one consignee, it is advisable to have the same identifying mark appear on all. Consecutive numbers should be used to distinguish the various packages. To illustrate:—If a shipment is prepared for Juan Silveira & Co., Buenos Aires, the identifying mark would probably be:

J. S. & CO.
BAIRES

If there were two bales or boxes, they would be marked:

J. S. & CO	J. S. & CO
BAIRES	BAIRES
Number 1	Number 2

and these marks and identifying numbers should appear on the consular invoices, the bills of lading, and on the commercial invoices, with the contents of each. and with the net and gross weights in kilos and the measurements in inches or in the metric system.

The principal port in the Argentine is Buenos Aires. Sailings are maintained from New York, Mobile and New Orleans. Shipments require consular invoice written in Spanish. Cases, bales and packages may be marked either with a stencil or brush. It is likewise necessary that cases, bales and packages bear the shipping mark and number as well as the name of steamer by which goods are shipped. This should appear on two sides. The observance of this rule will facilitate release through foreign customs.

PACKING AND IMPORT DUTIES

In connection with packing it is important to note that upon imports into most South American countries the duty is levied on the gross weight, meaning thereby the total weight less rough wooden or other container.

When container is of a nature the duty on which may be higher than that of its contents, separate duties are levied thereon.

Merchandise of various kinds, if packed in the same case or package, runs the risk of being assessed at the rate of the highest taxed article therein. Furthermore, if the description of the goods in declaration is such as to render doubtful the classification under which the shipment should be placed, foreign customs authorities always classify under the highest rating.

In practically all of our large cities it will be found that consuls of the various South American countries have offices, and before packing shipments, it is advisable for exporters to find out whether the duties to be imposed in the South American country of destination are calculated on the net, legal or gross weight. The net weight indicates the weight of the article itself, exclusive of its packing or wrapping. The legal weight signifies the weight of the article plus

its immediate covering. For example, on merchandise packed in cardboard boxes with perhaps a half gross or more of these boxes in a case, the legal weight is the weight of the merchandise plus the cardboard container, but not the weight of the outside wooden case. Gross weight means the total weight of the merchandise including the outside container.

A recent shipment of neckwear to Chile was refused by the consignee on the ground that the ties came packed in fancy cardboard boxes, one tie in a box, the container weighing three times as much as the tie itself. The duties in this instance were imposed by "legal weight," and had the merchant accepted shipment it will be seen that for each tie he would have been taxed four times, viz.: the duty on the tie, plus the duty at the same rate on the cardboard box, figured on its weight.

LABELS ON MERCHANDISE

Labels on the merchandise itself should be in Portuguese on shipments to Brazil, and in Spanish on shipments to other South American countries. This is an important detail to keep in mind, as labels in English mean little or nothing to the general public in South America.

These observations should be sufficient to indicate the necessity for the exercise of extreme care, if the interests of foreign clients are to be protected.

—THE NATIONAL CITY BANK OF NEW YORK.

Measure of Damages for Loss Caused By Negligence In Repairing Machinery

BY LESLIE CHILDS

It may be stated broadly that where one holds himself out as a machinist, and contracts to repair or rebuild machinery, he is presumed to be competent, and to realize the danger likely to result from negligent or unskilled work. And if the work is done in a careless or negligent manner, which results in future damage to the machinery, he will be liable for such damage if it was directly caused by his unskillful work.

However the measure of damages for losses caused by negligence in repairing machinery is controlled by certain well-defined limitations. And, as noted above, the machinist is only liable for loss caused by his negligence in repairing, which was within the contemplation of the parties when the contract for repairing was made. In other words he is only liable for loss which proximately resulted from his unskillful work.

The law books contain many cases illustrating the application of this rule in measuring damages for the breach of contracts of this kind. And it appears probable that the examination of a particular case of this kind would be of more profit than any number of abstract or general statements of rules. For this purpose the recent case of Moorhead vs. Arkansas Machine and Boiler Works, 205 S. W. 980 is of special interest, the facts involved being in the main as follows:

W. H. Moorhead employed the Arkansas Machine and Boiler Works to make certain repairs upon a steam engine. The repairs were made and Moorhead proceeded to use the engine, whereupon it wrecked itself.

Thereafter Moorhead brought an action for damages against the Arkansas Machine and Boiler Works for the loss caused by the destruction of the engine. This action was based upon the contention that the destruction of the engine was caused by the negligence of the other in making the repairs. In specifying the negligence complained of, the following language was used:

The Arkansas Machine and Boiler Works in doing the work failed "to drill a sufficient number of holes of a sufficient depth, and in not putting in a sufficient number of capscrews, and in not putting in properly the capscrews that were put in to hold the broken piece in place, in that the holes were not drilled into the broken piece as they should have been, but were only made like shallow dents, against which the capscrews were placed, but which allowed the broken piece to slip upward, thereby causing the flywheel shaft to jump out of its bearings and destroying the engine almost completely."

It appears that Moorhead used the engine for the purpose of pumping water for a rice crop, and that after the mishap to the engine he was put to considerable delay in getting another. So in his action he asked damages for both the destruction of the engine and for loss to the rice crop caused by the delay in getting another engine.

The Arkansas Machine and Boiler Works on the other hand contended that the measure of damages was the difference in value of the work as done, and its value if it had been done properly. They introduced testimony to show that the total charge for the repairs was but $11, and insisted that the measure of damages should be taken with this in view.

The trial in the lower court resulted in a judgment for $150 in favor of Moorhead for damage to the engine, but the court eliminated the question of damage for injury to the crop. From this judgment the Arkansas Machine and Boiler Works prosecuted an appeal to the Supreme Court, where in passing upon the record it was said among other things:

"One holding himself out as a machinist and accepting employment to repair a steam engine is presumed to know the nature and the character of the work he is about to do, and the results likely to follow a negligent performance of his work, and is, therefore, liable for the damage proximately resulting from a negligent and unskilful performance of his work . . . ."

The Supreme Court thereupon affirmed the judgment in favor of Moorhead rendered in the lower court. Holding that on the record he was entitled to damages for the destruction of the engine; this because such damage must have been within the contemplation of the parties when the contract was made.

The court, however, approved the acts of the lower court in eliminating the question of Moorhead recovering for damages to the rice crop, alleged to have been caused by the delay in getting another engine. This for the reason that such damages were too remote, and therefore were not in the minds of the parties when the contract for repairs was entered into.

The opinion in the above case is supported by the great weight of authority on the question involved and illustrates in a clear manner the limitations upon the liability of a machinist for negligence in repairing machinery. Holding that he is bound to do the work in a competent, workmanlike manner, being liable for any damage proximately resulting from his negligence; yet he cannot be made liable for remote damages, or those arising indirectly from his negligence, which were not in mind or contemplation of the parties when the contract was made.

Temperature Conversion Tables

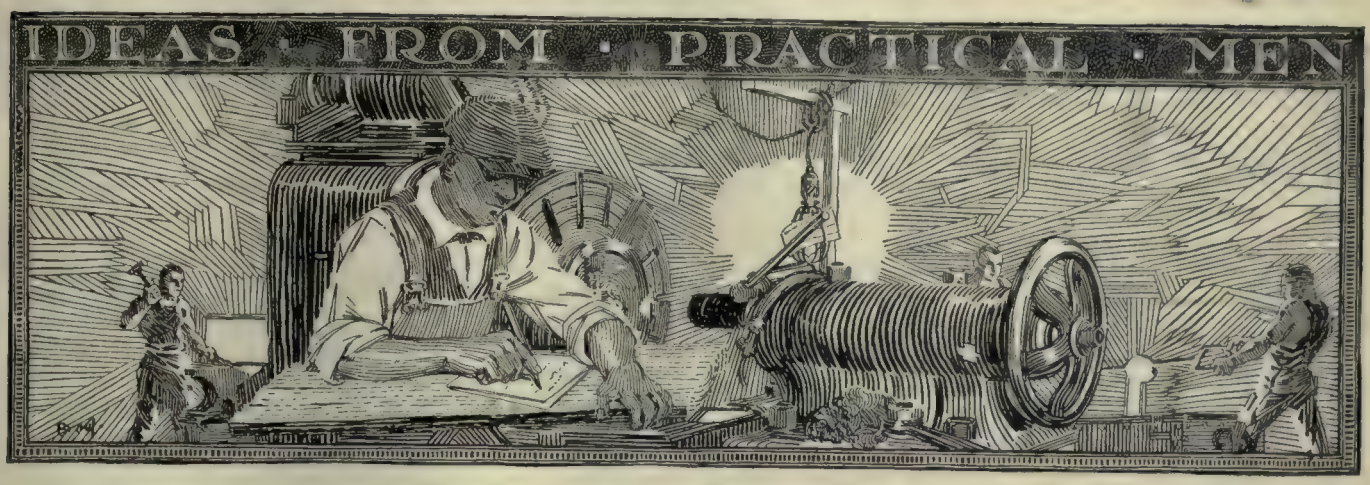
By Albert Sauveur

—459.4 to 0			0 to 100			100 to 1000			1000 to 2000			2000 to 3000		
C.		F.	C.		F.	C.		F.	C.		F.	C.		F.
—273	—459.4		—17.8	0	32	10.0	50	122.0	38	100	212	260	500	932	538	1000	1832	816	1500	2732	1093	2000	3632	1371	2500	4532
—268	—450		—17.2	1	33.8	10.6	51	123.8	43	110	230	266	510	950	543	1010	1850	821	1510	2750	1099	2010	3650	1377	2510	4550
—262	—440		—16.7	2	35.6	11.1	52	125.6	49	120	248	271	520	968	549	1020	1868	827	1520	2768	1104	2020	3668	1382	2520	4568
—257	—430		—16.1	3	37.4	11.7	53	127.4	54	130	266	277	530	986	554	1030	1886	832	1530	2786	1110	2030	3686	1388	2530	4586
—251	—420		—15.6	4	39.2	12.2	54	129.2	60	140	284	282	540	1004	560	1040	1904	838	1540	2804	1116	2040	3704	1393	2540	4604
—246	—410		—15.0	5	41.0	12.8	55	131.0	66	150	302	288	550	1022	566	1050	1922	843	1550	2822	1121	2050	3722	1399	2550	4622
—240	—400		—14.4	6	42.8	13.3	56	132.8	71	160	320	293	560	1040	571	1060	1940	849	1560	2840	1127	2060	3740	1404	2560	4640
—234	—390		—13.9	7	44.6	13.9	57	134.6	77	170	338	299	570	1058	577	1070	1958	854	1570	2858	1132	2070	3758	1410	2570	4658
—229	—380		—13.3	8	46.4	14.4	58	136.4	82	180	356	304	580	1076	582	1080	1976	860	1580	2876	1138	2080	3776	1416	2580	4676
—223	—370		—12.8	9	48.2	15.0	59	138.2	88	190	374	310	590	1094	588	1090	1994	866	1590	2894	1143	2090	3794	1421	2590	4694
—218	—360		—12.2	10	50.0	15.6	60	140.0	93	200	392	316	600	1112	593	1100	2012	871	1600	2912	1149	2100	3812	1427	2600	4712
—212	—350		—11.7	11	51.8	16.1	61	141.8	99	210	410	321	610	1130	599	1110	2030	877	1610	2930	1154	2110	3830	1432	2610	4730
—207	—340		—11.1	12	53.6	16.7	62	143.6	100	212	413	327	620	1148	604	1120	2048	882	1620	2948	1160	2120	3848	1438	2620	4748
—201	—330		—10.6	13	55.4	17.2	63	145.4	104	220	428	332	630	1166	610	1130	2066	888	1630	2966	1166	2130	3866	1443	2630	4766
—196	—320		—10.0	14	57.2	17.8	64	147.2	110	230	446	338	640	1184	616	1140	2084	893	1640	2984	1171	2140	3884	1449	2640	4784
—190	—310		— 9.44	15	59.0	18.3	65	149.0	116	240	464	343	650	1202	621	1150	2102	899	1650	3002	1177	2150	3902	1454	2650	4802
—184	—300		— 8.89	16	61.8	18.9	66	150.8	121	250	482	349	660	1220	627	1160	2120	904	1660	3020	1182	2160	3920	1460	2660	4820
—179	—290		— 8.33	17	63.6	19.4	67	152.6	127	260	500	354	670	1238	632	1170	2138	910	1670	3038	1188	2170	3938	1466	2670	4838
—173	—280		— 7.78	18	65.4	20.0	68	154.4	132	270	518	360	680	1256	638	1180	2156	916	1680	3056	1193	2180	3956	1471	2680	4856
—169	—273	—459.4	— 7.22	19	67.2	20.6	69	156.2	138	280	536	366	690	1274	643	1190	2174	921	1690	3074	1199	2190	3974	1477	2690	4874
—168	—270	—454	— 6.67	20	68.0	21.1	70	158.0	143	290	554	371	700	1292	649	1200	2192	927	1700	3092	1204	2200	3992	1482	2700	4892
—162	—260	—436	— 6.11	21	69.8	21.7	71	159.8	149	300	572	377	710	1310	654	1210	2210	932	1710	3110	1210	2210	4010	1488	2710	4910
—157	—250	—418	— 5.56	22	71.6	22.2	72	161.6	154	310	590	382	720	1328	660	1220	2228	938	1720	3128	1216	2220	4028	1493	2720	4928
—151	—240	—400	— 5.00	23	73.4	22.8	73	163.4	160	320	608	388	730	1346	666	1230	2246	943	1730	3146	1221	2230	4046	1499	2730	4946
—146	—230	—382	— 4.44	24	75.2	23.3	74	165.2	166	330	626	393	740	1364	671	1240	2264	949	1740	3164	1227	2240	4064	1504	2740	4964
—140	—220	—364	— 3.89	25	77.0	23.9	75	167.0	171	340	644	399	750	1382	677	1250	2282	954	1750	3182	1232	2250	4082	1510	2750	4982
—134	—210	—346	— 3.33	26	78.8	24.4	76	168.8	177	350	662	404	760	1400	682	1260	2300	960	1760	3200	1238	2260	4100	1516	2760	5000
—129	—200	—328	— 2.78	27	80.6	25.0	77	170.6	182	360	680	410	770	1418	688	1270	2318	966	1770	3218	1243	2270	4118	1521	2770	5018
—123	—190	—310	— 2.22	28	82.4	25.6	78	172.4	188	370	698	416	780	1436	693	1280	2336	971	1780	3236	1249	2280	4136	1527	2780	5036
—118	—180	—292	— 1.67	29	84.2	26.1	79	174.2	193	380	716	421	790	1454	699	1290	2354	977	1790	3254	1254	2290	4154	1532	2790	5054
—112	—170	—274	— 1.11	30	86.0	26.7	80	176.0	199	390	734	427	800	1472	704	1300	2372	982	1800	3272	1260	2300	4172	1538	2800	5072
—107	—160	—256	— 0.56	31	87.8	27.2	81	177.8	204	400	752	432	810	1490	710	1310	2390	988	1810	3290	1266	2310	4190	1543	2810	5090
—101	—150	—238	0	32	89.6	27.8	82	179.6	210	410	770	438	820	1508	716	1320	2408	993	1820	3308	1271	2320	4208	1549	2820	5108
— 95.6	—140	—220	0.56	33	91.4	28.3	83	181.4	216	420	788	443	830	1526	721	1330	2426	999	1830	3326	1277	2330	4226	1554	2830	5126
— 90.0	—130	—202	1.11	34	93.2	28.9	84	183.2	221	430	806	449	840	1544	727	1340	2444	1004	1840	3344	1282	2340	4244	1560	2840	5144
— 84.4	—120	—184	1.67	35	95.0	29.4	85	185.0	227	440	824	454	850	1562	732	1350	2462	1010	1850	3362	1288	2350	4262	1566	2850	5162
— 78.9	—110	—166	2.22	36	96.8	30.0	86	186.8	232	450	842	460	860	1580	738	1360	2480	1016	1860	3380	1293	2360	4280	1571	2860	5180
— 73.3	—100	—148	2.78	37	98.6	30.6	87	188.6	238	460	860	466	870	1598	743	1370	2498	1021	1870	3398	1299	2370	4298	1577	2870	5198
— 67.8	— 90	—130	3.33	38	100.4	31.1	88	190.4	243	470	878	471	880	1616	749	1380	2516	1027	1880	3416	1304	2380	4316	1582	2880	5216
— 62.2	— 80	—112	3.89	39	102.2	31.7	89	192.2	249	480	896	477	890	1634	754	1390	2534	1032	1890	3434	1310	2390	4334	1588	2890	5234
— 56.7	— 70	— 94	4.44	40	104.0	32.2	90	194.0	254	490	914	482	900	1652	760	1400	2552	1038	1900	3452	1316	2400	4352	1593	2900	5252
— 51.1	— 60	— 76	5.00	41	105.8	32.8	91	195.8				488	910	1670	766	1410	2570	1043	1910	3470	1321	2410	4370	1599	2910	5270
— 45.6	— 50	— 58	5.56	42	107.6	33.3	92	197.6				493	920	1688	771	1420	2588	1049	1920	3488	1327	2420	4388	1604	2920	5288
— 40.0	— 40	— 40	6.11	43	109.4	33.9	93	199.4				499	930	1706	777	1430	2606	1054	1930	3506	1332	2430	4406	1610	2930	5306
— 34.4	— 30	— 22	6.67	44	111.2	34.4	94	201.2				504	940	1724	782	1440	2624	1060	1940	3524	1338	2440	4424	1616	2940	5324
— 28.9	— 20	— 4	7.22	45	113.0	35.0	95	203.0				510	950	1742	788	1450	2642	1066	1950	3542	1343	2450	4442	1621	2950	5342
— 23.3	— 10	14	7.78	46	114.8	35.6	96	204.8				516	960	1760	793	1460	2660	1071	1960	3560	1349	2460	4460	1627	2960	5360
— 17.8	0	32	8.33	47	116.6	36.1	97	206.6				521	970	1778	799	1470	2678	1077	1970	3578	1354	2470	4478	1632	2970	5378
			8.89	48	118.4	36.7	98	208.4				527	980	1796	804	1480	2696	1082	1980	3596	1360	2480	4496	1638	2980	5396
			9.44	49	120.2	37.2	99	210.2				532	990	1814	810	1490	2714	1088	1990	3614	1366	2490	4514	1643	2990	5414
						37.8	100	212.0				538	1000	1832				1093	2000	3632				1649	3000	5432

NOTE:—The numbers in bold face type refer to the temperature either in degrees Centigrade or Fahrenheit which it is desired to convert into the other scale. If converting from Fahrenheit degrees to Centigrade degrees the equivalent temperature will be found in the left column, while if converting from degrees Centigrade to degrees Fahrenheit, the answer will be found in the column on the right. These tables are a revision of those by Sauveur & Boylston, metallurgical engineers, Cambridge, Mass. Copyright, 1920.

INTERPOLATION FACTORS

C.		F.	C.		F.
0 56	1	1 8	3 33	6	10 8
1 11	2	3 6	3 89	7	12 6
1 67	3	5 4	4 44	8	14 4
2 22	4	7 2	5 00	9	16 2
2 78	5	9 0	5 56	10	18.0



Can Anybody Help?

By Sandy Copeland

In a recent serious accident occurring near our factory, one that involved the partial collapse of a building and injury to a number of people, there was found upon clearing away the débris, the piece of metal reproduced in the accompanying illustration.

Though the piece has an exasperatingly familiar look, no one about the place has been able to positively identify it. As it is absolutely certain that it is no part of anything that was legitimately around the place when the trouble started; as the immediate cause of the trouble was a mysterious explosion, of the force of which the piece bears ample evidence; and as there is more than suspicion that the event was not entirely accidental, we believe that its identification may lead to positive knowledge that will go far toward preventing a repetition of the event.

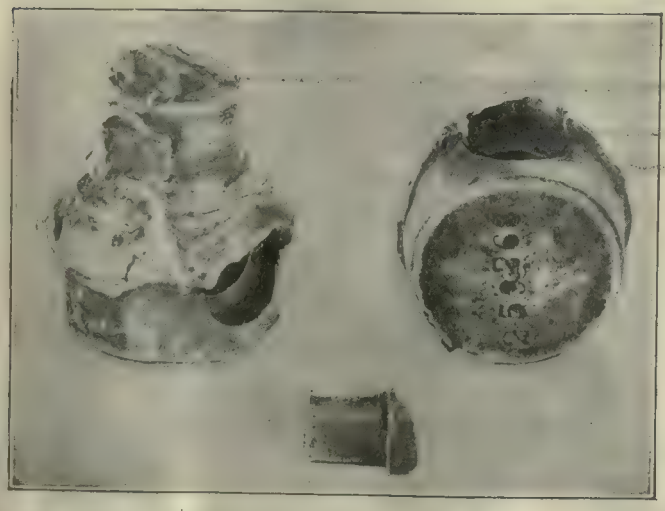
The object is of cold rolled steel, still bearing the toolmarks of the machine that produced it, and upon the larger end bears the maker's serial number running to six figures; indicating that it is by no means unique. The broken end is squared, indicating that a wrench was used in conjunction with it or that it was itself a wrench, belonging to some special machine or device.

The larger end is about 1 1/16 in. in diameter by 5/8 in. under the shoulder. The beveled part is also 5/8 in. long, running from the largest diameter down to the neck, which measures about 3/4 in. in diameter by 1/2 in. long. The square part, which has been broken off, was 3/8 in. square and of a length of course unknown.

The small piece to the right is apparently a shouldered stud, the smaller diameter fitting in the transverse hole shown in the large end of the piece. The diameter of this stud where it enters the hole is 3/8 in. and the shoulder apparently once fitted the counterbore. The stud was not broken off on the smaller end and therefore never passed more than half-way through the piece, though there might have been a similar stud in the other side, as the hole is counterbored at both ends.

Can anybody tell us what it is?

[We can vouch for our correspondent's sincerity in the above matter and are giving him publicity because of its importance. Any of our readers who can and will identify this piece of junk will have conferred a benefit upon humanity.—Editor.]

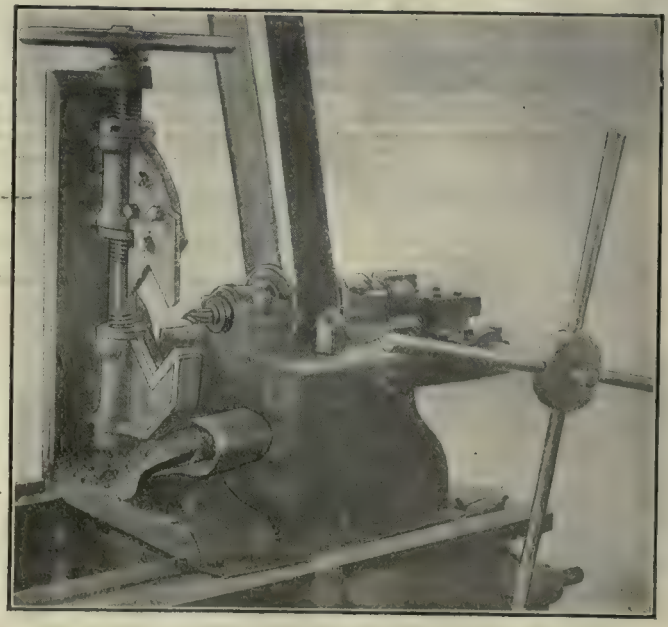


DO YOU KNOW WHAT THIS IS?

A Home-Made Centering Machine

By John Vincent

Those who sometimes wonder what becomes of all the old machine tools should make a few visits to the out-of-the-way corners of shops where the tools past their prime are gradually slid away and relegated to other uses. In a shop recently visited, an old lathe bed now



A HOME-MADE CENTERING MACHINE

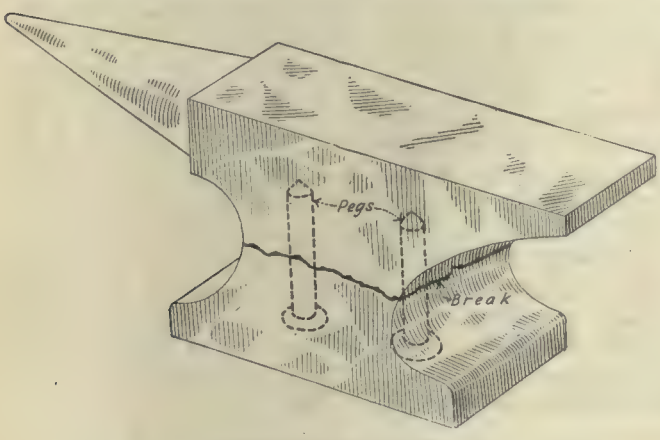
serves for the base of a centering machine as shown in the illustration. It has been fitted with a head casting carrying a sliding spindle driven by a single-speed pulley from the line shaft.

The spindle carries the centering tool and may be fed in and out by rack and pinion operated by the spoke wheel. It will be noted that a pipe vise for holding the work has been fitted on a vertical bracket that is bolted to the bed casting. The vise screws are fitted with an adjustment on each jaw so their position may be altered, should wear cause them to hold the work out of center.

Repairing a Broken Anvil

By G. Blake
Watford, England

"Repairing a Blacksmith's Vise," by Edward Heller, on page 795, vol. 51, of *American Machinist*, brings to the writer's mind the repairing of a blacksmith's anvil



THE BROKEN ANVIL

in the small shop where he served his apprenticeship. We had an anvil weighing about 250 lb., used principally for the forging of small lathe tools and similar work. It broke as shown in the sketch and was seemingly of no more use except as scrap iron; however, as this anvil was in constant demand in the shop and not being able to procure another one to replace it locally, it occurred to the writer that it could be repaired and made use of temporarily until the new one came along.

Two 1¼-in. holes were drilled and reamed in the base and through into the top part to a depth of 4½ in.; then two good fitting mild steel pegs were driven into position. This temporary repair lasted nine months.

Right-Angle Conventional Thread

By R. Beaver

On page 564-e of the *American Machinist*, there is shown a special triangle for indicating threads.

I attach a sketch showing a method of thread indicating. It is very simple and is always done at right angles with the axis. Everybody is familiar with this method but it is not much used, judging from what I see.



CONVENTIONAL THREAD

A Slide-Rule Kink

By Henry R. Bowman

I have struck on a little slide rule kink that simplifies the finding of a diameter when the number of sides of an inscribed polygon and the length of a side are known.

This applies to finding the pitch diameter of a sprocket or gear when the pitch (chordal) and number of teeth are known. Place the slide in the reversed position (trig. scales up) with indices exactly in line; scribe an accurate line on the sine scale opposite the graduation marked "2" on the left-hand "A" scale and fill in with ink or black shellac varnish so that it will be legible. Work out the formula: $A = \frac{180^\circ}{n}$ in the usual way on the "C" and "D" scales giving the center angle of the triangle of which the short side is one-half of the pitch and the hypotenuse the required radius.

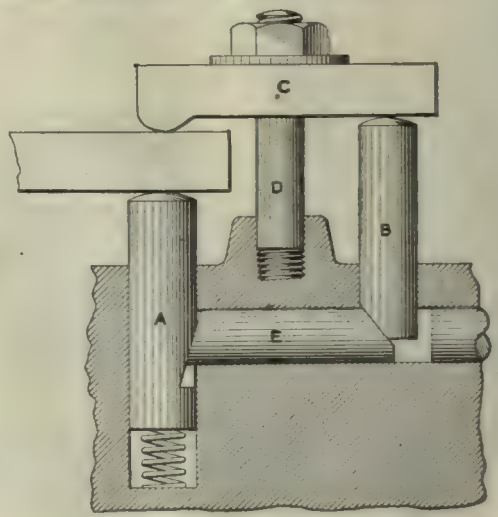
Set the runner to one-half of the pitch on the "A" scale, bring the angle A under the hair line of the runner, and over the scribed line on the sine scale read the required diameter on the "A" scale. This saves three operations; viz., moving the runner to the indices, reversing and resetting the slide and moving the runner to the graduation marked 2 on the "B" scale.

Clamping Device with Automatically Locked Spring Plunger Support

By George G. Little

Referring to the article on page 722, vol. 52, of *American Machinist*, entitled "Clamping Device With Automatically Locked Spring Plunger": It is not an efficient clamp owing to the difference in power of the two wedge surfaces A and B shown in the illustration herewith. This difference will permit the clamp C to force the work and spring plunger to a point below the spring locating position for the reason that the action of the wedge A, under same amount of pressure as applied to B, causes the spring plunger to crowd the pin E in the direction indicated by the arrow and which in turn crowds the pin B upward.

To overcome this fault the stud D should be located near enough to B to reduce the pressure on A sufficiently to equalize the pressures upon A and B.



THE EQUALIZING CLAMP THAT DOES NOT EQUALIZE

WHAT to READ —for the man in a hurry



Suggested by the Managing Editor

ANOTHER new tool description for a leader in this week's issue. The subject of the description is the double carriage production lathe of the Hamilton Machine Co.

On page 1023 is a rather unusual article on "Deep Hole Drilling," the first one of any importance we have had since Mr. DeLeeuw's series on the manufacture of the 75-mm. gun carriage. The author, Charles J. Starr of the New Britain Machine Co., tells of his experiences with some standard commercial drills for this work, points out the difficulties encountered and describes in detail the design of the drills that were finally found satisfactory for the work in question.

What to read was not a difficult matter to decide two hundred years ago when books were few and magazines unheard of. It is far different now when so much reading matter is offered to pass the time pleasantly or profitably as the reader chooses. We are doing our utmost to make the "American Machinist" not only profitable but indispensable as a clearing house of ideas and news of the machinery world. This page is the editors' advertisement of their section of the paper. It gives the high spots

All sorts of elaborate accounting systems have been worked out for the big shops and factories, but most of them have been entirely too complicated for the fellow with the little shop. On page 1026 there are some sample forms and a description of their use in a shop where the bookkeeping, costkeeping and correspondence are all taken care of by one girl.

The last of Prof. Bonis' articles on the simplification of acceleration determinations begins on page 1027. This one is supplementary to the one published last week in that it gives proofs of some of the steps taken in the various constructions which were assumed to be correct in the other article. The applications here are to the quadric chain and to the bar and circular link mechanism.

Then we have a manufacturing article describing the building of saw-mill machinery in the shops of the Willamette Iron Works out in Oregon. This is another of the stories Fred H. Colvin picked up on his trip to the coast last summer.

The fourth installment of "Seven Centuries of Brass Making" starts on page 1033. This week Mr. Kenyon discusses the making of phono-electric wire and also that of brass and copper seamless tubing. Like the other articles in this series this one is so well illustrated that it is hardly necessary to give very much descriptive matter to make the operations clear.

Designers and gear men will be interested in a suggested formula and tables for determining the proper backlash for spur gears. The author of the suggestions is C. H. Logue of the Brown-Lipe Chapin Co. and his work appears on pages 1040 and 1041.

The last of the series of sketches and brief descriptions of "Modern Airplane Engines" starts on page 1042. In this one we have four American commercial engines and in the description something on the future of aviation. This was written some months ago but little has happened since then to make any changes in the situation.

Our old friend Entropy is with us again on page 1044 with some remarks on the field for employment management. Most of us will agree with him when he says, "Polite stealing of help, big advertisements and all that goes with it have sunk out of sight. From now on it looks as though the function of an employment management is the legitimate one of a more or less scientific selection of help and their careful and thorough training for the jobs they are to do, and then making them content with the jobs but not content to make little of them."

Storing machine screws in a salt shaker sounds a little wild but it is only one of several interesting stunts described in Hunter's article on Building Optical Instruments. See page 1045. Following Hunter's article is one by E. A. Dixie on the marking of hardened tools by the etching process. Dixie knows how to handle the etcher's tools and you can believe what he says.

An unusually useful temperature conversion table is printed on page 1052. With it before you, you can take any number and secure immediately its equivalent either in Centrigrade or Fahrenheit degrees.

Beginning on page 1057 we have the story of the first meeting of American Engineering Council of the Federated Engineering Societies. Mr. Morrow attended this meeting for the *American Machinist* and gives in detail a running account of the events as they occurred and his impression of the sense of the meeting. We also have President-elect Hoover's speech in full. You can't afford to miss this. It is one of the best things that has come to our attention in a long time.

OFFICERS of AMERICAN ENGINEERING COUNCIL of the FEDERATED AMERICAN ENGINEERING SOCIETIES



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AMERICAN INSTITUTE of ELECTRICAL ENGINEERS. VICE-PRESIDENT



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AMERICAN INSTITUTE of MINING AND METALLURGICAL ENGINEERS. VICE-PRESIDENT



L. W. WALLACE
SOCIETY of INDUSTRIAL ENGINEERS
TREASURER

First Meeting of American Engineering Council of the Federated American Engineering Societies

TWENTY-ONE member-societies and ten participating organizations were represented at the opening session of American Engineering Council, the managing body of the Federated American Engineering Societies. All meetings of the three-day convention, Nov. 18, 19 and 20, were held in the New Willard Hotel, Washington, D. C. The thirty-one societies, having a total membership of about 60,000, sent seventy-two delegates. These societies represent 50 per cent of the aggregate membership invited, the member-societies alone representing 35 per cent.

Richard L. Humphrey, chairman of the Joint Conference Committee, called the Thursday meeting to order and made a short address in which he gave a brief accounting of the stewardship which was entrusted to the Joint Conference Committee at the organizing conference in June. He then outlined the activities which appeared to lie before the organization. Among them he included the organization and cataloging of the engineering resources of this country; constructive suggestions based upon careful study of the great national problems, such as transportation, conservation of labor, water, fuel and other natural resources; the securing of a National Department of Public Works; and assisting in many problems connected with the National Budget System. Mr. Humphrey closed his address by referring to the purposes of solidarity and service which have prompted the organization of the Federation: "The first step in realizing the dream of the engineering and allied technical professions for solidarity has been taken. The development of this solidarity is in the hands of the representatives of the member-societies of the Federated American Engineering Societies.

"The profession is looking with intense interest to this meeting and is hopefully anticipating forward work.

"The confidence which the speaker felt and voiced in his opening remarks at the organizing conference concerning the success of that meeting he now feels in far greater measure for the success of the Federated American Engineering Societies in accomplishing the desired end of solidarity in the engineering and allied technical organizations because of the great and growing enthusiasm for this organization; with no desire to repeat his previous address at the opening of the organizing conference on June 3, the speaker wishes to emphasize that in his judgment the keynote of that meeting was the 'desire first to serve our country, and, second, to serve the societies and organizations of which we are the representatives.' And it would seem to the speaker from all circumstances which have led up to the creation of this organization that the keynote of whatever policy you may agree upon now should be 'Service.'

"Indeed, the organization by the preamble adopted at the Organizing Conference, at which it was created, is dedicated to the service of the City, State, and Nation. In living up to this, you should carefully guard each act and each step in the progress of the organization, to the end that the Federated American Engineering Societies shall stand for the highest possible ideals and shall enrich the glorious traditions of the engineering and allied technical profession."

E. S. Carman, Cleveland, of the American Society of Mechanical Engineers, was elected temporary chairman and William E. Rolfe, St. Louis, Mo., of the Associated Engineering Societies of St. Louis, was elected temporary secretary. Immediately after the temporary officers had taken their chairs, a resolution was passed expressing regret that Mr. Humphrey and his colleagues of the American Society of Civil Engineers were not sitting with the Council officially. They were given the privilege of the floor throughout the meeting of the Council and the same privilege was granted the representatives of participating organizations.

The following temporary committees were appointed, the various duties being distributed to national, regional, state and local delegates: Program; credentials; constitution and by-laws; nominations; plan and scope; budget; resolutions.

As provided by the constitution the local member-societies were divided into groups, or districts, geographically, so that they will be able to get together without an undue amount of travel. Six districts were named, each of which is entitled to one representative on the executive board. The national societies are entitled to fourteen representatives on the executive board, making with the representatives from the local societies, a total of twenty. The other four members of the executive board (the constitution provides for twenty-four) were not to be named from the present member-societies, but from societies which it is expected will join. A resolution was then passed to the effect that any society joining by July 1, 1921, shall be a charter member.

The remainder of the morning session was devoted to a discussion of the location for headquarters. The choice quickly narrowed to New York or Washington but no decision was reached and the matter was deferred for later discussion.

Thursday Afternoon Session

Thursday afternoon was devoted to reports of the program and credentials committees, to addresses on Engineering Council and to discussion concerning the location of headquarters for American Engineering Council. Washington was finally chosen, an amendment to refer the matter to the executive board with power to act having been defeated. It was explained that at any time the board by consent of the council can change the place of the headquarters.

J. Parke Channing, chairman, Engineering Council, spoke on "Engineering Council." He told of the struggles which the council had during its earliest days and how things eventually straightened out until for the last two years Engineering Council has been sailing in smooth water. He then read the following list of accomplishments of the council and suggested that American Engineering Council follow in a general way the lines of Engineering Council based on its four years' experience.

"During the war we furnished the Government with the names of 4,000 engineers for war service; aided the Naval Consulting Board and the Army General Staff in examining 135,000 suggestions and inventions for war devices; assisted the Fuel Administrator and the Bureau of Mines in fuel conservation; helped secure exemption of engineer students from military service until the completion of their technical training; and supplied Congress with information about water power.

"On Jan. 1, 1919, we opened an office in Washington giving varied service to engineers, especially in supplying information concerning Congressional and Departmental activities and have also aided the Government in engineering matters.

"In April, 1919, we called a Conference at Chicago of seventy-four technical organizations having 105,000 members. This conference is permanently organized and is advocating the establishment of a National Department of Public Works by the modification of existing departments.

"Through an appeal to the President, we have brought together a conference of fourteen Government offices engaged in map making, with prospects of getting under one head the completion of the topographical map of the United States.

"We aided in securing increases of pay for railway technical engineers.

"We now have a Classification and Compensation Committee of Engineers, with sections on Railways, Federal Government, Municipal and State Governments, and are accomplishing results.

"We are working in harmony with the Congressional Joint Committee on Reclassification of Salaries.

"We have aided in the reinstatement of 350 engineers unfairly dismissed by the city of New York.

"We have organized a committee on types of Government contracts.

"We have just drafted a typical law for the registration of engineers.

"We have assisted the State of New York in preparing for the reorganization of State Government, particularly with reference to engineering branches.

"We joined with the National Research Board in a report on an improvement of the patent system as a result of which legislative action is being taken.

"We have participated in organizing the National Board of Jurisdictional Awards in the building industry and have a member thereon.

"Only last week, and at the request of the Federal Power Commission, we made recommendations to it concerning vital questions in the administration of this commission, and about a month ago we did the same thing for the State of Maine.

"This is only a partial list of what we have accomplished but it shows the general lines along which we have been working."

Alfred D. Flinn, secretary of Engineering Council and Dr. D. S. Jacobus and Philip N. Moore, members, described phases of the work of Engineering Council.

A brief discussion of highways, railways and canals was led by Lewis B. Stillwell, New York, N. Y., of the American Institute of Electrical Engineers.

Just before adjournment it was announced that the application for membership of the Taylor Society had been received and that Morris L. Cooke, Philadelphia, was its delegate.

L. W. Wallace, Baltimore, Md., of the Society of Industrial Engineers, opened the Friday morning session with an address on "Conservation of Labor." He spoke of human beings as the most important element in economics and the source of all wealth; analyzed the work done by the safety advisor and the welfare director; remarked concerning medical service, education and labor troubles. In conclusion he said that it is the duty of the engineer to analyze some conditions and foresee others and of the industrial engineer to prescribe for the ills of industry.

Hoover Elected President

Following the report of the committee on nominations Herbert Hoover, of the American Institute of Mining and Metallurgical Engineers, was elected president by unanimous ballot. Calvert Townley, New York, American Institute of Electrical Engineers, and William E. Rolfe, St. Louis, Associated Engineering Societies of St. Louis, were elected vice-presidents for two years. Dexter S. Kimball, Ithaca, N. Y., American Society of Mechanical Engineers and J. Parke Channing, New York, N. Y., American Institute of Mining and Metallurgical Engineers, were elected vice-presidents for one year. L. W. Wallace, Baltimore, Md., the Society of Industrial Engineers, was elected treasurer. In accepting the office of president of American Engineering Council Mr. Hoover said that he could not refuse to take any service where he could be of value to his profession and to the world at large; that he has long been in favor of such an association to enable the engineer to have a voice in the community; and that there has been no time when we have so needed the benefits of the knowledge of the trained engineer, who alone is able to speak on broad engineering subjects.

A number of amendments to the constitution and by-laws were voted on and the constitution and by-laws as amended were adopted. Among the amendments adopted were those changing the term "executive officer" to "executive secretary;" specifying "at least bimonthly" instead of "regular monthly" meetings, except during July and August; making the contributions of each member-society payable "quarterly" (on Jan. 1, April 1, July 1 and Oct. 1) instead of "semi-annually;" and changing the time limit for payment of dues to three months instead of six.

Friday Afternoon Session

The first business completed during the Friday afternoon session was that of announcing the twenty members of the Executive Board from the six districts to which the member-societies had been allocated geographically and from the national societies. Following are the names of the members and the sections or societies which they represent:

District No. 1.—New England and the State of New York.—W. B. Powell, Buffalo, N. Y., Engineering Society of Buffalo, and Byron E. White, Utica, N. Y., Mohawk Valley Engineers' Club—one-half vote each.

District No. 2.—Michigan, Wisconsin and Minnesota. —Burritt A. Parks, Grand Rapids, Mich., Grand Rapids Engineering Society, and D. J. Sterrett, Detroit, Mich., Detroit Engineering Society—one-half vote each.

District No. 3.—Ohio, Indiana and Illinois.—John F. Oberlin, Cleveland, Ohio, the Cleveland Engineering Society.

District No. 4.—Pennsylvania, Delaware, Maryland and the District of Columbia.—W. W. Varney, Baltimore, Md., The Engineers' Club of Baltimore.

District No. 5—All the southern states, including Louisiana and Texas.—O. H. Koch, Dallas, Texas, Technical Club of Dallas.

District No. 6.—Other local societies west of the Mississippi.—Lloyd B. Smith, Topeka, Kan., Kansas Engineering Society.

American Institute of Chemical Engineers.—Harrison E. Howe, Washington, D. C.

American Institute of Electrical Engineers.—H. W. Buck, New York, N. Y.; William McClellan, Philadelphia, Pa.; Charles F. Scott, New Haven, Conn.; Lewis B. Stillwell, New York, N. Y.

American Institute of Mining and Metallurgical Engineers.—Arthur S. Dwight, New York, N. Y.; Edwin Ludlow, New York, N. Y.; Philip N. Moore, St. Louis, Mo.

American Society of Agricultural Engineers.—Samuel H. McCrory, Washington, D. C.

American Society of Mechanical Engineers.—L. P. Alford, New York; Arthur M. Greene, Jr., Troy, N. Y.; E. S. Carman, Cleveland, Ohio; Fred J. Miller, Center Bridge, Pa.

The Taylor Society.—Morris L. Cooke, Philadelphia, Pa.

The report of the committee on plan and scope proposed that subjects for consideration by American Engineering Council may be initiated either by the board itself or by outside sources; the endorsement of Engineering Council's work; and the assumption of its topics. A list of topics was submitted, as follows:

1. To serve the public interest by investigation and advice to all public governmental and voluntary bodies, dealing with national economic problems.
2. Department of Public Works.
3. Conservation of natural resources.
4. Co-operation with other national organizations, technical, industrial and commercial.
5. Technical education.
6. Transportation, particularly highways.
7. Advice to state, regional and local societies.
8. National Bureau of Economic Research.
9. Public fire protection.
10. Patents.
11. National Board for Jurisdictional Awards.
12. International affiliation of engineers.
13. State organization of local affiliations.
14. Licensing and local registration of professional engineers.
15. Classification and compensation of engineers.
16. Engineering societies service bureau.

The report of the budget committee showed an estimated minimum income of $59,000 for the coming year, based on the assumption that no more societies will join the Federation and an estimated maximum income of $80,000 based on the assumption that all of the societies designated on the program as "participating" will join. The estimated minimum and maximum expenses of the organization for the year amounted to $56,500 and $92,500.

The American Engineering Council finished the business of its first meeting by passing resolutions of thanks to the four founder societies and to the Engineering Society of Washington; of appreciation and thanks to Richard L. Humphrey; and of appreciation concerning the support given by the daily and technical press.

At the evening session Herbert Hoover delivered an address, "Some Phases of Relationship of Engineering Societies to Public Service." Following this address there was an informal reception and smoker tendered by the engineering societies of Washington, D. C.

Meeting of the Executive Board

The first meeting of the executive board, held on Saturday morning, was presided over by vice-president William E. Rolfe. Charles F. Scott was elected temporary secretary. Representatives of participating societies were given the privilege of the floor.

Calvert Townley, L. P. Alford, John F. Oberlin, Charles F. Scott, Philip N. Moore and L. W. Wallace were named to act as a committee with President Hoover to canvas the persons eligible for the position of executive-secretary and to report as soon as practicable to the board.

Other results of the session of the executive board were the approval of the councils' action in selecting Washington as the headquarters; approval of the extension of time for charter-membership to July 1, 1921; and reference of the resolution on publicity to the committee on publicity and publications when appointed. It was voted to constitute the committee of Engineering Council on the Nolan patent bill the committee of American Engineering Council.

It was voted that the next meeting be called at the discretion of the president, not later than the month of January.

A resolution was passed favoring compilation and publication in English of Critical Tables of Physical and Chemical Constants.

The executive board endorsed the plan of Mr. Hoover for an investigation of industrial waste and authorized him to form an organization for this purpose.

The question of how dues are to be leveled by classes of membership of constituent societies was referred to the committee on membership and representation for report.

The executive board passed a resolution recognizing the great importance of the movement to organize and establish a Department of Public Works and declaring itself in favor of adding its efforts to that end.

Calvert Townley and William E. Rolfe were elected vice-chairmen of the executive board, and L. P. Alford was named to serve as temporary secretary until the next meeting. It was voted to request the American Society of Mechanical Engineers to assist Mr. Alford.

A Letter from A. S. C. E.

The following letter from the American Society of Civil Engineers was read with no little interest and with some surprise:

November 15, 1920.

Mr. Alfred D. Flinn, Secretary,
Engineering Council,
Washington, D. C.

I beg to transmit the following action of the Board of Direction of this Society taken at its meeting of November 9, 1920.

Whereas, the American Society of Civil Engineers by a vote of 3,278 to 2,330 has decided not to become a charter member of the Federated American Engineering Societies, and

Whereas, it has been suggested that the work of Engineering Council should be turned over to and taken up by the said Federated American Engineering Societies; be it

Resolved, that the Board of Direction hereby instructs its representatives upon Engineering Council to state to Engineering Council that they cannot participate in any action by Engineering Council in transfering its activities to the Federated American Engineering Societies.

Be it further resolved, that the Board instructs its representatives to express to the Council its hope that Engineering Council will for the present continue to carry forward its work.

Yours very truly,
(Signed) H. S. CROCKER,
Acting Secretary.

It appears that this unexpected move on the part of the A. S. C. E. may have some effect on what would otherwise be the smooth transfer of the affairs of Engineering Council to American Engineering Council. One of the rules of Engineering Council is that a negative action on the part of one of the member-societies holds up the action of the council. Therefore by action as indicated in its letter the A. S. C. E. can hold up the transfer. Such action might result in its being necessary for Engineering Council to go out of existence for lack of funds as three of the member-societies will withdraw from the council on Dec. 31. Or the three societies remaining with representatives on Engineering Council might carry on the council and its work. There is another point for consideration which is that Engineering Council functions under the United Engineering Societies which may have jurisdiction and be able to bring about the transfer of work from Engineering Council to American Engineering Council, dissolving the earlier organization.

MEMBER-SOCIETIES AND REPRESENTATIVES

Alabama Technical Association, Birmingham, Ala., Paul Wright, Birmingham, Ala.

American Institute of Chemical Engineers, Brooklyn, N. Y., Allerton S. Cushman, Washington, D. C.; Harrison E. Howe (alternate), Washington, D. C.

American Institute of Electrical Engineers, New York, N. Y., Calvert Townley (chairman), New York, N. Y.; Comfort A. Adams, Cambridge, Mass.; A. W. Berresford, Milwaukee, Wis.; H. W. Buck, New York, N. Y.; F. L. Hutchinson, New York, N. Y.; G. A. Waters, St. Louis, Mo.; William McClellan, Philadelphia, Pa.; L. F. Morehouse, New York, N. Y.; J. H. Finney, Washington, D. C.; Charles S. Ruffner, New York, N. Y.; Charles F. Scott, New Haven, Conn.; Lewis B. Stillwell, New York, N. Y.

American Institute of Mining and Metallurgical Engineers, New York, N. Y., Herbert Hoover, Palo Alto, Cal.; J. Parke Channing, New York, N. Y.; Arthur S. Dwight, New York, N. Y.; Edwin Ludlow, New York, N. Y.; Allen H. Rogers, Boston, Mass.; Philip N. Moore, St. Louis, Mo.; Percy E. Barbour, New York, N. Y.; Joseph W. Richards, Bethlehem, Pa.

American Society of Agricultural Engineers, Ames, Iowa, Samuel H. McCrory, Washington, D. C.

American Society of Mechanical Engineers, New York, N. Y., L. P. Alford (chairman), New York, N. Y.; Charles T. Main, Boston, Mass.; Arthur M. Greene, Jr., Troy, N. Y.; E. S. Carman, Cleveland, Ohio; Arthur L. Rice, Chicago, Ill.; Dexter S. Kimball, Ithaca, N. Y.; Paul Wright, Birmingham, Ala.; W. A. Hanley, Indianapolis, Ind.; William B. Gregory, New Orleans, La.; V. M. Palmer, Rochester, N. Y.; H. P. Porter, Tulsa, Okla.; Robert H. Fernald, Philadelphia, Pa.; L. C. Nordmeyer, St. Louis, Mo.; Fred J. Miller (alternate), Centre Bridge, Pa.; Robert Sibley (alternate), San Francisco, Cal.; Charles Whiting Baker (alternate), New York, N. Y.

Associated Engineering Societies of St. Louis, Mo., William E. Rolfe, St. Louis, Mo.

Detroit Engineering Society, Detroit, Mich., D. J. Sterrett, Detroit, Mich.

Engineering Association of Nashville, Tenn., A. F. Ganier, Nashville, Tenn.

Engineering Society of Buffalo, N. Y., W. B. Powell, Buffalo, N. Y.

Grand Rapids Engineering Society, Grand Rapids, Mich., Burritt A. Parks, Grand Rapids, Mich.

Kansas Engineering Society, Topeka, Kan., Lloyd B. Smith, Topeka, Kan.

Louisiana Engineering Society, New Orleans, La., William B. Gregory, New Orleans, La.

Mohawk Valley Engineers' Club, Utica, N. Y., Byron E. White, Utica, N. Y.

Technical Club of Dallas, Tex., O. H. Koch, Dallas, Tex

The Cleveland Engineering Society, Cleveland, Ohio, John F. Oberlin, Cleveland, Ohio.

The Engineers' Club of Baltimore, Md., W. W. Varney, Baltimore, Md.

The Society of Industrial Engineers, Chicago, Ill., L. W. Wallace, Baltimore, Md.

Washington Society of Engineers, Washington, D. C., E. C. Barnard, Washington, D. C.

York Engineering Society, York, Pa., William J. Fisher, York, Pa.; H. A. Delano (alternate), York, Pa.

PARTICIPATING ORGANIZATIONS AND DELEGATES*

American Institute of Architects, Washington, D. C., Percy C. Adams, Washington, D. C.

American Society of Heating and Ventilating Engineers, New York, N. Y., Champlain L. Riley, New York, N. Y.

American Society for Testing Materials, Philadelphia, Pa., C. D. Young, Reading, Pa.; C. L. Warwick, Philadelphia, Pa.

Florida Engineering Society, Gainesville, Fla., L. R. McLain, St. Augustine, Fla.

Illuminating Engineering Society, New York, N. Y., Walter C. Allen, Washington, D. C.

Iowa Engineering Society, Iowa City, Iowa, John H. Dunlap, Iowa City, Iowa.

National Fire Protection Association, Boston, Mass., Ira H. Woolson, New York, N. Y.; D. Knickerbacker Boyd, Philadelphia, Pa.

Society of Automotive Engineers, New York, N. Y., Howard E. Coffin (chairman), Detroit, Mich.; David Beecroft, New York, N. Y.; Coker F. Clarkson, New York, N. Y.; H. M. Crane, New York, N. Y.; C. F. Kettering, Dayton, Ohio; H. M. Swetland, New York, N. Y.

Society for the Promotion of Engineering Education, Pittsburgh, Pa., F. L. Bishop, Pittsburgh, Pa.

Taylor Society, New York, N. Y., Morris L. Cooke, Philadelphia, Pa.

Engineering Society of Massachusetts, C. L. Newcombe, Holyoke, Mass.

*These organizations are either considering or have given the matter of membership favorable considerattion but have not taken final action.



Some Phases of Relationship of Engineering Societies to Public Service

THE Federation of Engineering Societies, embracing the membership of between 100,000 and 200,000 professional engineers, has been created for the sole purpose of public service. This initial meeting surely warrants some discussion of a few of the problems to which this organization, for expression of the engineering mind, can quite well give consideration.

One of the greatest of the problems before the country and in fact, before the world, are those growing out of our industrial development. The enormous industrial expansion of the last fifty years has lifted the standard of living and comfort beyond any dream of our forefathers. Our economic system under which it has been accomplished has given stimulation to invention, to enterprise, to individual improvement of the highest order; yet it presents a series of human and social difficulties to the solution of which we are groping. The congestion of population is producing subnormal conditions of life. The vast repetitive operations are dulling the human mind. The intermittency of employment due to the bad co-ordination of industry, the great waves of unemployment in the ebb and flow of economic tides, produce infinite wastes and great suffering. Our business enterprises have become so large and complex that the old personal relationship between employer and worker has to a great extent disappeared. The aggregation of great wealth, with its power of economic domination, presents social, economic ills which we are constantly struggling to remedy.

I propose to traverse only a small fraction of these matters. I do not conceive that any man, or body of men, is capable of drafting in advance a plan that will solve these multiple difficulties and preserve the system which makes individual initiative possible. We have presented to us economic social patent medicines of one kind or another and in fact the great panacea of socialism is today in actual trial in its various forms. In Russia the attempt has been made to apply the most extreme form of complete communism. The Russian experiment is bankrupt in production. The populations of our modern states have been built up to numbers dependent upon an intensity of production that can only be maintained by stimulation of individual effort through the impulse of self-interest, and a departure from this primary incentive to production has now been demonstrated to lead only to famine and flame and anarchy. We have even had a gigantic experiment imposed upon the United States by the war in the necessity to operate a vast merchant marine at the hands of the Government, with a result that should offer little consolation to those who advocate even the mildest application of socialism.

We have built up our civilization, political, social and economic, on the foundation of individualism. We have found in the course of development of large industry upon this system that individual initiative can be destroyed by allowing the concentration of industry and service, and thus an economic domination of groups over the whole. We have therefore built up public agencies intended to preserve an equality of opportunity through control of possible economic domination. Our mass of regulation of public utilities and of many other types of industry, aiming chiefly to prevent combinations in restraint of free enterprise, is a monument to our attempts to limit this economic domination—to give a square deal. This regulation is itself also proof of the abandonment of the unrestricted capitalism of Adam Smith. While our present system of individualism under controlled capitalism may not be perfect, the alternative offers nothing that warrants its abandonment. Our thought, therefore, needs to be directed to the improvement of this structure and not to its destruction.

A profound development of our economic system apart from control of capital and service during the last score of years has been the great growth and consolidation of voluntary local and national associations. These associations represent great economic groups of common purpose and are quite apart from the great voluntary groups created solely for public service. We have the growth of great employers' associations, great farmers' associations, great merchants' associations, great bankers' associations, great labor associations—all economic groups striving by political agitation, propaganda and other measures to advance group interest. At times they come in sharp conflict with each other and often enough charge each other with crimes against public interest. And to me one question of the successful development of our economic system rests upon whether we can turn the aspects of these great national associations toward co-ordination with each other in the solution of national economic problems, or whether they grow into groups for more violent conflict. The latter can spell breakdown to our entire national life.

This engineers' association stands somewhat apart among these economic groups in that it has no special economic interest for its members. Its only interest in the creation of a great national association is public service, to give voice to the thought of the engineers in these questions. And if the engineers, with their training in quantitative thought, with their intimate experience in industrial life, can be of service in bringing about co-operation between these great economic groups of special interests, they will have performed an extraordinary service. The engineers should be able to take an objective and detached point of view. They do not belong to the associations of either employers or labor, of farmers, or merchants or bankers. Their calling in life is to offer expert service in constructive solution of problems, to the individuals in any of these groups. There is a wider vision of this expert service in giving the group service of engineers to group problems.

We have just passed through a period of unparalleled speculation, extravagance and waste. We shall now not only reap its inevitable harvest of unemployment and readjustment, but we shall feel the real effect of four years of world destruction, and from it economic and social problems will stand out in vivid disputation. One of the greatest conflicts rumbling up in the distance is that between the employer on one side and organized labor on the other. We hear a great deal from extremists on one side about the domination of the employer and on the other about the domination of organized

*Address of Herbert Hoover before American Engineering Council of the Federated American Engineering Societies.

labor. Probably the tendency to domination exists among the extremists on both sides. One of the most perplexing difficulties in all discussion and action in these problems is to eliminate this same extremist. There are certain areas of conflict of interest, but there is between these groups a far greater area of common interest, and if we can find measures by which, through co-operation, the field of common interest could be organized, then the area of conflict could be in the largest degree eliminated.

In this connection the employer sometimes overlooks a fundamental fact in connection with organized labor in the United States. This is that the vast majority of its membership and of its direction are individualists in their attitude of mind and in their social outlook; that the expansion of socialist doctrines finds its most fertile area in the ignorance of many workers and yet the labor organizations, as they stand today, are the greatest bulwark against socialism. On the other hand, some labor leaders overlook the fact that if we are to maintain our high standards of living, our productivity, it can only be in a society in which we maintain the utmost possible initiative on the part of the employer; and further, that in the long run we can only expand the standard of living by the steady increase of production and the creation of more goods for division over the same numbers.

The American Federation of Labor has publicly stated that it desires the support of the engineering skill of the United States in the development of methods for increasing production and I believe it is the duty of our body to undertake a constructive consideration of these problems and to give assistance not only to the federation of labor but also to the other great economic organizations interested in this problem, such as the employers' association and the chambers of commerce.

It is primary to mention the three causes of waste in production: first from intermittent employment, second from unemployment that arises in shifting of industrial currents, and third from strikes and lockouts. Beyond this elimination of waste there is another field of progress in the adoption of measures for positive increase in production.

In the elimination of the great waste and misery of intermittent employment and unemployment, we need at once co-ordination in economic groups. For example, our engineers have pointed out time and again to the bituminous coal industry where the bad economic functioning of that industry results in an average of but 180 days' employment per annum, where a great measure of solution could be had if a basis of co-operation could be found between the coal operators, the coal miners, the railways and the great consumers. The combined result would be a higher standard of living to the employees, a reduced risk to the operator, a fundamental expansion of economic life by cheaper fuel. With our necessary legislation against combination and the lack of any organizing force to bring about this co-operation, the industry is helpless unless we can develop some method of Governmental interest, not in Governmental ownership, but in stimulation of co-operation in better organization.

In help against the misery in the great field of seasonal and other unemployment, we indeed need an expansion and better organization of our local and Federal labor exchanges. We have a vast amount of industry, seasonal in character, which must shift its labor complement to other industries. The individual worker is helpless to find the contacts necessary to make this shift unless the machinery for this purpose is provided for him.

In the questions of industrial conflict resulting in lockouts and strikes, one mitigating measure has been agreed upon in principle by all sections of the community. This is collective bargaining, by which, whenever possible, the parties should settle their difficulties before they start a fight.

It is founded not only on the sense of prevention but on the human right to consolidate the worker in a proper balanced position to uphold his rights against the consolidation of capital. This measure, advocated for years by organized labor, was agreed to by the employers' group in the First Industrial Conference. It has been supported on the platform of both political parties. The point where the universal application of collective bargaining has broken down is in the method of its execution. The conflict arises almost wholly over the question of representation and questions of enforcement. The employer in some industries denies the right of men other than his own employees to conduct the negotiations. Labor organizations demand that, as such negotiations require skill, experience and bargaining freedom, they are of more than local application and that thus they can only protect the body of workers by presenting the case on their behalf by skilled negotiators.

The Second Industrital Conference, of which I was a member, proposed a solution to this point by the provision that where there was a conflict over representation the determination should be left to a third and independent party. It also proposed that each party should have the right to summon skill and experience to its assistance. It further proposed that where one of the parties at dispute refuses to enter upon collective bargaining, the entire question should be referred to an independent tribunal for investigation as to the right and wrong of the whole dispute—but only for investigation and report. That conference, embracing both a great employer and a most distinguished representative of organized labor, was completely convinced that the illumination of the public mind as to the rights and wrongs of these contentions would in itself make for material progress in their solution, and that in public education and the condemnation of public opinion of wrong-doing lay the root to real progress. No group should be afraid of authoritative publicity in these matters and I believe it would greatly advance an understanding of the cause of labor. The conference did not believe that industrial contention could be cured by compulsory arbitration or any other form of Governmental repression which must in the end use the jails for enforcement. The principles formulated by that conference should have your consideration.

There are questions in connection with this entire problem of employer and employee relationship, both in its aspects of increased production and in its aspects of wasteful unemployment, that deserve most careful study by our engineers. There lies at the heart of all these questions the great human conception that this is a community working for the benefit of its human members, not for the benefit of its machines or to aggrandize individuals; that if we would build up character and abilities and standard of living in our people, we must have regard to their leisure for citizenship, for recreation and for family life. These considerations, together with protection against strain, must be the fundamen-

tals of determination of hours of labor. These factors being first protected, the maximum production of the country should become the dominating purpose. The precise hours of labor should and will vary with the varying conditions of trades and establishments, but the proper determination of hours, based upon these factors, is an immediate field demanding attention of engineers. There is no greater economic fallacy than the doctrine that the decrease of hours below these primary considerations makes for employment of greater numbers.

There is a broad question bearing upon stimulation of self-interest, and thus increase in production that revolves around the method of wage payment. I need not review to you the advantages, difficulties and weaknesses of bonus, piece work or profit sharing plans that are in use as a remedy for the deadening results of the same wage payment to good and bad skill alike. The suggestion I wish to put for your consideration is the possible use of another device in encouragement of individual interest and effort by creating two or three levels of wage in agreements for each trade, the position of each man in such scale to be based upon comparative skill and character. This plan should be developed upon the principle of graded extra compensation, for added skill and performance, above an agreed basic wage. In order to give confidence, the classification under such scales must be passed upon by representatives of the workers in such shop or department. This plan is now being successfully experimented with.

We must take account of the tendencies of our present repetitive industries to eliminate the creative instinct in its workers, to narrow their field of craftsmanship, to discard entirely the contribution to industry that could be had from their minds as well as from their hands. Indeed, if we are to secure the development of our people, we cannot permit the dulling of these sensibilities. Indeed, we cannot accomplish increased production without their stimulation. Here again we cannot make an advance unless we can secure co-operation between the employer and the employee. In large industry this mutuality of interest that existed in small units cannot be restored to its former state without definite organization.

There has been a great increase in shop committees as a method of such organization. Where they have been elected by free and secret ballot among the workers, where they are dominated by a genuine desire on both sides for mutual co-operation in the shop, they have resulted in great good. One of the most important phases of that good has been the tendency to turn the aspect of some foremen from that of slave-driving to leadership. And a great good has been possible by the encouragement of men to creative effort, in the stimulation of their minds as well as their hands to the solution of these problems. It makes for pride of craftsmanship and is a real effort to offer them an opportunity of self-expression. Organized labor has opposed some forms of these committees because of the fear that they may break down trade organization covering the area of many different shops. There is economic reason for this fear in certain cases, deeper than appears upon the surface. One of the greatest accomplishments of organized labor has been the protection of the workers from the unfair employer, and it is worth the employer's notice that this is at the same time the protection of the fair employer from the unfair competition of the sweat shop. Again I believe the engineers could assist in the erection of a bridge of co-operation if organized labor, which has already made a beginning, would extend more widely its adoption of the principles of a shop committee, settling its problems of wage and conditions of labor in general agreement and applying its energies through shop committee organization to development of production as well as to the correction of incidental grievance. There would be little outcry against the closed shop if it were closed in order to secure unity of purpose in constructive increase of production by offering to the employer the full value of the worker's mind and effort as well as his hands.

There is an immediate problem in increased production that is too often overlooked by the theorist. While it is easy to state that increased production will decrease cost and by providing a greater demand for goods secure increased consumption and ultimate greater employment, yet the early stages of this process do result in unemployment and great misery. It takes a variable period of time to create the increased area of consumption of cheapened commodities, and in the meantime, when this is translated to the individual worker he sees his particular mate thrown out of employment. We accomplish these results over long periods of time, but if we would secure co-operation to accomplish them rapidly we must take account of this unemployment and we must say to them, the community, that if it is to benefit by the cheapening costs and thus the increased standard of living, or alternatively if the employer is to take the benefits, the entire burden should not be thrust upon the individual who now alone suffers from industrial changes. Nor can this be accomplished except by co-operation between groups. In fact, the whole problem of unemployment needs earnest consideration.

In summary, the main point that I wish to make is this: that there is a great area of common interest between the employer and the employees through the reduction of the great waste of voluntary and involuntary unemployment and in the increase of production. If we are to secure increased production and an increased standard of living, we must keep awake interest in creation, in craftsmanship and the contribution of the worker's intelligence to management. Battle and destruction are a poor solution to these problems. The growing strength of national organizations on both sides should not and must not be contemplated as an alignment for battle. Battle quickly loses its rules of sportsmanship and adopts the rules of barbarism. These organizations—if our society is to go forward instead of backward—should be considered as the fortunate development of influential groups through which skill and mutual consideration can be assembled for co-operation to the solution of these questions. If we could secure this co-operation throughout all our economic groups, we should have provided a new economic system, based neither on the capitalism of Adam Smith nor upon the socialism of Karl Marx. We should have provided a third alternative that preserves individual initiative, that stimulates it through protection from domination. We should have given a priceless gift to the twentieth century.

I am not one of those who anticipate the solution of these things in a day. Durable human progress has not been founded on long strides. But in your position as a party of the third part to many of these conflicting economic groups, with your life-long training in quantitative thought, with your sole mental aspect of construction, you, the engineers, should be able to make contribution of those safe steps that make for real progress.

EDITORIALS

The First Meeting of American Engineering Council of the Federated American Engineering Societies

THERE were represented at the first meeting of American Engineering Council, the managing body of the Federated American Engineering Societies, 50 per cent of the aggregate membership invited to join. Member societies represented 35 per cent and participating societies 15 per cent. The seventy-two delegates represented an aggregate of 60,000 engineers. Such a large representation indicates the widespread feeling of the need for such an organization and assures it a successful life.

Outstanding problems facing the convention were the choice of a city for headquarters, the definition of specific plan and scope and the selection of a president.

Washington was wisely chosen as the headquarters city. Washington is not the geographic center of the society representation nor does it offer quite the business possibilities of New York. But it is the center of national government and legislation, it offers the best opportunities for contact between engineers and government, the best libraries and records of industrial and economic questions, and its choice precludes the possible claim by the smaller societies that New York and the founder societies are controlling the F. A. E. S.

There are many problems which can be advantageously taken up by the F. A. E. S. Sixteen of them have been named and adopted under American Engineering Council's program of plan and scope. The first alone covers in a general way the objects of the federation and justifies its existence: "To serve the public interest by investigation and advice to all public governmental and voluntary bodies dealing with national economic problems." Service in the "Conservation of National Resources" is another of the tasks of large caliber included among the plans of the council. It offers a field broad enough and one so little understood that there will be no jealousy because engineers have taken hold of it.

There is no question as to the wisdom of American Engineering Council in electing Herbert Hoover president. Such action placed in the highest office of the newly formed federation, pledged to broad service, a foremost engineer who has been successfully carrying on programs of service, who is a statesman as well as an engineer and who is known throughout the world.

The basic problem, "Industrial Waste," was suggested by Mr. Hoover as a problem with which engineers seem especially able to cope. He included as industrial waste, waste in production due to intermittent employment, unemployment, strikes and lockouts; the dulling of the human mind by repetitive operations; and the aggregation of great wealth with its power of economic domination. The detached and analytic view of Mr. Hoover as concerns the relation of engineers to the great economic groups, "striving by political agitation, propaganda and other measures to advance group interest" is shown by a quotation from his address:

"This engineers' association stands somewhat apart among these economic groups in that it has no special economic interest for its members. Its only interest in the creation of a great national association is public service, to give voice to the thought of the engineers in these questions. And if the engineers, with their training in quantitative thought, with their intimate experience in industrial life, can be of service in bringing about co-operation between these great economic groups of special interests, they will have performed an extraordinary service. The engineers should be able to take an objective and detached point of view. They do not belong to the associations of either employers or labor, of farmers, or merchants or bankers. Their calling in life is to offer expert service in constructive solution of problems, to the individuals in any of these groups. There is a wider vision of this expert service in giving the group service of engineers to group problems."

It is of interest to note that only the previous evening Matthew Woll, vice-president of the American Federation of Labor, said:

"The viewpoint of the engineer is valuable because it is a viewpoint of a man whose position is such as to enable him to see the whole broad problem involved. He is in a position to know fully the value of being able to release the creative energy of workers to bring into play their interest and intelligence."

It appears that engineers may have much to do with adjustments of our great problem known as the "Labor Question," and if they do a large part of their work will best be done through the Federated American Engineering Societies.

The meeting of American Engineering Council was a success and the federation is now on its way.

L. C. M.

An Immigration Problem

ON another page will be found an article under the foregoing title, by William H. Barr, president of the Inter-racial Council. No one is better qualified to express opinions regarding matters of this kind than Mr. Barr. Some of the things he says should be carefully considered by our readers and by the next Congress. One of the most important is the modification of our immigration laws regarding the literacy test. At present thousands of good, honest workers are kept out and all too many educated radical agitators let in. These agitators, assisted by others of a like type here, are the cause of much of our labor trouble. We can sympathize with the worker who has a legitimate kick, but we have no use in America for the born trouble maker bred in the countries noted for this class. There is a vast difference between political freedom and political license, and those who believe in the latter should be sent back where they belong. On the other hand, every effort should be made to obtain the type of immigrant seeking political freedom and a home. E. V.

SHOP EQUIPMENT NEWS

-Edited By-
S. A. HAND

SHOP EQUIPMENT • NEWS •
A weekly review of modern designs and equipment

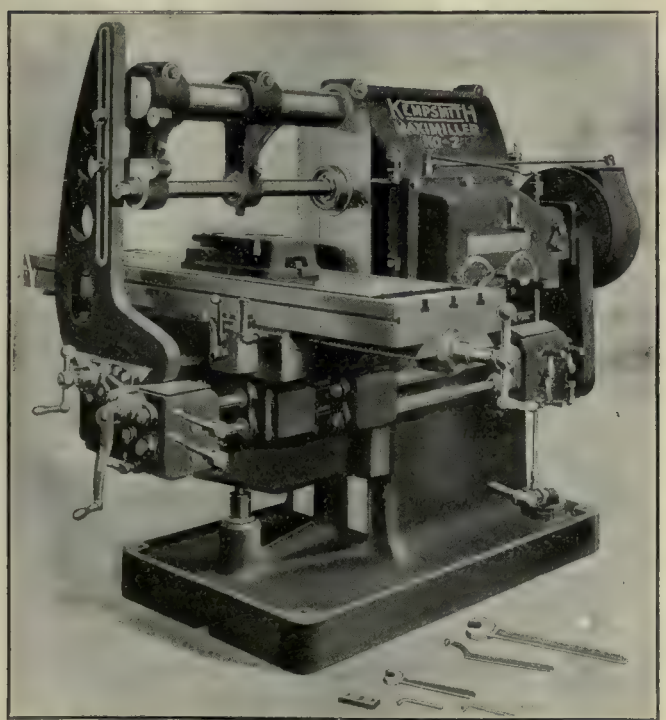
Descriptions of shop equipment in this section constitute editorial service for which there is no charge. To be eligible for presentation, the article must not have been on the market more than six months and must not have been advertised in this or any previous issue. Owing to the news character of these descriptions it will be impossible to submit them to the manufacturer for approval.

• CONDENSED • CLIPPING INDEX
A continuous record of modern designs and equipment

Kempsmith No. 2 Plain Maximiller

In announcing the No. 2 plain maximiller type of milling machine, the Kempsmith Manufacturing Co., Milwaukee, Wis., states that the machine is similar in all points of design to the No. 4 plain maximiller, which was described in the *American Machinist*, Vol. 49, page 595.

The machine is intended to give rapidity and convenience of operation and efficiency in production. It



KEMPSMITH NO. 2 PLAIN MAXIMILLER

Specifications: Working surface of table, 12 x 56 in. Table adjustment: Longitudinal, 28 in.; transverse, 10 in.; vertical, 19 in. Face of column to brace, 24⅝ in. Arbor: diameter, 1¼ in.; length shoulder to nut, 22¼ in. Spindle: front bearing, 4⅝ in. diameter by 4⅞ in. long; taper hole, No. 12 B. & S.; hole through spindle, 1⅛ in. Driving pulley: 3½ x 15 in.; speed, 400 r.p.m. Spindle speeds; number, 18; range, 16 to 400 r.p.m. Feeds: number, 18; range, ⅝ to 25 in. per minute. Power quick traverse; longitudinal, 100 in. per minute; transverse and vertical, 36 in. per minute. Floor space, 85 x 105 in. Weight: net, 4,200 lb.; domestic shipping, 4,500 lb.; export shipping, 4,900 lb.

is heavily made, as can be readily seen from the illustration.

Heat-treated steel is used for the gears and heat-treated alloy steel for the shafting, while the column, knee, saddle and table are semi-steel castings. The column is ribbed internally and has few openings. A solid rib or cross member midway of the column height serves to form a reservoir for the oil used for the driving gears. The knee has a solid top, with the cross-feed screw in a shallow depression located centrally between the V's. Consequently, the cross-feed screw acts centrally on the saddle. The saddle is long and heavy with the drive to the table located near one end, thus leaving the center solid so as to give more rigidity.

The table has a working surface of 12 x 56 in. and is taper gibbed, with provision for locking. The overarm is a steel bar 4¼ in. in diameter, and is held with a "wedge lock," which keeps the cutter arbor in alignment with the spindle. An outboard support of the open-side type permits easy access to the work. The spindle nose is so made that it can drive face-milling cutters in either direction. A spindle reverse has been incorporated in the machine. The friction-plate clutch is operated by a hand lever located at the front of the machine, forcing the plates together by a combined toggle and plain lever movement. The clutch is easily adjustable for wear. A brake is provided for quickly stopping the spindle.

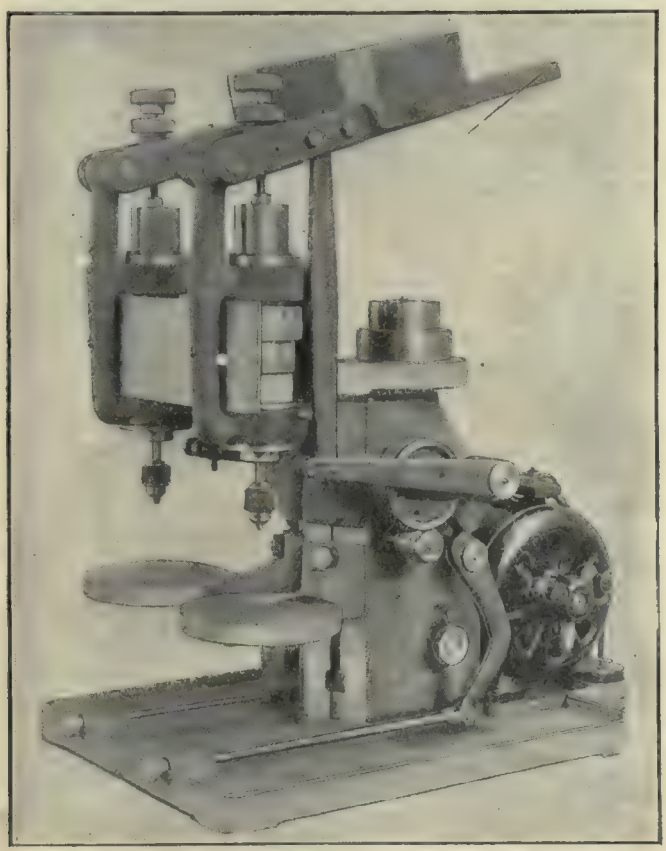
The longitudinal movement of the table is controlled by two levers, one for the feed and one for the power quick traverse. The movement is in the direction toward which the lever is thrown. Two levers located on the knee control both the knee and saddle movements; the movement actuated being determined by operating push pins located close to the hand-feed handles. The feed-change mechanism provides eighteen changes of feed in geometric progression. The power quick traverse can be used for moving the table without disturbing the set-up or the rate of feed in service, and is at the rate of 100 in. per minute. The power quick traverse for the cross and vertical travel is at the rate of 36 in. per minute.

All gears and bearings in the entire speed and feed mechanism either run in oil or are splash lubricated. Sight feed oilers are used for the spindle bearings and drive pulleys. The spindle runs in adjustable phosphor-bronze bearings, while all other shafts in the speed transmission run in ball bearings. A single pulley drive is used, the gearing giving eighteen changes of spindle speed. All speed changes are secured by sliding gears, and there are never more than three pairs of gears in mesh for any speed.

A centrifugal pump, engaged by means of a clutch, is provided for the coolant system. The machine can be furnished with motor drive arranged through a belt, the motor recommended being of 7½ hp., running at 1,200 r.p.m.

Kingsbury Automatic Sensitive Drilling Machine

The bench, automatic-feed drilling machine shown in the illustration has been placed on the market by the Kingsbury Manufacturing Co., Keene, N. H. The machine is intended for production drilling on small



KINGSBURY AUTOMATIC-FEED SENSITIVE BENCH DRILLING MACHINE

Specifications: Capacity, ⅛-in. drills. Spindles; diameter, $\frac{7}{16}$ in.; standard stroke, $\frac{7}{8}$ in.; vertical adjustment, $\frac{3}{4}$ in. Vertical adjustment of tables, 5 in. Distance between spindles, 8 in. Spindle to column, 6 in. Bottom of chucks to tables, maxmium, 8 in. No. of speeds, 3; 1,500, 2,400 and 3,750 r.p.m. with drive-shaft speed of 750 r.p.m. Drive pulley, 5 in. Height, 28 in. Base; belt-drive, 16 x 20 in.; motor drive, 16 x 24 in. Weight; belt drive, 250 lb.; motor drive, 270 lb.

parts. Gravity feed is utilized, in conjunction with a mechanical control by means of which the operation of the feed is rendered automatic and "sensitive."

Both spindles are driven by the same belt running on vertical cone pulleys. The drills are held in Jacobs chucks, which are furnished as regular equipment. The feed of each spindle is independent of the other, the pressure required for drilling being supplied by the weights adjustably mounted on the arms at the top of the machine. The length of stroke of each spindle is $\frac{7}{8}$ in., a vertical adjustment being provided in addition.

To regulate the action of the feed, the mechanism shown on the side of the machine comes into play, it being the same for each spindle. The small, hardened, grooved friction-roll shown on the side of the column runs at constant speed. The large grooved wheel is mounted eccentrically on a pivoted arm, so that the weight of the spindle and of the counterweight keep it in contact with the small roll. The friction between the two wheels causes the eccentrically mounted one to rotate and thus raise and lower the spindle. A catch is so arranged as to relieve the wheel of the weight it carries as the spindle starts downward at the completion of a cycle, thus keeping it at the top of its stroke. To again start the feed, the knob on the front of the machine is pushed.

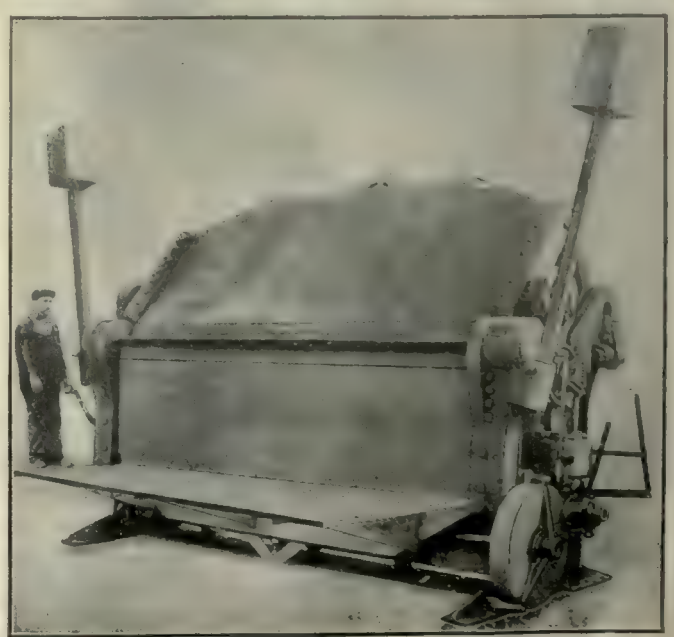
When the drill in moving downward strikes the work the weight is taken off the friction wheels, so that slippage occurs, and the pressure of the feed is derived from the weight on the arm of the spindle. When the drill breaks through the work, the spindle cannot drop because the friction wheels again engage and move it at the predetermined speed. This speed is ordinarily such that a complete cycle is performed in $\frac{1}{25}$ min. with no resistance in the path of the drill. Thus, it is necessary for the operator only to replace the work and to start the feed.

This machine can be furnished with a device which automatically warns the operator that the drill is becoming dull. The time allowable for drilling the work must be determined, a means of setting the mechanism for it being provided. If the drilling requires more time than that taken for the predetermined number of revolutions of the friction-roll shaft, a stop is actuated, so that the feed does not start when the knob is pushed for the next piece of work. The operator is thus warned to sharpen the drill.

S.K.F. ball bearings are used on the spindles, idlers and the vertical shaft, while Non-Gran bronze bearings are used on the horizontal shafts. All gears are of steel and placed inside the column, the bevel gears running in oil. Either motor or belt drive can be furnished. Floor stands, for either one or two machines, are made. It is claimed that the use of the machine lessens drill breakage, saves work on the part of the operator, and saves time by keeping the drill cutting.

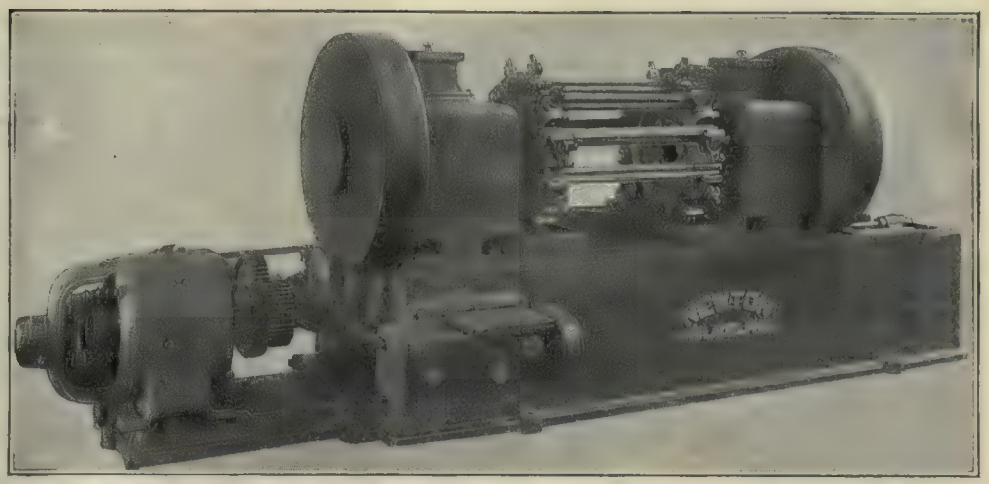
Dries & Krump Plate-Bending Brake

What is said to be the largest plate-bending brake in the world was recently built for the Newport News Shipbuilding and Drydock Co., Newport News, Va., by the Dries & Krump Manufacturing Co., Chicago, Ill. The brake weighs 30 tons, and can bend cold plates 12 ft. long up to $\frac{3}{4}$ in. thick. It is built of steel throughout, the main body being constructed of large



LARGE DRIES & KRUMP PLATE-BENDING BRAKE

steel plates braced with truss rods, the housings being steel castings, and the links which connect the upper and lower jaws being forgings. The nose of the upper jaw carries a tool-steel edge. The motor is mounted within the machine, driving a shaft carrying direct and reverse friction clutches. The reverse motion for lowering the bending leaf is obtained through an idler gear. The bending leaf is counterweighted. The upper jaw is raised and lowered by means of a manganese-bronze worm-gear. The clamps holding the plates are driven through friction clutches, no adjustment being required for various thicknesses of plates.



NEWTON MODEL 0-3 CONTINUOUS MILLING MACHINE FOR FACING

An adjustable dog is provided, which automatically stops the bending leaf for any desired angle on the work. Plates are free to pass between the housings, permitting bends to be made at any distance from the front or rear ends of the plate. Adjustment is provided for changing the radius of the work being bent. As sharp as 1½ in. radius can be bent on ¾-in. plates, and as large a radius as is desired.

It is claimed that the machine operates rapidly, the time consumed in making a right-angle bend being less than one minute. No dies are required for different thicknesses of metal, radii of bend, or degree of angle to which the plates are bent. The brake requires a floor space of 16 x 12 ft.

Newton Model 0-3 Continuous Milling Machine

The continuous milling machine shown in the illustration has been placed on the market by the Newton Machine Tool Works, Inc., 23rd and Vine Sts., Philadelphia, Pa. It is known as the Model 0-3 and is intended for face milling the ends of such work as shafts, rods and crankshafts.

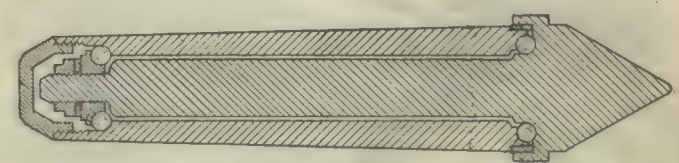
The machine consists of a heavy bed carrying two heads, one of them being movable along the bed in order to accommodate work of different lengths. An individual motor drive is employed, a shaft running through the bed transmitting power to both heads. The spindles, driven through worms and worm-wheels, are at the height of the center of the work-holding fixtures, being behind the fixtures in the illustration. End or face mills are used, an adjustment for varying the depth of cut being provided. All bearings of the machine are oiled by a cascade system.

The work is secured at each end in a fixture fastened to the head. The feed motion is obtained by rotation of the fixtures, which are driven by gears from a common pinion shaft, so that they move at the same speed. With the fixtures shown, the operator loads the machine and clamps the work in position. After the ends have passed over the cutters to machine the work to length, the handles of the clamps strike stops, so that the shafts are automatically released at the bottom of the fixture, and then roll down the inclined edges of the pans into tote boxes or to a roller conveyor.

The work-holding drum shown has ten stations, there being a considerable distance between each set of bars. In order to save time while the cutters are passing through the clearance spaces, a rapid traverse at a speed ten times the cutting speed is automatically put in operation when the cutters are running idly. It is stated that a production of 250 pieces per hour can be obtained with this arrangement, the shafting being 1⅜ in. in diameter. Different sorts of work can be held by using different fixtures or drums. Where the pieces of work can be placed closely together, it is not necessary to use rapid feed in the clearance spaces, the feed being continuous. A coolant system can be furnished if desired.

Snellex "Frictionless" Center

The Snellex Manufacturing Co., Rochester, N. Y., has recently placed on the market a ball-bearing center. The device is intended to decrease friction between the work and the center, to make it unnecessary to regrind



SECTIONAL VIEW OF SNELLEX "FRICTIONLESS" CENTER

center points, and to eliminate the wearing and burning of center holes in the work.

The general construction of the center can be seen in the accompanying illustration. The ball race at the rear end is held in place by a lock-washer and check-nut, and it is protected by an oil cap. The device is regularly made in four sizes, from Nos. 1 to 4 Morse taper, other sizes being made to order.

Wilkes Toolholder

The Dawson Tool Corporation, 51st and Lancaster Ave., Philadelphia, Pa., has placed on the market the Wilkes toolholder, shown in the illustration. W. A. Schurmann, of the same concern, is lessee of the product.

The holder is intended for heavy-duty, high-speed work, the point of the cutting tool being supported by a projection of the holder underneath it. No setscrew is used to hold the tool, the clamping action being obtained by means of the nut at the rear end of the



WILKES HEAVY-DUTY TOOLHOLDER

holder. Because of the absence of a set-screw, the front of the holder can be passed through the toolpost. It is claimed that the holder will stand very severe use, and that it holds the tool so securely as to decrease chatter. The body is heat-treated. The holder is made in a range of sizes to take tools from $\frac{3}{16}$ to 1 in. in size.

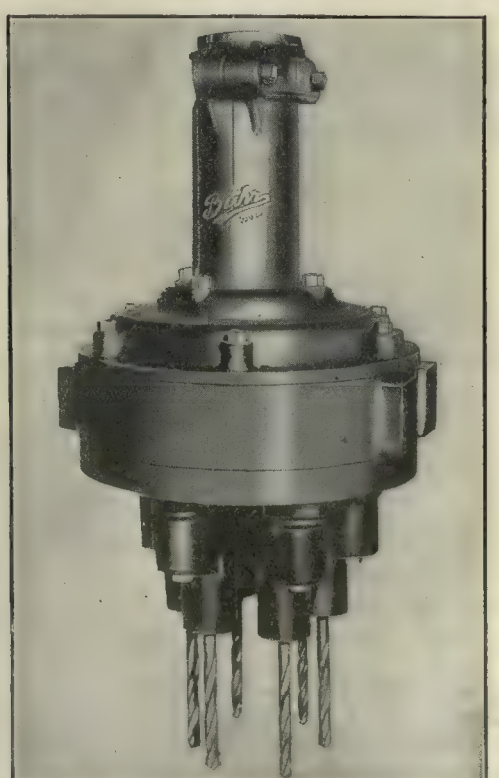
Buhr Multiple-Spindle Drill Heads

The Nelson-Blanck Manufacturing Co., Dubois and Clay Sts., Detroit, Mich., has placed on the market a line of ball-bearing, fully adjustable Buhr multiple-spindle drill heads. The illustration shows head No. 16-F, which has six spindles, although heads having any number of spindles from 3 to 12 are made.

The heads are equipped with detachable adapters and drivers. The drive is through spur gears from the main shaft to the spindles, each spindle being capable of being swung about the center of the spur gear driving it, and these centers, in turn, being adjustable in toward or away from the center of the head. Thus the range of positions in which the spindles can be placed is increased over the old type. Special arms can be furnished for close center distances.

The mechanism is completely inclosed, being dust-proof. Ball-bearings are used throughout. All moving parts are made of heat-treated chrome-nickel steel and run in light grease. It is stated that each spindle unit has three times the strength required to drive the maximum size of drill which can be used, thus making it possible to mount special arms carrying two or more drills, if necessary.

The head is manufactured with four capacities. The smallest, or high-speed machine, running at 5,000 r.p.m., is equipped with No. 1-A Jacobs chucks taking drills up to $\frac{1}{4}$ in. in diameter. The next size is equipped with No. 1 Morse taper holes in the spindles, and can handle drills up to $\frac{5}{8}$ in. in diameter. The heads having No. 2 Morse tapers will accommodate $\frac{7}{8}$-in. drills; while the largest size, having No. 3 Morse tapers, will carry drills up to $1\frac{1}{4}$ in. in diameter.



BUHR MULTIPLE-SPINDLE DRILL HEAD NO. 16-F

"I. T. C." Self-Loading Electric Truck

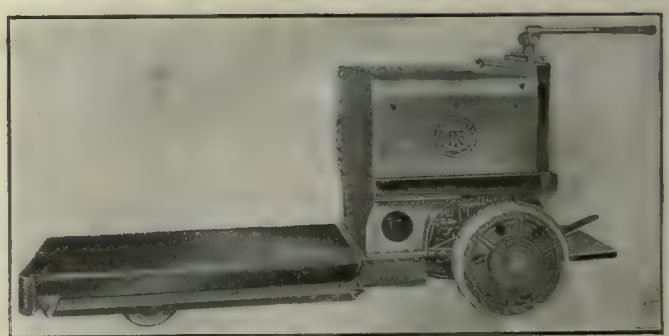
The elevating-platform electric industrial truck shown in the illustration has been placed on the market by the Industrial Truck Co., a division of the Cowan Truck Co., Holyoke, Mass. It is of all-steel construction and has a capacity of 5,000 lb., the lift being $4\frac{1}{2}$ in.

The lifting action is vertical and is said to be very rapid, requiring only 5 or 6 seconds to elevate the platform. Lowering requires only 3 seconds. The platform is operated by an independent heavy-duty, series-wound motor having a worm-gear speed reduction, and controlled from the driving end of the truck.

Steering is done on all four wheels. A single reduction is used in the worm drive to the power axle. It is claimed that the mechanism is easily accessible. The rear end of the truck is equipped with a bumper to protect the platform, and a draw-bar attachment to enable the use of the truck as a light-duty tractor.

The truck has a turning radius on the extreme outside point of 7 ft. 10 in. and is said to be capable of being operated in intersecting aisles 60 in. wide. By folding up the step and raising the steering handle the length of the truck can be shortened for use on elevators. A drum-type controller is used for the driving motor, three speeds being provided in both directions. It is necessary that the pedal on the step be held down in order to operate the truck. In case the pedal be raised while the truck is in operation, the circuit is broken, a brake applied and the truck instantly stopped.

Either alkaline or lead batteries can be used, the standard equipment being 21 Edison A-6 cells or 12 cells of the 15-plate Ironclad-Exide type, although batteries of greater capacity can be furnished.



"I. T. C." SELF-LOADING ELECTRIC INDUSTRIAL TRUCK

Specifications: Capacity, 5,000 lb. Loading platform: length, 55 in.; width, 26 in.; height lowered, 11 in.; height raised, $15\frac{1}{4}$ in. Driving motor: 24 volt; 50 amp.; 1,500 r.p.m. Elevating motor: 24 volt; 35 amp.; 1,800 r.p.m. Gear reduction, $17\frac{1}{2}$ to 1. Speeds: 3 forward, 3 reverse. Wheel diameter: driving end, 20 in.; trailing end, 10 in. Turning diameter: outside wheel, 14 ft. 3 in.; outside point, 15 ft. 8 in. Wheelbase, $59\frac{3}{4}$ in. Height, 51 in. Width, 36 in. Length: overall, 102 in.; step raised, $91\frac{1}{2}$ in. Weight: without battery, 2,150 lb.; with Edison battery, 2,600 lb.; with lead battery, 2,700 lb.

Binder pp 1668a-2.

Wickman Universal Gage Measuring Machine

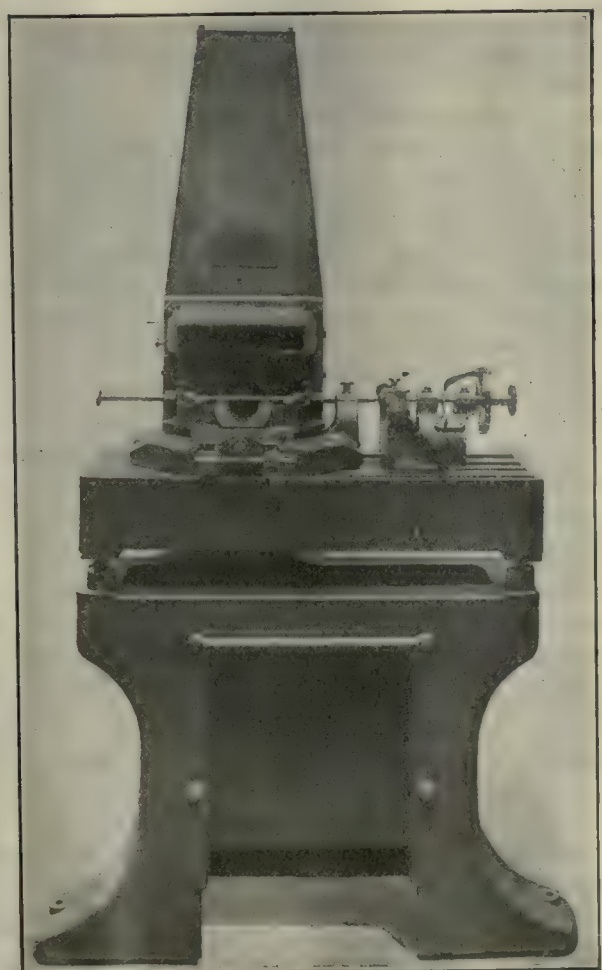
The illustration shows the Wickman universal measuring machine recently placed on the market by Alfred Herbert, Ltd., Coventry, England, and 54 Dey St., New York City. The machine is intended for measuring gages of all descriptions, the capacity being as follows: Length gages, up to 12 in.; outside, pitch and root diameters of screw plug gages up to 6 in. in diameter; pitch of screw plug gages up to 4 in. in diameter; outside, pitch and root diameters and pitch of screw ring gages up to 3 in. in diameter; and thread forms of screws up to 4 in. in diameter.

The heavy, ribbed bed is mounted on three points on the base. The measuring head is mounted on ways at the right of the bed. The micrometer screw can be calibrated against standard gage blocks, the operation requiring only about 5 min. By means of a compensating device on the head, any progressive error can be allowed for. A split nut is not used on the micrometer screw, and it is stated that the mechanism is so accurate that measurements can be repeated within 0.000005 in.

The carriage at the left of the bed has a longitudinal movement of about 4 in., being mounted on $\frac{1}{8}$-in. balls, of which there are three sets of three balls each, one set being at the front and other two in the same ways at the rear. The ways consist of hardened and lapped steel shafts $\frac{3}{4}$ in. in diameter, each way being made of two shafts. The top way at the front consists of a flat plate, so that the movement of the carriage cannot be constricted. It is stated that the carriage and its equipment, although weighing about 75 lb., can be moved by a force of $1\frac{1}{2}$ ounces, so that very light pressure between the anvils can be obtained. The ways are fastened to bosses on the bed and carriage, the castings proper not being machined, so that the warping caused by such a procedure does not occur.

The indicating mechanism is enclosed and situated in the rear of the carriage. The hood above it covers the lighted scale and is used merely to prevent outside light from affecting the illumination.. The screw plug gage between the centers is measured by the use of a point or stylus which touches it. A special type of stylus is provided for the internal measurement of ring gages. There is a mechanical magnification of the deviation at the point of 60 to 1. The moving parts are made of duralumin, and the levers are fitted with vanes dipping in oil wells.

The mechanical magnification is then multiplied about 70 times by means of light, so that the total magnification of the movement of the stylus is 4,000 to 1. It is stated that the machine can work to an accuracy of 0.00001 in., or to 0.000005 in. when used as a comparator. It is said, also, that this accuracy does not depend upon any particular skill of the operator in taking readings, as the reading is made by fitting the projected shadow $\frac{1}{4}$ in. in diameter into a tinted section, an accuracy of only $\frac{1}{20}$ in. being required in so doing.



WICKMAN UNIVERSAL GAGE MEASURING MACHINE

Wickman Gear Pitch and Concentricity Measuring Machine

A machine for measuring and gaging gears is shown in Fig. 1, it being the product of Alfred Herbert, Ltd., Coventry, England, and 54 Dey St., New York City. It is known as the Wickman gear-pitch and concentricity measuring machine. It does not test the form of the teeth. The gear to be tested is mounted upon a mandrel which accurately fits its bore and which is held in the taper of the vertical arbor of the machine by a draw bolt. The arbor can be rotated by means of a worm and wormwheel, the graduated dial on the shaft of the worm being used to determine the amount of rotation of the arbor. The worm is mounted

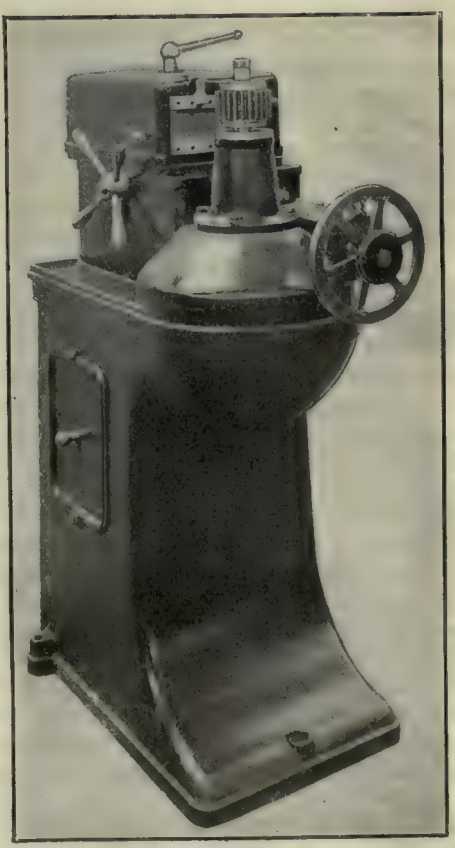


FIG. 1. WICKMAN GEAR PITCH AND CONCENTRICITY MEASURING MACHINE

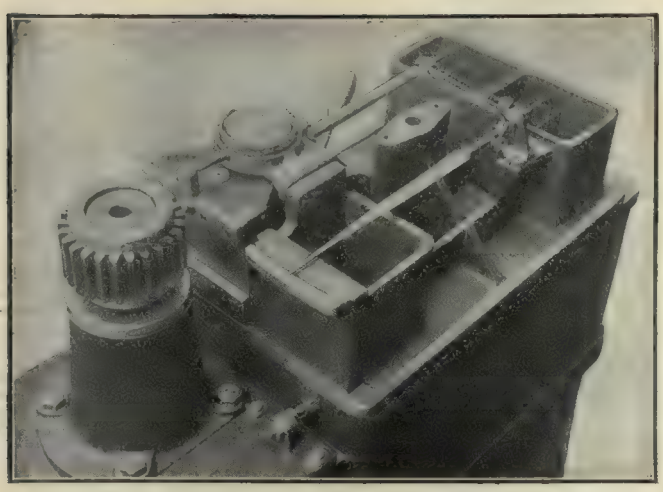


FIG. 2. INDICATING MECHANISM OF WICKMAN GEAR MEASURING MACHINE

on a slide having taper adjustments, so that backlash between the worm and wheel can be eliminated. It is stated that the worm and wheel are lapped to an accuracy in pitch and form of 0.0001 in.

The box mounted on ways at the top of the machine carries the gaging mechanism, a view of which is shown in Fig. 2, the cover of the box being removed. It will be seen that an arm pivoted near its center about a vertical axis carries a point or stylus, which fits at the pitch line the space between the teeth of the gear being tested.

In operation the carriage is brought forward until the stylus presses in the space between two teeth. By turning the worm, the long needle at the right is brought to zero, this needle being so connected to the arm carrying the stylus that the motion is magnified. In order to dampen the action of the needle, the vanes shown fastened to the ends of the levers are immersed in oil, which renders the mechanism dead-beat and free from vibration. The dial indicator on top of the arm carrying the stylus is then adjusted to read zero.

Quick Readings

The wormwheel is revolved, the stylus thus being brought in the next tooth space. When the long needle again registers zero, the reading of the graduated dial on the worm shaft is taken, this reading showing the true pitch of the tooth. The reading of the dial indicator shows whether or not the pitch diameter has changed, thus checking the concentricity of the pitch circle with the bore of the gear. The process is repeated for all the teeth, two curves being plotted from the data, one showing the pitch error between the teeth and the other showing the concentricity error. It is stated that a gear having 30 teeth can be tested and its curves be drawn in less than 10 minutes.

The device is intended chiefly for testing one gear from each lot, both before and after hardening, rather than for testing every gear. Gears from 2 to 12 in. in diameter can be tested. It is stated that the machine is to be provided with a vertical adjustment of 6 in.

Our Immigration Problem*

By WILLIAM H. BARR
President, the Inter-racial Council

THERE are some people who have been demanding that the "gates be closed" to immigrants. They insist that our country and our institutions are endangered by immigrants. That attitude, backed up by what has amounted to a campaign against the foreign born during the last two years, and by proposed legislation to shut off immigration, and by enacted State legislation barring immigrants from certain occupations in certain states, was one of the principal reasons for the enormous outflow of immigrants from America following the armistice, when more than 400,000 loyal, able-bodied immigrants left this country and no male immigrants were coming in to replace them.

If there has been any danger to America, it has not been from the immigration of the foreign born to this country. The danger has been from the departure of foreign born, from the lack of sufficient numbers of foreign born workmen in the industries that depend upon foreign born labor, from the restrictionist attitude of some of our people, and from the indifference of American business.

There are more than 10,000,000 foreign born workmen in this country, working on jobs in the cities. Those of foreign birth and parentage represent only one-third of the people of the United States—yet, they mine three-fourths of the coal, manufacture three-fourths of the clothing, half of the silk, linen, wool, lace and embroidered goods; bake more than half of the bread, refine more than half of the sugar, and put up half of the canned food. They have built our railroads with the aid of American capital, and still do half of the maintenance work on both the railroads and streets. Half of the work in the blast furnaces, in the carpet mills, hemp and jute factories, and in the copper, silver, brass, gold, rubber and leather goods—half of the work in those industries is done by the foreign born, and two-thirds of the iron and steel for the railroads, for buildings and ships is produced by them.

To what extent would this country have progressed if during the last twenty years the admission of foreign born had been prohibited? Who would man the mines, the iron and steel mills and foundries, the machine shops, the silk mills, the knit goods shops, the glass factories, lumber mills, and other industries? Our native-born workers are largely skilled workmen—as they should be—and we cannot look to them to provide the industries with the primary grades of work. We must look to the foreign born to provide the unskilled labor. If this class of labor is not forthcoming, how can the wheels of industry turn around? How can the skilled workers find employment if the basic work is not performed? We cannot build houses unless the excavation is dug; we cannot operate trains unless the roadbeds are constructed and the tracks laid.

Opposition to Immigration

There are some people who would stop immigration entirely, regardless of what it would mean to this country, who would shut off this necessary flow of unskilled labor into America. They would shut it off, because of the alleged lawlessness of foreign elements and

*Address before the Philadelphia Chamber of Commerce.

because of the fear that the foreign born may not be loyal to this country and to American institutions. As to the alleged lawlessness of the foreign born, it may surprise us to learn that in the report of the Provost Marshal General, referring to the war, it is stated that of the foreign born who registered for the draft, a percentage of one and four-fifths was reported for desertion. The percentage among the native born reported for desertion was three and one-fifth. The foreign born serving in the army were less inclined to overstep the barriers of army discipline. Yet, we hear it said time and time again that the foreign born are a lawless and disloyal element and a bad lot.

In the question of loyalty, the recent war afforded striking evidence of the whole-hearted service of our foreign born, who poured out their life's blood on the battlefields. From a population of only one-fifth that of the native born, the foreign born gave one-third of the overseas fighting men. They over-subscribed their loan quota every time. They supplied one-half of the workers in war industries. Acts of heroism performed by foreign-born heroes in the American army were numerous. This talk of disloyalty is nothing more nor less than the old Macedonian cry over again, or the cry of the time of Caesar when all aliens were barbarians. Those who raise this cry warn us that the "barbarians" must be barred out of this country. They tell us we have already received more immigrants than is good for the country.

Turning to the discussion of our present volume of immigration, we again find the tendency to disregard facts and to manufacture false arguments. The columns of the newspapers the country over have been filled with articles relating to a supposed enormous volume of immigration. Nearly every week an announcement is made about some record-breaking inflow of foreigners, and interviews are published that predict a glut of labor on the American market.

Let us consider the character of the immigration now coming to this country. It includes an extraordinarily large number of women and children and old men, who are fleeing destitution in Europe. These women and children and old men are not coming for the purpose of engaging in industries. They are coming to join relatives who sent for them. They mean nothing at all to the industries, although it is not unlikely that they may exert a stabilizing influence on the foreign born whom they are coming to join.

Of the able-bodied males who are arriving, many are returning reservists who have rights of residence in this country, and who intend to go back to the jobs they left behind them when they responded to the call to arms of their motherland overseas. The present volume of immigration may be large, as compared with dull periods of immigration. But there is every evidence to show that the present immigration is not in the nature of an industrial invasion. The supply of unskilled labor from the present influx will be very limited. Although unemployment is reported in certain industries, and in certain localities, the demand among the general run of industries for unskilled labor is still urgent.

Analysis of Immigration Figures

The flow of unskilled labor to the industries was shut off for the period of the war. And following the armistice, the movement of foreign-born workers was *away* from America, and not *to* America. Before the war, more than a million immigrants were coming in annually. About 300,000 were going out, leaving a net gain of more than 900,000. For the fiscal year ended June 30 last, the permanent net increase in our alien male population was merely 9,877. That fact is revealed by an analysis of the official figures of the Bureau of Immigration. More aliens left America in the last fiscal year to remain permanently in Europe than were admitted from European countries. The total increase in the alien female population (135,246) was more than thirteen times as large as the increase in the permanent alien male population.

From these statistics, and from the fact that the present immigration is composed of large numbers of women and children and old men, it would seem that the present talk that we are being overwhelmed with immigrant labor is misleading.

Let us turn to the arguments that are advanced by those who are constantly harping upon the numbers of immigrants now coming in, but who do not go to the pains of analyzing the figures to determine the numbers of unskilled workers among those immigrants. The first argument is that the immigrants will underbid the American workers in the labor market. I stated earlier in this address that the American workers are largely skilled, whereas the foreign-born workers in America are largely unskilled. How can there be any competition between these two classes of workers? If the immigrant workers are graduated to the semi-skilled or skilled grade of work, they get the prevailing wages for that work. There is no competition and no underbidding. I have always been at a loss to understand upon what grounds the argument that the foreign born underbid the native born is based.

We are told also about the menace of hard times, and the laying off of men in the industries. We are informed that this condition will increase with a great horde of immigrants, and that with the bad conditions in Europe, the tide of immigration will rise and rise until America is virtually overwhelmed with people from Europe. You will note the use of superlatives by immigration restrictionists. Always they speak of hordes.

Answers to their arguments are simple. The laying off of men is a temporary condition, and cannot be made the basis for a permanent policy on immigration.

There is nothing new about the argument against immigration, based on hard times. We seem to forget that the immigrant comes here to better his economic situation. That being true, is it likely that the immigrant will migrate to America in time of industrial depression when jobs are scarce, and money is not available for wages? Immigration diminishes in periods of bad times. The statistics of the Bureau of Immigration show that to be the case. They show also that the unstabilized foreign-born labor in America moves out of the country when an industrial crisis is threatened. There is no danger of such a crisis in this country now. I insist there is ahead of us a period of unprecedented prosperity.

When long-term credits have been established and the exchange is back at normal, our exports will take an unprecedented jump. But they will take that jump only in the event that we have sufficient labor on hand to manufacture for foreign as well as domestic needs. If the labor supply is inadequate, then we will have to let the foreign market "go to the dogs," for we will be fortunate indeed if production keeps pace with the needs at home. Our industries will resume operations approaching capacity, and there will be a pronounced

shortage of labor, due to the non-industrial character of the people coming in and because of the industrial character of the aliens going out.

The bad conditions in Europe that are referred to will not drive immigrants here indefinitely. Europe will not always be starving. Europe, of necessity, must get back on its feet again. Political and race persecution will come to an end, and these two things have been responsible for a large part of our immigration of the past. Today, few immigrants are coming to this country for freedom's sake. The European countries have won their independence as a result of the war. They have their own little nations and they are in process now of reconstruction.

Periods of reconstruction are invariably fraught with disturbances and with hard living conditions, and at the door of these things we lay the increase of immigration during the last few months. The future holds in store for the present of Europe advanced legislation and concessions of land. These things will militate against emigration from Europe in the future.

Stabilizing Immigration

Don't bank on a ceaseless flow of immigration. The time may come when we shall have to wish for it. What we must do is to endeavor to stabilize the foreign born now in this country, to try to induce them to remain here, to convince them that they should establish their homes in America and become good Americans.

If it is worth while admitting the immigrant, it is worth while attempting to have him stay permanently and become a citizen. For too long a time we have left the immigrant to shift for himself.

We have compelled him to seek employment unaided and without information as to localities where jobs are available. He has had to rely upon his countrymen in America for information and guidance, and the result is that he has gravitated to one or the other of the racial communities scattered over the country.

We have allowed the immigrant to get his impressions of American life through his experiences with unscrupulous people who have attempted to exploit him. We have left him to the mercy of dangerous ultra-radical agitators who at least pretend to take an interest in him, and, finally, we rail at the immigrant if, after a few years in America he has not applied for citizenship papers, and has not taken on some of the outward appearances of a native-born American.

There has been a lot of nonsense about the Americanization of the immigrant. Some people conceive Americanization as the waving of flags, and singing of patriotic songs. The way to Americanize the immigrant is to insure him steady work and to obtain for him square treatment on the job and off the job; to provide him with facilities for learning the English language, and to give him the right kind of an industrial start. These things coupled with protection and with a decent sort of attitude, will do more to make the immigrant love America than all the patriotic activities put together. Americanization is not a task for sentimental philanthropy. It is a man-size job, and a job that devolves rightly upon clear-headed business.

Certain things are necessary in bringing about the assimilation of our immigrant population. We must accord the immigrant, first of all, a proper reception on his arrival. There should be some way of getting to him information about jobs in various parts of the country, the conditions of work and the amount of compensation. We should have a service of distribution functioning both in Europe and in America. Before embarking on the other side, the immigrant should be informed where the best opportunities exist in this country, and every effort should be made to scatter the immigrants throughout the United States, so as to insure that all localities requiring immigrant workers shall get the benefit of their labor. Incidentally, this would have the effect of checking the growth of the racial communities that have grown up because of our neglect in the past to provide adequate Federal machinery for distribution.

Information for Immigrants

At Ellis Island, where 90 per cent of the immigrants are admitted, there should be a competent staff to assemble information from all parts of the country concerning opportunities for employment, wages, and other data useful to the foreign born. The staff of the department should be under the direction of a non-partisan official, serving, say, as an assistant to the Commissioner of Immigration, and acting in the interest of the industries of the United States—not for a certain group of industries, but for all the industries that require foreign-born labor. Our immigration should, first of all, be made to serve the productive needs of the nation.

Scientific distribution will help those productive needs, but I would suggest other steps besides scientific distribution. I would suggest that our Department of Labor send representatives to Europe to select the kind of immigration that is most assimilable and that best suits the industrial requirements of this country. At the present time our immigration machinery is inadequate. It has no facilities abroad; it depends upon the consular offices, which are part of our State Department, for whatever investigations into immigrant applications for passports are necessary. The situation is taxing our consulates in Europe, and the original purpose of those consulates—to gather business facts of interest to our business men—is being lost sight of.

When the immigrant is admitted we must take steps to protect him and to educate him. We should educate him as to the opportunities in America. We should show him where safety and profit exist, on the one hand, and, on the other hand, where danger lurks in the form of ultra-radicalism, violence and disorder.

We have seen the ultra-radicals spreading their doctrines of violence and revolution, while American business men have been placidly about their business, not realizing that they were sitting on top of a volcano. Revolutionary agitators have been boring from within in the labor organizations; they have been running magazines and papers in English and in foreign languages.

It is conservatively estimated that the I. W. W. sells $300,000 worth of literature a year. What has the American business man been doing besides giving inspirational addresses, and besides playing with amateurish experiments in Americanization? If the American business man were awake to the situation he would go about the business of combatting ultra-radicalism and revolutionary propaganda as systematically as he has gone about his own business enterprise.

The foreign born can be reached effectively in several ways—through their organizations, through the press, and through the individual plants. Recognizing that fact, a number of business men formed the Inter-racial

Council a little over a year ago. The council today is composed of more than 1,100 of the leading industrial establishments in the country, and conference groups from among thirty-two of the races in the United States. These two elements in the council have been working together in the interests of good, wholesome Americanism, and they have been directing their efforts through three channels:

First—Through the foreign language press, with news and advertisements relating the impracticability of Bolshevist theories, and the real meaning of American democracy.

Second—Through the English language press for the purpose of eliminating racial antagonisms, which are fertile soil for the seed of Bolshevism.

Third—Through the individual plants, by means of surveys by experts who know the races and their psychology.

The council is endeavoring also to impress the American public with the necessity of applying scientific principles to immigration. It is striving to create a new view point of the subject, to develop public knowledge of its importance to the prosperity of the country, and its relation to industry and citizenship.

That immigration is of paramount importance to American prosperity is beyond question. Since the foreign born came to this country in large numbers, beginning in 1850, the wealth of the United States has grown from less than ten billion, to over one hundred billion dollars; the money in circulation has increased from less than three hundred million to five billion; the deposits in savings banks have grown one hundred times as large and exports have jumped from one hundred and forty million dollars to many growing billions.

Since the immigrants arrived in large numbers, wages have increased twenty times, and the value of the products produced have jumped from one billion to twenty-five billion dollars.

The Inter-racial Council has been stating these facts to the country through the newspapers, and syndicate services, through trade journals, house organs, through addresses before business organizations, and groups of leading influential men. But it has not been doing half enough; it has not been doing one-tenth of its job, and why? Because this is a big job, requiring the support of the entire business field, requiring an organization extending all over the United States and ramifying into all of the leading cities of the country.

Until such time as the Council can command the unified support of American business, it will go on hitting the high spots, at least, and will continue to refute the ridiculous arguments of restrictionists who would limit the progress of America to the gait of a lame pedestrian. One thing it will not fail to do will be to point out the foolish character of much of the legislation in various States that prohibit the foreign born from engaging in certain occupations. We have proclaimed in our Declaration of Independence that all men were created equal; that they were endowed with equal rights, among them life, liberty and the pursuit of happiness. We state those things in our Declaration of Independence, but we enact laws in our state legislatures denying the foreign born the right to pursue happiness. In the State of Pennsylvania, if the children of a foreign born resident have a dog, he must shoot it or otherwise get rid of it. In Pennsylvania and other states, an immigrant may not secure a job on public works. In Wyoming he is forbidden to be a guide in the mountains; in Virginia he may not be a junk dealer, and in Florida, Virginia, Texas, Washington and Ohio he may not sell fish or oysters. In Michigan he may not become a barber. I could cite a score of other instances of discriminatory laws against the foreign born.

Then there is the literacy test, which bars admittance to immigrants who cannot read and write 40 words in any language. This test may keep out the illiterates who may be, and often are, very intelligent; it does not keep out the potential crooks, and revolutionary agitators who, as a rule, can read and write in several languages. There is the regulation which bars the stimulation of immigrants. This regulation is so worded as to prohibit the dissemination in Europe of information relating to opportunities and conditions prevailing in the United States.

What about legislation on the positive side, instead of the negative? What about an up-to-date twentieth century policy that will consider things in a common-sense way—a policy that will provide for information, protection, selection and distribution and that will handle the immigrant from the time he embarks aboard ship until he is settled down in his job in America. This is a business proposition. The best interests of American business require that such steps be taken. American business has been passive on the subject if not indifferent to its best economic interests.

The steps that ought to be taken in the interests of our immigration are well defined. It is not a question of hitting in the dark as we have on many other occasions. For over a year every phase of this subject has been studied thoroughly by the Inter-racial Council, which has assembled these facts from all over the world. It knows what must be done, but these things cannot be done without the co-operation of the business bodies; it cannot be done without the expenditure of funds in the interest of education and information. These things will not take care of themselves.

The agency already exists for planning; for getting the people together; for presenting the proper viewpoint; for mobilizing the facts—that agency is the Inter-racial Council, and I commend it to you for your wholehearted co-operation and support.

Expanding Punch for Aluminum Ware

By John Lindgren

On page 615 of the *American Machinist* J. R. Sheppard asks why a hydraulic press is not used instead of the expanding punch for producing panels on aluminum ware.

There are several reasons, perhaps the most important of which is the extra time required. A two-piece die, such as he mentions, has been tried on the operation, using a rubber filler instead of hydraulic pressure with fairly good results; but difficulty was encountered in supplying a locking mechanism strong enough to hold the pressure and at the same time be easily operated.

It is doubtful if a shell could be expanded by the hydraulic method so as to save a spinning operation, for the reason that the body of the utensil is larger than the neck, and in expanding a drawn shell from, say 4½ to 6 in., the metal would continue to stretch at its weakest point till it broke.

A spinning operation would be required anyway, to take care of the trimming and beading.

SPARKS FROM THE WOR

Valentine Francis

The Situation of the German Machine Industry

A close survey of the present situation of the German machine industry shows a slight improvement. Reports from various industrial centers would indicate that the utter stagnation which obtained up to a few weeks ago has given way to an increased activity which is more or less marked in the different branches. One of the industries reporting improved business is the textile machinery line while the sewing machine branch is likewise doing better than in the beginning of the year.

An inquiry among manufacturers as regards prices would show, however, that a reduction of sales prices in the near future appears unlikely in view of the fact that foundries are unable to reduce prices owing to the high prices for iron imported from abroad.

The situation in the machine-tool industry still remains unsatisfactory, though in this industry, too, a slight improvement has been noticeable. Many concerns report a decided activity so far as inquiries are concerned, but the number of deals closed is still meager on account of the reticent attitude of consumers, who firmly believe in an imminent break of prices. Manufacturers, on the other hand, strongly deny the possibility of a reduction of prices in the near future on a scale worth mentioning. Another interesting feature of the general situation is the marked absence of foreign orders for German machine tools, which is generally explained by the overstocking of foreign markets.

The agricultural machinery and implement industry is severely affected by adverse conditions. Sales are lacking and a number of factories are working part time only, while some works have even closed down altogether. Foreign orders are scarce owing to the overstocking of warehouses, and the negotiations between the Allies and Germany for the purpose of placing orders with the German industry have not advanced beyond the initial stage as yet. Although the present time of the year was never conspicuous for lively business the fact should not be overlooked that the stagnation of business in this industry is rather marked. Practically the same applies to the woodworking machinery line as well as the electrical machinery and apparatus industry, where business on a small scale only is being done.

The bicycle industry is also complaining about the scarcity of orders, and this in spite of the recent reductions of prices.

A War Memorial

As a recognition of its employees who served either at home or abroad during the great war the Brown & Sharpe Manufacturing Co., Providence, R. I., has issued a worth-while memorial in the form of a splendidly printed volume of ninety-five pages, bound in a substantial manner. These books have been distributed first to the families of the nineteen who lost their lives, second to all of the 911 who saw service and who could be located, and finally to the several thousand employees now with the company who served during the war period. It has been impossible to locate all of the boys who went into the service and if any of these who read this will communicate with the Brown & Sharpe Manufacturing Co. they will receive a copy which has been reserved especially for them.

The book is illustrated with a color frontispiece, showing the service flag and a portrait of each of the nineteen who died in service. There is a note of appreciation from Henry B. Sharpe, which refers to the patriotic endeavors of all the employees during the crisis and expressing the thought that the whole record is one to which everyone will look back with pride in the years to come.

The volume has been prepared with extreme care, not only as to text but also its illustrations, arrangement and general appearance. It makes a highly commendable appreciation of the services rendered and will be treasured by those who formed a part of the Brown & Sharpe organization during the war.

Steel Fabricating Corporation Building New Factory

The Steel Fabricating Corporation, of Harvey, Ill., is building a new plant at Michigan City, Ind., to provide for the increasing demand for its sectional steel buildings. These buildings are designed according to the best engineering practices and are built for strength, service and satisfaction. The trusses, for example, supporting the roof are of the standard Fink type hot riveted throughout, the same as are used in the heaviest engineering jobs, such as skyscrapers and bridges. These trusses not only support the roof but will carry extra overhead loads, such as line-shafting for running machinery, or trolley conveyors for distributing materials around the factory, up to three tons without additional bracing.

The new factory will cover more than two city blocks and a half mile of switches in and around the plant have been installed.

Soviet Russia Places Big Order in United States

Following are the commodities, with the quantities, that Washington D. Vanderlip says the Russian Soviet Government has ordered from him and to supply which, he asserts, he will organize a Pacific Coast syndicate:

"Five thousand locomotives, 50,000 box cars, 2,000,000 tons of rails and rail fixtures, 2,100 gasoline and steam tractors, 1,000,000 plows, harrows, cultivators, drills, mowing machines, threshers and binders, 1,500 gasoline tractors, 2,000 linotype machines, 2,000 lathes, 500 steam boilers, 300 water turbines, 350 narrow gage locomotives, 50 generators, 350 gasometers, 10,000 automobile trucks and cars, 50,000 electric motors and dynamos and 7,000,000 tools.

"Three hundred thousand tons of metals, lead, tin, babbitt, antimony, etc., 50,000 tons rubber, 30,000 tons binder twine, 25,000 tons cocoa and coffee, 100 excavators, 500 steam engines, 100 oceangoing steamships of 10,000 tons and upward, 2,000 river steamers, motor boats and launches, 500 electric locomotives, 10,000 airplanes, 2,500 passenger cars, 5,000 street cars, 50,000 tons axles and tires, 5,000 sets of pumps and accessories, 30,000 sets of telegraph and telephone apparatus and 5,000 automatic block system sets.

"A thousand grain storing elevators, 10,000 cold storage plants, 250 dredgers for gold mining, 1,000 railroad excavators, 250 dredgers, 1,000 powerhouse installations, 100,000 tons of tool steel, 50,000 typewriters, 50,000 weighing scales and measures.

"Two hundred seventy thousand tons cotton, 6,000,000 tons coal, 25,000,000 pairs footwear, 50,000 tons leather, 125,000 tons hemp and flax manufactures, 500,000,000 cans condensed milk, 500,000,000 cans meat and other canned goods.

"Thirty-five thousand tons of resins, 1,000,000 tons copra, 10,000 tons joiners' and turners' precision work, 60,000 tons saltpetre, 20,000 tons chemical products and materials, 160,000 tons tanning materials, 60,000 tons dyeing materials."

—*New York Herald.*

Railroad Income Short

The Bureau of Railway Economics announces that the net operating income for September of Class I railroads of the country fell approximately $29,343,000 or 26.9 per cent short of the amount expected under increased rates. This figure is based on reports from 207 railroads of that class having a total mileage of 237,899 miles.

LD'S INDUSTRIAL FORGE
News Editor

Money and Markets

Credit Situation

The country's credit requirements have, during the period under review, reached a maximum level. Pressure may for a time continue at this current high level but no substantial increase is anticipated in the demand for banking accommodations, either for crop financing or to meet commercial and industrial requirements. The credit position is essentially sound and the future is to be regarded with confidence.

The banks and reserve institutions have financed the enormous volume of current requirements with no weakening of their reserve strength. The beginning of a reduction in the aggregate of these requirements is now evident. Loans of reporting member banks of the reserve system expanded steadily until the middle of October. A moderate contraction is now shown. Interior banks in diverse sections of the country are moderately increasing the volume of their purchases of commercial paper, an evidence of the release of funds from other employments. They have also begun, in a small way, to reduce their borrowings with other banks. Such contraction as has occurred is not of large volume. It is important, however, because in the present difficult situation it indicates an ability greater than might have been anticipated on the part of both the interior banks and their customers to liquidate outstanding obligations.

Money Rates

Open market rates on commercial loans have continued unchanged on an 8 per cent level, with country banks purchasing paper in fair volume. Call money was tight, ruling throughout most of the period at from 9 to 10 per cent, but easing at the close to 7 per cent. The continuing high rates in the call money market reflected the general stringency of credit rather than the requirements of the stock market, where sharp liquidation continued throughout the period. Moderate offerings of time money may reasonably be expected shortly, as funds are released from other uses. This would result in lower quotations. Prime bank acceptances were in active demand in reduced supply.

General Conditions

The determining factor in the entire situation continues to be the reluctance of consumers to buy, partly because of their expectation that prices may go even lower, and in part because of the curtailment of purchasing power of large sections of the buying public. Farmers are not purchasing actively at present because prices of the products which they have to offer in exchange have declined sharply. Wage earners hesitate to purchase because their earnings are being curtailed by increasing unemployment and in some cases by reduction in wages.

The adjustment of prices to new conditions of supply and demand has proved difficult. Two factors on the buying side of the equation offer much encouragement, however. In comparison with those classes whose income increased rapidly during the period of rising prices, the decline in prices which has already taken place has increased the purchasing power of salaried employees and persons in receipt of fixed incomes from investments. Large crops assure a fair volume of buying throughout the agricultural parts of the country, especially the grain states. Farmers unquestionably are delaying their purchases until the prices of what they must buy approach the level at which they must sell their crops. As that level is approached they will buy in increasing volume, because their position is essentially sound.—*National Bank of Commerce in New York.*

Steel Products Engineering Co. Buys Averbeck Patents

The patent rights and tools of the Henry J. Averbeck Shaper Co., of Covington, Ky., have been purchased by the Steel Products Engineering Co., of Springfield, Ohio, for the purpose of manufacturing the Averbeck shaper on a big production scale. Henry J. Averbeck was president of the company and was also inventor and designer of the shaper. He and his brother Lawrence will continue in general machine-shop business at their present address, having kept their standard machine-shop equipment. The Steel Products Engineering Co. also manufactures airplane motors and a universal gage grinder.

Georgia To Make Pig Iron?

The special train of the Georgia School of Technology with about 150 prominent business men of Georgia aboard left Atlanta Wednesday afternoon, Nov. 17, for an industrial tour which included inspection of industrial plants in the cities of Cincinnati, Buffalo, Niagara Falls, Pittsburgh, Boston, New York and Washington. One of the main purposes of the tour was to inspect iron and steel plants in the above named cities with a view to establishing blast furnaces in Georgia to make pig iron from ore mined in that state. All Georgia-mined iron ore is now sent outside the state for this purpose as there are no furnaces there.

Cancellation of Orders Affecting Our Standing Abroad

Order cancellations, the repudiation of contracts and the protesting of irrevocable credits on technical grounds by some American import concerns have lately assumed such proportions that they threaten to jeopardize the standing of the United States in the markets of the world.

These practices (according to the Guaranty Trust Company of New York in "American Goods and Foreign Markets," its semi-monthly survey of international trade), whatever justification they may or may not have, present the most serious feature of American foreign-trade relations today. They have been resorted to in most cases because the recent decline in commodity prices has occasioned substantial losses to importers here, who, consequently, are endeavoring to relieve themselves of obligations entered into with foreign houses.

American business men, on the other hand, complain that contracts abroad have been cancelled even oftener than in this country, and that infractions of the rules of business ethics are less common here than abroad.

The following letter from a prominent Far Eastern bank is a typcial expression of the general dissatisfaction in foreign fields over the situation:

To our extreme regret we must inform you that lately both banks and merchants here feel some uneasiness concerning the possibilities of continuing the close business relations which were established with your country during the war and which until recently have developed to the satisfaction of all concerned.

This uneasiness, which we are sorry to observe almost everywhere, is due to unfortunate experiences of late regarding the attitude of American buyers toward their business contracts.

Refusals by American banks to honor drafts drawn under their letters of credit because of quite insignificant deviations from the usual wording of letters of credit have recently occurred again and again, notwithstanding that the bankers have immediately offered guarantees of redress for such small inaccuracies. Obviously, these refusals were instigated by American buyers, and one cannot help feeling inclined to attribute the attitude of American banks to the changed attitude of American merchants.

Although it may be that such methods are practiced only by merchants who have already acquired repute in your country for unsympathetic commercial principles, you will readily understand that the victims here naturally generalize in their conclusions, and thus great harm is being done to the development of our trade with America.

The exchange banks in Java, under the circumstances, are reluctant to take American bills. Hence, the extent of our business relations may be seriously affected, which we are trying our best to prevent.

We deem it our duty to draw attention to these facts, and trust that they will bring home to American importers the fact that such acts as those mentioned in the foregoing ultimately will prove seriously detrimental to American business relations abroad, the growing extent and intimacy of which we have been watching all these years with the utmost pleasure and satisfaction.

In justice to American business men, however, it should be stated that most of them are living up to not only the letter but also to the spirit of their contracts here and abroad. And, although we have no desire, of course, to excuse any American business man or bank from the responsibility of carrying out a contract in an honorable way, it must be admitted, in fairness, that there are extenuating, if not wholly justifiable, grounds for some of the repudiations of contracts.

For instance, it is asserted that in numerous cases, when an American importer has purchased sugar in Java, the merchant there postponed shipment as long as possible on a rising market and traded "in and out" to the imminent risk of the American buyer; and very frequently, it is contended, only when forced by a declining market and by the approaching expiration of the letter of credit under the contract has the Java merchant shipped the sugar.

It is also alleged by American importers that, more frequently than occasionally, merchandise purchased abroad has not actually been on board ship within the time specified and that bills of lading have been issued dated back within the life of the credit. Consequently, American merchants feel that they are entitled to reject the goods on a legal technicality, in order to protect themselves against what they regard as commercial bad faith on the part of the shippers.

American importers complain likewise that contracts have been cancelled abroad oftener than here, citing large numbers of such repudiations in South America and in Europe, including Great Britain. They point out that even legislation has been invoked to make the entrance of their goods into port illegal (referring specifically to the rice situation in Cuba).

American bankers can testify that it has become a hazard to make advances on collections drawn on buyers in many foreign countries. As a matter of fact, so great has this hazard become that most bankers in the United States are disposed now to make advances on such collections only in the case of drawers of the strongest financial responsibility. And whatever the foundation for the complaints of foreign banks, we are confident that it is not related to the action of any of the long-established international American banks.

But in this critical readjustment period, it is even more essential than in normal times to preserve the highest business ethics in foreign trade, as well as domestic commerce. Our whole commercial structure rests upon a contractual basis, which, in turn, is founded upon solemn moral obligations. We cannot ever afford to impair the stability of that structure, and certainly not at this time, of all times, by permitting any weakening or deterioration of its very cornerstone.

The man who always retains his head can usually retain a goodly share of other things.—*Forbes Magazine* (N. Y.).

The Metric System and the Lumber Industry in South America

South American countries have been pointed to in recent metric propaganda as enthusiastic users of the metric system of weights and measures.

Nowhere does theory differ more widely from practice. The lumber industry furnishes one of the many instances that can be quoted, as will appear from the following letter received by American Institute of Weights and Measures:

> Permit me to say that I have had considerable personal experience in practically every important Latin-American country, with the exception of Venezuela and Colombia, in work involving the use or purchase of lumber, and with very few exceptions I have not found the metric system to be used to any appreciable extent. It is true that in certain government specifications in certain countries lumber is calculated by the cubic meter, and in other countries they find it convenient to speak of square meters of lumber, which is estimated to be 1-in. thick, but wherever the English measure is not very obviously the one used I have found the tendency to be to use a corresponding Spanish measure of feet and inches, which varies very slightly from the English inch. It is, of course, a matter of considerable annoyance at times to have a divergence in the use of technical terms, but any attempt made to compel people to use the metric system, as regards the lumber industry, would, in my personal and humble opinion, be futile.
>
> I have just returned from a trip to the major portion of all the principal countries of South America and have made it a point to consider this subject in more than an incidental way, and my experience has been such that I would not feel justified in recommending a transfer to the metric system in handling lumber.
>
> (Signed) V. L. HAVENS,
> Editor, *Ingeniería Internacional.*
> Aug. 23, 1920.

The lumber interests in the United States are fully aware of this fact. Their position is indicated by the resolutions quoted below as being opposed to the compulsory adoption of the metric system:

New Jersey Lumbermen's Association, Executive Committee, Newark, N. J., Sept. 14, 1920:

> Be it resolved, that the New Jersey Lumbermen's Association is decidedly and unanimously opposed to the adoption of the metric system. It is felt that the adoption of this system would result in endless confusion and great expense, and there is no necessity for a change in our system of weights and measures.

National Retail Lumber Dealers' Association, Board of Directors and Executive Committee, Chicago, Ill., Oct. 22, 1920:

> Absolutely and positively opposed to the proposed metric system, and is in favor of our present system of weights and measures.

Fritz J. Frank Now President of Iron-Age Publishing Co.

Fritz J. Frank, vice-president of the Iron Age Publishing Co., has been elected president of that company, following the resignation of William H. Taylor, who has been president and general manager for more than ten years.

Mr. Taylor has resigned because of ill-health, and has retired from active connection with the Iron Age Publishing Co. He came to the *Iron Age* as general manager, after a group of publishers had acquired the ownership from David Williams. Previously, Mr. Taylor had been connected with various trade and engineering publications over a period of fifteen years, having for a time been vice-president of the McGraw Publishing Co. and, later, president of the Taylor Publishing Co. of Chicago, which consolidated the *Engineer and Steam Engineering.* He and his associates on acquiring the *Iron Age* separated what had long been the hardware department of this journal, and established it as *Hardware Age.*

Fritz J. Frank, who succeeds Mr. Taylor, has been with the Iron Age Publishing Co. since 1910, after an active association with other trade publications, among them *Colliery Engineer* and the *Mining and Scientific Press.* He has a wide acquaintance in the iron and steel and machinery trades, is experienced in business journalism, and is thoroughly committed to the traditions and standards of *Iron Age,* which belongs in that progressive group of business publications which put editorial service to the reader as the basis for substantial and sound publishing development.

McCormick's Plan for Reorganization of U. S. Departments

Reorganization of Government departments is provided in a bill drafted by Senator Medill McCormick of Illinois for introduction in the coming session of Congress. The provisions of the measure have been discussed by Senator McCormick with President-elect Harding, who, according to a statement issued through Senator McCormick's office, expressed great interest in the proposition. The bill will not be pushed until after the new President takes office.

New departments of public works and public welfare are created by the bill. The Interior Department is abolished. All bureaus and functions not germane to the national finance are taken away from the Treasury Department and all duties not connected with the national defense are taken from the War Department. Existing agencies which are scattered irrelevantly through the Government organization are co-ordinated and grouped in related departments.

The bill brings together in the Department of Public Works all important engineering and building services of the Government, and authorizes the secretary of public works to make such changes in the organization of these existing agencies as will increase their efficiency and lead to economy of expenditures. Included in the new Department of Public Works will be the Geological Survey, the Bureau of Mines, the Reclamation Service, the General Land Office, the National Park Service, the Division of Capital Buildings and Grounds, and the Alaskan Engineering Commission, all of which are now in the Department of the Interior; the office of supervising architect, which is now in the Treasury Department; the Bureau of Public Roads and Forest Service, which are now in the Department of Agriculture, the Board of Engineers

Condensed-Clipping Index of Equipment

Patented Aug. 20, 1918

Demagnetizer, "Demagnetool"
William Brewster Co., 30 Church St., New York
"American Machinist," Nov. 4, 1920



It is claimed that this demagnetizer will demagnetize tools to zero instantly and that it is not necessary to rub the tools back and forth on the demagnetizer, but only to put them on and take them off.

Grinding Machine, Disk, Vertical-Spindle, "No. 142"
Badger Tool Co., Beloit, Wis.
"American Machinist," Nov. 4, 1920



This machine is of the vertical spindle type. The work to be ground is placed on top of the disk and suitable crossbars or stops prevent it from revolving. The spindle is mounted in radial and thrust ball-bearings, the thrust bearing being adjacent to the disk collar. The machine is built in motor-driven type only. Specifications: Disk, 42-in. diameter. Motor, 15 hp. Speed, 600 r.p.m. Complete equipment includes: Steel disk wheel, press for attaching abrasive disks, oil compensator, extra assortment of abrasive disks and an assortment of supplies. Weight 3,000 lb.

Dresser, Grinding-Wheel, "Metcalf"
Oliver Machinery Co., Grand Rapids, Mich.
"American Machinist," Nov. 4, 1920



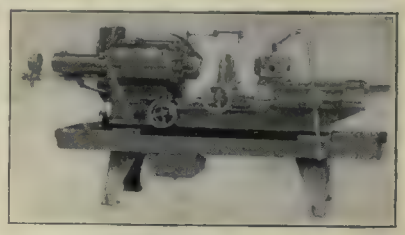
There are three types, "A," "B" and "C." Type "A" is for hand dressing and is shown by the illustration. Type "B" is for use with a toolpost. The dresser consists of a 4 x 1½-in. abrasive wheel revolving freely on its axis. The type "A" wheel is recommended for truing square, round, bevel or V-edges on wheels 1 in. or less in thickness; type "B" for use with cylindrical grinding machines, and type "C" for working in close quarters to true square, round, bevel or V-edges on wheels 1 in. or less in thickness, and the sides on straight or dished wheels.

Drill, Two-Spindle, Electric
Black & Decker Manufacturing Co., Towson Heights, Baltimore, Md.
"American Machinist," Nov. 4, 1920



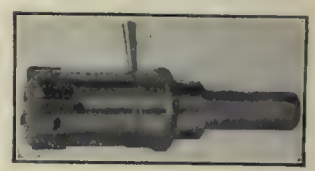
This drill is intended for drilling the holes for automobile curtain fasteners. The handle of the device is like that of an automatic pistol and a pull on the trigger sets both spindles in motion, while a second pull stops them. The motor and the driving gears are said to be simple, yet rugged, the gears being made of heat-treated steel. The two spindles, which are only ¾ in. from center to center, have special chucks for holding ⅛-in. drills.

Lathe, Turret, Geared-Head
Warner & Swasey Co., Cleveland, Ohio
"American Machinist," Nov. 4, 1920



This machine is designed for machining alloy-steel gear blanks, long drilling operations in the solid, and taking heavy facing and forming cuts. Twelve spindle speeds and reverse are obtainable. The No. 4 lathe is equipped with the standard No. 4 cutoff; the No. 6 can be equipped with the regular cutoff or with a "heavy-duty" carriage. There are six power cross-feeds and the turrets can be equipped with power feed having four changes. Specifications—No. 4, maximum capacities: Round bar stock, diameter, 1½ in. Length turned, 10 in. Swing over bed, 16 in. Swing over cross-slide, 7 in. No. 6, maximum capacities: Round bar stock, diameter, 2¼ in. Length turned, 12 in. Swing over bed, 20⅜ in. Swing over cross-slide, 9¼ in.

Tap, Collapsible
Rickert-Shafer Co., Erie, Pa.
"American Machinist," Nov. 4, 1920



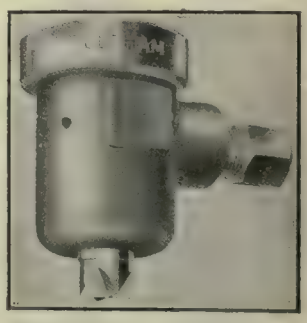
The claims made for this tap are: that the action of withdrawing or collapsing the chasers is positive with no liability to stick; that in tapping to a predetermined depth or close to the bottom of a hole, full reliance may be placed on its action as the chasers will collapse at the proper point; that adjustment for size can be made to fractional thousandths of an inch; that the tap will hold to size within the most exacting limits and that the use of sizing hand taps can be dispensed with. Taps of this type are made in sizes from one to ten inches.

Riveter, Stake for Marine Boiler Flanges
Baird Pneumatic Tool Co., Kansas City, Mo.
"American Machinist," Nov. 4, 1920



This riveter can readily be used in the fabrication of any boiler or tube work where the requirements call for operating equipment having the possibility of adjustment necessary in any of the difficulties met with in such construction. The adjusting screw is of the buttress type and the air cylinders are of the tandem-unit type, both pistons being on the same rod. Specifications: Reach, 5 in. Gap, 12 in. Die adjustment, 3 in. Will drive 1-in. rivets. Air consumption, 4 cu.ft. per drive. Length, 33 in. Height, 40 in. Weight, 750 lb.

Scaling Tool, Valveless
George Oldham Son & Co., Baltimore, Md.
"American Machinist," Nov. 4, 1920



This tool is intended for removing scale from boiler tubes and crown sheets, as well as paint and rust from all metal surfaces. It is claimed that it gives a light rapid blow that removes scale without injury to the surface. It can be fitted with a pipe extension that enables it to reach places which could not be reached otherwise. It measures only 3½ in. overall, weighs 2¼ lb., and will operate on any standard air pressure.

for Rivers and Harbors, the Board of Engineers of New York City, the office of Supervisor of the Harbor of New York, the United States Engineers offices, the Mississippi River Commission, the Board of Road Commissioners for Alaska, and the Office of Public Buildings and Grounds, all of which are now in the War Department. The Federal Power Commission is abolished, and its functions transferred to the Department of Public Works.

New departments of Public Works will include the Bureau of War Risk Insurance and the Public Health Service, now in the Treasury Department; the Pension Bureau, and the Office of Indian Affairs, now in the Interior Department; the Women's Bureau of the Department of Labor; the Federal Board for Vocational Education, and other miscellaneous agencies.

The bill abolishes the office of Controller of the Currency and transfers the functions of that office to the Federal Reserve Board. Inasmuch as the Controller of the Currency is ex-officio member of the Federal Reserve Board this action would automatically decrease the membership of the board from seven to six and make the Secretary of the Treasury the single ex-officio member of the board.

The bill enlarges the jurisdiction of the Department of Commerce by transferring to it the Patent Office which is now in the Department of the Interior; the Weather Bureau, which is now in the Department of Agriculture; the Coast Guard, which is now in the Treasury Department; the Lake Survey Office, which is now in the War Department; and the Inland and Coastwise Waterways Service, which is now in the War Department.

The bill creates an additional Assistant Secretary of State who would have jurisdiction over insular affairs. Jurisdiction over territories such as Alaska, now under the Department of Interior, would be transferred to the State Department.

The Alien Property Custodian's office and the Division of Secret Service are placed under the Department of Justice.

The Board of Mediation and Conciliation is abolished and its functions transferred to the Department of Labor. The Council of National Defense is abolished and its functions discontinued. The botanical garden is transferred to the Department of Agriculture.

The reorganization is similar to that which was effected in the State of Illinois by Governor Lowden. Senator McCormick was a member of the Illinois Legislature at the time an investigation was begun looking toward such consolidation and figured prominently in the movement.

Senator McCormick, just before his departure for Europe this week, said the purpose in introducing the bill at the approaching session is to bring about discussion and study, to the end that when Congress acts the best possible scheme will have been worked out.

The Rebirth of French Industry

The French information service of the Bankers Trust Co. of New York has obtained data compiled by the ministry of the liberated regions covering industrial reconstruction progress in the devastated parts of France up to Oct. 1, 1920. The ministry's figures show that the number of damaged or destroyed industrial plants again operating in these regions on that date was more than two and a half times as many as were operating on the same date last year. These establishments comprise more than 76 per cent of the total number of industrial plants in the devastated territory which were damaged or destroyed.

In spite of scarcity of labor due to the loss of man-power in the war, the high cost of materials and the huge task of restoration necessary before productive activity could be resumed, these plants are now employing in actual production nearly half as many men as were employed in all the industrial establishments in the desolated regions in 1914.

The enormous task represented by this progress and its importance, not only to the economic stability of France but of western Europe generally, may be realized, in part, from the fact that the devastated territory in the north where France has made such great strides toward business rehabilitation was before the war the richest industrial section of the country.

Ruin in Productive Regions

The twelve invaded departments, ten of which were left in ruins, produced 63 per cent of France's total steel output, 81 per cent of her textiles, 92 per cent of iron ore and more than 50 per cent of fuel.

France's increasing resumption of industrial activity in the departments in the north which were wasted by war is illustrated by the table showing by three-month periods the progress made in beginning anew the operation of mines, factories, manufacturing plants and other industrial establishments:

	No. of Factories Resumed Work in Whole or in Part	Per Cent of Total Number Damaged or Destroyed
October 1, 1919.....	1,278	30
January 1, 1920.....	1,806	42.5
April 1, 1920.....	2,412	56.9
July 1, 1920.....	3,004	70.8
October 1, 1920.....	3,239	76.4

What the Census Shows

The census of industrial establishments damaged or destroyed as of Oct. 1, 1920, totalled 4,241, employing twenty or more workmen. These concerns employed before the war 773,639 workers. The latest data available from the affected areas shows that on Oct. 1, 1920, 345,664 workers had again taken up productive occupations in industry in these areas. This was 44.6 per cent of the total number employed before the war and more than twice as many as the number employed in production a year ago. The percentage of workmen returned on Oct. 1, 1919, was 20.8 per cent.

In textile manufacture, especially woolen, cotton and linen, France's industrial recovery has made notable progress. This is particularly true of the Lille district including Roubaix and Tourcoing where 409 out of 478 factories damaged or destroyed have wholly or partly resumed manufacture and more than 67 per cent of the prewar number of workers are again employed.

Blast Furnaces Active

Although severely handicapped by lack of coke, the metal and metal working industry is rapidly assuming satisfactory productive capacity. Of fifty blast furnaces damaged or destroyed, thirty-seven have been lighted again; of 844 metal working plants, 736 have resumed production with 50 per cent of their normal force of employees; 62 per cent of the copper and bronze foundries damaged or destroyed are working to full or partial capacity; 51 per cent of the iron foundries and 45 per cent of the nut and bolt factories.

In the chemical industry in the devastated districts 111 out of 142 plants affected by the war are again in operation and 54 per cent of their normal working force is employed. France expects to make even more of her chemical industry now than ever before.

Large installations of hydro-electric power have been made for the conversion of chemical plants which were engaged in explosives manufacture into electro-chemical plants and electro-metallurgical operations. It is expected that French agriculture will benefit considerably from the native production of nitrates which it is hoped will take the place of nitrates hitherto obtained from Chile.

Speeding the Coal Output

Reconstruction of the coal mines of France is being pushed with all possible speed and effectiveness. In the department of Pas de Calais the work is more difficult than in the department of the Nord (these two being the principal coal regions) because the devastation was absolute above and below ground. In spite of this fact, however, the production of coal in Pas de Calais in September this year was 714,292 tons, nearly 100,000 tons more than September a year ago. The total coal production of France for the month of September was 2,419,015 tons as compared with 1,838,000 tons in September, 1919.

Business Items

The Morse Chain Co., Ithaca, N. Y., manufacturers of the Morse "rocker-joint" silent chain, used on automobiles for power transmission, has established a Detroit branch factory, which will be devoted exclusively to the manufacture of silent chain sprockets and the Morse adjustment. The company will con-

Condensed-Clipping Index of Equipment

Patented Aug. 20, 1918

Measuring Machine, Gage, Universal, "Wickman"
Alfred Herbert, Ltd., Coventry, England.
"American Machinist" (European Edition), Sept. 4, 1920



This machine gives comparator readings of diameters and pitches to an accuracy of 0.00001 in., and, it is said, has proved capable of obtaining comparator measurements of length and diameters to an accuracy of 0.000005 in. Magnification is carried out by a combination of mechanical and optical means; a mechanical magnification of 60 to 1 is magnified approximately 70 times by means of light, resulting in a magnification of 4,000 to 1, which eliminates the personal element. Capacity: Length gages up to 12 in.; major, core and effective diameter measurements of screw plug gages up to 6 in. diameter; pitch of screw plug gages up to 4 in. diameter.

Drilling Machines, Radial, Elevating-Arm
William Asquith (1920), Ltd., Halifax, England.
"American Machinist" (European Edition), Sept. 4, 1920



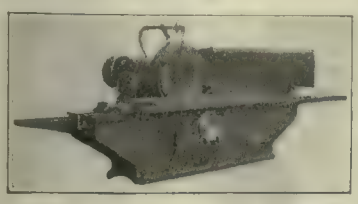
This machine is made in 3 ft. 9 in. and 4 ft. 6 in. radii, with either flat baseplate or self-contained box bed, and 5 ft. radius with flat plate only. The spindle can be started, reversed or stopped at any speed; the self-acting feed motion, through worm and wormwheel, is instantly engaged or disengaged by friction gearing. Fine hand feed motion is provided as well as quick hand adjustment. The auxiliary spindle is driven off the main spindle and runs on ball bearings, enabling the machine to drill both large and small holes at the correct speeds. Either motor or belt drive can be furnished.

Drilling Machine, Radial, Girder
William Asquith (1920), Ltd., Halifax, England.
"American Machinist" (European Edition), Sept. 4, 1920



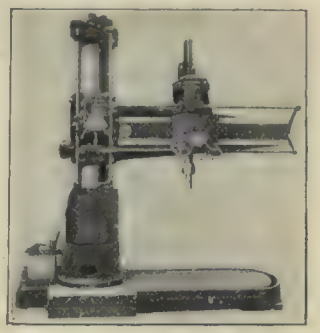
This is said to be practically a "ball bearing" machine, giving easy running and operation. It is made in 6-ft. radius size only. This type can be adapted to various forms of drive, both belt and motor. The spindle is supported on a sleeve, which carries the steel feed-rack, with double ball-thrust washer and ball-bearing journal. A compensating spring balance device is provided for the vertical adjustment of the spindle, and a lever on the saddle starts or stops the spindle instantly. A hand and self-acting traverse to the spindle is embodied in the machine.

Grinding Machine, Surface, Horizontal
Lumsden Machine Co., Ltd., Gateshead, England
"American Machinist" (European Edition), Sept. 4, 1920



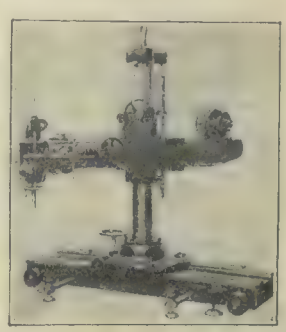
This machine is suitable for general plain surface work, such as flasks, cast-iron covers, hoods, lathe legs, columns, etc. Exceptional mass has been provided to insure rigidity, and the safety of the abrasive mounting has been provided for. The wheel consists of a set of blocks secured by wedges in a housing, from which they project; its diameter is 30 in. The table is 70 x 20 in., with a maximum traverse of 7 ft. The maximum length that can be ground is 72 in., and the height from table to top edge of wheel is 27 in. Feed, 0.0005 to 0.016 in. per reverse of table. Power required, 30 hp. Floor space, 22 x 7 ft. Weight, 5 tons.

Drilling Machine, Radial, Medium Size
William Asquith (1920), Ltd., Halifax, England.
"American Machinist" (European Edition), Sept. 4, 1920



Designed as a high-speed drilling machine of medium size, it drills holes of moderate diameter. The sleeve carrying the arm is rotated on ball and roller bearings. A triple lock lever simultaneously clamps the saddle to the radial arm, the radial arm to the sleeve and the sleeve to the internal pillar. Double ball-thrust washers take the thrust on the spindle to which ball journal bearings are fitted. Either belt or motor drive can be furnished. Sizes, 5 ft., 5 ft. 9 in., 6 ft. 3 in., and 7 ft. radii; and also a heavy-duty machine, in sizes from 5 to 10 ft. radii. For a 1-in. drill the penetration per minute is stated to be 31.3 in. at 500 r.p.m.

Drilling Machine, Radial, Universal, Portable
William Asquith (1920), Ltd., Halifax, England
"American Machinist" (European Edition), Sept. 4, 1920



The column of this machine can be locked on the bogie in any position along its base. Adjustable screw jacks lift the machine clear of the floor for working. The radial arm is built in two sections, and hand and power elevating motions are employed. The arm will swing a complete circle and has a tilting motion by hand of 30 deg. The drilling head at the end of the arm will swivel to any angle. The spindle end is bored to standard Morse taper. The motor is 3-hp., self-contained and reversible; three speeds are obtained. Sizes, 4 ft. 9 in., and 5 ft. 9 in.

Grinding Machine, Gage and Form Tool
Lumsden Machine Co., Ltd., Gateshead, England
"American Machinist" (European Edition), Sept. 4, 1920



The bed is of box section, and at its rear carries a sliding horizontal shaft, the free end of which holds the grinding-wheel spindle and the profile follower. The large handwheel is for operating the shaft carrying the grinding wheel, which can be traversed longitudinally 12 in. The horizontal handwheel permits of fine lateral adjustment for the work table, each division in the graduations of the periphery of the handwheel representing a movement of 0.001 in. The total movement of the table thus obtained is 1 in. The work table can be tilted to 20 deg.; it is 27 x 8 in. The grinding wheels are 10 in. in diameter, running at 2,100 r.p.m. The swinging travel of the wheel arm is 4 in.

Drilling Machine, Sensitive, Three-Spindle
F. Pollard & Co., Ltd., Leicester, England
"American Machinist" (European Edition), Sept. 4, 1920



This machine is equipped throughout with ball bearings, and is made with two, four, or six spindles and in a single-spindle bench model. The spindle brackets have a vertical adjustment of 8 in. and are clamped in position by a central locking bolt. The feed levers are adjustable. Each spindle has four speeds, ranging from 385 to 1,092 r.p.m. Diameter of spindles, 1 in.; bored No. 2 Morse taper; vertical movement, 5 in. Distance between spindles, 9 in.; from center to column face, 7½ in.; from spindle end to table face, 25 in. Table, 13 x 31 in. Weight, 1,120 lb.

Clip, paste on 3 x 5-in. cards and file as desired

tinue to manufacture chains and power transmission at the main plant at Ithaca. The Detroit branch will be under the general management of F. C. Thompson, with F. M. Hawley as chief engineer and C. B. Mitchell as factory manager. Sales and engineering offices are located at the Detroit plant, corner of Eighth and Abbott Streets.

The Greist Manufacturing Co., with a plant and main office at New Haven, Conn., has opened a New York sales office at 296 Broadway. This office will handle the company's contract work, consisting of accurate metal stampings, screw machine work and complete assembled machines of light and accurate construction. The office is in charge of A. L. Barrett, recently factory superintendent for the Berger & Carter Co., San Francisco, Cal.

For the purpose of establishing a plant to manufacture electrical batteries of various types, mainly for industrial use, the F. V. L. Smith Battery Co. has been organized and incorporated in Atlanta, Ga., with a capital stock of $300,000. A new plant is to be immediately constructed that will be the first of its kind in the Southeast, and have a daily capacity of 1,000 batteries. A chain of stations will also be established throughout the South.

Obituary

THOMAS W. CLARKE, engineer for the Standard Oil Co. of New Jersey, died suddenly in Tampico, Oct. 28, 1920. Mr. Clarke was born in Roxbury, Mass., Oct. 21, 1872. He received his engineering education in Massachusetts Institute of Technology and was highly experienced in both mechanical and civil engineering. On leaving college he was associated for a time with Manning, Maxwell & Moore. During the Spanish-American War he was an officer in the navy. In 1902 he became associated with the Standard Oil Co. as plant engineer of the Eagle works. In 1905 he was sent to China for the Standard Oil Co. of New York, where he was superintendent of construction and designing engineer in South China. In 1908 he returned to the United States and was assigned to the S. T. Baker Oil Co. to build a compounding and exporting plant for handling the Galena oils. Mr. Clarke later took charge of the construction of domestic trade plants for the Standard Oil Co. of New Jersey throughout the United States and Canada. In 1913 he left the service of the Standard Oil Co. to become vice-president and engineer of the New England Foundation Co. In February, 1920, he again entered the service of the Standard Oil Co., to do special engineering work for the general engineering department of the New Jersey Co. He was assigned to the Cia Transcontinental de Petroleo, S. A., and arrived in Tampico, March 1, 1920.

Personals

EMANUELE MASCHERPA, Via Padova 6, Milan, Italy, whose business was founded in 1903, is an agent for machine tools and accessories for the industry and will accept concessions and agencies or will act as representative of first-class American firms in the machine industry.

WEBSTER TALLMADGE, who has been connected with the Westinghouse Electric and Manufacturing Co., South Philadelphia Works, Lester, Pa., is now manager of the power division, Thomas A. Edison Industries, Orange, N. J.

WALLACE H. MARTIN has resigned as associate professor of mechanical engineering at the Pennsylvania State College and is now professor of heat engineering at the Oregon Agricultural College.

FRANK T. WRIGHT, resident manager of the United States Cast Iron Pipe and Foundry Company, Burlington, N. J., was recently tendered a reception in honor of his leaving to become associated with his brother in the varnish manufacturing business at Schenectady, N. Y. Mr. Wright, who was connected with the Burlington company for eighteen years, was presented with a handsome gold watch. Many of the officials of the company attended the event.

W. B. DUMONT, export sales manager of the Greenfield Tap and Die Corporation, Greenfield, Mass., returned recently from an eight months' business trip to England, France, South American countries and Cuba.

LEWIS E. BELLOWS, president of the Walden-Worcester, Inc., manufacturer of tools, etc., of Worcester, Mass., was elected a member of the executive committee of the Associated Industries of Massachusetts, at the annual meeting held recently at the Copley-Plaza Hotel in Boston.

JOHN C. SPENCE has been appointed works manager of the grinding machine division of the Norton Company, of Worcester, Mass. He has been with the company for a number of years and previous to his new appointment was superintendent of the grinding division.

G. ELLSWORTH BROWNELL has been appointed superintendent of the grinding machinery division of the Norton Co. of Worcester, Mass. Mr. Brownell was formerly assistant superintendent of this division.

GEORGE E. QUIGLEY has recently been appointed in charge of the Detroit territory of the Wickwire-Spencer Steel Corp., of Worcester, Mass., and Buffalo, N. Y. Mr. Quigley's office will be in Detroit.

FREDERICK T. DAVIS is now connected with the New York branch of the Becker Milling Machine Co., Reed-Prentice Co. and Whitcomb-Blaisdell Machine Tool Co., located at Grand Central Palace, New York City. Mr. Davis was formerly with the Davidson Tool and Manufacturing Corporation.

ALBERT H. HOPKINS has resigned from the presidency of the Engineering Advertisers' Association of Chicago, and from the managership of advertising and sales promotion departments of the C. F. Pease Co., Chicago, to become Chicago manager for the J. Roland Kay Co., international advertising agents, at its new building at 161 East Erie St.

C. F. MEYER, assistant secretary of the Landis Machine Co., Waynesboro, Pa., will leave shortly for an extended trip to the Orient in the interests of his company. Mr. Meyer will visit England, India, Dutch East Indies, Australia, Philippine Islands, China, Japan and the Hawaiian Islands.

GEORGE H. MORGAN has been elected treasurer of E. F. Houghton & Co., Philadelphia, manufacturer of oils and leathers. Mr. Morgan will retain the position of managing director of the leather manufacturing department of the company.

Trade Catalogs

Standard Radius Lathe and Planer Tool. R. G. Smith Tool and Manufacturing Co., Newark, N. J. A 3½ x 6 in. catalog, describing and illustrating a standard lathe and planer tool for cutting standard radii accurately and quickly.

Ready Reference Catalog. Ready Tool Co., Bridgeport, Conn. Catalog, pp. 32, 4¼ x 6 in. A quick reference catalog, describing its new tools and specialties; prices are also included.

Marine Pumps. Worthington Pump and Machinery Corporation, New York. Catalog BK-3000, 126 pages, 6 x 9 in. A well-bound catalog giving complete data on all kinds of marine pumps and other auxiliaries. Reciprocating and air pumps, air condensers, centrifugal pumps, and other miscellaneous marine products are fully described. Numerous tables and specifications are also included.

Standardized Leather Belting. Graton & Knight Manufacturing Co., Worcester, Mass. Bulletin No 101, ninety-six 5 x 8-in pages. One of the several catalogs issued by this concern, covering the leather industry. This booklet treats of all kinds of leather belting, giving tables, specifications and other useful data on this subject.

Light, Heat, Power. Dwight P. Robinson & Co., New York. Circular of this recently consolidated firm (with Westinghouse, Church, Kerr & Co.) giving summary of work of design and construction of power plants, factories, mills, railroad shops and terminals, hotels and office buildings.

Forthcoming Meetings

The 1920 annual meeting of the American Society of Mechanical Engineers will be held in the Engineering Societies Building, 29 West 39th Street, New York City, from Dec. 7 to Dec. 10.

The American Institute of Weights and Measures will hold its annual meeting at 2.30 p.m. in the United Engineering Societies Building, 29 West 39th St., New York, Dec. 10, 1920.

The Society of Automotive Engineers will hold its annual meeting on Jan. 11 to 13 inclusive at New York.

December 9, 1920 American Machinist Vol. 53, No. 24

The Use of Money in Business

By W. R. BASSET
Miller, Franklin, Basset & Co.

Are you a manufacturer or a speculator or do you do a little of both? When you have read this masterly article of Mr. Basset's you will probably have discovered several things about your methods of conducting business that will give you something to think about. The author's advice is sound, his remarks are very much to the point. Although some of the points he discusses are sore ones for many manufacturers just now, there is much to be gained by taking thought to the prevention of a recurrence of the troubles that now beset us.

WHEN a man in business needs money, his first thought is to borrow it. One may find elaborate treatises on business finance in which the whole subject is approached as though in business we dealt with money as such. One might infer that successful business somehow grew out of creating marketable securities, or forming sound financial connections, or in some other way closely linking banking and business.

Let us take business finance out of the marble halls of banking and see if more real financing cannot be done inside than outside the shop. Let us see if an insistent demand for money is an indication of prosperity, or an indication of bad business management which has confused the functions of business and of banking, or—further—whether the management, in a desire for easy money, has borrowed for speculation instead of for business processes.

Positive Rules Will Not Do

It will not do to put down positive and invariable rules; each case stands squarely on its own merits. This manufacturer may find that he is first of all a banker. He may find that his most profitable way of doing business is to lend goods over long periods. He may have a class of customers who want extremely long credits. Of course, one might say that his proper course would be to educate these customers into the use of short credit, but that is the counsel of perfection. No reason in the world exists why he should not extend one-, two- or three-year credits if, and this is the important point, he so organizes himself that the manufacturing and the banking phases of his business are not confused—if he remembers that he is appearing in two functions; first, as a manufacturer, and second, as a banker who lends goods instead of the money to buy them. His danger is in confusing the costs, the profits, and the losses of the two operations. Because the Germans worked out a right division of functions they were able to sell against all competitors in the long-credit markets such as Russia and South America.

Again, it may be the speculative feature that is of the highest importance. This is especially hazardous because speculation in materials is so often defined as "skilled buying." I know of hundreds of concerns with elaborate manufacturing and selling organizations that really depend for profit upon the ability of the executives to buy raw materials at a low price and sell them, slightly converted, at a high price. The maker of a product in which the value of the raw material is high as compared with the value of the labor finds himself burdened with all the problems of making and distributing, but dependent for his profits upon guessing the course of the raw material market. Most cotton-goods manufacturers are in this position; so are the makers of leather belting, of automobile tires and of food preparations. This entire class is apt not only to buy heavily against estimated needs in a rising market but also, when opportunity offers in such a market, to buy far beyond their needs in the hope of reselling the raw material at a profit. They thus mix the functions of manufacture and commodity speculation and because they make more money in trading with raw materials on a rising market than in manufacturing them, they usually get so deeply into the speculative side that they are caught with heavy inventories when the market turns.

Wise Speculators Get from Under

The wise speculators take their losses at once; the foolish ones, putting statistics against human trends, decide that the slump will be only temporary. They attempt to hold their stocks for still higher prices until finally they can no longer sustain their extended borrowing capacity and are compelled to unload at a crushing loss. There is nothing inherently reprehensible in speculation. In the end it promotes production and really equalizes prices over a period. The point is for the owners to decide whether they want to be manufacturers or speculators. If they decide that they are speculators the next decision to be made concerns whether or not it is economy to support a factory and a sales organization. They might do better to chuck those bits of trouble and take on a ticker service; why should a speculator have a high overhead?

Then we have the business which combines banking and speculation. The jobber often answers this description. A jobber is sometimes an industrial banker in that he finances both the small manufacturer and the retail distributor, but more often he is a speculator depending for his profit not upon a brokerage on the goods he handles but in buying them low and selling them high. Sometimes he has all of these functions. Likewise the retailer may be more of a speculator than

a merchandiser. Instead of putting his usual mark-up on a lot of goods that he buys at an exceptionally low price and thus getting a reputation for fair pricing, he may choose to put such goods into his warehouse in the hope that he can sell them later in a higher market.

Most of the dangers in business finance arise out of putting the speculative side above the fabricating or merchandising. It is just as dangerous for a corporation to speculate in goods as to speculate in the stock market; in many ways it is more dangerous because very few staple markets are nearly so well organized as is the stock market and hence one cannot often get so quickly out of goods as out of stocks.

Strictly Business or Strictly Speculation?

The first policy, therefore, to be determined in any business institution is whether the strictly business or the strictly speculative feature shall dominate. One or the other should dominate, but often I wonder, in observing the demands of some concerns for money, whether their executives and bankers realize this self-evident fact. How often do corporations ask aid to help carry speculative purchases that are disguised in the statement of condition as "raw material," "goods in process," or "finished product." I will commonly take a large inventory not as an evidence of forehandedness but as an evidence of possibly unconscious speculation.

The divorce of manufacture and speculation would go far toward the stabilization of industry. The present policy is unscientific. A manufacturer will commonly offer his wares for future delivery at a price which he arrived at by guessing the course of the raw material market. If, at the time of delivery, the price of the raw stuff has gone down then he will try, by curtailing production, to keep up the market price on the finished product so that both he and the customer may get out at the price quoted.

From time immemorial manufacturers have met in solemn conclave and decided officially or unofficially, according to the legal advice that they received at the moment, to maintain prices by curtailing production but they have never made a nickel by so doing. Were it not that so few of them know the cost of manufacture and especially the cost of idle plants they would not cling to that ancient notion—a notion that comes down from the days when plant investments were small.

So when we talk about financing operations of this sort, dignified as a rule under some phrase that contains a note or two about "steadying the market," we are not really having much, if anything, to do with business. We are rather finding satisfactory excuses for sending good money after bad. When a concern fails because of its inability "to carry" its inventories, frankness should compel a somewhat different verdict running more to the effect that the company had bet on the wrong horse.

Manufacturing and Selling Do Not Mix with Speculation

The mixing of manufacturing and selling with speculation is the greatest of all deterrents to sound business practice and organization. It is the function of a manufacturer to manufacture, of a merchandiser to merchandise. They should look for their recompense to the results of the skill with which they perform their functions. Their profits per dollar must necessarily be small—and arduously earned. They cannot expect to become millionaires over night. It is hard for men pursuing this conservative course to see others come into the market and, without manufacturing or merchandising skill, clear stupendous profits merely by buying low and selling high. If a market, during a considerable period, continues to rise one will find very few business men who are able to keep their heads and to remember that a day of reckoning is inevitable. Almost without exception they will cast aside the principles upon which they built business and engage in a mad scramble of speculation.

We have just been through such a period. Business economics have been thrown aside. Suggestions or rules for financing a mixture of business and speculation are not any more useful than rules for beating roulette wheels. The way to finance speculation is to borrow all the money you can and keep on borrowing as long as you can. If, during the progress of the borrowing, you can sell your goods then you can pay off your notes. If you cannot get rid of your goods and the banks refuse to renew the notes, then the approved course is to authorize an increase of capital stock and try to work that off on somebody. If there are not enough fools around to buy your stock certificates and nobody will take the goods off your hands, why then you are what is termed unfortunate, and you fail. If, in addition to being a speculator, you are also blessed with a benevolent disposition, you will gracefully try to get your employees in on the stock subscription. This latter form of benevolence has not been wholly overlooked.

Money Not the Only Remedy in Over-expansion

In the inevitable depression that follows a period of undue prosperity and speculation, the over-extended speculators usually fail. The survivors gather to learn what business is and to study the use of money in business instead of in speculation. But so deeply ingrained is the thought that business somehow depends upon money instead of money upon business that a deal of unnecessary attention is still devoted to getting money—when money is not to be had. For instance, I found one large company badly in need of money—so it thought. But an investigation and study of their situation made it appear that what they needed was more method in the shop and less activity in the banking department. They had a goods-in-process inventory of $4,000,000; half-finished goods were everywhere in nooks and corners waiting for some department of the factory to turn out the missing parts. A thorough revision and planning of their schedule of output and a co-ordination of their plant cut down the inventory to $1,000,000. They borrowed all the money they needed right from themselves not only without interest but with a premium in addition in the way of lessening their costs of production! They had been giving their attention to finance instead of to manufacturing. They had held with so many others to that compressed bit of unwisdom which is expressed in:

"Money makes the wheels go round."

Does it? And what of it if it does? That is not business. Business is not simply the stimulation of the motion of wheels; it is a result of the motion of wheels. The wheels going round make money. It is only in the unsuccessful business enterprise that money makes the wheels go round—or, putting the whole less cryptically, we may go into business because we have money

(and undoubtedly we need money before we can go into business), but we cannot stay in anything that may properly be described as business unless money results from our operations.

The whole thought of business enterprise is clouded by failing to grasp the real part that money plays. We get to thinking in terms of dollars instead of in terms of goods. Manufacturing is only a process of converting goods. At one end of the shop we take in raw material, add to it labor either in the form of handiwork or in the form of machine work, which is only the previously accumulated hand work, and then turn out at the other end of the shop, our raw material plus all of this labor and try to make an advantageous exchange of this, which we call our product, for more raw material, and for food, fuel, clothing and housing, to recompense ourselves and those who have labored with us in the transformation of the raw into finished material.

Why Money Is Necessary

Because the direct exchange of what we make for what we need is quite too cumbersome a process we use, instead of the goods themselves, accepted exchange equivalents which we think of as money and which are expressed in terms of money but which, as a rule, are in the form of credit instruments—the bank notes of governments, or the promises to pay of individual institutions.

If we kept strictly to the practice of exchanging goods for goods, a proprietor and his workmen would not eat until the goods they made had been exchanged, unless at some previous time the proprietor had exchanged his product for enough food to build up a surplus to tide over the next trading period. In such case he would not need any elaborate accounting to discover whether or not he was conducting business at a profit. His stomach and the stomachs of his workers would give a quick and accurate statement of business condition. The business man would be in exactly the same position as the Indian trapper who brings his pelts to the trader and receives return in kind, or of the small cotton grower who exchanges his cotton with the local storekeeper for such of the necessities of life as he cannot produce on his own farm.

Instead of this seemingly simple, but actually rather complex, process of trade, we first substituted the more convenient medium of money, but finding even that less arduous method of actual exchange of goods for goods too awkward, we have practically substituted credit in many forms, and it is the management of this money and credit which created that department of business which we term finance.

Finance, then, is not that which causes business but is only the management of the value representations of the various goods and services that go to make up business. This is simple, elementary economics—so simple and so elementary, indeed, that it would be unnecessary to set it forth as a background of finance were it not that we have fallen into the habit of approaching business with the thought uppermost that it is money that makes the wheels go round. Then we quickly lose ourselves in a technical maze of financial principles expressed in financial jargon. One can be an extremely good business man without knowing the difference between a promissory note and a trade acceptance, or between a bond and a debenture, or between a bank and a trust company, or even between a bill of exchange and a check, or between a gold brick and a gilded brick. It is true that a capable business man whose mind was blank on these subjects might have not a little difficulty in retaining the results of his business capability, but most people have difficulty in doing that anyway and I am not sure that the man who is successful in business without the slightest knowledge of finance as applied to other than his own immediate concerns is not safer with his pile than is the equally successful business man who sets up later as a financier!

One of my friends who is a lawyer asserts that a great boom would come to the legal profession if only a book instructing every man on how to be his own lawyer could be widely circulated. For then a resurgent passion to dabble in the law would arise and instead of simple and inexpensive cases the lawyers would have great and complex ones!

Borrowing Ability Not Indispensable

Because of this wrong approach, of this notion that it is money that makes the wheels go round, we find those who have acquired a reputation for financial acumen in business get it as a rule because of a certain skill in borrowing money, which connotes an acquaintance with bankers and banking methods. These are valuable additions to the mental equipment of any man in business, but too marked a proficiency is apt to be evidence—as uncanny skill with a billiard cue is evidence of a misspent youth—of a misspent business life.

Any man with a pleasing personality, a knowledge of bankers and banking conditions, and a certain deftness in the formation of financial statements, can borrow money. If he extends his acquaintance among bankers he can borrow to meet his borrowings and thus acquire the essential reputation of meeting his notes. And he can do all of this honestly, for it is easy to persuade oneself that every cent borrowed will in time be returned. And then quickly and insensibly, one may be caught in the endless chain system of finance.

This is a soul-racking method of prolonging business life and depends solely upon being able to borrow increasingly large amounts of money. It is the certain road to ruin and only rendered more certain by the occasional earning of large profits that enable the overextended margin of indebtedness to be cleared up. Because a bank will commonly lend between four and five times the amount of a depositor's daily and average balance is no assurance to the borrower that he will be able to repay. The bank works on a law of averages. The borrower works on his individual productiveness. His average cash balance has nothing to do with his own true estimate of condition and while borrowing to pay off former loans is at times inevitable, its necessity is always carefully to be analyzed. Adopting the Ponzi financial system is easier than one imagines. Not a few people have made comfortable livings out of borrowing money but do not let us confuse respectable panhandling with business borrowing, and do not let us get business borrowing out of its really very subordinate position in truly productive activity.

Managing Ability More Important Than Financial Dexterity

Business is not founded on financial dexterity; it is founded solely on the management of production or merchandising. If you call the roll of the great business men of the country you will not discover one who is, or was, pre-eminently a financier. They are super-

latively skillful in either production or merchandising—never in finance. I do not recall a single business institution that was built by a financier. A. T. Stewart, Marshall Field, and John Wanamaker built as merchandisers; P. D. Armour based his success on being able to get more out of a hog than the hog's anatomy could reasonably be expected to deliver; Carnegie was a maker of steel and a manager of men—so is Schwab; Gary is a manager of corporations; Ford is a maker of automobiles; and so on through the list. J. P. Morgan, who organized more corporations than any other man in the country, would never under any circumstances put a financier at the head either of a railroad or an industrial enterprise.

Money does not produce goods; goods produce money. The process of finance is, then, merely to see that enough money is produced through the exchange of the articles manufactured to pay for the purchase of new raw materials, labor and depreciation of plant with enough over—that is, enough profit—properly to recompense those who initially ventured their money.

We have two general divisions of money in business—that which represents capital—the means of production, and that which represents goods in process. It is only as we confuse these two classes of money and confuse their relations to what we are doing that we get into financial trouble.

The part of the capital which is represented by the means of production is commonly termed the fixed capital while that which is involved in the goods in process is the working capital. The line between the two is not distinctly marked and their functions are so interdependent that neither is worth much without the other.

Fixed Capital the Stake of the Owners

It has been the practice in the past to regard the fixed capital and a portion of the working capital as the stake of the owners and then to go out and borrow in a temporary way the additional working capital that may from time to time be needed, and it has been considered conservative, legitimate business management to borrow money whenever that borrowing will result in the production of goods that will turn into money.

Take first the fixed capital. We are not concerned here with the legal organization or the nature of the instruments that the contributors of the initial capital get in return for their money except to point out that mortgage bonds or any form of obligation which puts a lien upon the property of the company and fixed charge upon the earnings is extremely dangerous. The safety of a mortgage upon an industrial corporation has been overestimated; the investor should want earning power—not something he can sell. He does want earning power but a mortgage often, in the early years, destroys the chance to obtain earning power, and so the investor gets only an opportunity to join in a reorganization. A well-equipped manufacturing plant should be so special in its construction that it will have little or no value when sold at a forced sale. If it is large it cannot be sold anyway. It really has to be reorganized and the bondholder must get, of the securities issued in the reorganization, somewhat less than he held in the first place. The best financial plan is that which involves only common stock of no par value; the next best plan, and the one, for sales reasons, which is commonly adopted is to issue preferred stock, with or without a convertible feature and to sell a certain amount of common stock in the same package.

But with this side of finance I am not concerned. The amount of the fixed capital—the amount of the total resource—which is invested in assets that have to do with production is the paramount concern. The plant has to be profitable and it cannot be unless it is fitted to its work. Its fitness is not to be arrived at by guessing. The factory itself will be built to obtain a certain planned output in the most economical fashion. The plan will contemplate increases in productive capacity with the increase in market and these additions will go on as complete units—not in haphazard fashion.

Do Not Expand Too Much for Emergency Orders

The cost of plant will, therefore, have a direct ratio to planned sales; the sales necessary to operate the first unit to capacity will be known and additional units will be added only as orders over a considerable period give a fair certainty that the additional demand will be stable. It is hard to turn down orders in boom times, especially when prices are high, but the wise financier will not extend his plant to meet emergency orders. Good manufacturing depends upon continuous capacity output—upon being busy in so-called dull times. Adding capacity to take care of the order peak means that normally the plant will not be running at capacity and hence will not operate with the planned economy and at the planned costs. After every boom period we see magnificent plants that cannot produce cheaply enough to find large markets simply because of the heavy fixed charges for idle plant. Of if the idle portion of the plant is not charged into the overhead it has to be taken out of the profits made by that portion which is working, with the result that profits are depleted to the vanishing point.

I am not advocating a cheap plant—I am urging the kind of plant that can turn out goods with the minimum of cost—the eventually, not the initially, cheapest plant. We base a new plant on the work it is to do—it is a tool and we need just the right size of tool and no other. We are setting out to do a certain job—to make a certain amount of product, and we expect to make it so well and at such a price that it can be sold. The amount that it will cost to buy that exact tool is hence known to us in advance and that will be the amount of capital that will have to go into the fixed division.

In the old plant the general rule holds—transform it into a tool for the work that it must do. Any plant that has not been scientifically designed or in which the work and methods are not planned and the labor is not co-ordinated, can commonly be increased from 25 to 50 per cent or more in capacity by the adoption of modern methods of routed work and instructed labor. I have assisted in cases where we have taken an old plant, rearranged the machinery, then installed a planning board, properly instructed the employees, and have not only decreased the cost and increased the volume of production but have been able also to lease part of the property that was formerly thought wholly essential. This gained an outside revenue which considerably decreased the burden of the overhead expense.

Manufacturing Efficiency the Goal

The point is to get everything into the plant that will lessen the expense of production and to get everything out that tends in any other direction. In short, the amount of capital to be tied up in plant and machinery is first of all an engineering and sales affair and only secondly a question of finance. If one has not the

money to do the job as it should be done then the decision has to be made as to whether or not a compromise is worth while. The horse may pull through even if lame, but a wise driver rarely starts on a long trip with a lame horse.

Now we have decided on a certain volume of output. The tools to fabricate that output will cost an amount we have ascertained. The next point is to determine how much money it will take to send the materials through our course of fabrication—that is, how much money it will take to buy the various kinds of raw or semi-finished material that enter into our product, to pay the wages of labor in the making, to pay all other charges, and to keep on paying until the customers to whom we have sold have paid their bills. This makes necessary a considerable number of important decisions. We will have to know what credit will be extended to us in buying and what credit we shall extend in selling. Picturing the production of the factory as a wheel, a single revolution of which represents a day's output, we shall have to determine how many revolutions of that wheel will take place before we begin to be paid for what we do. We shall have to advertise, pay salesmen, and incur many and various sorts of expenses before, under the most favorable circumstances, we can expect to earn a profit. All of these expenses may be tabulated, they may be put into a budget and their sum will determine the minimum amount of working capital.

New Company Should Have a Year's Reserve

If the product and all of its processes of sale and distribution have been scientifically worked out the chances are that the company will make money, but just as a salaried individual is not to be considered in good circumstances until he has enough money in reserve to support himself for a year without working, so a company beginning business should be in a position to call upon enough money to keep itself going through at least a year without making money. Although it is presumed that all of the plans will have been worked out with a maximum of human skill that does not of itself absolutely guarantee success. One must be prepared against contingencies, and be prepared to meet these contingencies not by borrowing but by the acquisition of additional capital.

We can borrow to finance operations, but borrowing to meet depletions of capital or for any capital purpose holds within itself the highest danger, for we may thereby begin that endless chain system of finance that must end in absolute ruin.

I have given no figures as to the relative size of the fixed and the working capital and it must be apparent that to settle upon any such arbitrary figures is only to assert that the business has not been previously planned and that its most important factors are being left to guesswork. Neither have I dealt with the borrowing policy because that is really a question of planning—not of finance. Neither have I taken up the case of the older corporation that finds itself in financial difficulties. The arrangement of its finances does not in the least differ from that of a corporation starting in business. And finally I have offered no suggestion as to how to get along without money for the excellent reason that there is no such method—that is a question of individual genius.

The whole point that I want to make is that the management of finance is a question subsequent to and not precedent to the management of production.

Keeping Presses At Work With Oxy-Acetylene

By I. B. Rich

No matter how perfect the design or how good the material, the shocks and stresses to which a crank press is subjected when used day after day on production work, seem to start, or perhaps to develop, cracks which occasionally let go and put the press out of commission. Accidents of this kind seem bound to happen at the most inopportune times when the press is particularly needed. The long delays which have been necessary in

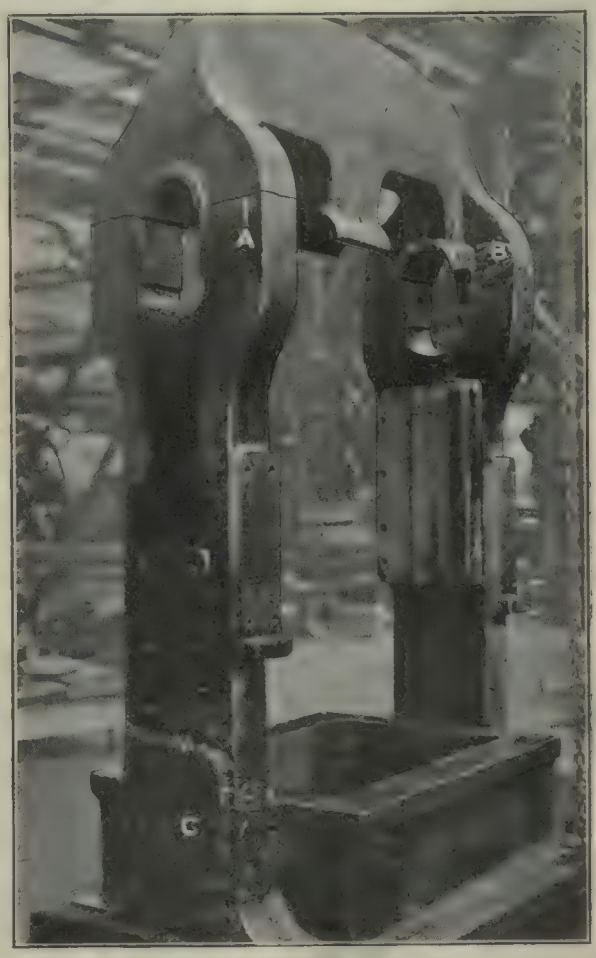


FIG. 1. THE THIRD BREAK

the securing of new machines or new parts are probably responsible for the development of the system of repairing broken press frames which is described in this article. The judicious use of oxy-acetylene welding has enabled presses to get back on the job at a much earlier date than would have otherwise been possible. The examples shown herewith are from the shops of the Michigan Stamping Co., Detroit, Mich., and the results secured were largely due to the activities of Oscar C. Bornholt, then production manager of the plant.

Fig. 1 shows a typical break in the press housing at *A* and also that a similar break has previously occurred on the other side at *B*; while the large patch at *C* indicates clearly that at least two previous breaks have been repaired and the machine put back into commission. It is noticeable that in no instance has the next break occurred at the weld.

Fig. 2 shows the welding of the housing shown in Fig. 1, and incidentally the method used in cases of this



FIG. 2. PRE-HEATING AND WELDING

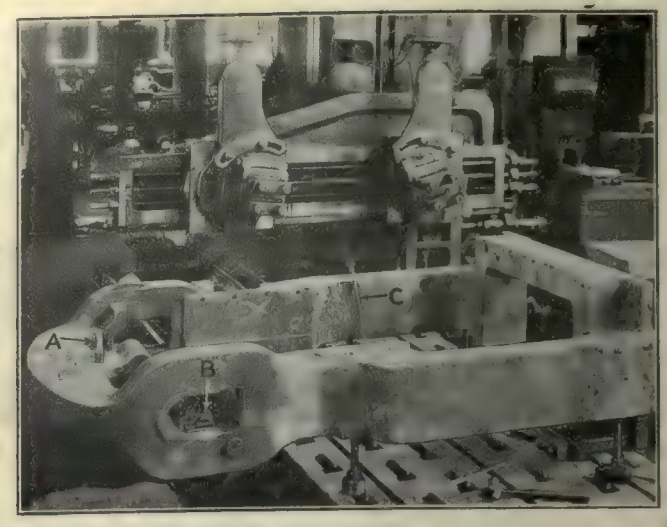


FIG. 3. PLANING THE FRAME

kind. The frame was laid on its side and a temporary furnace built around it with firebrick loosely laid into the desired shape. A good charcoal fire was then built on the metal plate which forms the base of this impromptu furnace and the frame thoroughly preheated before welding was attempted. When the frame was heated to the desired point the welders set to work as shown and welded and built up the frame in accordance with previous experience.

In one instance a press of somewhat greater capacity was needed and none could be secured, the difficulty was met by cutting the original frame and welding on new sides of the desired width and length. This made four different welds but the work was successfully accomplished. Fig. 3 shows the frame mounted on the open side planer for machining. Great care was taken in lining up the frame, the levels at *A* and *B* and the surface gage at *C* being an indication of the methods used. Fig. 4 shows the press again mounted on its legs and ready to be put into commission.

That this kind of repair work was not confined to smaller presses can be seen from Fig. 5 where a very heavy machine broke through the bearing section of the housing. Only two of the repaired breaks are shown at *A* and *B*, but four different welds were required to put the machine back in commission.

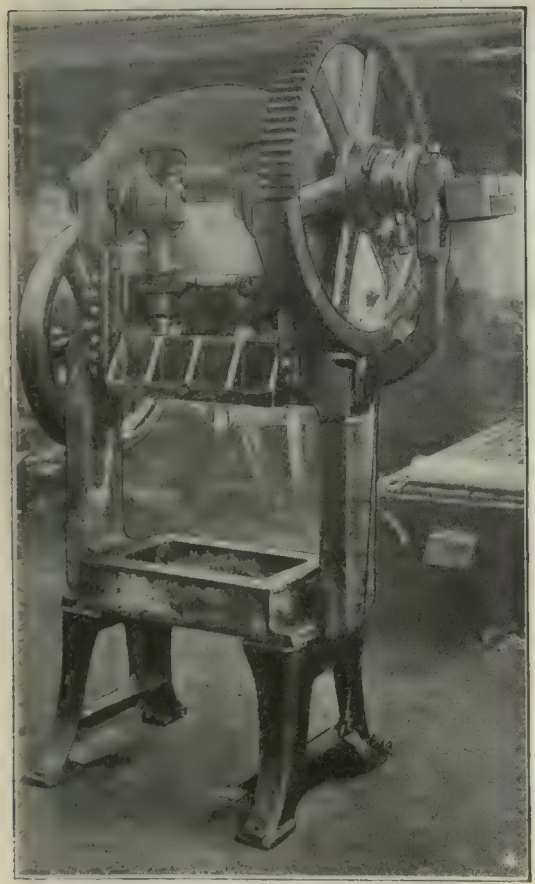


FIG. 4. THE WIDENED PRESS

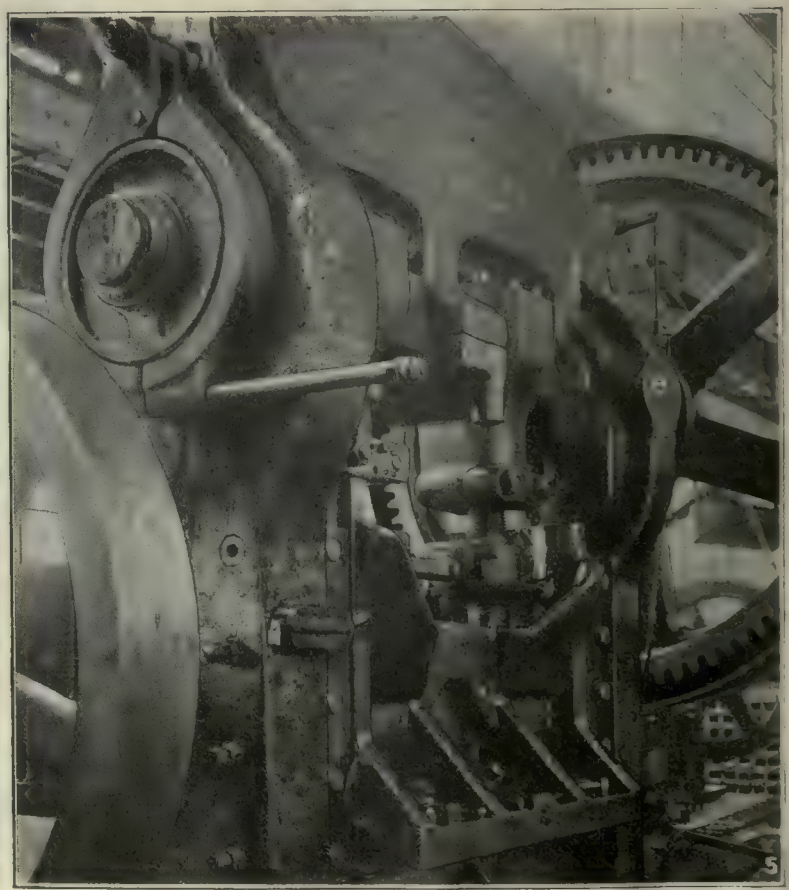


FIG. 5. A LARGE PRESS REPAIRED BY WELDING

Two Light Punching-Machine Jobs

BY JOHN SIMON
Vienna, Austria

The tooling arrangements for punch-press work shown here come from Austria, and give an idea of what is done there in the way of special tools for particular jobs. Both of the arrangements given are for high speed on very light work, and they show ingenuity on the part of their makers.

THE accompanying illustrations, Figs. 1 to 3, show a die for punching out small plates used in a common type of fuse for electrical circuits. These plates are fastened to the silver wire in the fuses, their purpose being to show whether or not this wire is melted out, since they drop out of position when the wire melts. One of the plates, which have holes punched in the middle and resemble copper washers, is shown in Fig. 3.

Fig. 1 shows the die, which was made in the following manner: After planing all surfaces, the die plate *A* was laid out for punching twelve plates at one stroke of the press, two sizes of holes being needed. In order that the plates and scrap could fall through the die easier, it was milled out from the back side, which also makes it easier for the diemaker to drill the holes when the die is not so thick. The larger holes were bored out. With the help of a drill jig the small holes were drilled and then taper-reamed from the back. The plate was then hardened and ground.

As can be seen, the gage plate *B* was made longer and screwed to plate *D*, in order to give more feeding surface for the stock. After this, the close-fitting stripper plate *F* and punch plate *H*, Fig. 2, were bored through the die plate *A*. Then the guiding plate *G* was made to fit the head *J*.

At first we worked on a press with a 10-mm. stroke. Of course, the punches always came out of the stripper and wore themselves off when entering into it again, so that with time they became dull and broke off. In order to overcome this trouble we made the head *J* with a T-slot 12 mm. high through it. The part *K* was turned so that the end was 6 mm. smaller than the T-slot itself, thus reducing the stroke of the punches to 4 mm. and leaving them always in the close-fitting stripper.

The side punch *C*, with a length *L*, cuts the stock 1 mm. narrower, thus giving a means of determining the proper distance for feeding the stock forward against an edge on the plate *B*. Fig. 3 shows a piece of punched-out stock. The difference in the width of the stock before and after punching should be noticed. With this die we had good results, making easily 12,000 pieces hourly.

Die for Forming Fuse Caps

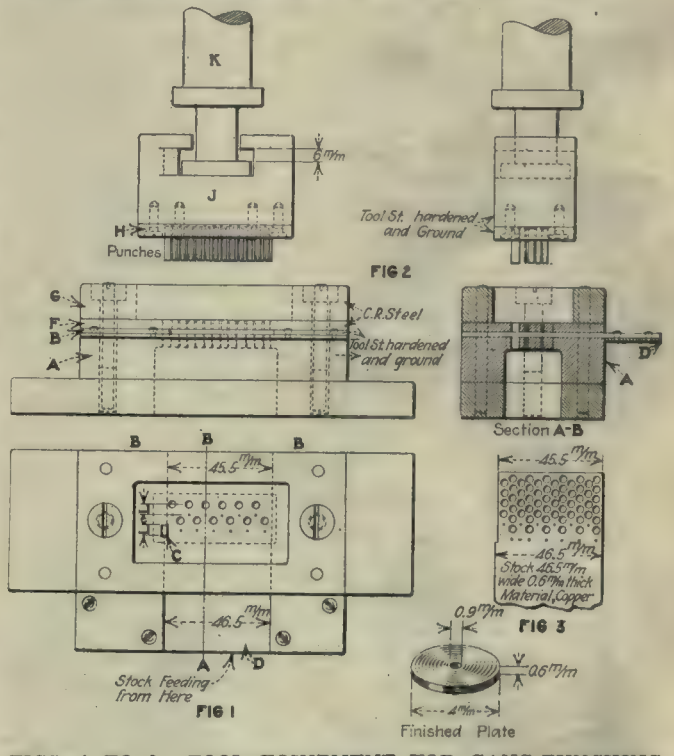
In Figs. 4 to 8 is shown a die for making the small caps for these same fuses for general use in electrical work. It is an interesting combination die that performs progressively piercing, embossing, engraving, cutting-out and drawing operations. It works very well, producing 4,500 pieces hourly and making three finished caps at one stroke of the press to the shape and dimensions given in Fig. 4 (a high degree of accuracy not being required). Fig. 5 shows the general plan of the die. Fig. 6 shows a section through the die on line *AB*, and also a section through the punch above it, showing how the various punches are held in the plate *O*.

As can be seen, the die uses the principle of the side-cutter *S*, which cuts a length of 22.5 mm. at each stroke, making the stock 1 mm. narrower. By this means, proper locating is obtained by feeding the punched edge of the stock forward against a shoulder on the gage plate *B*.

The first operation performed is the breaking through (not punching) of the small 0.8 mm. hole with the needle *N*, thus leaving no scrap in the inserted die *D*. This operation is followed first by the embossing, done with the shoulder of the needle *N* in the die *D*, and secondly by the engraving or lettering die *M*. Next, the stock is pushed 22.5 mm. forward, bringing it over the form *E* under the embossing punch *L*, which "draws in" the stock a little. This operation is necessary in order to insure that after the drawing operation the caps will be straight on the top.

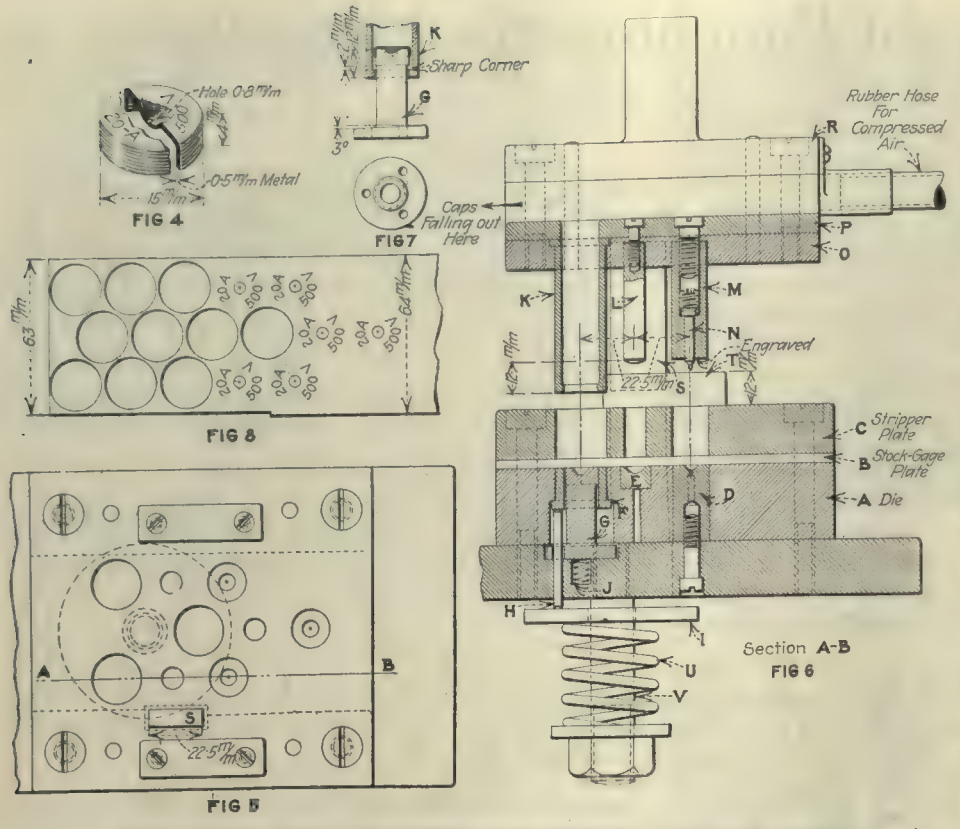
Drawing and Stripping Caps

The final operation is the cutting-out and drawing, which is done by the punch *G*. Drawing die *K* holds the finished caps, one on top of the other, until they rise up to the level of plate *P*, where compressed air blows them into a box. In Fig. 6 is shown the drawing punch *G* with its stripper bushing *F*. This bushing rests on the pins *H*, which hold the stripper flush with the cutting level through spring *U* and washer *I*.



FIGS. 1 TO 3. TOOL EQUIPMENT FOR GANG-PUNCHING SMALL PLATES

Fig. 1—Die for holding work. Fig. 2—Punch, showing lost-motion device. Fig. 3—Punched work.



FIGS. 4 TO 8. TOOL EQUIPMENT FOR FORMING CAPS FOR FUSES

Fig. 4—Fuse cap completely formed in press. Fig. 5—Plan of die. Fig. 6—Section through punch and die. Fig. 7—Method of stripping caps from drawing punch. Fig. 8—Punched out stock.

In Fig. 7 is shown the drawing die *K* entered into die *A*, the depth of entering being limited by the blocks *T*, Fig. 6, when they touch the surface of the plate *O*. Furthermore, the blocks do not allow the damaging of the engraving punch *M* and the needle *N*. In order surely to strip off all the finished caps, the sharp corner of the drawing die *K* must pass the larger diameter of the drawing punch. The punch is then lifted by the little spring *J* underneath it, so that the eccentrically turned flange rests against the bottom face of die *A*. This tilts the punch to one side and thus gives the sharp corner the opportunity to catch the edge of the cap and strip it from the punch as the ram of the press rises.

In Fig. 8 can be seen a piece of stock from which some caps have been punched, the difference in the width of the sheets being clearly shown. It will be noted that there are three sets of dies acting simultaneously, which accounts for the large production.

A Simple, Accurate and Easily Made Pantagraph

By E. A. Dixie

We had a number of flat hardened steel gages to mark. Ordinary hand etching was not good enough because of lack of uniformity as the gages were in lots of thirty or more of the same size. The man in charge of the job sent out inquiries with the result that a machine suitable for the work could be bought for $800 and delivery might be made within six months.

As the job would hardly stand an additional expense of $800 and the customer positively would not stand for six months delay we decided to build some sort of a makeshift ourselves.

An order was therefore issued to one of the tool-makers to make a pantagraph which would be good enough to do the work but that no extra time be spent on making it pretty.

The pantagraph, the entire cost of which was less than $75, is shown in Fig. 1. Fig. 2 shows two samples of its work, one of letters in five reductions from a model having letters $\frac{3}{8}$ in. high; the other of figures, in five reductions from a model $\frac{1}{2}$ in. high.

The machine as shown has six possible changes of size but other sizes can be obtained by the simple drilling of two $\frac{5}{16}$-in. holes and the drilling and tapping of two holes for 10/32 screws.

Some ingenuity was displayed by the man who made the instrument. He selected four long and two short pieces of $\frac{5}{16}$ by $\frac{3}{4}$ in. cold-rolled flat steel for the main members. As each of the four long members has a plain end and a yoke end, he got out eight short pieces of the same stock to form the yoke ends. As the simplest way to make the yoke ends was by brazing, the following method was pursued:

One of the long pieces had two of the short pieces clamped to one end of it as shown in Fig. 3, the short pieces projecting beyond the end of the long piece suf-

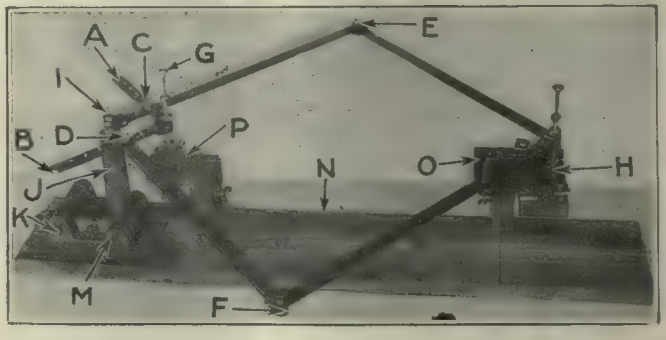


FIG. 1. THE COMPLETE PANTAGRAPH

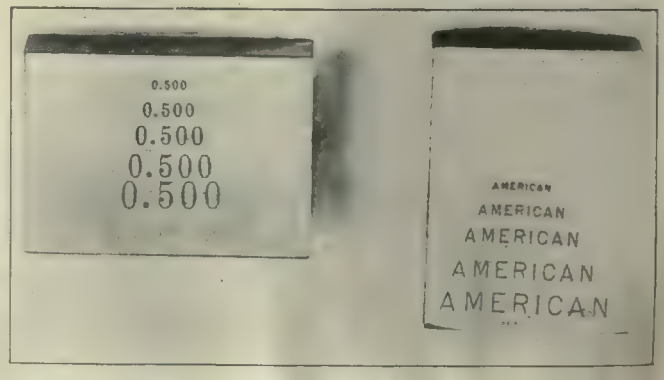
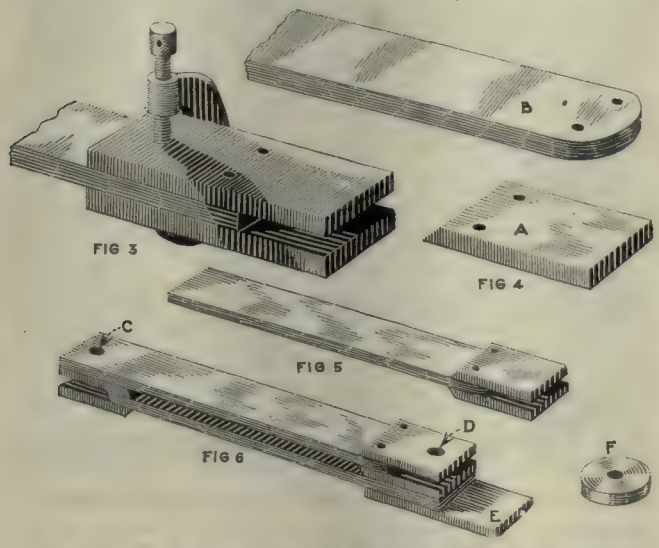


FIG. 2. SAMPLES OF ETCHING

ficiently to form the yoke end. Two holes about $\frac{5}{32}$ in. in diameter were then drilled through all three pieces so that they could be riveted together later on. In a similar manner the other three long pieces were assembled each with two of the short pieces and the rivet holes drilled.

The inner ends of the short pieces were then chamfered and the end of each of the long pieces rounded as shown at *A* and *B*, Fig. 4, after which the pieces were assembled as shown in Fig. 5 and the rivets driven to keep the assembly together during the brazing operation. The yoke ends were brazed in the blacksmith's fire in the usual way, using soft yellow brass wire and boric acid so as to avoid hard scale.



FIGS. 3 TO 6. HOW SOME OF THE PARTS WERE MADE
Fig. 3—Building up the yoke. Fig. 4—Parts rounded and chamfered. Fig. 5—Yoke end ready for brazing. Fig. 6—One member used as a jig.

After brazing, one of the long pieces was laid off and the $\frac{1}{16}$-in. holes *C* and *D* drilled in each end, as shown in Fig. 6. This piece was then used for drilling the three other pieces. Under the one end was placed a packing piece of $\frac{5}{16}$ x $\frac{3}{4}$ in. cold rolled flat as shown at *E*.

Two washers *F* were made of tool steel and hardened. These were $\frac{3}{4}$ in. in diameter by about $\frac{1}{16}$ in. thick and each one had a $\frac{1}{16}$-in. hole in it. Placing one of them on each side of either the yoke end or the plain end of the long pieces and passing a $\frac{1}{16}$-in. bolt through they were used as a filing jig to round the ends off.

Drilling the Small Pieces

The small members *A* and *B*, Fig. 1, were made in the same way as the long members. These and two of the long members were then drilled for the screws *C* and *D*. The screws are simple shoulder screws with heads $\frac{3}{4}$ in. in diameter. The bodies of the screws are $\frac{1}{16}$ in. in diameter and the threaded ends 10/32. The holes in *A* and *B* were drilled $\frac{1}{16}$ in. and the holes in the long members drilled and tapped 10/32. The adjustment or proportion holes are spaced about an inch apart. A simple jig was made from a piece of cold rolled steel for this purpose. It had only two holes in it and was stepped along from hole to hole after the first two holes were drilled.

The joints *E* and *F* are held by special $\frac{1}{16}$-in. bolts. A small pin through the head of each bolt and into the yoke end prevents the bolt from becoming loose. The follower *H* and the stylus *G* are made of $\frac{1}{16}$-in. drill rod. They are held by hollow members, shown in Fig. 7 at *B*, whose outsides fit the holes in the yoke. The top and bottom ends of the hollow members are split and tapered so that nuts will clamp both the stylus and follower securely when they are once set.

The pantagraph is carried on a pin *I*, Fig. 1, which is a turning fit in the member *J*. The member *J* is pivoted at *K* so that when the follower *H* is lifted out of the model the stylus *G* also lifts.

A setscrew *M* can be set so as to limit the amount of lift of the stylus.

The base *N* is cast iron about $\frac{3}{8}$ in. thick. Its dimensions are given at *A* in Fig. 7.

The bracket *O* carries the model letters or figures to scratch on the work with the stylus. It is a sliding fit on the dovetail on the base. A setscrew is provided to secure it in place when set.

The bracket *P* carries the work. It is also adjustable on the base and secured in the same way. A detail of the brackets is shown at *C*, Fig. 7.

Clamps are provided on both the brackets for holding the model and the work.

Operation of the Follower

The work is varnished with spirit varnish made by dissolving gum guaiacum in denatured alcohol. This varnish dries sufficiently in a very little time. The work is then clamped in position and the follower is dropped vertically into one of the letters or figures of the model. The operator runs the follower several times over the whole letter or figure, lifts the follower vertically and drops it into the next, and so on. If the model is made deep enough the operator need not be careful to lower and lift the follower vertically for with a deep model when the follower is out of the impression the stylus is clear of the varnished surface of the work. With a little practice an operator can scratch three lines of etching having about ten letters each in less than two minutes.

A 25 per cent solution of nitric acid and water is then applied to the work for from one to five minutes, depending on the depth of etch required. If the work is entirely covered with the varnish it can be immersed in the acid, if not, the acid can be applied with a medicine dropper. When the acid has bitten in to the required depth the work is immersed in strong soda water to "kill" the acid. It can then be put in denatured alcohol and the varnish will wipe off clean.

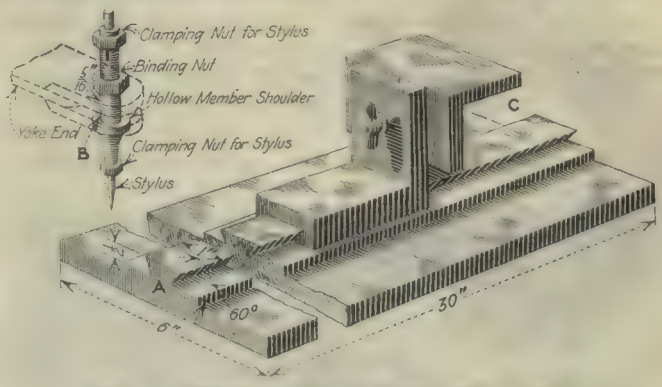


FIG. 7. DETAILS OF SOME OF THE PARTS

Work should be scratched within an hour or two after it has been varnished as the varnish is apt to become hard and brittle and flake off if it stands too long before it is scratched with the stylus.

Programs of Apprenticeship and Special Training In Representative Corporations

By J. V. L. Morris



VI. The De la Vergne Machine Co., New York

The time-honored system of apprenticeship with some new features in instruction seems to be the most popular form of trades education that really provides a thorough training. The method of training apprentices in a small plant where the problem is not particularly complicated is shown in this article, the plan of instruction, both in the shop and in the corporation school, being taken up.

(*Part V was published in the Nov. 18 issue.*)

THE De la Vergne Machine Co. offers an excellent opportunity for the study of apprenticeship as applied in a plant of comparatively small size. About 200 first-class machinists are employed here, with forty apprentices in this trade. This number includes twenty-five toolmakers, in which special branch there is only one apprentice. Also, supplementary to the twenty patternmakers are three apprentices. It is thus seen that a standard ratio of one apprentice to five journeymen is maintained in the machinists' trade and of about one to eight among the patternmakers. The products of the plant are oil engines and ice machines, the manufacture of which offers ample variety of experience at the standard machine tools, on the test floor and in assembling. This no doubt accounts for the fact that a system of apprenticeship has been maintained since the occupation of the present plant in 1898.

The apprentices are under the general supervision of the assistant production manager, who is a young mechanical engineer, and seemingly well fitted to handle the school which is provided to supplement the practical work. To insure proper supervision of shop work the apprentices are grouped under selected gang bosses in the ratio of about one boss to six apprentices. A schedule card is kept of each apprentice, assignments being approximately as follows: As tool boy, 25 to 30 weeks; at cold saw, not more than ten weeks, but eliminated altogether for most boys; progress through different engine lathes (Fig. 29), 40 weeks; Gisholt turret lathe (Fig. 30), 20 weeks; drill press, 20 weeks; milling machine, hand, 4 weeks, all sorts (including universal), at least 20 weeks; shaper or planer, 10 weeks; bench work and assembly, 10 weeks, but if the apprentice shows an aptitude and inclination to become a mechanical engineer, 25 weeks; boring mill (Fig. 31), 10 weeks; test floor, if machinist, 15 weeks, but if specializing on gas engines, 30 weeks; at forge and



FIG. 29. APPRENTICES AT WORK IN LATHE DEPARTMENT

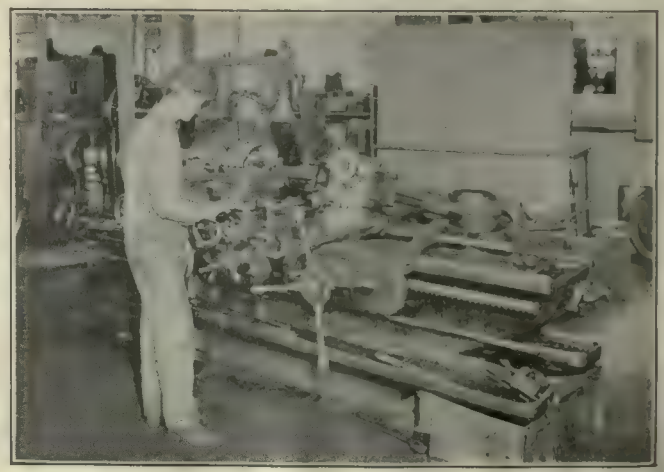


FIG. 30. APPRENTICE OPERATING A TURRET LATHE



FIG. 31. APPRENTICE RUNNING A BORING MILL

steam hammer, 5 weeks; and in the foundry, 3 weeks. Regular periodical ratings are made of progress in the shop work as regards workmanship and deportment, and in the class work in mathematics and drawing. Fig. 32 shows the form of the card used for recording this information.

For the class work the apprentices are divided into two groups of about twenty each, two hours a week being devoted to regular assignments in the excellent texts at present available in shop mathematics, and a second two-hour session being given to drawing. As there is considerable variation in the advancement of the apprentices, the instruction of the advanced students is largely individual, though the four hours of school are required of them just the same as for beginners.

Pay of Students

The compensation of apprentices reflects the improved rates of pay of machinists. As recently as 1917 the apprentice started at 8 cents an hour with two-cent increases every six months to a maximum rate of 22 cents. The rate now starts at 26 cents with increases every three or every six months, reaching a maximum of 44 cents in the last period of the fourth year. Fig. 33, showing the other side of the card in Fig. 32, gives these rates. Upon graduation a certificate is conferred, a bonus of $200 is paid and advancement is made to first-class journeyman's rating.

Another phase of employee instruction provided in this plant has been voluntary trade extension classes held after working hours for the adult workers. These are not in operation at the present time owing to lack of available space for holding them, but they are to be resumed in the early fall.

The method of administration is worth noting, as it seems to have met with general satisfaction. It consists in placing the responsibility for the conduct of the apprentice system in the hands of a committee of three members, made up of the works manager, the supervisor, who is the assistant production manager, and a journeyman machinist in the company's employ, regarding whose choice the apprentices were consulted. This committee passes upon the apprentices at the conclusion of the trial period and signs the agreement then entered into, as also does the boy, his parent or

	Weeks	Check Number	DATES From	DATES To	Math.	Dwg.	Industry	Workmanship	Deportment	
Tool Boy	35									
Cold Saw	10									
Lathes	50									
Drill Press	12									
Milling Machine	30									
Shaper	10									
Bench	10									
Boring Mill	10									
Floor and Assy.	20									
Gisholt Lathe	10									
Tool Maker	11									
	208									

E-Excellent 90-100%
G-Good 80-90%
F-Fair 60-80%
P-Poor Below 60%

Average for 4 Years

Final Grade

FIG. 32. CARD USED FOR GRADING APPRENTICES

Surname Given Name Address

Reg. No. Parents or Guardian Address

Application Received Engaged Left Rejected Discharged

Contract Signed Deposit Received Finished Apptc'ship. Released

Nationality Date of Birth Place of Birth

Education

PERIODS AND RATES PER HOUR

	1st 26¢	2nd 28¢	3rd 30¢	4th 32¢	5th 34¢	6th 36¢	7th 38¢	8th 40¢	9th 42¢	10th 44¢
When Rate is Scheduled to take effect.										
When rate did take effect										

REMARKS

FIG. 33. RECORD CARD FOR APPRENTICES, SHOWING WAGE RATES

guardian and the general manager, as representative for the company. It may also recommend changes in the procedure of apprenticeship, and in general it provides a clearing house for the discussion and initiation of any new features in the program.

The *esprit de corps* of the apprentice department is also promoted by encouraging athletics. Each season the boys have their baseball, football and basketball teams, in which considerable interest is taken by the management.

The general impression gained of the apprenticeship system offered by the plant is that the boys' interests are being considered, and that from the standpoint of the company apprenticeship is abundantly justified in spite of the relatively small number that can be provided for.

Folklore Philosophy

By A. M. Simons

Every people has one set of folktales that turn about the antics of the village fool. Along with this goes another set that pokes fun at stupid people who expect, by shrewdness, to get something for nothing.

One such very old American tale that came down to me through a line of New England ancestors, illustrates both phases. It tells how a Yankee schooner was wrecked on a desert island, barren even of vegetation. Here the narrator stops for the fool to ask, "How did they live?" Then comes the brilliant repartee, "They all got rich taking in each other's washing."

Students of folklore know that such stories persist through the centuries only because they strike at deep-seated, universal weaknesses in human character. The reason why millions continue to smile, even faintly, at each re-telling is because each of us thinks of someone they hit. One reason, besides their antiquity, that keeps the smile faint, is the suspicion that the moral may hit us.

"Help Wanted" Ads and "Experience"

Every time I look at the "Help Wanted" columns I know one good reason why this particular folktale does not die. Fully three-fourths of the advertisements call for "experience." Perhaps one in fifty offers to supply experience.

The vast majority of employers expect to get rich by stealing experience from each other. Of course they do not succeed, any more than the sailors in the story. Nevertheless, like the village fool, they continue to "bite" at the old "catch." They are unable to see the defect in the logic.

Is it not about time to learn the moral of the old folktale in this field and to know that there is no way to get more experience out of the labor supply than is put into it? This carries the other lesson that those who put experience worth having into labor are apt to get the benefits of it. Firms and nations with training systems and technical schools are able to retain such of their workers as are worth having. Labor is an attribute of human beings and humans prefer, with other getting, to get understanding, and will stay where they can get it.

Firms who give least valuable experience, and employees who absorb least are the source of most of the experience which is available to advertisers. In business we deal with large masses and majorities, not with exceptions. Those who have had experience at one job and are seeking others are most often products of defective jobs or defective abilities, or both. In either case it is an least as probable that his experience should render the person an object of suspicion as of acceptance. Experience alone will never be a reliable qualification until it is possible for sailors to get rich taking in each other's washing.

Knowledge and Experience

Industry seeks knowledge, not experience. It is true experience is a school, though a hard one. But the important question is the possession of the knowledge, not the way it was obtained.

The moment there is any method of testing knowledge experience ceases to be a criterion of ability. Testing substitutes knowledge for guesswork on the part of the employer, and we are learning that here also exact methods of investigation and recording facts are of much more value in hiring than long experience in "judging human nature" by mystical "hocus pocus."

When we are able to determine the thermal units in coal we quit asking our neighbor what has been his experience with different kinds of fuel. As soon as a method is found for determining abilities and rating production, experience becomes of less importance in making up the qualifications of employees.

"What about the man who knows all about a job but can't fill it?" asks someone who has not yet learned that things equal to the same thing are equal to each other. The answer is, "There ain't no sich animile." The entire personnel department of the American army thought there was. So did the similar departments of the British and the German armies. They hunted through millions of men to find him. He was not there. Whenever a man was found who knew all about the job he could do the work. If he had years of experience and did not know about it, he could not do the work.

These armies spent millions of dollars and thousands of lives finding out this fact. But they did find it out. Industry has probably spent much more in the same search but has not yet entirely discovered the fact.

Knowledge Is Power

Whether the man got his knowledge in schools, out of books, in the shops or by inspiration ceased to interest the examiners. If he knew, he could do. They learned over again, as we seem compelled to learn every truth over and over again, that "knowledge is power."

Civil service examiners learned the same lesson long ago. They tried hiring people who said they had done the required work and had experience. The results were uneven and unsatisfactory. After a while they found that the important question was not how long a person had been to school, but how much he had learned; not how long he had worked at a trade, but how much he had learned.

Employers seek experience, only because they do not know how to measure knowledge. Every time they advertise for experience they also advertise the fact that they have no means of finding out whether an employee is really competent.

When we get out of the folklore stage we will establish training systems and technical schools to put the knowledge into the labor supply and then analyze our jobs to determine the knowledge they demand and, finally, develop tests to find out whether the proposed employee possesses the knowledge.

Modernizing Locomotive Terminals*

By G. W. RINK

Engine terminals play an important part in the operation of the railroad, as the transportation department is at all times entirely dependent upon them for its supply of serviceable power for the movement of both passenger and freight cars. Should the capacity of the terminal or the facilities for making repairs be inadequate, the result will soon reflect itself in more time being required to prepare engines for service and more frequent detention on the road due to failures.

THE general layout of engine terminals, also the extent of shop facilities provided, depends entirely on their location with reference to the general locomotive repair shop. When located in close proximity it is necessary to provide only such facilities as may be necessary to make the general run of roundhouse repairs, depending upon the main shop for the manufacture and supply of a large percentage of materials required for use at the terminal. But when engine terminals are located some distance from the general locomotive repair shops, they should be provided with enlarged facilities so as to perform all the necessary machine, blacksmith, and boiler-shop operations required when making more extensive repairs, and be entirely independent of the main shop.

The location of the engine terminal with reference to the general locomotive repair shop will have some bearing on the necessity of performing relatively heavy repairs at the terminal. Where they are within reasonable distance of each other, it may be desirable to have a considerable part of the heavy repair work transferred to the main shop, where the repairs can be performed more expeditiously and the engine returned to service.

The arrangement of tracks at the engine terminal, including inbound and outbound tracks, will depend entirely on the location of available space assigned. The successful operation of the terminal requires a complete analytical study of the entire project from an operating standpoint, taking into consideration the number and type of locomotives to be handled and the possible future increase in requirements.

With reference to existing terminals, a careful study of the property will no doubt disclose the fact that improvements can be made whereby greater efficiency may be obtained. Modern facilities should be installed wherever it is possible to produce a saving in time and labor. Special consideration should be given to the various items which comprise the terminal. The type of house, number of stalls, and number of single or double houses will have to be determined by a careful study of the conditions to be met, such facilities as will work out to the best advantage being installed.

Coaling Stations and Sand Storage

The type of coaling stations selected must depend on the number of engines handled, the number of tracks which may be available for coaling engines and the kind of coal to be handled. Some roads in the East use bituminous, broken anthracite, and buckwheat. Where the quantity of coal handled is small, the locomotives can be coaled from an elevated platform using one-ton buckets or by means of a locomotive crane direct from car. When it is necessary to deliver coal to two or more tracks, a mechanical type of coal-handling apparatus is generally installed. Marked improvements have been made in receiving, hoisting, and distributing equipment, which has resulted in smaller operating forces being required. Measuring devices are also installed for recording the amount of coal delivered to tenders. An electric winch should be provided at large terminals at the loaded coal-car track so that cars can be hauled to position over track hopper.

The sandhouse should be located at the coaling station. Sufficient wet-sand storage space should be provided as well as means for drying the sand by coal stove or steam. Compressed air should also be available so that the sand can be delivered to overhead storage bins, having suitable outlets to deliver the sand direct to engine by gravity. All important engine terminals should have a complete installation of this character.

Ash Handling

At small engine terminals provisions are made to handle cinders in various ways. One method is to provide a pit located between rails, the cinders being shoveled to track level and loaded into cars by hand or locomotive crane. This system is satisfactory where but few engines per day are handled.

During recent years the tendency when constructing large terminals has been to install pits filled with water. The cinders drop directly into the water and move toward the center of the pit, due to the outer wall sloping inwardly, and are removed either by a locomotive crane or by an overhead crane traversing the entire length of the cinder pit, the cinders being deposited by means of grab buckets directly into cars located on the loading track.

Steam-jet ash conveyors can be installed to advantage where ample supply of steam is available. The system consists of an 8-in. cast-iron pipe made exceedingly hard to withstand wear, with intakes provided at suitable intervals. The cinders are drawn by suction through the main pipe line and then propelled by means of the steam jet direct to car or storage bin, suitably located.

Turntables

The length of turntables installed is generally governed by local conditions, also type and wheelbase of locomotives to be turned. The usual length is 100 ft., which is ample in all cases except where large Mallets are handled, when it is desirable to provide 110-ft. tables to insure greater leeway for balancing the locomotive under all conditions.

Inspection pits are now being installed at a number of large engine terminals. These are located on the inbound tracks with the view of making inspection of locomotives before they are placed over the cinder pit. Fires can then be withdrawn when the engines pass over the cinder pit, if inspection develops defects which warrant this procedure, thus saving time and expense in-

*From a paper presented at the annual meeting of the American Society of Mechanical Engineers, New York, Dec. 7-10, 1920.

volved if the engine was inspected within the roundhouse after passing over cinder pit.

Heating and ventilation are of first importance in a modern and efficient roundhouse. With the possible exception of small isolated houses in mild climates, where sufficient natural ventilation can be obtained, a properly designed system combining heating and ventilation should be adopted.

A combined heating and ventilating system should supply sufficient air for the quick removal of smoke, gas, and vapors. Ventilating sash, louvers and other openings should be provided at the high points of the room to supplement the forced system by directing the flow of air currents and facilitating the removal of hot gases. This feature should be carefully considered, for in roundhouse ventilation it is not so much a question of diluting the air as it is of establishing a positive flow of air which will carry the gases along with it.

Adequate daylight facilities through large window areas together with light, cheerful surroundings are highly desirable.

Much needed improvement is desired in connection with artificial lighting of engine terminals. In the roundhouse proper, lights mounted on the outer wall and reflected between engine pits have given satisfactory results when augmented by sufficient lights suspended from the ceiling to afford general illumination.

For lighting the roundhouse circle, flood lights should be used whenever possible, as general illumination will add considerably to the safe movement of locomotives to and from turntable and engine house. Ashpits can be illuminated by rows of reflector lights placed on poles, and similar provision should be made at other points beyond turntable or by the use of flood lights on the top of coaling stations.

Facilities should be provided for washing out boilers, using hot water under pressure and refilling with hot water after washing.

Hot-water washout and refilling systems can be economically installed in any size to meet the requirements in any engine terminal of moderate size. The usual practice is to deliver washout water at temperatures varying from 100 to 140 deg. The refilling water generally has an average temperature of approximately 210 deg.

Screw-jack locomotive hoists especially designed for unwheeling locomotives are being more extensively used at engine terminals, and their use has made possible a large saving in both time and labor. These hoists operate with a high degree of safety as compared with the drop-pit system; furthermore, they can be located within the roundhouse or installed in a separate building, in which case it would be desirable to also install the wheel lathe and other tools and appliances for taking care of heavy running repairs.

Space for blacksmith and boiler shops is generally provided adjacent to the machine shop. Facilities should include steam hammer, forges with down-draft hoods (number and size to suit work to be performed), punch and shear, plate-bending rolls, straightening plate, flange fire, etc. Stock flues, sheet iron and bar iron and steel should be kept outdoors in covered racks.

Autogenous cutting and welding outfits are also considered indispensable and are used principally in making repairs to locomotive fireboxes, engine frames, and in reclaiming miscellaneous parts which can readily be repaired by this process.

Oil houses should be separated from other buildings, should be of fireproof construction, and of a size to suit the requirements.

The storehouse should comprise a structure of ample size, conveniently located to machine shop, with platform and track facilities for handling material to and from cars, building provided with sufficient natural and artificial light, steel shelving, bins, etc., separate alcove for electrical repair shop and provision for office staff on second floor.

Important engine terminals should be provided with a power plant of sufficient size to take care of the future as well as immediate needs of the terminal. In a number of cases this plant is required to provide steam for thawing snow at switches on main-line track leading to the terminal passenger station and supply heat and light to station buildings, and function in general as a service station.

Acme Threads in Motor-Jack Bushings

By A. J. Schwartz

The article on page 397 of the *American Machinist* on "Tapping Acme Threads in Motor Jack Bushings," by H. W. Armstrong, is of value in that it gives information on how to increase the production of the bushings, and at the same time decrease the cost for taps. It is with pleasure that articles on the subject of Acme threads are read, particularly when the faults in manufacture are cited and the remedy given to overcome them by some one engaged in actual manufacture and thus qualified to give additional information. A few more dimensions on the drawings of the taps would, however, be greatly appreciated.

Will Mr. Armstrong kindly supply the readers with a little more information in respect to the exact dimensions for the perfect threads on the tap and also the theoretical dimensions of the thread in the ¾ in., 4 pitch, bushings this tap is to produce?

It is to be supposed that in this age of interchangeability the bushings are made within certain limits of tolerance and that "go" and "no go" gages are used to check the work; therefore, there must be a point at which the taps will cease to cut to the proper size and should be discarded. Now as the minimum hole for screw thread product is considered basic and required by the United States government, it would seem advisable and desirable to make the taps slightly over-size by a few tenths, or even a few thousandths of an inch, and it is information in regard to the amount of over-size on all dimensions of the tap that is desired.

There is no reference in the article to the screw that is to fit in the bushings, nor information regarding its manufacture, but for quick assembling, the mating parts should have ample initial clearance or allowance, as otherwise, unnecessary time will be consumed in putting these parts together. Assuming the bushings produced by the taps to be in agreement with the theoretical thread data as given in the "American Machinist Hand-Book," it will be absolutely necessary to make some departure or deviation from this data when making the screw, as it is impossible for the 4-pitch Acme thread bushing to go over a screw having exactly the same dimensions except for clearance at the major diameter of the bushing and the minor diameter of the screw.

If it is possible to do so without giving away the firm's secrets, I would, therefore, request that the basic dimensions and the tolerances for a ¾-in., 4-pitch Acme thread screw be given to the readers.

Making Eccentric-Headed Studs

BY FRANK S. WARD

The manner in which eccentrically headed studs were made in an English munition plant is unique enough to warrant examination. The ways in which the speed of production was increased without the use of automatic machines show that there are probably large possibilities of improvement in regard to rate of production in the average machine shop.

THE making of eccentric-headed studs on a large contract presented some interesting problems to the shop which undertook the job. The contract called for 10,000 studs, more or less. The material, which was furnished by the buyer, was 3-per cent nickel steel. The only machines available were 14-in. swing hand-lathes. That is to say, the spindle of such a lathe was belt-driven, the traverse driven by hand only, and the slide-rest, though adjustable along the bed, possessed no saddle. The operators were girls.

As it was impossible to cut off in the lathes, the stock was sawed off into pieces the length of two studs with a minimum allowances of $\frac{1}{8}$ in. for cutting them in two. As the bars were just over $1\frac{1}{4}$ in. in diameter and as the pin had to be 1 in. in diameter, eccentric to the extent of $\frac{3}{64}$ in., there was not much material to waste. The heads were not turned, as they had to be milled later to a special form.

At first the job may strike the reader as very ordinary, but he will find, the author has reason to believe, that the procedure has in it not a little of the new. Although an ideal turret-lathe job, it was done in comparatively light lathes at a pace that the turret lathe had hard work to beat.

PECULIARITIES OF THE JOB

On this particular job, turret-lathe users had one trouble to face which they surmounted only by running the spindle at a comparatively low speed. Imagine the effect of running at a high speed a 12-ft. bar of $1\frac{1}{4}$-in. steel set eccentric nearly $\frac{1}{8}$ in. The price paid for the studs was very low and those firms that followed the ordinary practice of cutting off and turning the studs between centers lost money. One or two small firms went "broke" with the job.

By making the job a chucking one, we saved at least $\frac{1}{4}$ in. of material on each stud and about 1,000 lb. of metal altogether. Centers could not be left in, which is one item of interest. Another item is the use of a universal chuck without any alteration for chucking eccentrically. The author conceived the idea of inserting the jaws in the chuck in the wrong order just to see if the right amount of eccentricity could be obtained, or so close an approach to it that the jaws would not require much grinding. As luck had it, it was found that the roughing operation, illustrated in Fig. 1, about cleaned the stock up all around. Occasionally, a little black was left on at A which, however, never failed to clean off at the finishing cut. This idea may afford to someone else the opportunity of avoiding the use of special eccentric chucks for similar jobs.

The way we avoided length stops may not be without novelty. In addition to the turning tool *B*, we fixed in the rest an ending tool *C* and provided a gage *D* to facilitate setting the tools the proper distance apart. The operator had instructions to level up the end, removing a minimum amount of metal, a means whereby we were enabled to reduce the cutting-off allowance. A trial proved the impossibility of truing up the end to the center, there being too much vibration.

Now, at the outset, I started with the impression that the tool, if made as for turning tool steel, would be about right for 3-per cent nickel steel. Consequently, the top rake adopted was 10 degrees. After a little experience our girls were averaging about 8 ends per hour. Naturally, we had not aimed at a high surface speed for we regarded the material as requiring approximately the same speed as tool steel. A coolant was not used at first, but after pumps had been fitted, we found higher speeds possible and the output went up to some 10 an hour, and there was not a little saving in tool-setters' labor.

CHANGE IN TOP RAKE

This continued for some time, when some fool of a tool-setter, having run out of the ordinary tools, inserted one of our standard tools, such as used for soft mild steel and having a top rake of 35 degrees. That day the output showed a considerable increase, so great an increase, indeed, that a reason was sought and, of course, found in the tool. Without burdensome explanation, we must say that after a little experimentation we found it possible to nearly double the speed, and that enabled the operators to double the feed without feeling increased fatigue. Our average production went up to 21 ends an hour and our record to 27, inclusive of toolsetting time. A section of the cutting end of the tool is shown.

A minor point that is worth while talking about arose. We found that there was less tendency for the tool to dig in when it was set well below the center. When set above the center this type of tool, if it yields,

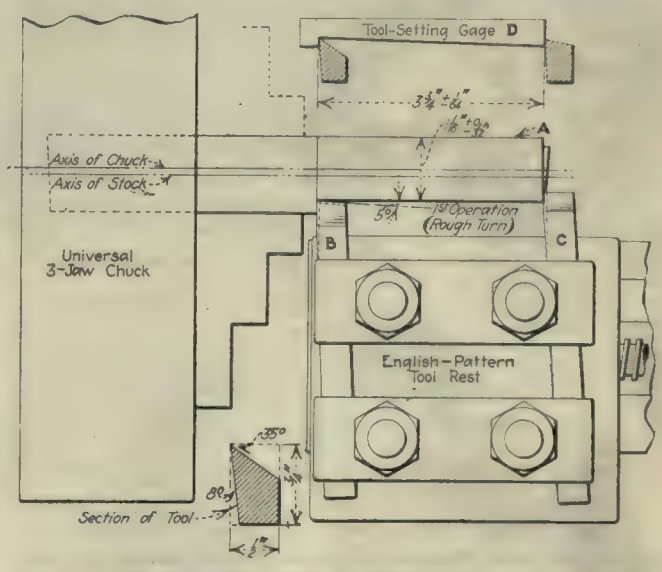


FIG. 1. FIRST OPERATION, ROUGHING ONE SHANK

digs into the parts being reduced. Again, by setting the tool below the center, the length of cutting edge in action is slightly increased.

Two lathes were employed for roughing. The first operation was roughing one end eccentrically, Fig. 1,

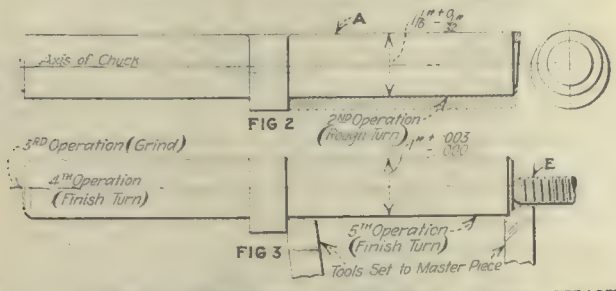


FIG. 2. SECOND OPERATION, ROUGHING OTHER SHANK
FIG. 3. FINISHING THE STUDS

leaving from $\frac{1}{32}$ to $\frac{1}{16}$ in. for a finishing cut. The blank was then transferred to the second lathe, see Fig. 2, in the chuck of which the turned end was held concentrically. When a line of black had been left at *A*, it was always set against a jaw. A blank that happened to be a little small (the bar being undersize) was in this way frequently saved, if not at both ends, at least at one end.

Facing and Finishing Turning

The next operation, Fig. 3, was the grinding off of the unlevel ends. It was concluded that a little time would be saved owing to one handling only being needed, instead of the two required if this process had been left until the pieces were cut in two. In grinding, the pieces were simply rolled on a flat rest across the face of the wheel, the finishing of each end occupying but a few seconds.

The fourth and fifth operations, finish turning the ends, were practically repetitions of the second, the ends however, being chamfered instead of merely leveled. The output was about 24 an hour. In this case the top rake of the tools was 15 deg. only, but a coolant was used as before. An end stop *E*, Fig. 3, was attached to the top slide (the toolslide) of the rest.

It might be well to explain here that the output was increased a little by replacing the handles of the slide-rests by longer ones fitted with heavy balancing balls, which enabled the operator with a spin to return the slide to its starting point. With the short handles, roughing was very hard work.

Sawing

The arrangement for sawing is not without interest. The bush illustrated in Fig. 4, of mild steel case-hardened at the right hand end, was recessed to a depth equal to the finish length of the head. The saw attendant had instructions to allow the saw to touch the bush lightly. It was impossible to saw off so that the heads came too short, and they were generally a little too long, or rather longer than the nominal. Only rarely was it necessary to face the inner stud to length, and the finish as left by the saw was good enough. The inspector, after sawing, set aside the studs with long heads for facing, which was a simple lathe operation unless the amount to be removed was excessive. In that case, the stud was returned to the saws and the excess sawed off.

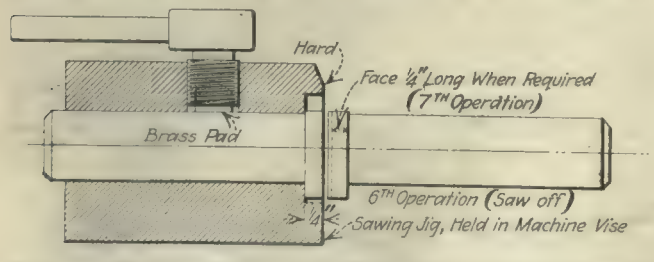


FIG. 4. MEANS OF HOLDING THE WORK WHILE SAWING STUDS APART

One would imagine that the rubbing of the saw against the hard bush would be detrimental to saw life. It may have been, but if so, the loss was quite inappreciable. What was more important, our lathes were enabled to earn more than could possibly have been lost on extra saws.

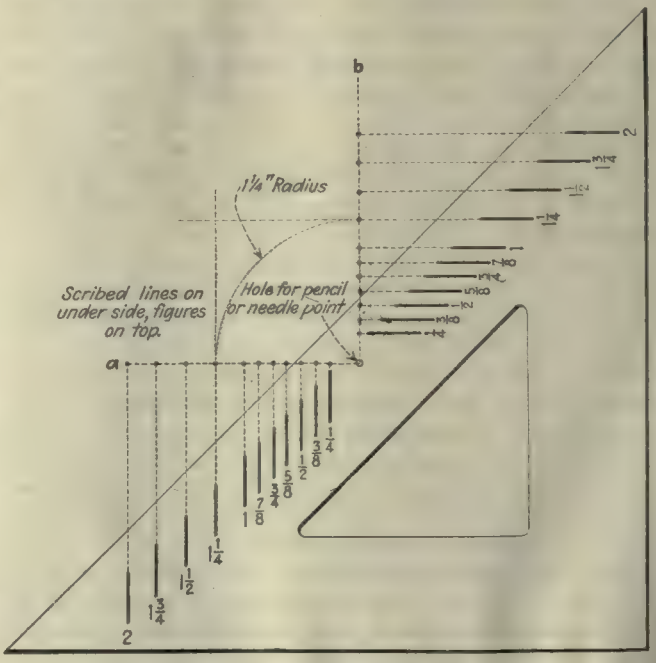
The average time per stud for all the operations except sawing was 7 minutes. Those who recognize the stud will be interested to learn that, together with the operations not described, the total time worked out at 12 minutes each—with poor machines.

Locating the Center of Radii

By Chester E. Josselyn

There are two methods in common use for locating the center of radii on a drawing. One is to set the compass to the required radius and then make several guesses at the center, usually getting it somewhere near right; and the other is to measure off the distances with dividers and draw intersecting lines. The sketch herewith shows a simple instrument for accomplishing the purpose that combines the precision of the latter method with the speed of the former.

All that is needed is a 45-deg. triangle of celluloid with a small hole near the center of the long side for the needle point, and with a series of short lines at suitable intervals located equidistantly on either side of the hole. The lines should be upon that side of the triangle that is next to the paper, while the figures may be on top.



TOOL FOR LOCATING THE CENTER OF RADII

Industrial Dental Dispensaries

By SANFORD DeHART
Director of Hospital, R. K. LeBlond Machine Tool Co.

Does an Industrial Dental Dispensary pay?
What is the approximate cost of Dental Service?
Do the employees respond to the treatment?
Do the employees respond to the dentist's suggestions?
Do they resent it as being too paternalistic?
Are there any "don'ts" you might suggest?

THE questions in italics and various others are asked us by many manufacturers in different parts of the world. I say world, because we have received inquiries from as far off as Calcutta, India. London, England, has manifested an interest by requesting information in two different instances. Recently we received an inquiry from a representative of the government of New South Wales, Australia, requesting information relative to the success attending our work. This representative explained that it was a matter affecting the lives and futures of all the people of Australia, and he was anxious to procure facts, figures and personal opinions from the R. K. LeBlond Machine Tool Co., so that he might, as he expressed it, "convince the apathetic government dentists of New South Wales of the extreme urgency of Industrial Dentistry along proper lines." Recently I made a survey of plants employing dentists either part or full time, and I ascertained that the methods pursued were not to fill decayed teeth, not to straighten teeth nor treat "pyorrhea." I found that they cleaned the teeth, charted the mouths, noted decays and sent the patient to his family dentist. Some extracted teeth and some did not. Most of the dentists interviewed were in favor of extracting the teeth in their Industrial Dental Dispensary. In a few of the dental dispensaries the company carried the entire expense. Four of the industries furnished free dental service to the children of the employees. In some of the dispensaries the employees paid half, and in others the Mutual Aid of the plant paid the expense of the dispensary.



DENTAL DEPARTMENT OF THE LeBLOND CO.

Industrial Dentistry has received a great impetus since the war, owing to the fact that each of the 5,000,000 soldiers and sailors who went into training camps had his teeth examined, and where defects were found they were corrected. It was the work of the army dentist to keep the teeth of the recruits in first class shape, with the result that the teeth of the American soldier won the admiration of Europe. Many of these men who have returned to civilian life have learned the importance of taking care of their teeth and are serving as guides to other people who have not been taught the ill results of neglecting their teeth. Dr. Charles H. Mayo, the distinguished surgeon of Rochester, Minn., says—"the next greatest step in medical progress in preventive medicine should be made by the dentists." It is difficult to estimate the time lost from work due to defective teeth. All of the firms surveyed, which were operating dental clinics, advised me that the service pays for itself in the time saved in preventing toothache. One can very well appreciate the economic importance of an industrial dental clinic to an industry situated some distance from the center of things. It has been conservatively estimated that the savings to the LeBlond Co., on extractions alone, was approximately $2,200 in production, for the year 1919, based on the time a man would ordinarily lose if he were to visit his family dentist during working hours for the relief of toothache. It often happened that an employee reporting for work after a sleepless night, due to an ulcerated tooth, was willing to continue work after being relieved by our dentist. If we had not been situated so that we could promptly relieve these conditions we would have lost the services of these men for the entire day.

An idea of the work accomplished in the LeBlond dispensary can be illustrated by the following report:

Toothache	122	Examinations	121
Caries	104	Preventive	351
Treatments	386	Pyorrhea	39
Fillings (temporary)	64	X-ray	13
Extractions	306		

There were 1,506 mouths examined and charted during the year. Our records show that there were 96 per cent in need of dental services, only 4 per cent were found to have mouths that might be considered hygienic, 6 per cent were free from caries and responded to treatment readily, the remainder had disease-producing symptoms known to dentistry, such as abscesses, pulp stones, inflamed pulp, ill fitting crowns and ragged fillings causing irritation.

Normally, the LeBlond Co. has one thousand employees on its pay-roll. From the foregoing it may be gathered that the dental department has a good clientele.

Industrial dentistry is comparatively a new subject. In a list furnished me by the publishers of *Dental Register*, I find that there is but one Industrial Dental Clinic in Detroit. This is surprising in view of the fact that Detroit is a progressive city, and is the home of many large factories. There are four Industrial Dental Clinics in Cincinnati.

The Dental Department of the R. K. LeBlond Machine Tool Co., consists of a room 8 x 10 ft. equipped with an Industrial Unit, that is: a dental chair, gas, air, tray, light, drill, water, cuspidor and motor. This makes an ideal combination for industrial dentistry, particularly where the room is small. The utility is also enhanced since there is no lost motion so far as the work of the dentist is concerned, as he has his utensils conveniently near. The dental room is also equipped with a cabinet, file and a gas-oxygen outfit for the administration of anaesthetics. The usual small tools and appliances for extraction and preventive work is also a part of the equipment. A dental room such as I have just described could, with the present inflated prices, be installed, I am advised by dental supply houses, for approximately $1,800.

The personnel consists of a dentist, a graduate nurse who has specialized in dentistry, and an anaesthetist, who visits the plant when his services are required.

The dentist spends one hour a day at the plant, four days a week, and in view of the fact that his nurse has been trained to anticipate his wants, he is usually able to treat on an average of seven patients during his stay.

Our dentist has been practicing his profession for twenty-five years, and is considered one of the leading dentists in this city. Since he has naturally mastered his profession he is enabled to eliminate many of the non-essentials, thereby rendering him particularly efficient in expeditiously treating his industrial patients. It is hardly likely that a younger man or one not possessing these qualifications would be able to treat seven patients per hour and do justice to them.

This brings us to the point of the qualifications of an industrial dentist:

Qualifications

First—He should be a man of mature years, who has been practicing dentistry not less than ten years.

Second—He should know something about industry and the men he is to treat. He should be conservative in his statements as to the benefits derived in removing neuralgic and other obscure pains by the extraction of teeth. It may be well to note in this connection that the medical profession has of late been protesting against the reckless extraction of teeth. Dentists have obtained such beautiful results in some cases by extracting teeth, that some of them are now trying to explain most diseases on the basis of these focal infections. It has been the policy to pull the teeth first, and if the pain does not subside they look further to ascertain the cause of the pain. This phase of the work has met with many disappointments and has engendered a certain amount of distrust among the employees.

Third—He should have a pleasing personality and understand the social side of man. He should view dentistry from the employees' angle.

Scope of an Industrial Dental Department

Emergency work should be treated as conditions arise. Toothache should be relieved in all cases at once. Advisory work, consisting of thorough examination of the mouth and teeth and suggestions as to the proper work required should be done. Educational work, such as explaining to the patient all the details in connection with his case in terms that he can interpret should be included. Each mouth should be charted and a copy given to the employee. When defects are found the employee should be referred to his family dentist. It should be the work of the dentist or his assistant to check these cards every sixty days to ascertain whether or not the employee has had defects corrected. (With reference to the forms for a dental department, the author will be pleased to send blank forms to interested persons.)

Extractions should be done in the Industrial Dental Clinic, with the aid of gas or the different local anaesthetics. Teeth cleaning and polishing should be a feature of the Dental Clinic. Initial treatments for "pyorrhea" should be a part of the dentist's work, and the patient referred to his family dentist for subsequent treatments. Occasional talks on hygiene of the mouth supplemented with lantern slides will do much to cement good relations between the dentist and the patient.

In describing the foregoing functions of the dentist, I have been guided solely by what has been accomplished in the LeBlond Dispensary. To take care of all the dental needs of a plant employing 1,000 would require the services of several dentists giving all their time. Filling, making of teeth, crowns, etc., should not be done in the factory.

A Few Don'ts

Don't employ a young man to take charge of your dental work. There are too many complicated problems arising for a young man to solve in industrial work. Don't permit your dentist to attempt too much. I recall a case on whom a dentist was attempting some operative work in an industrial clinic, which terminated disastrously, and had it not been for the combined efforts of two physicians and the dentist the case might have been a fatality. Don't have your dentist visit the dispensary at irregular hours. Have a specified time for the dentist to report for work, so that the employees may know when to find him in his office. Much time is lost by the employees visiting the dental dispensary to inquire the dentist's hour. Don't employ a man who is not tactful.

As to the cost of operating an Industrial Dental Dispensary, I have conferred with a number of dentists engaged in this line of work and have read a vast amount of material on this subject. The consensus of opinion seems to be that good dentistry can be furnished industry for approximately $1.50 a year per employee.

The Law in Regard to Strikes—I

By CHESLA C. SHERLOCK

The ever-growing necessity for the enactment of laws, Federal and State, to govern or fix the responsibility for strikes and lockouts, which cause financial loss and inconvenience to the public, is one of the biggest problems in our present era of social and industrial development. What the law covers at this time is ably discussed in this first installment.

NO BETTER example of how public opinion forces the growth and development of law can be given than the case of strikes and lockouts. Just now we are in the midst of a great period of growth in the law in regard to this phase of human relationship, a growth that is at once tremendous and, at the same time, sane.

Jefferson, speaking just a hundred years ago, said: "I know that laws and institutions must go hand in hand with the progress of the human mind. As that becomes more developed, more enlightened, as new discoveries are made, new truths disclosed, and manners and opinions change with the change of circumstances, institutions must advance also and keep pace with the times. We might as well require a man to still wear the coat which fitted him when a boy, as civilized society to remain ever under the regimen of its barbarous ancestors. It is this preposterous idea which has lately deluged Europe in blood."

The "deluge" to which Jefferson referred was, of course, the French Revolution and the campaigns of Napoleon, but had the statement been made but yesterday it could not sound more up to date!

The development of the law in regard to strikes is of comparatively recent origin. In fact, most of it has taken place within the last half-century. And in the tracing of that development we have but to keep in mind the fact that law has ever followed public opinion to understand why some of its growth has been so one-sided, so imperfect, and, perhaps, so illogical.

In a previous discussion touching upon the subject of contracts with trades unions we brought out the fact that the courts have ever been reluctant to deal with individuals in the mass. The law is upheld for the protection of the individual and to clearly define his rights. The law has never willingly consented to merge individual rights into a mass and treat the mass with anything like the consideration shown the individual.

Business must, of necessity, often be conducted under a mass arrangement. So the Romans gave us the corporation, which by fiction of law is considered a legal entity or *person*. And, even then, we find the law in regard to corporations even more strict and specific than it is in the case of individuals, because the law has recognized from the beginning that an organization of people for a specific purpose presents a serious menace to the rights and privileges of individuals unless such organization is held in continuous check.

In trades unions, which are of very recent origin, the law is presented with a very different matter from that of corporations. The trades workmen represent a mass of individuals banded together for a specific purpose; namely, to further their own interests to the exclusion of the interests and rights of others. And, whether we care to look the facts in the face or not, the trades union is, under the normal expression and feeling of the law, dangerous to the rights of individuals.

Why? Largely because they represent an irresponsible mass which, at law, cannot be controlled in its obligations and covenants. Trades workmen, as everyone knows, will force a contract for wages from the employer either under the coercion of a strike or a threat or by actual violence. Then, next week, or next month, they may decide to have their wages advanced and there is no power which can compel them to work and render to society that service which they owe, until their demands have been satisfied. In fact, recent developments disclose that even the constituted authorities of the trades unions have no conclusive power over their mass, to look to the enforcement of agreements and covenants which the men have previously assented to.

The men may even assent to arbitration and an adjustment of their differences, but there is no power, as the law now stands, to compel them to abide by the decision rendered and carry out their portion of the agreement. Only public opinion today can, in any way, curb or control the action of the trades unions, and when we speak in this sense we refer to the right to keep the men at work.

The Rights of the Individuals

When you come to the right to work or to refrain from working you must lapse back to a consideration of the rights of individuals. Under our law men in the mass can be compelled to work against their will only when they have transgressed against the law and been convicted thereof, or when they have entered the military service. The individual, however, cannot be compelled to work. It is his right to refuse to work or to work as he wills it. In the making of an agreement through his trades union with an employer he avails himself of the advantage via the threat route of the mass, but when the performance of the agreement comes he avails himself of his individual right to quit work any time that pleases his whim or the whim of his fellows.

What else can be said of the relation? The courts have, through the force of expediency, declared that an agreement of workmen to strike cannot be considered a conspiracy. It is not in restraint of trade, for labor is not a commodity to be bought or sold. I think we all agree to the wisdom of the ruling that labor should not be treated as a commodity to be bought and sold, but let any other mass of individuals in the country seek mutual advantage through mass movement and they will promptly be haled into court for trespassing the rights of other individuals—with the exception of farmers banded together in co-operative enterprises, and here again we find the finger of political expediency.

This situation has come to us from the common law, due largely to the stress of the law at that time upon the rights of individuals and to the fact that in those days the courts were not called upon to treat of rights in any other form. Trades unions were unknown to the common law. Workmen were not organized. They dealt with their employers independently and as individuals. Hence, the solution of their problems did not serve to tangle the threads of individual rights. And in regard to employers who massed together in their enterprises, the law required them to incorporate and treated their corporation as a single person in the rights acquired, and held times without number that individuals massed together in a corporation could acquire no greater rights than an individual in the same calling, with certain enumerated exceptions.

Unions Should Be Controlled by Law

Trades unions are doubtless essential in our present-day commercial world. They serve a necessary purpose and they can serve a larger purpose in our industrial scheme of things, but, as in the case of the individual and of the corporation, their powers must be curbed and enumerated more specifically by the law, or the good which they can do will be obscured by the evil which they will accomplish. We must find some way to define more clearly the rights of all parties to the industrial tangle and to distinguish those rights clearly and without favor, if our "institutions are to advance also." We cannot ever bend under the "regimen of our barbarous ancestors" and escape paying the piper.

The solution will doubtless come when the courts and the legislative branches of our respective governments are content to consider and define the rights and liabilities of individuals in mass, and to abandon, so far as necessary, the old feeling that rights can be adjusted and considered only on the individual basis.

In fact, the solution will doubtless come in the acceptance of an early English decision, which has been lost sight of in the overwhelming maze of other decisions relating to strikes and labor troubles. In this decision, the court recognized the right of society at large to be considered in such disputes, and it had the courage to treat of the rights of respective parties in mass.

The coal strike a year ago crystallized public opinion more than anything else in this direction. It brought to the attention of the people for the first time what employers have known for a long time, namely, that there are more than two parties to a labor dispute, and the utter inadequacy of the law to meet such a situation and compel action. And this last summer we have witnessed another exhibition on the part of the trades union men where, in two separate unions, "illegal" walkouts were staged—walkouts not even sanctioned by the constituted leaders of the unions themselves.

Public opinion has in the past forced legislation and court decisions carefully and specifically setting out the rights, duties and liabilities of the employer. He is pretty well hedged in by legal restrictions as to what he may do and what he may not do. Properly so. But the weakness of the law as it stands today is not in its failure to curb the employer so much as in its failure to curb the employee and enumerate his rights, his duties and his liabilities. And, in considering this question which must necessarily involve a consideration of some means of controlling a mass, the rights, duties and liabilities of society must likewise be enumerated.

Society has the right to the uninterrupted enjoyment of the service of labor. But in asserting this right, the rights of labor need not be transgressed in the slightest degree. The courts have said from the beginning of time that society had a right to the peaceable adjustment of private disputes. And to guarantee that right the law has taken away the firearms of the individuals or the right to the uninterrupted use of them, and substituted arbitration through the courts of the differences between the parties.

A gun in the hands of an irresponsible party is a constant threat to society; the right to strike in the hands of an irresponsible mass is a constant threat to society. The taking away of the right to strike from trades unions can jeopardize their rights no more than the taking away of the right to use a gun anywhere and everywhere has jeopardized the rights of individuals. For honest rights once acquired, can never be taken away from individuals by the law, and never will be, unless other rights achieving the same end are substituted in their place.

The strike in the past has not been illegal; it is not illegal, in a general sense today. It is possible that it has been morally wrong to strike, but beyond that no one dares to go, and even moral rights are grounded in the expressions of organized public opinion, and nowhere else.

Just what might happen if union men were to strike in defiance of a law prohibiting strikes cannot, of course, be definitely stated, but a fair indication may be drawn from a case which recently occurred in the Federal District Court for the Southern District of Iowa.

The Des Moines Incident

The street railway men in the City of Des Moines have been engaged in a series of wage disputes and two strikes during the past year. A year ago they promulgated a strike for higher wages. The company has been in the hands of a receiver for the past two years.

The strike came at a very inopportune time so far as the city was concerned, being just before the Iowa State Fair when hundreds of thousands of visitors were expected in the city.

The strike at that time intimidated everyone. Judge Wade of the Federal Court, in order to get the men back to work, granted an increase of wages on the understanding that the city council was to submit a proposal to the voters to increase the fare which might be collected under the franchise. The men went back to work, but the people voted down the fare increase. The men, however, were paid the increase out of other funds on hand.

In the Spring, the men again demanded a further wage increase, doubtless moved by their successful experience the preceding fall. They demanded an increase averaging about 20 cents per hour above what the court had awarded them the year before. Arbitration was held and the men were granted an increase which the company, due to its insolvency, was unable to pay. The company did, however, continue to pay the old wage and to credit the men with the extra award, agreeing to pay it as soon as funds were available.

The men worked through the summer until state fair time again in August. In the meantime, the State Supreme Court had held that a franchise for a fixed fare for a fixed period of time was not valid and that the fare provision might be changed by the courts upon a showing of necessity. Judge Wade of the Federal Court promptly increased the city fare to 6 cents and ordered the receivers to pay the men the back pay out of the increased fare as rapidly as possible.

The men, however, demanded that the court order the receivers to advance them their back pay out of other funds on hand for taxes so that they might have the money in a lump sum. The court refused to do this, stating that it had no authority under the law to do so.

"But you did it last year!" argued the men.

"I did it because I thought the people would vote an increased fare to take care of the increased wage, but they didn't do it," answered Judge Wade. "I allowed expediency to govern me then, to cause me to do a thing I had no legal right to do, and I will not so act again."

The men then went out on a strike.

Judge Wade then issued an order to the receivers to close the car barns, cease operations, and further he cancelled the contract between the company and the men and declared that they had forfeited all wage rights under the contract and the arbitration awards and must be considered no longer as employees of the company.

It was not two hours until the union representatives were petitioning the court to rescind this order, on the understanding that the men would return to work under the preceding one.

Irresponsibility of Trades Unions

This case undoubtedly establishes a precedent in the country and it is fortunate that it occurred in a Federal Court, where the findings will have wide publicity. For it clearly brings out the utter irresponsibility of the average trades union in carrying out its obligations.

In this case a means was found to bring the men back to work peaceably, and in so doing the court also marked out a course along the definition of the rights of mass movements. No right of the men had been jeopardized, nothing taken away from them. They were merely trying to take advantage of a favorable situation and bring the court and the company to them on their knees as they had done the previous year.

Conclusion

There is no problem presented to employers and to the nation at large at the present moment that should call for the serious consideration and thought which the strike should call for. It is a matter which is going to be adjusted. We have expressed the weakness in the law, the people have sensed that weakness and public opinion is slowly moving, as it always does, toward a solution of that weakness and a better definition of all the rights of all the parties concerned in labor disputes.

In bringing out this weakness in the law as it stands today, it has forced us to necessarily exclude in this discussion many other points of vital interest, and probably more practical concern to employers, in regard to the strike and lockout. We shall discuss these matters in subsequent articles.

Slivers and Infections

By Alexander L. Prince
Medical Director, Industrial Department, Aetna Life Insurance Co.

In a recent issue of the *American Machinist* there appears, in the section devoted to "Ideas from practical men," an article by B. W. Franklin entitled "Sliver gouge made from part of broken light bulb."

In this article, Mr. Franklin describes how a "surgical tool" for removing slivers from the skin can be made from a discarded Mazda bulb, and shows by means of an illustration how this tool can be carried in a spectacle case.

The only inference which can be drawn from this article is that factory employes, machinists in particular, will find it practical and convenient to carry this instrument in the recesses of their spectacle cases and to use it for the purpose of digging out slivers from various parts of their anatomy.

If the removal of a sliver from the skin were a simple mechanical process free from all danger, Mr. Franklin's ingenuity would deserve commendation, but as the removal of a sliver is a surgical procedure requiring skill and training in order to prevent subsequent infection, the promiscuous use of Mr. Franklin's "surgical tool" cannot be too severely condemned.

A sliver wound, like all other wounds, is subject to invasion by "pus" germs and this means infection. To prevent infection is the function of the trained first aider, the nurse or the physician. These individuals are trained to take care of sliver wounds. They know that to use unsterilized instruments on human flesh is dangerous, therefore they use sterilized instruments and not germ laden "surgical tools" carried in a germ laden spectacle case. They also know about the after care of a sliver wound. They know how to keep the wound free from germs until healing has taken place. Furthermore, they do not believe in taking chances with "blood poisoning" as the man does who makes a practice of digging slivers out of his fingers.

To the man with a sliver in his hand—Play Safe. No matter how trivial your injury may seem, let a trained individual take care of it for you. A sliver properly removed and a sliver wound properly treated mean little or no inconvenience, but indiscriminate sliver digging will give "pus" germs an opportunity to thrive in your wound and the consequences may be so serious as to incapacitate you for weeks or months. Taboo the amateur "sliver digger" and avoid infection.

[While the industrial surgeon is to be commended for all work of this kind, we must remember that there are thousands of small shops where none can be maintained and where no hospital is available. In such cases the "shop surgeon" is bound to continue for some time to come. The great importance of cleanliness and the use of suitable antiseptic solution, both in connection with the wound and the instrument used, cannot be over emphasized.—Editor.]

The first openhearth reverberatory furnace in Manitoba recently commenced operations at Selkirk, about 10 miles northeast of Winnipeg. The plant, which represents an investment of about $1,000,000, is known as the Manitoba Rolling Mills, and its equipment is said to be of the most modern type, consisting principally of one 15-ton furnace, three 15-ton ladles, crane, dumps, molds and other machinery. All machinery is operated by electricity supplied by Winnipeg hydro-electric stations.



Concrete Ships

BY

Fred H. Colvin

EDITOR AMERICAN MACHINIST

The interesting mechanical features introduced in the building of concrete ships makes the subject of more than general interest even though the commercial future of such ships has not been assured and is subjected to much criticism.

THERE is much discussion, pro and con, as to the merits of the concrete ship. But whatever may be the ultimate outcome, the concrete ship is an experiment which interests the average mechanic in a number of ways. One of the largest concrete ships is shown in the accompanying illustrations, the "Selma" which is being finally fitted out in the drydock of the Alabama Drydock and Shipbuilding Co., of Mobile, Ala. The length of the ship is about 450 ft. and, as can be seen, is large enough to practically fill the dock, which is by no means small.

One of the things which impress the visitor to a concrete ship for the first time, is the trim, clean looking sides, the solid character of the guard rails, and the general appearance of neatness due to smoothly rounded corners give a much more pleasing impression than is generally expected. There is nothing of the concrete block appearance about it.

The mechanical equipment was installed while the ship was in the drydock where she was taken because it was considered necessary to introduce a large number of stirrups which are, in reality, large U-bolts or "hairpins" to tie the outer skin to the ribs on the inside. Channels were cut by air drills from the outside as in Fig. 8, so as to allow the U-bolt to lie in a recess below the surface of the concrete, these channels being filled with concrete after the stirrups are in place, in order to protect the iron from the corrosive action of the water.

The illustrations show a number of the most interesting features such as the plate let into the bow to protect the sides against the chafing of the anchor. The absence of a metal covering for the stem to protect it from being chafed by the cable when the anchor is down, has however been commented on.

This, it is believed, is an error in judgment, and it is feared that with the anchor chains down, and swinging across the bow at times with the changing tide, that serious chafing and crumbling will take place. Whether this will occur remains of course to be seen, and unless the concrete ships are used more than they have been, this is not likely to cause serious difficulty.

Fig. 2 is a view toward the stern and shows the heavy oil piping, the runway at the right for maintaining communication between the bridge and the after deckhouse in bad weather or without climbing over the pipes, an open hatchway at the left, and the appearance of the ship generally.

The stern railing is shown in Fig. 4, the braces being cast solid with the rail and tying it firmly to the deck, which is also of concrete. The towing bitt is cast solidly into place in the deck. Another piece of railing, partly curved, is shown in Fig. 5. Fig. 6 is looking toward the bow and shows a continuation of the runway

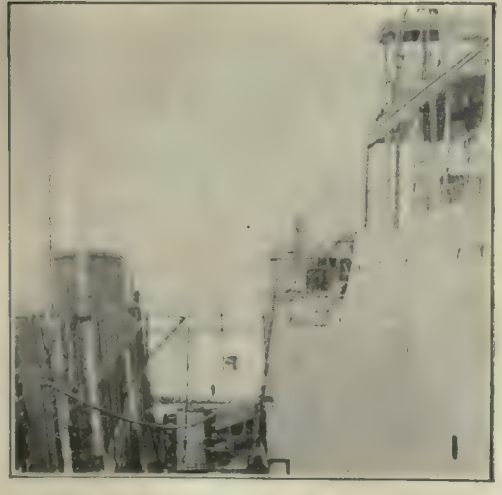


FIG. 1. BETWEEN DOCK AND SHIP

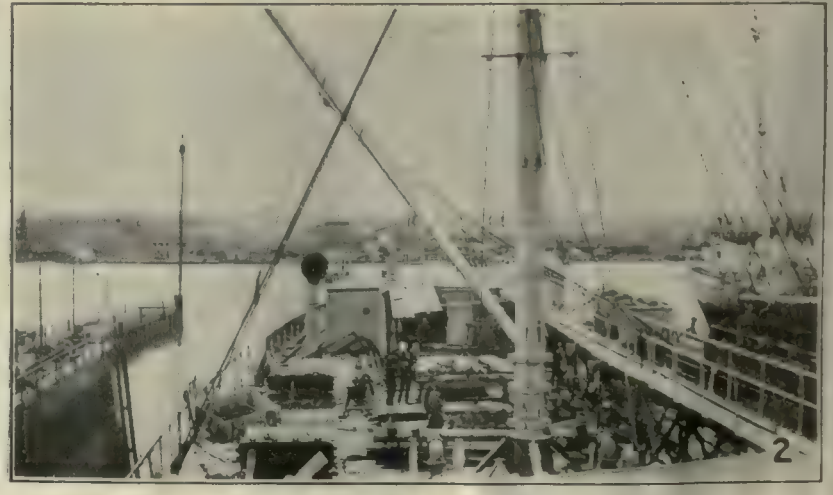
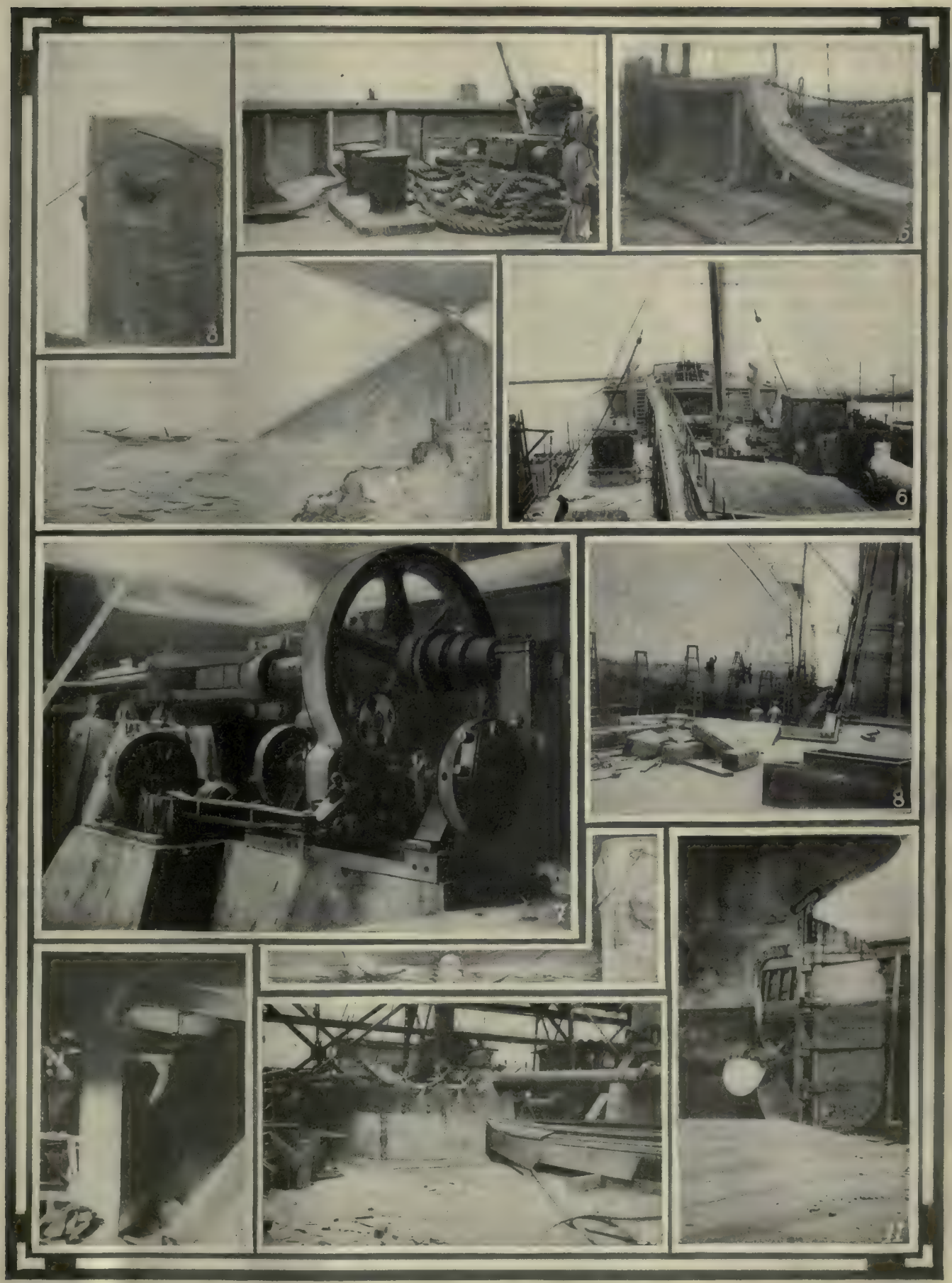


FIG. 2. LOOKING TOWARD THE STERN



FIGS. 3 TO 11. THE CONCRETE SHIP IN DETAIL

Fig. 3—Anchor and protecting plate. Fig. 4—Stern railing. Fig. 5—Part of railing. Fig. 6—Looking toward the bow. Fig. 7—Steering engine housing. Fig. 8—Strengthening the sides. Fig. 9—Concrete deck supports. Fig. 10—Concrete housing and pipe supports. Fig. 11—How the stern frame is held.

which connects the bridges. This part of the deck is comparatively clear.

Perhaps one of the greatest advantages in this form of construction is seen in Fig. 7, where the steering engine is mounted on concrete foundations which are a part of the ship itself. These are cast in forms of suitable shape and it is difficult to imagine more satisfactory mounting for machinery on shipboard.

Another view in this same locality is that in Fig. 9, which shows a column, cast of concrete, which ties the decks together. This is right beside the steering engine and the inclined wall at the right is the outer skin of stern of the vessel, with its strengthening ribs.

A concrete housing over the tanks and cast concrete pipe supports are shown in Fig. 10. Fig. 11 shows the rudder with its frame which contains the outboard bearing for the propeller shaft. This shows the way in which the frame is cast into the concrete so as to form an integral part of it.

The ease with which any desired form of railing or support for machinery or for piping can be secured is shown in Figs. 4, 5, 7, 8, 9 and 10. This is readily accomplished by pouring or casting the concrete in suitable forms. The general appearance of the ship can be seen from the two views in the headpiece as well as from some of the details.

Setting Diamonds for Truing Grinding Wheels

By E. E. Henry

I have given the mounting of diamonds for wheel dressing a great deal of study in actual practice, besides searching standard works and writing to many concerns who are large users of diamonds. After trying each method that seemed good, I have found the method here shown to be the quickest, simplest and most substantial way of all.

I use ½-in. cold rolled steel for a holder 2½-in. long and drill a hole lengthwise entirely from end to end but only let the drill point barely come through the farther end just enough to leave a very small hole. This leaves a shoulder against which the diamond may set. The size of the hole, of course, depends upon the size of each diamond, but this hole should be slightly larger than the diamond so as to allow the latter to turn over or around and to allow one to get the desired point forward that is to protrude from the end of holder.

The back end of the holder is threaded for a headless setscrew not under ⅛ in. in size and the thread must run deep enough to let the setscrew fully inside of the holder. Care should be taken to grind the drill so as to form the shoulder as near to the shape of the point of the diamond as can be done, so as to give as much support as possible to it.

After drilling and tapping the holder as shown in the sketch drop the diamond into it with the point ahead that is chosen for the cutting point. If the diamond does not come right to stick out of the end as desired, push it in from behind with a square-ended rod or punch and with a scriber or sharp ended file, one can reach in through the small hole and work the point to any desired position; then when it does come right, hold it by lowering the front end of the holder to a vertical position.

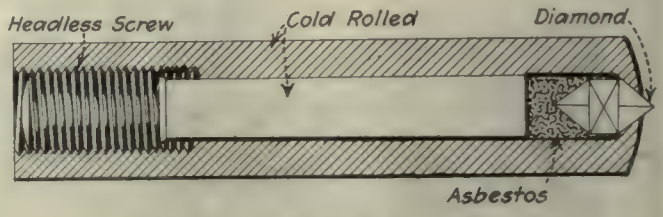
Now take a sheet of asbestos, roll it up in a wad or ball, and drop it in on top of the diamond. This acts as a cushion and fills in all around the diamond and forms a perfect seat in which the diamond becomes solidly imbedded when pressure is applied. Cut a piece of cold rolled steel or brass rod that will fit loosely into the holder and long enough to occupy the space between the asbestos and the setscrew.

Easy to Reset

As the diamond point wears off and the end of the holder also wears back, this same holder can be made just as good by backing the diamond out, upsetting the front end and turning the diamond around for another cutting edge. The diamonds can always be made tight by setting up on setscrew. The grade of diamond to use depends entirely upon the size, thickness and grade of the wheel, but this method of setting has proven good in all cases. Its advantages are many and we get much longer life out of the diamond. The best feature, however, is that they are so easily reset.

Our grinder foreman closely watches each diamond and when one becomes flat it is only a matter of five minutes to turn it over to a new cutting edge or put it into a new holder; also, should one become loose or show a flaw, it is only a matter of a few minutes to reset or tighten it.

I have tried most of the methods described in books and have also tried a couple of methods described in



METHOD OF SETTING A DIAMOND

American Machinist. One was a method of mounting the diamond in a holder and welding it in with cast iron. This method holds all right but is a great deal of trouble to set, and then there is the same trouble over again as the diamond wears flat and it must be cut out and reset.

When diamonds are too small to be set this way, they are then brazed in, in the usual manner. Our diamonds run in size from 1 to 3½ carat but when below 1 carat we braze them and use them on small wheels.

Diamonds Need Attention

All users of diamond dressers know that a sharp diamond dresses nicely and gives good results, while a diamond that has worn flat will not give good results but heats while dressing, seems to glaze the wheel, and will not give an even finish. It is also likely to cause chatter.

My experience has taught me to set diamonds so they are easily changed, look them over every day, do not allow them to get very flat and keep them tight and turn them over often to keep a sharp point. Use a great deal of water while truing up the wheel and take light cuts. Mark each diamond so that one can tell which it is and if it looks doubtful or is small, favor it on light work and use the large solid ones on the heavy work.

It is to be noticed that some grinder-men will get several times the wear out of a diamond that their partners can on the same wheel, which goes to show that common sense and good judgment are factors in their use.

An Appeal on Behalf of the Nolan Patent Office Bill H. R. 11,984

THE purpose of the Nolan Patent Office Bill H.R. 11,984, is to increase the examining and clerical forces of the patent office and to raise their salaries so as to give that office a sufficient force and at salaries that will attract and hold competent men to enable it to make its examinations with that reasonable promptness which is necessary to make it worth while applying for them, and with such thoroughness as to reduce the percentage of errors to as low a limit as sufficient time for the work and proper qualifications can possibly effect.

Engineering Council appointed its patents committee for the purpose of aiding the Nolan bill and urged the membership of the constituent societies to communicate with the patent committees of the House of Representatives and the Senate and with the Representatives and Senators from the districts and states of the respective members on behalf of the said bill. The influence thus exerted and that of other organizations was so powerful that at a hearing before the rules committee of the House of Representatives, which was largely attended by officers of members of Engineering Council and of the said societies and organizations, the Nolan bill was ordered made special and the House of Representatives promptly passed it without amendment by a very large majority.

A similar hearing on the bill was held by the patent committee of the Senate, but, in order to remove objection to unanimous consent to a special hearing by the Senate, before adjournment of the session, the patent committee of the Senate consented to amendments so seriously reducing the force and salaries of the bill as passed by the House of Representatives as to reduce the examining and clerical forces below the numbers now actually employed in the patent office. The increases of the salaries provided in the bill were also cut down to where they are seriously inadequate to attract or hold a sufficient number of qualified men to enable the patent office to do its work. The steady exodus of examiners from the patent office, which has been going on for some time, has not been stayed at all by the passage of the bill by the Senate.

The bill was referred by the Senate to a conference committee, of which the Senate members are:

Senator George W. Norris, of Nebraska; Senator George B. Brandegee, of Connecticut, and Senator William F. Kirby, of Arkansas.

The members of the conference committee for the House of Representatives have not been appointed, but Hon. John I. Nolan, of California, is certain to be one.

Engineering Council regarding the matter as of grave importance unanimously passed the following resolutions on October 21, 1920:

Resolutions of Engineering Council Concerning the Nolan Patent Office Bill H. R. 11,984

"Whereas, the United States Patent Office is vitally important to our industries, to induce the production of scientific and technical improvements and to enable our industries to keep abreast of those of other countries and,

"Whereas, the volume of work of the patent office for many years has increased much more rapidly than its examining and clerical forces have been increased, and the work in the past fiscal year has increased 36 per cent above the work of the previous year; and,

"Whereas, the salaries of examiners, except for a war bonus, have only been increased 10 per cent in seventy years and are so low that resignations of examiners are constantly occurring in a steady stream, averaging 25 per cent per annum, and resulting in such frequent changes that much inefficiency unavoidably results therefrom, even where examiners are qualified for the work, and many men are necessarily employed as examiners who cannot pass the examination required to qualify for their positions; and the salaries of the clerical forces are considerably below the average of salaries for corresponding work in the governmental departments generally; and,

"Whereas, as a result of such situation, the patent office is at such a great disadvantage that it unavoidably grants an undue proportion of defective patents, resulting in heavy losses both to the inventors and the public, due to useless development and unnecessary litigation, and the patent office is so far behind in its work that the value of many transactions with it is greatly reduced and in some instances destroyed by the delay; and,

"Whereas, as a partial remedy for such situation Nolan Bill H. R. 11,984 was introduced into Congress providing for an increase in the examining corps of the patent office of but 5.8 per cent and an increase in the clerical force of but 3.9 per cent, and providing increases in the salary for the position of primary examiners from $2,700 to $3,900 and of assistant examiners in proportion, and providing increases in the salaries of the clerical force only to bring them up approximately to the average corresponding salaries of other governmental departments and bureaus, and as the cost of the increased salaries and force of the said Nolan bill was more than met by an increase in the fees for patents provided therein; and,

"Whereas, the United States Senate so amended the said Nolan bill that instead of increasing it decreases the examining corps by 15.7 per cent and reduces the clerical force by about 1 per cent below the present insufficient numbers of said examining corps and clerical force actually employed in the patent office, as well as reduces the salaries, both of the examining and the clerical forces, so that the total present pay roll is reduced 5.9 per cent, notwithstanding that the increase in the fees for patents which were made to provide funds for the increased force and salaries were retained in the bill; and,

"Whereas, in the opinion of Engineering Council, the general effect of the changes in force and salaries made by the Senate would amount to a catastrophe for the patent office; and,

"Whereas, the salary of $3,900, provided in the bill as it passed the House of Representatives, is low for the position of principal examiner when compared with the salaries paid by private corporations and employers for engineers having a similar grade of responsi-

bilities and requirements—that is, engineers required to make and assume responsibility for final decisions in important matters and to have highly technical knowledge—especially as such examiners must have both legal and technical knowledge and notwithstanding allowance for the fact that governmental salaries are not as high as those paid by private interests; and the salaries for other grades of examiners are low in proportion;

"Now, therefore, be it resolved, that Engineering Council, representing 45,000 engineers, regards it of large importance that the numbers of the examining and clerical forces for the patent office and the salaries therefor in Nolan Patent Bill H. R. 11,984 be restored to those in the bill as it passed the House of Representatives; that the bill be freed from any riders, such as section 9 thereof, which may delay or jeopardize the passage thereof, and that the bill be made a law at the earliest possible moment."

"Engineering Council, having on the 21st day of October, 1920, passed a resolution urging the restoration to their original values of the figures for the examining and clerical forces of the patent office and the salaries therefor in the Nolan Patent Office Bill H. R. 11,984, recommends that the constituent engineering societies which it represents request their memberships to communicate with their Representatives and Senators in Congress, urging action in accordance with the said resolutions."

As the patent office is steadily losing more and more of its competent men and is rapidly getting farther and farther behind in its work, and as to get much farther behind would mean for it practically to cease to function, and as the bill, as amended by the Senate, is wholly inadequate to accomplish its purpose, and would be worse than useless, every effort should be made to induce Congress to restore the figures of the bill to their values as passed by the House of Representatives.

The conference committee will probably take the bill up for consideration the middle or latter part of December. Each member of the society is therefore most earnestly requested to write or telegraph to the member of Congress from his district, to the Senators from his state and to the members of the conference committee, urging that the figures of the Nolan Patent Office Bill H. R. 11,984 be restored to the values which passed the House of Representatives.

It would also be well to urge that the bill be freed from any riders not related thereto, so that its early enactment will not be hindered by opposition to such riders.

The names of the Senators and Representatives can be obtained from the World Almanac or similar publications and from postmasters.

Increasing the Capacity of Old Locomotives*

By C. B. SMITH

Mechanical Engineer, Boston and Maine Railroad

The usual policy of the railroads with reference to the purchase of new locomotives and the conversion of old ones is not, in the opinion of the writer, as well provided for as the demands of the service require. The difficulty lies in the fact that shop facilities are inadequate, a large amount of both time and money being unnecessarily consumed in order to keep locomotives in service. The problems of adapting the old-type locomotives to suburban and local service are discussed and the items which are to be considered in any program for increasing locomotive capacity are listed.

IN THESE days of the high cost of railroading, responsible officers of the mechanical departments realize that the necessity for reducing the cost of all locomotive operation and maintenance is more urgent than ever. Such saving can be acomplished in two ways, one by using new and modern locomotives, the other by rebuilding old types.

The purchase of new locomotives is usually confined to the largest units permissible for each type required, and they are equipped with superheaters and other modern devices as selected by the purchaser. Older engines of modern type, but not originally supplied with superheaters, are also being so equipped at general shoppings of these engines on the greater number of the roads of the country, and as rapidly as local conditions will permit. This improvement brings the older locomotives up to the capacity of those more recently purchased, and such reconstruction will undoubtedly be continued until all such locomotives have been modernized. The wisdom of this work is known to all.

On the majority of our roads there are still locomotives of the earlier modern types whose general features of construction are satisfactory, and which only require modernizing to make them economical transportation units. Improvements for such classes of locomotives may include, in addition to superheaters, piston valves in place of slide valves, outside valve gears in place of Stephenson motion, and such other improvements as are usually made upon engines at general shoppings.

Items in Locomotive Repair Program

Items which are to be considered in any program for increasing locomotive capacity are: (1) Superheater; (2) pyrometers; (3) brick arch; (4) valve motion; (5) mechanical stoker; (6) power reverse gear; (7) automatic fire door; (8) feedwater heater; (9) improvements in boiler design when new boilers are required; (10) improved boiler circulation; (11) increasing firebox heating surface; (12) flexible staybolts—breakage zones; (13) covering steam pipes; (14) flange oilers; (15) automatic driving-box wedges on heavy locomotives; (16) steam-pipe joints at smokebox; (17) pneumatic bellringer, and (18) chime whistle on freight—more audible to train crew. These items are numbered for convenient reference and do not necessarily indicate the order of importance.

*Paper presented at the Annual Meeting, New York, December, 1920, of The American Society of Mechanical Engineers, 29 West 39th St., New York.

Factors which will increase the capacity of a locomotive may do so directly or indirectly, singly or in connection with others. When setting out to rebuild a locomotive the experienced supervisor appreciates the opportunity to apply many devices and facilities which will standardize the engine in accordance with the railroad company's practice, and in so doing, reduce repairs and stores department expense in maintenance.

The aggregate of such improvement results in a locomotive which in proportion to its capacity will produce service results comparable with those of entirely modern construction, and at a cost approximately one-half that for a new locomotive of similar capacity. The difficulty in carrying forward an extensive reconstruction program, however, is in finding the shop facilities either on the railroad or among the locomotive builders in order to advance the work at a satisfactory rate of progress. Nevertheless, despite this difficulty the results which could be obtained from the operation of reconstructed locomotives, if they could all be rebuilt within the next few years, would justify a special effort on the part of railroad managements to bring it about.

On roads where the number of old locomotives which warrant rebuilding is sufficient to require a period of more than three years to complete the work, it would seem necessary to arrange for enlargement of shop facilities in order to hasten the reconstruction. If, however, adequate shopping facilities are not forthcoming, the improvement program for locomotives must be confined chiefly to the application of superheaters and the substitution of piston for slide valves, together with the minor but relatively important betterments that may usually be applied at the shopping period. On some roads this work alone will require six years at the present rate to equip what can rightly be called the "early-modern" locomotives.

Some of the engines built within the past ten years have developed weaknesses in frames and in parts of running gear. It has proved justifiable to reconstruct them by substituting new parts of stronger design and thus avoid recurring breakages which interrupt both the road service of these engines and the repairs to others.

Old locomotives requiring new boilers have very generally been scrapped, but where light train service demands no heavier engines than formerly, the writer believes it advisable to rebuild such engines with radial-stay boilers, superheaters, new piston-valve cylinders, main frames when necessary, and outside valve gears. If there is to be no increase in the boiler pressure over that formerly carried by the locomotive and the valve motion has given little trouble by breakages, the Stephenson motion may be connected to the piston valves through the usual rocker-shaft connections.

Old locomotives that are unsatisfactory as to wheel arrangement may be rebuilt and changed to another type and service. One road has converted 2-8-0 type or Consolidation locomotives to 0-8-0 switching service by removing the leading truck, applying a new boiler, new cylinders, outside valve gear, power reverse gear, and modifying the frames as required. The boiler was located properly to balance the engine. The use of the running gear and many of the parts of the original locomotive doubtless justifies such extensive reconstruction work where additional switching locomotives are needed.

The old eight-wheeled, American-type locomotives having crown-bar boilers with deep fireboxes between frames have become obsolete on many large roads, but on the small roads and on branch-line and local train service in much of the New England territory these engines, modernized as far as consistent, should be carefully considered where the traffic conditions warrant.

Because of limiting weight conditions, Mogul or 2-6-0 type locomotives have been assigned to passenger-train service on some outlying divisions. The application of superheater and piston-valve steam chests with outside steam-pipe connections as the principal features of improvement, has increased the economy of these engines, added one passenger car to their tonnage capacity, and reduced train delays. Outside valve gears were not applied, shop limitations preventing, but their addition is desirable.

Atlantic-type locomotives having outside valve gears have had their capacity and economy increased by the application of the superheater. This work permitted the use of the engine in long-distance through service which was not previously successful.

Consolidation locomotives reconstructed with superheaters, new piston-valve cylinders, outside valve gears, new front-frame sections, and frame cross-ties have also had their capacity increased, and have been successfully used in regular freight service on a mountain division greatly needing such power. The cost of the above-mentioned improvements, including heavy general repairs and entirely new fireboxes, would not exceed one-half the cost of new locomotives of the same capacity.

When rebuilding locomotives there is a favorable opportunity for replacing old tenders as well, transferring the latter to older locomotives for spare use or as substitutes for damaged equipment. When the condition of old steel tender frames requires that they be replaced, the one-piece steel casting and a larger-capacity tank should be used, as both will reduce future expense in repairs. The success of autogenous welding eliminates any objections to the use of large steel castings for fear of breakages.

Tanks should be reconstructed in coal space to permit gravity delivery of the greatest amount of fuel that is possible at the coal gates within reach of the fireman's shovel. Application of power-operated coal pushers should be made to tanks where alterations for the gravity delivery of coal cannot be satisfactorily made and where the service conditions will show a saving in expense by its use over hand methods of shoveling forward coal while on the road or at short lay-over stations. Moving forward the rear coal board or plate on tanks and building higher side plates or "dickies" is one method which has been successful in making the maximum amount of coal accessible at the gates. Furthermore, care must be taken not to overload the journals of the forward truck axles.

Some Mechanics of Hand Made Tires

SPECIAL CORRESPONDENCE

Way down in the southwestern corner of the United States, in San Diego, Cal., to be more exact, is the Spreckels "Savage" Tire Co., which specializes in hand made tires, but utilizes all the mechanical devices possible for aiding the hand worker. The stands for holding the tire while the treads are being put in place are shown in Fig. 1. Each stand carries a spider which holds the tire core, allowing the wheel to be revolved or to be turned to any position. The tread of the tires is not molded in the usual sense, although when anti-skid devices are desired the tread



FIG. 1. STANDS FOR PUTTING ON TREAD



FIG. 2. WRAPPING THE NON-SKID TREAD

strip has the design molded in it in a long press before the strip is applied to the tire itself.

Fig. 2 shows the way in which the anti-skid depressions are maintained during the curing pressure under heat. This type is what is known as a wrapped-tread tire, the machine in Fig. 2 showing how the wrapping is accomplished. The tire *A* is swung into position on a revolving table, and conical rollers *B* hold it firmly in place while the table is revolving. The wrapping tape or cloth is carried on spools in the frame *C*, which surrounds the tire, the spools carrying the tape around the tread as shown.

In order to preserve the indentations aluminum blocks are fitted into the depressions as shown at *D*, the wrapping tape holding them firmly in place during the curing of the shoe. After the tire has been properly treated the wrapping is removed and the aluminum blocks are taken out of the depressions.

Device for Grinding Engraving Tools

By J. V. Hunter

The degree of successsful service obtained from an engraving machine depends very largely upon the grinding of its tools. In the shop of the S. A. Rhodes Manufacturing Co., Chicago, a Gorton engraving machine is used for graduating dials and other delicate and extremely accurate work on optical instruments. The tools for this engraving work are ground on a special device, Fig. 1, which was designed by Mr. Rhodes.

A cast-iron base supports a small motor, carrying the grinding wheel, and a bracket, upon which a compound toolslide is mounted.

An essential requirement of the engraving tool is that its point shall lie in its axis of rotation. For grinding it is mounted in an arbor or sleeve, Fig. 2. The outside surface of the sleeve is ground concentric with its bore. A knurled end is provided for a finger hold while grinding. The illustration shows a tool in its sleeve, lying in a gage. This device has a finished V-groove in which the sleeve lies, and along which the needle point, which does the gaging, is adjustable. The base of the groove is slotted and a spring friction block is provided to hold the needle block firmly in the groove. It will be noted that the point of the tool shown was ground true with the center axis of the shank. Rotation of the sleeve and tool shows whether or not the point is central in all positions of the tool.

For grinding the tool sleeve is laid in the V-grooves of the bracket of the grinding device. The three slides make it possible to set the tool at the proper angle with the grinding wheel, feed it in and out and adjust it vertically. In starting to grind the cutting edge of the tool is turned slightly above the line of contact on the wheel and a clearance angle is ground back of the cutting edge of the tool in the same manner that clearance is provided on a drill. After grinding the edge is carefully stoned by hand and again gaged.

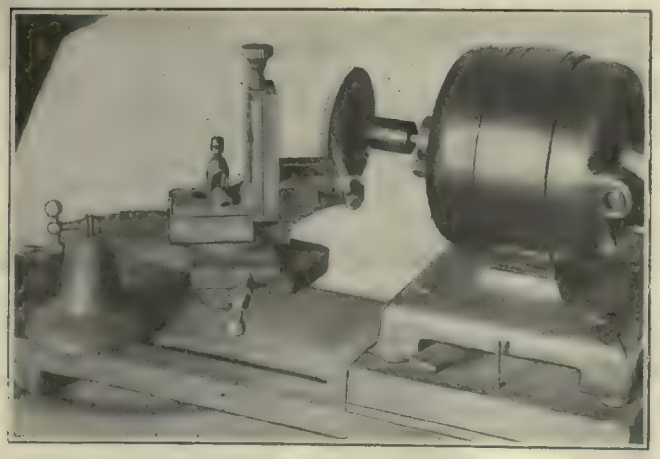


FIG. 1. DEVICE FOR GRINDING ENGRAVING TOOLS

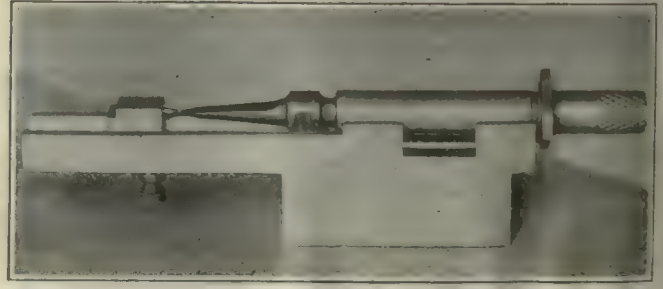


FIG. 2. GAGING ENGRAVING TOOL POINT



Assembling Cleveland Parts

By FRED H. COLVIN
Editor, *American Machinist*

Assembling the different units in motor vehicles involves many problems not usually found elsewhere. Many of the solutions, however, are applicable to some extent in other lines of work. Modifications of progressive assembly methods are making their way into small shops on large production work.

ALTHOUGH the Cleveland Automobile Co. makes comparatively few of its units at the present time, the rear-axle assembly is largely put together in its own erecting shop. One of the first operations is that of forcing on the housing which supports the band brakes at the rear wheels as is shown in Fig. 1. This operation is done on a Metalwood press which has been devised particularly for this kind of work and carries its own pumps for securing the necessary pressure. The pressed steel axle-housing is laid over the stop *A*, which locates it and also holds it against the thrust of the forcing-on process. The malleable casting *B*, which supports the brake bands and also carries the rear spring seat, is about to be forced into position on the turned end of the axle housing. A pile of these housings are shown behind the press, while a few of those which have had the end castings forced into place are shown at *C*.

A Double-Deck Track

The method of assembling the complete rear-axle unit is shown in Fig. 2. Small four-wheeled trucks *A* are provided to run on the raised track *B*. The trucks are substantially made and carry V-shaped blocks *C*. This is a case of progressive assembling, the units being completed at the end of the line and, after the axles have been removed, the trucks are returned on the lower rails as at *D*. This form of double-deck track is one that can be applied elsewhere.

The completed rear axles go to the testing stand shown in Fig. 3, where they are run by the motor *A* while the load is supplied by the brake *B*. By this method full load can be applied, so that noises or interferences of any kind may be readily discovered.

Running in Motors

Although the engines are not built in this factory, they are run in and tested before being assembled in the chassis. The method of running in is shown in Fig. 4. The arrangement consists primarily of sub-



FIG. 1. PRESSING ON BRAKE HOUSINGS

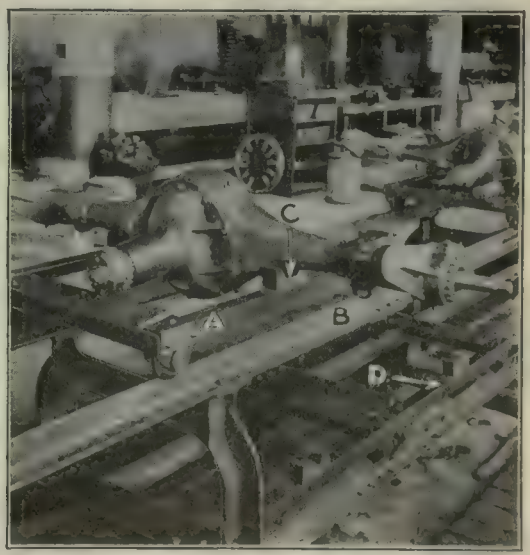


FIG. 2. ASSEMBLING FIXTURE AND TRACK

AUTOMOTIVE CONSTRUCTION

stantial tanks which contain pedestals on which the engine rests in an inverted position, as can be seen from the one that is being lowered into the first tank. After being fastened in position, it is connected to the electric motor shown and the cover closed. The motor runs on a 500-volt circuit and usually requires from 100 to 120 amp. at the start. As soon as the bearings limber up so that the amperage drops to 50 the cover is raised and the oil pipe is swung into the tank. The oil is then turned on to the bearings and the engines run from 5 to 10 min. This is a combination of running in the bearings dry and also with lubrication. The installation is very neatly arranged, the air hoist making it easy to handle the engines and at the same time the tank and covers keep the place comparatively free from splashing oil.

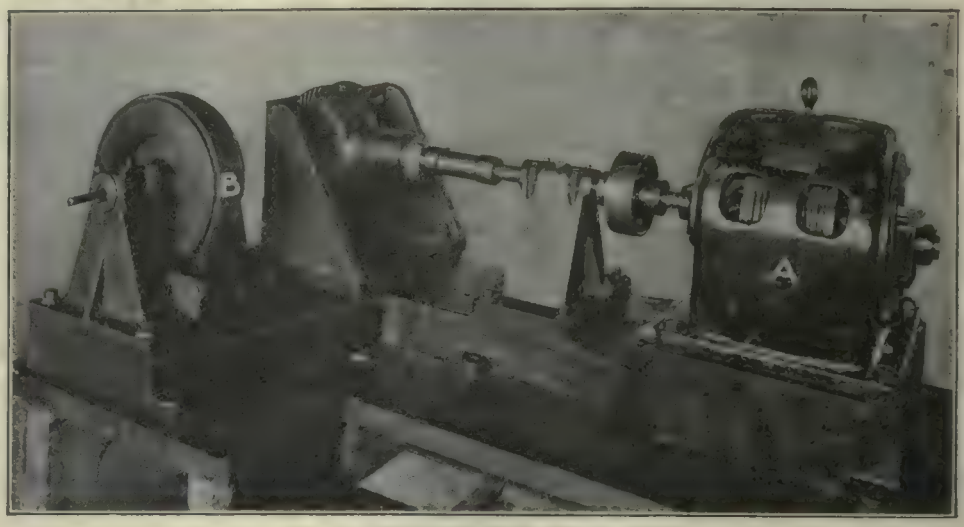


FIG. 3. TESTING THE REAR AXLE

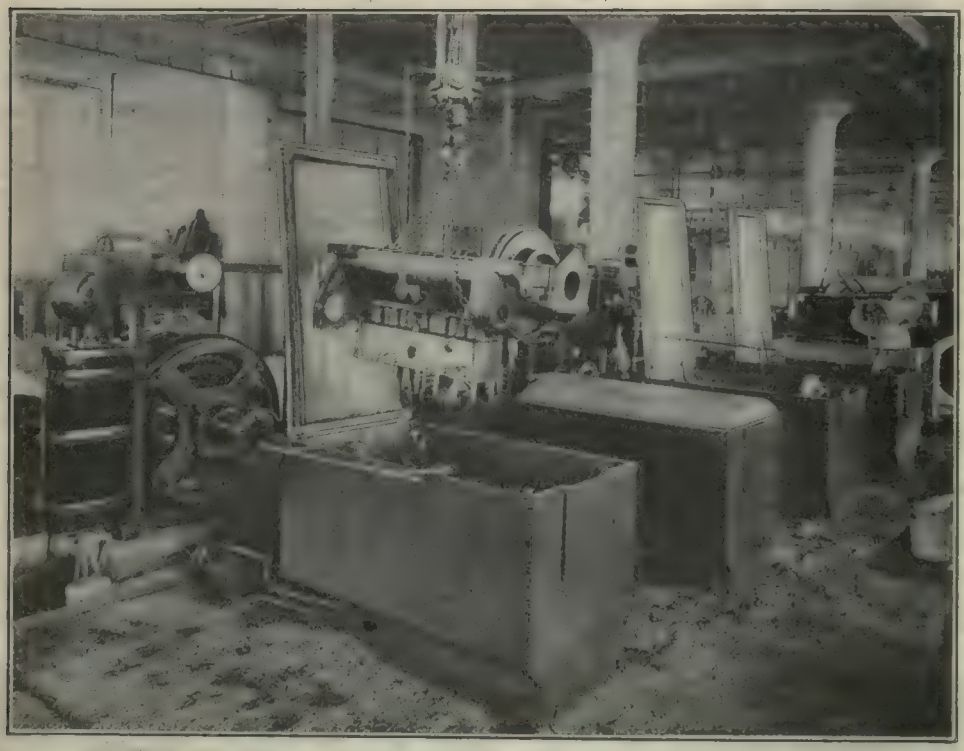


FIG. 4. RUNNING-IN STANDS FOR MOTORS

Industrial Housing—Whose Job?

By Entropy

During the war it seemed to be assumed quite generally that if a shop was having trouble keeping a sufficient body of workers it was up to the shop to provide housing. Previous to that it was pretty safe to assume that wherever there was a body of workmen real estate men would follow pretty closely. Of course these people furnished housing for the profit to themselves and not at all because the shops needed it. Nor did they concern themselves overmuch about the beauty of the houses they built, though the last few years before the war saw a great improvement in this direction. The profit in real estate, as real estate, must be very large to make the business as a whole profitable. After it is ascertained that there is to be a good number of people who could profitably occupy houses in a new district the land must be bought cheap, dirt cheap so to speak. It must be bought as farm land by the acre even though it is to be sold by the foot. Then there is the chance of taking a quick profit by selling house lots. A steam shovel is run through the street locations, and the knolls put in the hollows and street signs put up at the intersections. An elaborate entrance with stone lamp posts is put up and away go the lots, all on the installment plan. The small payment down that is required is sufficient to cover the total cost to the promoter. The additional payments made and the re-sale of the numerous lots on which payments are defaulted constitute a nice little profit.

The next stage is to build houses. Of course if the location is excellent and money is easy to get it may not be necessary to do that but it is a source of profit under normal conditions. A house built to sell is not of much use for any other purpose unless the building laws are rigid and well enforced, in which case the promoters are not so apt to start a campaign. Estimates for building costs are very likely to be made on the basis of cost per cubic foot. The purchaser of a house 30 feet

square and two stories high expects naturally that it costs about the same for one house of that size as another. He is mistaken and that is where the builder of houses for sale makes his money. He depends on the purchaser, and also the banks, valuing his houses by the cubic content. There is a very great difference. It was possible before the war to build a house that would stand up and carry a coat of attractive paint for half what ought to have been put into it and for a third of what it was profitable to put in. Cellar walls of field stone laid loosely and pointed on the inside with lime mortar, frame under-weight and wide spaced, no bracing, small stock windows, stock finish of poorest quality lumber that will run through a finish mill, second-grade glass full of streaks and bubbles, plumbing that looks the part and stops there, inadequate furnaces in a climate that calls for steam or hot water, pressed steel hardware brass-plated, electric light fixtures ditto. All the way through from cellar to roof and perhaps a little more on both cellar and roof the "Jerry" builder cuts costs. When he gets through and the second coat of paint is on the thing looks just like a regular house and the savings bank, or at any rate the co-operative bank, loans all that the land and building cost. The profit came, as it did with the land, in such future payments as were made and in the resale of the property that was released by people who could not or would not pay the installments. The purchaser spends at least twice as much for coal as he should and is never comfortable. He pays taxes on more than the house cost to build and he begins to repair long before he should.

The advantage is this, houses are built and the workmen in nearby shops get a place to live. Without the profiteering builder he does not unless the firm builds for him. But the firm cannot build that way. The firm is in the limelight and everybody keeps close tabs. In fact about the first thing that a company does before starting to build is to advertise that it is going to use only the best of materials and that the houses are to be sold at cost. They are usually sold, if at all, below cost. But they are usually pretty good houses with only one defect common to them all and that is that they are built for a race of pygmies with small families. That is, the only legitimate way to get a low cost house that is well built is to make it small.

On the other hand it should be said that the real estate man's way has been productive of good results no matter how unethical it may seem. These houses do not fall down. The cost a great deal for repairs but in the course of time are repaired until they are something like the boy's jack knife with six new blades and three new handles but the same jack knife still. The total cost is more than it would have been to build a good house to begin with but the people who bought could not have bought a good house at all, so there is a distinct gain, because the cost has been distributed over a longer period of time. It really seems better for a family to have a large enough home so that they have a little elbow room than to build a tiny house of better quality.

The real question is, cannot our engineers tell us where we can cut the cost of a long-lived house without cutting its size? Simplicity of design has a great deal more to do with cost than most builders imagine. A few large rooms cost less than many small ones. Plaster and paper cost money and a large number of partitions adds to the area to be covered. Plumbing can be concentrated so that one stack takes care of it. If the walls, roof and windows are tight a small steam heater will do the work and assure comfort where a large furnace would be inadequate. If coupled to this the lines of the house are good, that is if it is in good proportion and graceful, no ornamentation is necessary. It costs no more to build a house that looks right than it does to make the plainest sort of box. It costs much less than it does to put gingerbread ornamentation all over it.

What hinders our getting houses? Nothing but lack of money with which to build. That everything is high goes without saying. Builders and lenders of money for building seem to expect lower prices but it does not seem likely that any great gain can ever be expected. Prices of lumber had not gone up previous to the war, in proportion to the increased scarcity of growing timber. Nails may come down. Labor may but it is very doubtful. The best that can be hoped is that the labor may become more productive. Other materials such as concrete, brick, etc., are even more largely made up of labor costs than lumber. There will probably be an evening up of costs so that a man may choose between different building materials more freely than now. It is likely that wooden houses may ultimately become more or less of a luxury as we have thought brick houses to be.

The most important thing however is to induce the banks which make long term loans on real estate to resume loaning on a similar ratio to cost that they formerly did. Loans of real estate for residential purposes are the safest possible investment. It costs something to handle them because so many who buy houses are for the first time saving money and they cannot always predict what misfortune may compel them to ask for more time on their loans. They necessarily have little financial reserve or none at all. However, that is the way they learn thrift. In case of necessity not caused by downright extravagance, banks can well afford to forget the purely business quality of the transaction and act slightly human.

The complaint is made from all directions that banks are loaning money for the building of moving picture houses and garages and have nothing for dwellings. That this is so shows a lack of interest on the part of the depositors in the banks. The great bulk of mortgage money is derived from the multitude of small deposits made by people who one day or another are likely to wish to buy a house themselves. A little concerted effort to let the bank presidents know that their money should be loaned to people of their own kind would be enough to change all of this. Moving picture houses pay, just now. Garages pay, just now. Both are overdone and when the time comes, as it is very likely to, that bank depositors become more thrifty and do not spend their money on movies and automobiles, these investments will be much less secure than mortgages on homes.

If the savings banks can be pursuaded to get back to their legitimate field there will be no need for manufacturers to enter on a housing program. If coupled with this a sane code of building laws can be enacted so that the builder will not be burdened with unreasonable restrictions and yet so that he cannot actually cheat the banks and the purchasers, the housing of workmen will be taken care of in the natural way by people who know the building business and who can beat out any manufacturer who takes it on as a side issue.



Setting the Tool for Multiple Cutting

By H. A. Persson,
Machinist Instructor, Southbridge, Mass., Vocational School

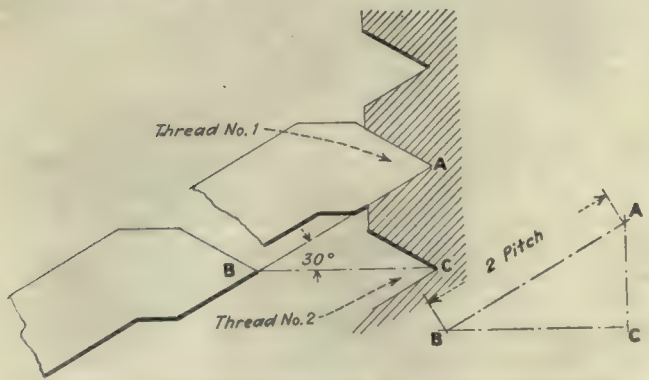
Some time ago while having a group of students build up a screw pitch demonstrator, which necessitated the cutting of single, double and triple pitch screws, with a nut to fit each, it was found that the conventional methods, such as turning gears a certain number of teeth, or the use of slotted faceplates, did not, for several reasons, produce very satisfactory results from the boys.

The idea embodied in the accompanying sketch then suggested itself to the writer, and after being tried out, was found to be so much better than any other method, that he would not now consider cutting a multiple thread in any other manner.

With the compound rest set at 30 deg. draw the compound slide back over a distance *A B* which is equal to pitch x 2, then move the cross-slide forward over distance *B C* equal to pitch x 1,732. In applying this method to the cutting of square threads it will be necessary to work from the surface; first drawing the cross-slide back over the distance *D* to avoid interference.

The advantage of this method over others will be readily noticed from the diagram, which shows the method of procedure for cutting external threads, the cutting of internal threads being even simpler, inasmuch as the compound rest is swung around to an angle of ninety degrees to the cross-slide. After the first thread has been cut the other threads are obtained by advancing the compound rest an amount equal to the pitch of the thread being cut, and feeding the cross-slide the required depth.

Whether or not this idea is original, is not known, but the writer has not, either before or since, met any one who seems to have any knowledge of it, and is therefore sending it along for the benefit of those who may find use for it.

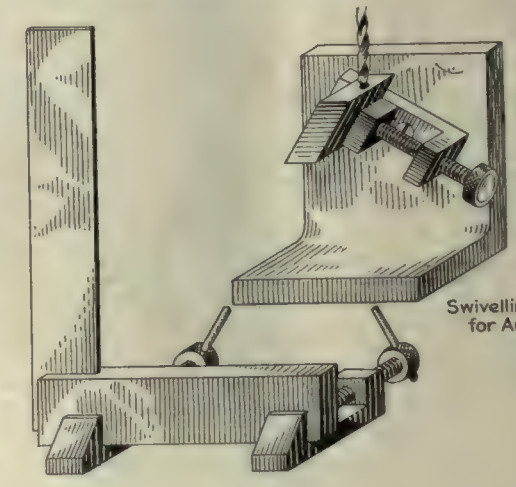


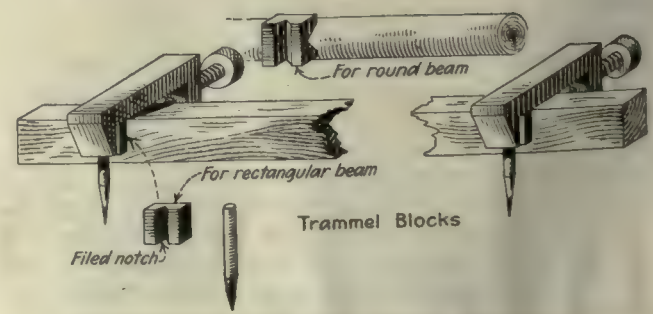
SETTING THE TOOL TO CUT MULTIPLE THREADS

Suggestions for the Use of the Toolmaker's Clamp

By H. H. Parker

The common vise-clamp which many toolmakers make, usually in pairs for themselves, is a very handy little tool and lends itself readily to many odd jobs that would be difficult of accomplishment without it. The clamp can be made very easily and quickly from odds and ends of material and with a little care in the final grinding operation to make it truly square and parallel, becomes a dependable and accurate tool. The illustration presented herewith suggests a few of the many uses to which it may be adapted.





SUGGESTIONS FOR THE USE OF VISE-CLAMP

WHAT to READ
—for the man in a hurry



Suggested by the Managing Editor

YOU probably cut your business eye-teeth on the well-worn saying "Money makes the wheels go round." Yet here is a man who has the temerity to dispute the correctness of this ancient axiom and to declare that the statement should be reversed, in other words that wheels going round make money. He goes on to say, "Because of this wrong approach, of this notion that it is money that makes the wheels go round, we find those who have acquired a reputation for financial acumen in business get it as a rule because of a certain skill in borrowing money, which connotes an acquaintance with bankers and banking methods. These are valuable additions to the mental equipment of any man in business, but too marked a proficiency is apt to be evidence—as uncanny skill with a billiard cue is evidence of a misspent youth—of a misspent business life."

What to read was not a difficult matter to decide two hundred years ago when books were few and magazines unheard of. It is far different now when so much reading matter is offered to pass the time pleasantly or profitably as the reader chooses. We are doing our utmost to make the "American Machinist" not only profitable but indispensable as a clearing house of ideas and news of the machinery world. This page is the editors' advertisement of their section of the paper. It gives the high spots

Mr. Basset has paused long enough in his work on the "Modern Production Methods" series to write us this unusual leading article on the "Use of Money in Business." Coming as it does in the midst of a period of depression and readjustment, it is very timely and decidedly to the point.

Very little has been heard from Austria since the outbreak of the war, but they are still doing business there even though it be on a much reduced scale. On pages 1075 and 1076 John Simon tells of a couple of light punch press jobs as handled in what is left of the old Austro-Hungarian Empire.

Part VI of Morris' Apprenticeship series begins on page 1078. The shop from which this article was secured is that of the De La Vergne Machine Co., where the apprentice system is essentially a modernized form of that used a generation ago.

For the men from the railroad shops we have abstracts from two of the railroad papers presented at the annual meeting of the American Society of Mechanical Engineers, which is in session as we go to press. The first one on page 1081 tells how engine terminals can and should be modernized to make the most of the present available equipment. The other on page 1094 attacks the same problem from another standpoint, that of making improvements in the locomotive itself.

On page 1083 Frank S. Ward tells of several interesting discoveries made in an English munition plant where the shop was turning out eccentric-headed studs. There may be an idea in this for you.

Does an Industrial Dispensary Pay? Do the employees respond to the treatment? Sanford De Hart, hospital director of the R. K. LeBlond Machine Tool Co., asks himself these and several other pertinent questions and then proceeds to answer them with facts and figures.

Someone has said that it must have taken a man with a solid concrete brain to think of building ships of reinforced concrete. Nevertheless they have been built and are being built. Fred Colvin ran across one under construction at Mobile and secured some photographs and a brief description of some of the operations. See page 1090.

It is to be hoped that the mighty wave of economy which is to sweep through Washington when the new administration takes hold, will fail to hit the patent office. This neglected department has had most of its efficiency economized out of it and what it needs just now is a little generosity. The fact that salaries have not been raised appreciably since before the Civil War is a pretty fair indication of the condition of affairs that exists there at present. The Nolan Bill which seeks to improve matters to some extent, will be reintroduced in the next session of Congress. The engineers of the country are behind this bill and the resolutions passed by Engineering Council several weeks ago show very clearly why the measure merits support. We give them in full on pages 1093 and 1094, and we hope that they will move you to write to your Congressman endorsing them.

We publish, page 1104, an address on "Conservation of Labor," by L. W. Wallace, president of the Society of Industrial Engineers. He strongly advocates the square deal, saying that any successful plan of overcoming labor trouble must have behind and in it the spirit of fairness, honesty and justice.

EDITORIALS

The Patent Office Needs Your Help

WHAT are you doing to insure the passage of the Nolan Patent Office Bill? Probably you have forgotten all about any such bill and the reason for its introduction. But the need is greater now than it was when the bill came up in the last Congress.

The patent office is a vitally important department of the United States government to every manufacturer in the country. Properly run it can serve the inventor, the constructor and the merchant well. But when allowed to deteriorate as it has been for the last seventy years it not only loses its power to aid but becomes a positive menace to the smooth functioning of business by opening the door to endless delays and litigation.

Last spring we gave you all the miserable details of the present situation in the patent office where the expert examiners after years of education and training, both legal and technical, receive almost as much as a good carpenter. The rate of pay has been increased just 10 per cent in seventy years and the work has grown far beyond that figure both in quantity and in difficulty. As a result the trained examiners have been compelled to go into commercial work and it has naturally been impossible to fill their places with men of the same caliber.

The Nolan Bill aims to correct those longstanding evils and bring the patent office back to its former wide usefulness. The bill has the support of the national engineering societies as is shown by the resolutions passed by Engineering Council which we are printing on another page. Read them and then do your part in securing the speedy enactment of this wise legislation.

K. H. C.

Neglecting the Employment Manager

ALL thinking men will agree that this is not the time to let any of our machinery of production deteriorate. It is a time to improve it in every way possible.

This is as true of systems and methods as of machine tools or jigs and fixtures. It is particularly true of the methods of employing and of training labor. For this is no time to go back to outgrown and antiquated practices just because men can now be secured without undue effort.

Those who really understand the true functions of an employment department will not think of curtailing its operation except as changed conditions make it necessary. A properly organized employment department is a great aid in harmonizing shop relations and maintaining a good spirit in the shop. And this is just as necessary now as when times are booming. Far sighted managers are utilizing the present to strengthen their organizations so that more and better work may be done when demand again becomes normal.

There are cases, however, where the decreased demand for labor has led to the abolishment of the employment department. This shows clearly that it was considered solely as an emergency measure to assist in getting men when they were scarce. It shows that all do not yet appreciate the real value of a well organized employment department.

When business begins to be normal again the shops which have their employment departments well organized will be able to get into operation much more readily than those who have let them fall by the wayside. In the meantime employment managers should study ways and means of making their profession of the greatest value, not only to the individual employer but to industry as a whole. For as Hoover and others clearly pointed out at the recent meeting of the Federated Engineering Societies, narrow viewpoints stand in the way of both harmony and progress.

F. H. C.

Repetitive Operation

FREQUENT expression is again being given to belief in the evils of repetitive operations. Some years ago much effort was expended on investigation of this evil and corrective measures were adopted in many factories. It was found that the constant repetition of a limited sequence of sub-operations seriously dulled the mind, and thereby left it easily susceptible to influences dangerous to society but attractive to the mind deprived of the ability for clear judgment. Certain rather exhaustive investigations showed that the repetitive evil, coupled with noise, was capable of very seriously lowering the morals and the quality of citizenship of the employees of a factory, and even of an entire town, where it was devoted to a class of manufacture almost wholly consisting of monotonous operations. It is easy to conceive that the way may be thus paved for the advance of I. W. W.-ism, Bolshevism and kindred destructive programs, since education properly directed, clear-headedness and individuality are the chief qualifications favorable to good citizenship, the natural enemy of destructive tendencies.

Our rapid industrial expansion previous to the war, the concentration of effort during the war and our present attempts to increase production have been responsible for neglect to a great extent in furthering corrective work. But it has not been abandoned nor forgotten. Citation of a few references to our subject by men qualified to know of its existence and its influences will show that it is a problem that at some time must be met and solved.

Herbert Hoover, addressing American Engineering Council of the Federated American Engineering Societies: "Some of the greatest of the problems before the country, and in fact before the world, are those growing out of our industrial development. The enormous industrial expansion of the last fifty years has lifted the standard of living and comfort beyond any dream of our forefathers. Our economic system under which it has been accomplished has given stimulation to invention, to enterprise, to individual improvement of the highest order; yet it presents a series of human and social difficulties to the solution of which we

are groping. The congestion of population is producing subnormal conditions of life. The vast repetitive operations are dulling the human mind. The intermittency of employment due to the bad co-ordination of industry, the great waves of unemployment in the ebb and flow of economic tides, produce infinite wastes and great suffering. Our business enterprises have become so large and complex that the old personal relationship between employer and workers has to a great extent disappeared. The aggregation of great wealth, with its power of economic domination, presents social and economic ills which we are constantly struggling to remedy. . . . We must take account of the tendencies of our present repetitive industries to eliminate the creative instinct in its workers, to narrow their field of craftsmanship, to discard entirely the contribution to industry that could be had from their minds as well as from their hands. If we are to secure the development of our people, we cannot permit the dulling of these sensibilities. Indeed, we cannot accomplish increased production without their stimulation. Here again we cannot make an advance unless we can secure co-operation between the employer and the employee. In large industry this mutuality of interest that existed in small units cannot be restored without definite organization."

L. W. Wallace, president of the Society of Industrial Engineers, addressing American Engineering Council of the Federated American Engineering Societies: "The greatest possible service that any individual, group of individuals or agency can render is that which adds to the potential value of a human being. To the degree that the potential value of an individual is increased, to that degree is society and the world enriched. At this period of the world's history its economic value is greatly lowered by the loss of millions of men. Therefore to increase the potential value of all individuals is, at this time, of the greatest importance. Not only is it of great importance to increase the potential value of all human beings, but it is of equal necessity that the energy, the vigor and morale of all be conserved."

William B. Dickson, vice-president of the Midvale Steel and Ordnance Co., addressing the fortieth anniversary meeting of the American Society of Mechanical Engineers: "Our modern system of the division of labor, consisting in the assignment of a highly specialized task to each individual workman, has deprived men of the joys which they once secured through the exercise of creative instinct in their work. The result of this condition will tend to stunt men mentally, unless it is counteracted by some other mental force. It cannot be met by reverting to original and obsolete methods; our factories must continue to produce efficiently, but not at such a sacrifice of individuality."

Labor leaders, too, seem to be grasping the significance of individualism. This is gratifying because it is inherently opposed to their present scheme of one rate of pay for all workers in a given trade regardless of their separate capabilities. Going a step further, true individualism is just as surely opposed to the closed shop.

Samuel Gompers, president of the American Federation of Labor, addressing the fortieth anniversary meeting of the American Society of Mechanical Engineers: . . . "The old feeling of craftsmanship which existed before the industrial revolution came about has been greatly modified because of the perfection reached in machine design. This process, however, has been carried entirely too far, for in many places the man has become a human connecting link in a machine and mastered by it instead of controlling the machine himself, as he did with the tools that he used in the old shop days. The result is that today man's work tends to become mere toil, so it seems to me that the task that lies before us is to develop a definite kind of working environment which will be attractive and which will inspire rather than repulse the workman. The work itself must become of central concern. This cannot be brought about unless the man finds the opportunity for self-expression in the day's work and a chance to exercise his creative impulses. . . . It is the deadly monotony of repetitive work that is at the root of most of our troubles and I, therefore, urge you engineers to direct your energies to the solution of this problem."

Matthew Woll, vice-president of the American Federation of Labor, in an address at Washington: "Permit me to point to the original idea of those who devised the various systems of what we know as 'efficiency work.' Their first concept was that the workmen in industry were to be measured just as steel and iron are measured. They overlooked the human factor. That idea has been largely abandoned, because it was the wrong idea. There is coming to be a more general understanding of the human element, the human factor in industrial life. This takes into account that mysterious thing which gives self to men, and it does not stop at the idea that men are merely the instruments through which a given amount of commodity is turned from raw material to finished product."

Such primary regulations as the single wage rate do not destroy the "opportunity" for self-expression wanted by Mr. Gompers, but they do destroy in large part the incentive which is equally necessary. And they imply a measurement of the workman in industry just as steel and iron are measured, a concept which Mr. Woll decries.

Repetitive operation has not found its way extensively into machine-tool manufacture. But the tendency to develop it exists and for that reason its serious faults should be recognized at once. Back in the days of "Chordal," of *American Machinist* fame, it was necessary to agitate for such things as washrooms with running water, in contrast to the individual and even partnership bucket, sanitary toilets, cuspidors and similar necessities of today which contribute extensive beneficial effects on the individual and therofore on the work he does. Education was necessary in regard to the advantages of the workman's owning his own home as a contributing factor toward decrease in labor turnover and lessening the number and extent of strikes. More recently there have been apparent the good results from proper welfare work to stimulate betterment and self-expression of the individual in his home life, his garden, his lawn and finally his community.

And now we must go further by overcoming the repetitive operation evil. As America is the industrial leader in, and largely through, "mass production," so must she be the leader in fostering individuality, which results from education, the opportunity for self-expression and the exercise of craftsmanship and is productive of our greatest asset, good citizenship. L. C. M.

Conservation of Labor*

By L. W. WALLACE
President, Society Industrial Engineers

SOME months ago we read an article written by Mark Sullivan entitled "The New World," in which he said, "The situation of the world this morning is that the bankers, the economists and the journalists have been making their inventories and their reports in terms of material things, of trade stagnant, of credit destroyed, of currency depreciated, of governments tottering. "But the truth is such an inventory or report should begin not with factories, or money or trade, but with human beings. Human beings are the most important element in all economic wealth. They are the ultimate source of all wealth."

We have quoted the foregoing to again remind you that the greatest possible service that any individual, group of individuals, or agency can render, is that which adds to the potential value of a human being. To the degree that the potential value of an individual is increased, to that degree is society and the world enriched. At this period of the world's history its economic value is greatly lowered by the loss of millions of human beings. Therefore, to increase the potential value of all individuals is, at this time, of the greatest importance. Not only is it of great importance to increase the potential value of all human beings, but it is of equal necessity that the energy, the vigor and morale of all be conserved. The methods whereby the potential value of human beings may be increased and conserved are not entirely unknown or untried. Many demonstrations of actual accomplishments are on record. We shall not have the opportunity of discussing such methods in detail, but we hope to indicate to you some possibilities and to suggest some fundamental principles.

Work of Safety Advisors

One of the best pieces of work that has been accomplished in recent years in conserving the physical vigor of labor has been that done by the safety advisors. The safety movement has saved untold millions of dollars and thousands of human lives. It is one outstanding example of what a systematic organization can accomplish. The way in which standard practice has been established is indeed remarkable.

Many have been the discussions as to the functions and the value of the welfare advisor.

However welfare work may have been exploited, however badly handled, however disliked, yet all those who are conversant with this subject must admit that an untold amount of good has been accomplished through such efforts. There is unquestionably still a need and a place for it in American industrial and commercial life. To accomplish the most lasting and the most wholesome results, it must be administered in a different manner and from an absolutely changed point of view than previously. As a sop it is a failure; as a substitute for wages justly due, it is pernicious; as paternalism, it is dangerous. If administered as supplementary to fair and full wages—if conceived as giving that justly due—if guided by the sincerest motives and if participated in through the spirit of human kindness and cordiality, it will be a benediction and will result in maintaining a high morale, a better moral and physical condition of the worker and his family—thereby obtaining a more virile manhood through which business and society will profit.

Ill Health Means Inefficiency

The industrial medical advisor is an absolute essential in this day of intensive and mass production.

To quote: "Investigators tell us that only one industrial worker out of five in need of a physician calls on one. What is the connection between these two facts and the lost time in the plant? There must be some relation between the physical condition of workers and industrial accidents; between the deterioration of physical health and labor turnover; between facts noted above and the impressive number of chronic invalids; between the great number of persons who are only casually employed and the unemployable . . ."

The loss in wages to the employee must be very large and the loss to the employer much larger when it is remembered that bad health plays a large part in inefficiency; in irregularity in attendance, which results in a lower standard of living; in the shifting from job to job, which reduces stability of character.

It is these considerations that have led a large and growing number of factory managers to add to their staff the industrial physician. That his work has been valuable is unquestionably true as many know. We are told that in one plant where the health conditions were properly supervised teh absence from work in the plant was only approximately 3 per cent, whereas the average for other shops in the same vicinity, where preventive work was not done, was 10 per cent.

In a published statement, the Norton Co., of Worcester, Mass., says that a 75 per cent reduction in loss of time on account of illness has been obtained since the establishment of their medical department.

If by conservation of labor we imply the making of labor more contented, more intelligent and therefore more effective, then some forms of industrial engineering will be most effective. The intelligence of all labor must be raised. Arthur Williams, of the New York Edison Co., made a very true statement some time ago when he said, "If those who have written the history of civilization from its beginning down to the present are correct in their conclusions, the greatest forces vital to the progress of the human race are the moral and the intellectual. To be willing to perform our duty is the moral part; to know how to perform it, is the intellectual part; while the closer these two parts are knit together the greater the harmony with which they work and the more securely shall we lay the foundation for the further advancement of mankind.

"The intellectual part can be developed only through education. The training must be broad in character and so carried on as to develop the individual mind and inspire the individual to strive for a standard of accomplishment as high as the individual can conceive. Other things being equal, the trained mind always excels the untrained mind."

There is a great need in this broad land of ours for

*Address delivered at the first meeting of American Engineering Council of the Federated American Engineering Societies, Washington, D. C., Nov. 18, 19 and 20.

more education—education of the type to benefit the masses, an education that will enhance the breadth of vision and the potential possibility of every individual. As the general intellectual level is raised there will be more peace and harmony and a larger recognition of individual responsibility. It is ignorance that accounts for much of the dissatisfaction, discontent and violence which have been so evident in recent months.

The need for education, however, does not end with the general education, for there is a very great need for more general and better industrial education. The term industrial education is herein used in a very broad sense. We have in mind not only the education of the worker at the bench or lathe, but the sub-foremen, the foremen, the superintendents, the engineers, the managers and, yes, the chief executives. We sometimes feel that it is the last-named class that is in a greater need of a course in industrial education than any other one group.

It is our conviction, founded upon a rather intensive study and observation of industrial affairs for several years, that much that is evil, that is inefficient, that is troublesome in the industrial realm of the world is due to lack of information, which leads to a misinterpretation of causes and effects. This ignorance permeates every human element connected with industry. The employer oftentimes does not know any more, if as much, about the real economic situation as does the employee. The employee does not have a correct conception of the laws of management, the methods of manufacture, the cost of production, hence is easily persuaded to believe that the management is domineering, that its methods of manufacture are oppressive and wrong and that the employer is making enormous profits. As a result of lack of knowledge on the part of both parties, grievous mistakes are made; rank injustice results; estranged relationships become a fact. The employer, employee and the public suffer mentally, physically and financially. This condition can best be eliminated through a broadly conceived and wisely administered form of industrial education. Such a form of industrial education would inevitably result in increased production through the efficiency that would arise from trained workmen.

Decided progress has been made in training workmen. This was especially evident during the war. However, in all such efforts not enough stress has been placed upon the fundamental principles. The effort has centered too much upon training the worker to be an effective piece of machinery and not enough emphasis has been placed upon the factors that are conducive to making the workman a broadminded and an intelligent employee. The intellectual development has been too often sacrificed for the sake of the physical as expressed in the dexterity with which the worker performs his task. Indeed some intellectual development resulted but not a sufficient amount to be of material consequence in enabling the man to have a greater appreciation of his responsibility as an employee, as a prospective executive or employer, as a citizen and as a member of society, which are important and should be an unfailing thought back of the purpose. And again, if this phase of the training be neglected there will not be an ample amount of intelligent material from which to select the subordinate executives. And it is in the foreman group where is found a very sad condition. It is one of the weakest chains in the entire industrial system. It is no wonder that there is so much waste of material, of time, of labor in the industrial plants, when one is conversant with the poor leadership. There is no greater opportunity for accomplishment in industrial education than among the foremen.

If there be developed a large and a better trained group of industrial leaders, a very advanced step will have been made toward conserving labor, as measured in its increased efficiency, through better methods of management and more constructive leadership, and through an increased mutual and physical vigor produced by more wholesome working conditions and surroundings.

Noah Had Labor Troubles

The strike is a very large source of waste of human labor. Millions, I do not know how many millions, of hours of labor are lost each year through strikes. All of this loss could be conserved if the strike could be entirely eliminated, but we do not believe that this will ever come to pass. We are reminded that "ever since the time that the first carpenters started to work for Noah & Co. on the Ark, there have been conditions arising in the manufacturing business that have been more or less of an annoyance to the employee, and generally a thorn in the side of the employer."

That statement was contained in a letter addressed to a manager of a prominent manufacturing company by an employee. In the letter, the employee sought to make clear that certain internal conditions needed to be changed in order that the employees might more fully enjoy their work and consequently be happy, contented and efficient.

The reason for quoting the statement is to remind you that from time immemorial there have been labor problems and it is our conviction that, since labor problems have always existed, so they will continue to arise as long as humanity is constituted as it is. Therefore, I do not anticipate that at this time, or at any future period, there will be evolved a panacea that will forever solve any and all problems that may arise between employer and employee.

This is no more possible than that a plan can be evolved whereby there will be no more wars between nations. Indeed plans can be formulated and principles can be laid down which will greatly reduce the probability of labor disputes and which will eliminate the likelihood of many wars. Some form of industrial democracy on one hand and a league of nations on the other unquestionably will be agents of great value and influence, but those agents within and of themselves will not eliminate labor troubles, nor make impossible future wars.

In recent weeks we have heard much about the efficacy of industrial democracy, of shop committees, of Senate and House plan, of collective bargaining, as the panaceas for all labor problems. During the same period we have had striking examples of the inadequacy of all these plans. Industrial democracy is a misnomer unless fairly and honestly applied. Collective bargaining is a great danger if wrongly applied and is used as an instrument of autocratic power.

Fair Play the Only Panacea

No, labor problems have always existed and are likely to continue. There is no panacea, as industrial democracy, profit sharing, committee system, open shop, closed shop or collective bargaining. None of these agencies will accomplish or avail much unless there be behind them and disseminated through every fiber and thread,

the spirit of fairness, honesty and justice. If these principles be present, there will be no labor troubles. And again, if they be present, it does not matter much what plan is used. This accounts for many striking examples of the successful management of labor through each of the plans named. Because these successful examples can be pointed out is the reason for the confusion in the minds of many—whereas if a close analysis be made, it would be found that the wholesome conditions existing in each case were not due to the plan in vogue, but to the fact that the employer and the employee each in turn, was a believer in, and a practicer of, the cardinal virtues of honesty, fairness and justice. The unfortunate thing is that many employees, many employers, many associations of employers and many labor organizations, have violated and ignored these principles. Through the utter disregard of them, great damage has been done, and, to quote: "Great powers have been used arbitrarily and autocratically, to exact unlimited profit or compensation by both capital and labor. This policy of exacting profit rather than rendering service has wasted enormous stores of human and natural resources, and has put in places of authority those who seek selfish advantage regardless of the interests of the community." The problem before the American public is to evolve those plans and to inaugurate those policies that will make it a great offense against the community, for any such arbitrary power to evoke its wrath against the will and against the welfare of the masses. Such plans should provide severe and sure punishment for the autocratic employer or autocratic labor leader who wilfully violates the principles of economic justice and by such violations brings hadrships, despair and heartaches upon the masses.

Many of the abuses have grown up through ignorance of cause and effect. Poor management, watered stock, incompetent supervision, excessive equipment, large inventories, poor equipment, bad management, inadequate sales policies and other causes have resulted in reduced income and a loss of net profits. Lack of information as to the causes leads to a misinterpretation of the reason for the effects. In arriving at a solution, incompetency in management again shows itself; faulty analyses and incorrect conclusions follow. Wages are cut, demands increased, working conditions made less desirable; all of which result in strained relationships, strikes, bloodshed, destruction of property—no one benefited.

Lack of information as to cause and effect on the part of labor leads to many misinterpretations and faulty conclusions, such as to believe that to limit production is to benefit the worker, to unduly decrease the length of the work-day is conducive to the prosperity and the well being of society and of labor and to place all workers in a given trade on a par, regardless of capacity or ability, is beneficial to the cause of labor. These policies lead to a reduction of production, increased cost; to suspicion, to disregard of rights of property, to rights of individuals and to rights of society, the result being strained relations, strikes, bloodshed, destruction of property—no one benefited.

Mission of the Industrial Engineer

It is the function and province of the engineer to make the correct analysis, to predict effect through known causes. It is purely the mission of the engineer of wide experience, of great foresight and of unselfish motive to see to it:

First—That every action is based upon the principles of honesty, justice and fairness to the employee, the employer and the public.

Second—To so formulate the plan of action as to eliminate all unfair privilege of employer and employee and to make it possible for each to fulfill its responsibilities to the community.

Third—To so organize the plan or industry as to make it exceedingly difficult for an incompetent to hold a position of authority or to have autocratic control.

It is the industrial expert who must finally work out these problems. He is the specialist who understands causes and effects. He is the one to make an unbiased and detailed diagnosis and to prescribe the treatment. His treatment may at times be severe, may never be the same for any two cases. It must always be honestly and fairly given, and to be for the good of the employer, the employee and the community. If the industrial expert is to be of the greatest possible value to society, his conduct, his professional actions and attainments must be such as to merit the confidence and respect of society in general.

The various phases and angles to human relations have not been analyzed as they should. The world has lost millions of men through the ravages of war. This loss does not only affect the present, but future, for generations to come will realize the loss of these men and their potential posterity. To offset this loss, the industrial engineer must devise new plans, new methods, new equipment.

To offset this loss the engineer must give consideration to devising means of using that large army of industrial handicaps. Men and women who, through accident or through miscarriage of the laws of nature are lacking in some essential faculty or sense. A close analysis of the jobs of work to be done in modern industry will disclose that in the modern industrial plant there is an opportunity for men and women with every sort of handicap imaginable to do successfully some piece of work. It is the duty and responsibility of the engineer to relieve industry and society of such expense and loss, by making it possible for men, however handicapped, to find useful employment.

Think of the many hours being wasted, with all that means to posterity, to society, to industry, because we have not analyzed the requirements of the job and because we have not trained the man. The engineer cannot afford to overlook this potential labor supply and this potent opportunity to save mankind and society by restoring to an economic and social standard the so-called handicapped.

We have not the time to further discuss these matters, but we wish to emphasize that many of the angles of the present day industrial situation clearly come within the purview of the industrial engineer. He is the hope; will he meet the occasion with vigor, with enthusiasm, with fairness, with sufficient prestige to put it over? We sincerely trust he may. Great the pity if he does not. So look well to your oars and into your stroke put all the constructive effort that pure manhood, wise judgement, tried experience, sincere and accumulated wisdom will permit.

And out of it all, we hope, there will eventually come into all industry because of the effects of the engineer, a fine spirit of comradeship, of loyalty and of genuine pleasure in association of boss with men, which if it does will be one of the largest possible means of conserving labor in all its aspects.

SHOP EQUIPMENT NEWS

-Edited By-
S. A. HAND

SHOP EQUIPMENT • NEWS •
A weekly review of modern designs and equipment

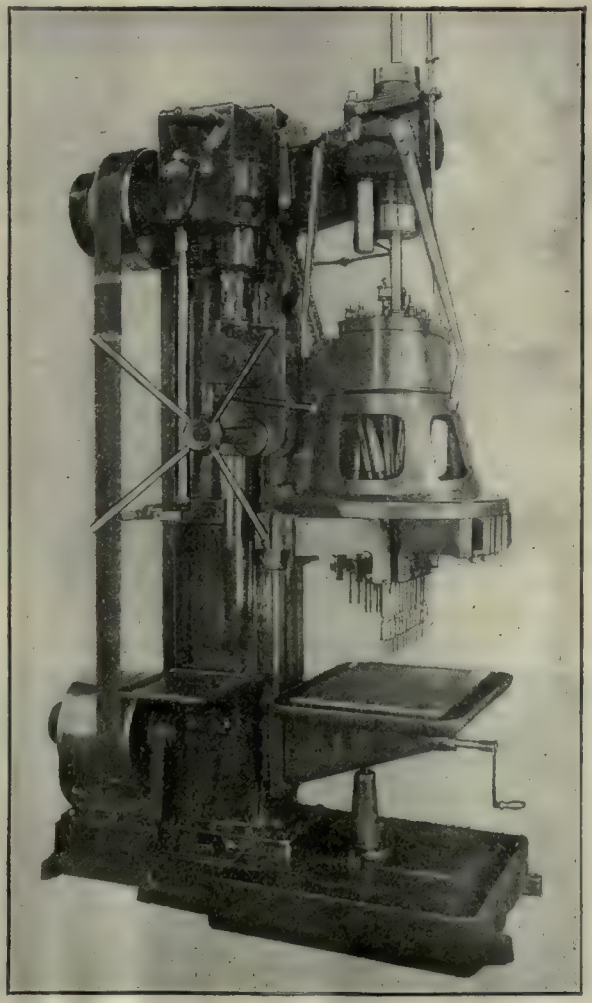
Descriptions of shop equipment in this section constitute editorial service for which there is no charge. To be eligible for presentation, the article must not have been on the market more than six months and must not have been advertised in this or any previous issue. Owing to the news character of these descriptions it will be impossible to submit them to the manufacturer for approval.

• CONDENSED • CLIPPING INDEX
A continuous record of modern designs and equipment

Fox Multiple-Spindle Tapping Attachment

The Fox Machine Co., Jackson, Mich., has placed on the market a tapping attachment for use on its multiple-spindle drilling machines. It is necessary that some changes be made in the machines when they are equipped for tapping, the drive-shafts being mounted on ball bearings.

The machine shown in the illustration is of the D-22 type equipped for drilling and tapping, the tapping mechanism being applicable also to the D-12 and to the D-32 types of drilling machines. It is stated that the machine illustrated has tapped twelve $\frac{5}{8}$-in. holes in cast-iron plates $1\frac{1}{4}$ in. thick in five seconds, a maximum of 6 hp. being consumed.



FOX MULTIPLE-SPINDLE DRILLING AND TAPPING MACHINE NO. D-22

The upper drive pulley at the rear of the speed-change box is mounted on a plate friction clutch. By means of a lever at the front the clutch can be operated for stopping and starting the machine. On the vertical drive-shaft to the head is a 12-jawed positive driving clutch having 12 right-hand teeth on one side and 12 left-hand teeth on the opposite side. These teeth can engage opposing clutch members driven by a bevel pinion mounted on the horizontal shaft which runs into the speed-change box. The movement of the clutch from the forward to the reverse position is controlled by a lever at the front of the machine. This lever is so connected to the lever which operates the friction driving clutch that when the tapping lever is moved from the forward to the reverse position, or vice-versa, the first movement disengages the friction clutch driving the machine.

Further motion of the tapping lever carries the toothed driving clutch from one position to the other, this being accomplished while the power is off from the spindles. After the positive clutches are in engagement the final motion of the tapping lever allows the friction clutch to engage, thus driving the spindles in the reverse direction. Provision is made against the possibility of the teeth of the clutches striking on top of each other when being reversed which would prevent the clutches from engaging.

When the tapping attachment lever is pulled forward the spindles are given a right-hand rotation, and a strong, inclosed spring is put under compression and latched in this position. Upon the vertical stop-rod is an adjustable stop which can be set so that when the taps reach the desired position, the stop comes in contact with the trip arm and releases the spring. The movement of the spring then carries the tapping attachment lever automatically from the forward to the reverse position so that the operator does not have to trip the tapping mechanism when the desired depth is reached.

After the tapping attachment lever is thrown forward and the automatic trip locked in position the operator can manipulate the tapping lever back and forth if he desires to reverse the taps after starting into the work and before they reach their bottom position. This is of importance in the case of breakage of a tap. The reversing does not, however, affect the tripping of the mechanism when the taps finally reach their lowest position. The positions of the spindles carrying the taps can be changed to suit different layouts for different jobs.

Oliver No. 80 "Variety" Saw Bench

A wood-working machine that is intended to be of particular service in a shop doing general work, is built by the Oliver Machinery Co., Grand Rapids, Mich. It will do ripping, cross-cutting, dadoing and gaining, and can be furnished with a special table equipment that permits it to be used for boring and mortising.

The machine, shown in Fig. 1, has a capacity for ripping boards up to 23 in. in width when using a universal ripping fence, or 27 in. in width with a plain ripping fence. It will cut off material 32 in. wide by 3 in. thick with a saw 14 in. in diameter, or 4 in. thick with a 16-in. saw. The same saw is used for both ripping and cross-cutting. Dados can be worked up to 4 in. in width. The mortising and boring attachment, the small table of which can be seen at the right, will bore holes 2 in.

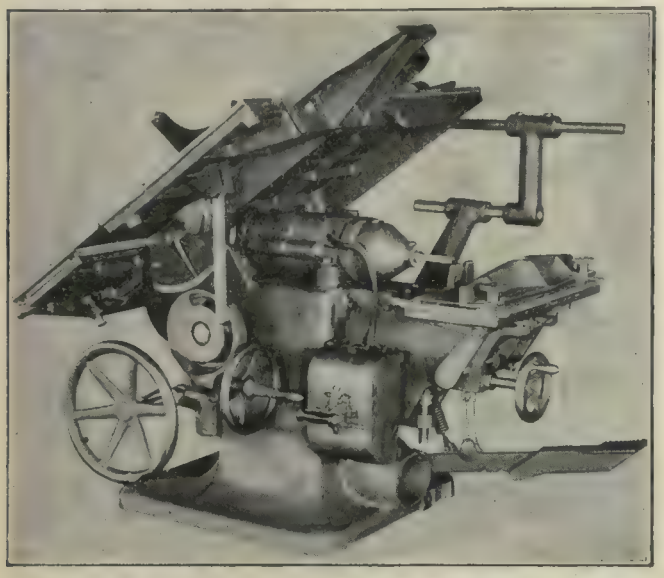


FIG. 1. OLIVER NO. 80 "VARIETY" SAW BENCH WITH TABLE TILTED, SHOWING MORTISING ATTACHMENT

Specifications: Table; universal or plain, 36 x 44 in. Universal table; tilts to 45 deg.; movable section, 15-in. wide; vertical adjustment, 4 in. Capacity; ripping, 23 or 27 in. wide; cross-cutting, 32 x 3 in.; dados, 4 in. wide; mortising, ¾ x 4 in.; boring, 2 in. diameter by 6 in. Saw arbor, 1 in. diameter. Driving pulley; 600 r.p.m.; 18 x 5 in. Motor drive; 5 hp.; 1,800 r.p.m. Weight; crated, 1,650 to 1,700 lb.; boxed, 1,850 to 1,900 lb. Export box, 60 cu.ft.

in diameter to a depth of 6 in., or mortise holes up to ¾ in. square by 4 in. deep.

The base is a single casting of box section. The dust chute is part of the base and extends through its center to a flanged discharge opening on the right-hand side.

The table is of ribbed construction. It may be tilted to an angle of 45 deg. toward the left in the manner shown in the illustration. Plain or universal types of tables can be furnished, the latter type having a moveable section 15 in. wide mounted on ball-bearings, which permits it to be moved forward and back with slight effort. This moveable table can be seen at the front in Fig. 2. By means of a pin it can be locked in a stationary position when so desired. It may be moved as much as 4 in. from the saw, thus permitting the use of a dado saw or special head.

A handwheel can be used to raise or lower the table for a distance of 4 in. Tilting the table is accomplished by a handwheel operating through a worm and gear connected with the table by a link. A graduated dial is provided to aid the operator in adjusting for any angle.

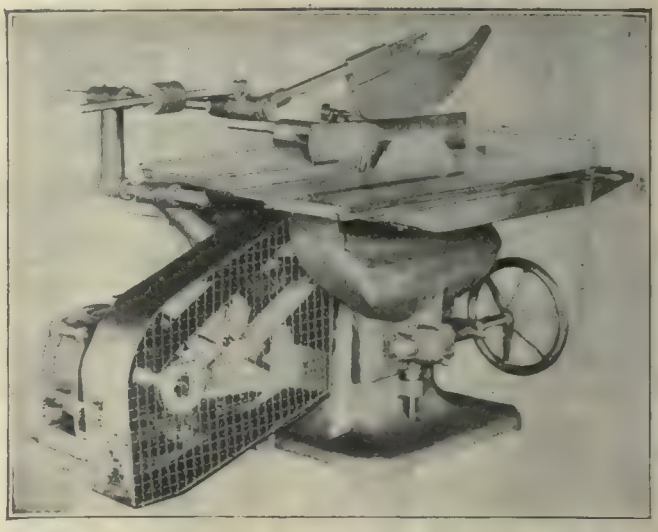


FIG. 2. OLIVER SAW WITH BELTED MOTOR DRIVE

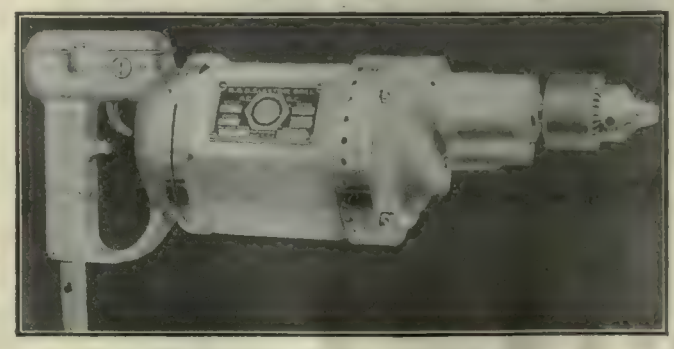
Two interchangeable forms of arbor-head are built, the belt-driven and the direct motor-driven. The saw arbor is 1 in. in diameter and mounted on ball bearings that are completely encased to exclude dirt. The end of the arbor opposite the saw is used to carry the boring and mortising tools, a feature that can be easily seen in Fig. 1. The table of this attachment is supported by a heavy bracket which may be adjusted 3 in. vertically on gibbed ways. An adjustable pedal is used to move the table in and out. The application of the attachment makes the machine of service when other machines doing such work are not available.

A universal ripping fence, miter cut-off gages and guard are furnished as regular equipment. When belted drive is used, the motor can be mounted on an extension of the base, as shown. A roller-bearing countershaft can be mounted in place of the motor, if drive from an over-head shaft is desired.

Black and Decker Body-Builder's Drill

The quantity manufacture of automobile bodies calls for a hand-portable drill which has speed and endurance and which is light and can be easily handled. The Black & Decker Manufacturing Co., 661 Liberty St., Baltimore, Md., has recently placed on the market an electric drill for body building that will drill holes up to ⅝ in.

The gears are made of hardened steel. Light weight is obtained by making the entire housing of the motor and gears of aluminum alloy. The motor is cooled by forced circulation of air through the motor and the windings, and is said not to heat up even when used con-



BLACK & DECKER HAND-PORTABLE DRILL FOR BODY BUILDING

tinuously. The motor develops ¾ hp. and has a no-load speed of 1,480 r.p.m. A pistol-grip handle is furnished, and the control switch is operated by means of a trigger, the arrangement being shown in the accompanying illustration.

The drill is equipped with a three-jaw chuck for holding straight-shank drill bits, 15 ft. of duplex electric cable and separable attachment plug. The motor runs on either alternating or direct current and can be supplied for 110, 220, or 32 volts.

Langhaar Self-Adjusting Ball Bearing

The Langhaar Ball Bearing Co., Aurora, Ind., has placed upon the market a ball bearing that is intended to carry high thrust loads as well as radial loads. It is stated that the bearing has been designed to meet the requirements and principles of ball-bearing design published in the transactions of the American Society of Mechanical Engineers in May, 1907.

Fig. 1 shows a sectional view of the bearing. It can be seen that there are two rows of balls, each one having an independent ball cage or spacer cut from a ring. Between the rows of balls are two rings separated somewhat by small slightly curved pieces of spring steel held between them. This is the self-adjusting feature of the bearing, as it allows the two rows of balls to suit themselves to their proper positions in the races, applies only a definite pressure to them and adjusts for wear.

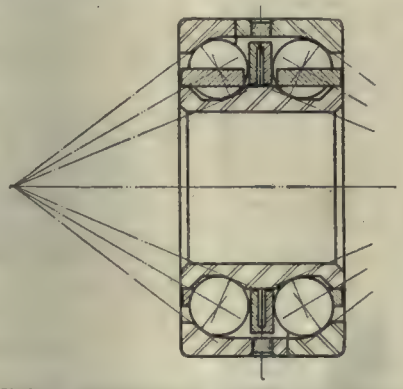


FIG. 1. SECTIONAL VIEW OF LANGHAAR SELF-ADJUSTING BALL BEARING

It is said that the lines of contact of the balls with the races form cones, as shown in the sketch. Spinning and grinding of the balls is said to be largely obviated. The inner race is solid. The outer one, however, is made in two parts, as can be seen in Fig. 2. The parts fit together in the manner of jaw clutches, and are fastened by the inserting of pins in holes provided at the joints. A substantial case is thus made, the appearance of the assembled bearing being shown in Fig. 2.

It is claimed that the bearing is adaptable to any speed ordinarily used, having proved reliable and satisfactory at speeds as high as 8,000 r.m.p. It is stated that a thrust load as large as the radial load can be carried.

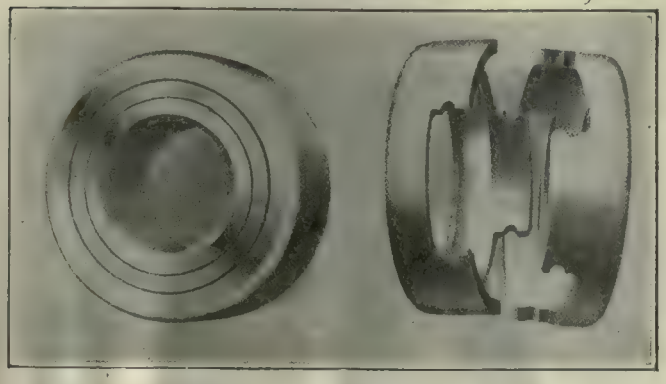
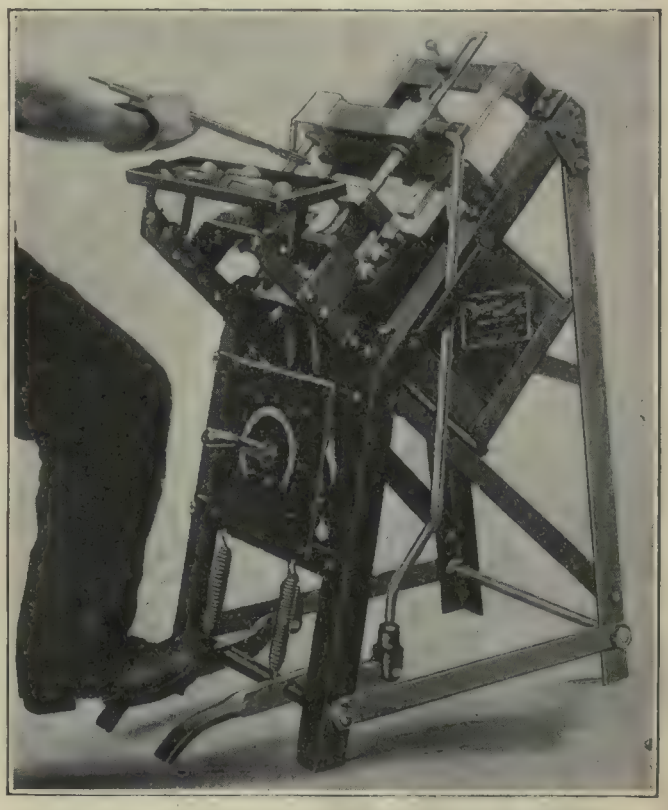


FIG. 2. LANGHAAR BALL BEARING AND TWO-PART OUTER RACE

Taylor Electric Rivet Heater

An electric rivet-heating machine has recently been placed upon the market by the Taylor Welder Co., Warren, Ohio. The illustration shows the method of operation, the operator handling the rivets with tongs and actuating the dies by means of a pedal.

The machine is intended to hold two rivets at a time, it being stated that an operator can be kept busy handling this number, since a ¾ x 4-in. rivet is heated in about 30 seconds. The angle at which the rivets are tilted keeps them in plain sight of the operator, so that they can be removed when at the proper heat. A 6 x 16-in. tray is provided at the front of the machine for holding rivets. It is not necessary to actuate a switch for each rivet, as the circuit is automatically closed when the rivet is placed in position for heating.



TAYLOR ELECTRIC RIVET-HEATING MACHINE

The machine is made of angles and plates, permitting light weight. It is intended for permanent installation in one place, but can be provided with a bail so that it can be picked up and moved by means of a crane.

The machine is equipped with a 15-kw. transformer and a five-step regulator for controlling the current. The transformer is air cooled and the capacity is sufficient to prevent overheating in continuous operation. It is stated that the cost of operation is low, the power consumption being approximately 18 kw.-hr. per 100 lb. of rivets heated.

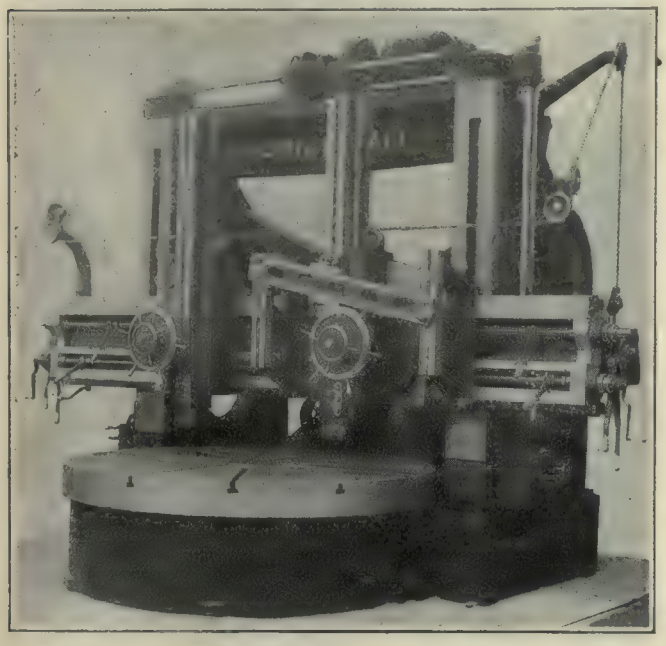
The extreme height of the machine is 40 in., the dies being 32 in. above the floor. The floor space required is 31 x 18 in. and the weight about 400 lb.

Taper Attachment for Cincinnati Boring Mills

For turning and boring tapers approaching nearly a horizontal line and to suit which the swiveling head is not adaptable, the Cincinnati Planer Co., Cincinnati, Ohio, has brought out a taper-turning and boring attachment. The device, shown in the illustration on an 8-ft. mill, is intended for use on all sizes of boring mill from 42 in. up to 12 ft.

The principal parts are a slanting member or sine bar, sine-bar supports and the sine-bar guide fastened to the ram. In order to provide up and down adjustment to the ram, without loosening the sine bar and thereby changing its position, the face of the ram is machined and fitted with a T-slot equal in length to the vertical travel.

When mounting the attachment, the sine-bar supports, the sine-bar guide and sine bar are first placed



TAPER ATTACHMENT ON A CINCINNATI BORING MILL

in position loosely, and then clamped securely in place after the proper angle has been determined. The power feed to the ram is disengaged by means of the small handwheel, so that the ram is fed vertically as the head traverses. The use of the attachment is recommended for angles up to and including 18 deg.

Durkee Defectoscope

A device for the testing of steel magnetically, and known as the defectoscope, has recently been placed upon the market by the Durkee Manufacturing Co., Grasmere, S. I., New York. It has been invented and developed by Dr. Charles W. Burrows. The instrument is intended for the examination of commercial steel products, being a means of checking the physical uniformity and structure of the work under examination by determining the variation in magnetic homogeneity along the length of the specimen. It is especially adapted for use in locating defects in steel wire, cables, rods, rails and bars.

Fig. 1 shows a general view of the defectoscope arranged for testing rails. The device consists of several distinct elements. The first one produces the

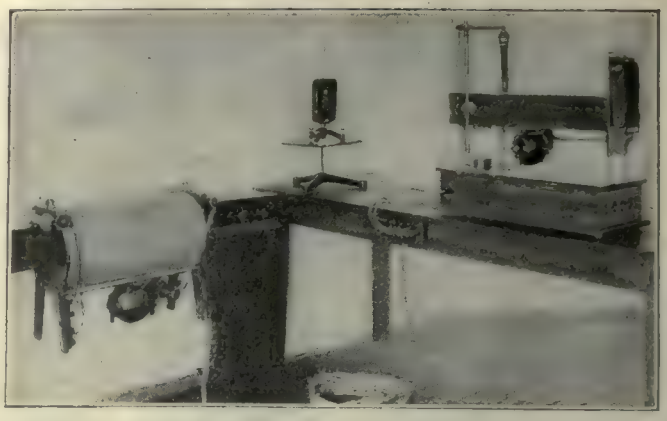


FIG. 1. DEFECTOSCOPE SET UP FOR THE TESTING OF STEEL RAILS

magnetizing effect, being a relatively short solenoid energized by commercial direct current, so that the magnetization of the specimen is carried well beyond the knee of the induction curve. The solenoid is mounted on a carriage which can be driven along the rail at a uniform rate by the small motor under the coil. The rail is mounted upon steel supports connected by an auxiliary rail, so that a closed magnetic circuit may be formed.

The next element is the means for detecting the magnetic variations in the rail. It consists of two test coils surrounding the specimen, having the same number of turns each and rigidly connected to the magnetizing solenoid. When the carriage moves, the detector occupies different positions along the length of the rail, and, if the specimen is not quite uniform, the magnetic induction threading one of the coils is different from that threading the other, the electromotive force also being different.

This differential emf. is impressed upon a device for indicating its magnitude, a heavily damped D'Arsonval galvanometer of short period being used for this purpose. The indication given by the galvanometer, shown at the left end of the table, is recorded by means of the camera at the right.

The recorder consists of a photographic film caused to move uniformly across a small slit through which a ray of light is reflected by the galvanometer through the dark box. The small motor under the bottom of the dark box furnishes the motive power for the film.

The control box, shown on the table underneath the dark box, contains all the switches and rheostats necessary for the operation of the apparatus. The ammeter for indicating the current in the magnetizing solenoid and the electric lamp used for the reflecting galvanometer are shown mounted on the control box.

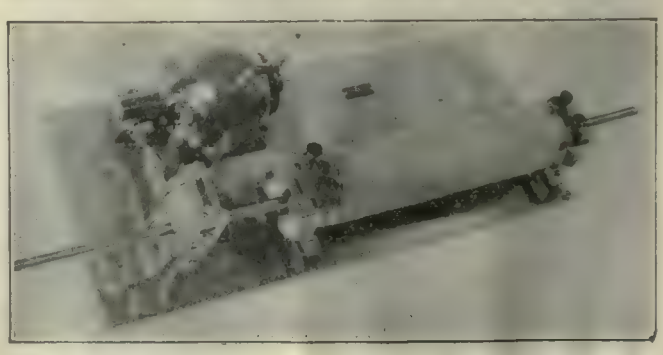


FIG. 2. MAGNETIZING AND FEEDING ARRANGEMENTS USED WHEN TESTING RODS

When making a test the carriage is caused to be moved along the work, the film being exposed at the same time. The film can then be developed to show the record of the magnetic homogeneity of the rail, the straighter the line on the film the more uniform being the structure of the specimen. If a permanent record is not desired, the photographic part of the equipment may be replaced by a translucent scale or a telescope and scale for optical observation.

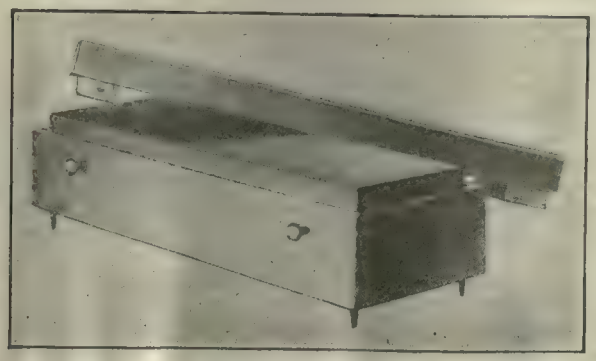
When small specimens are to be tested, it is usually more convenient to have the solenoid stationary. Fig. 2 shows the arrangement used for testing rods, a small motor moving them at a uniform speed through the solenoid. The detecting and recording arrangements are the same as used with the other type of solenoid. A somewhat similar arrangement is used for testing cables and wires, the solenoid being kept stationary. It is said that the device can be mounted whenever desired, so that wire in the course of manufacture may be tested. When testing cables, a break in one wire will be shown by a notch in the original straight line of the record. Instruments have been developed for testing various parts of symmetrical shape, such as races for ball bearings.

It is said that the defectoscope can well be applied to the testing of steel in the process of manufacture, as between operations or before and after heat treatments, and that only moderate skill is required of the operator. Accurate results are claimed, as the effects of heat treatment and chemical composition upon magnetic properties are known. The process is, of course, not destructive to the specimens under test.

Raughtway Self-Cleaning Oil-stone Holder

The oil-stone holder shown in the illustration has been placed on the market by J. A. Raught, 1006 Grand Ave., Racine, Wis. It is made of cast aluminum, the surfaces being ground and polished. There are four sharp pegs in the bottom of the holder to prevent it from slipping on the bench. The cover is provided to exclude dirt.

The stone rests on four buttons $\frac{1}{4}$ in. high on the bottom of the holder and is prevented from shaking in the holder by four screws in the sides. The stone lies in a bath of oil, thus keeping one side of it soaked. It is claimed that by this method the stone can be prevented from clogging and glazing, as it is kept clean and sharp. The holder is made in sizes, to hold stones 1 in. thick, 2 in. wide and either 6, 7 or 8 in. long, and it can be furnished either with or without the cover as shown.

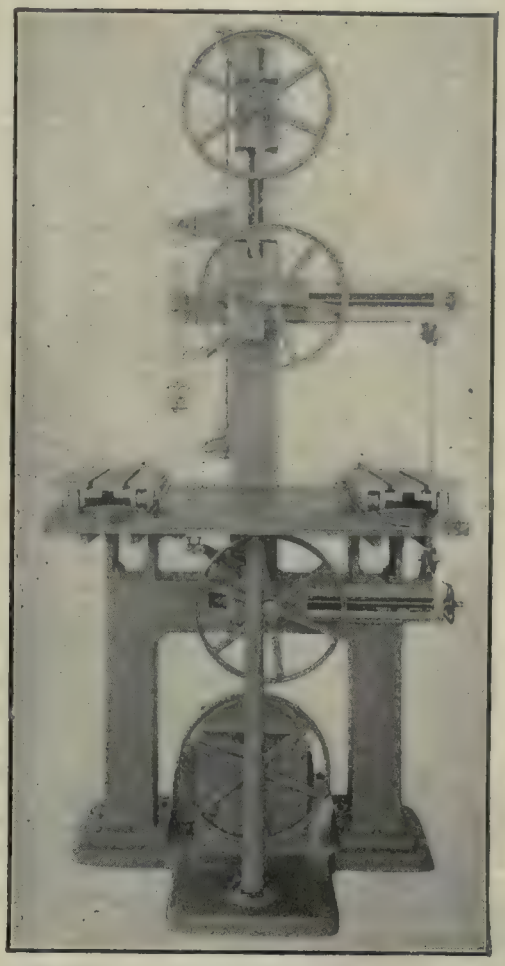


RAUGHTWAY SELF-CLEANING OIL-STONE HOLDER

Seattle Metal-Cutting Bandsaw

The Seattle Machine Works, Inc., 37-51 W. Lander St., Seattle, Wash., has recently built the metal-cutting bandsaw shown in the illustration. It is intended for cutting out solid forged crankshafts, for cutting slots, and for cutting pieces to length. This is accomplished by having the saw cut on both sides of its loop, its motion, of course, being downward on one side and upward on the other.

In order to change the distance between the two cutting portions of the blade, two idlers having horizontal movement are provided, the screws in the slides being connected by means of a chain running on sprockets so that they operate simultaneously. The top wheel is adjusted vertically by means of a handwheel, so that the saw can be kept tight for any position of the idlers. The machine can be used as an ordinary bandsaw to make a single cut by moving the idlers out of contact with the saw.



SEATTLE METAL-CUTTING BANDSAW

The saw is driven by a motor mounted in the base. The work is rested and clamped upon two carriages on the table of the machine. The carriages are mounted on rollers, so that weights hung at the back of the machine and fastened to them furnish the pressure for the cut. In order to take a single straight cut in a long piece of work the cutting blade can be twisted slightly, the idlers being run out to the right. The movable carriages can then be swung so that the direction of their travel will be parallel to the cutting portion of the blade. In this way the work will clear the upward-traveling loop of the saw.



General Business Conditions

Many Branches Covered—Past and Future Discussed—Labor and Retailers

The downward movement of prices, of which the first signs appeared last May, and which became quite evident in October, has become more general and precipitate in the last month. The hopes that had been entertained that the descent to a lower level would be accomplished so gradually that the losses would be covered by current profits, without serious interruption to business and without unemployment, have proved illusory. Rarely, if ever, has there been so great a decline in commodity prices in so short a time. The twelve basic commodities included in the price table of the Federal Reserve Bank of New York, to wit: wheat, corn, hogs, sugar, pig iron, copper, lead, lumber, petroleum, cotton, hides and rubber, have declined on an average 33.5 per cent since the high point of the record in May.

Petroleum is the only one of this group which has not suffered severely, and owing to the growing demand for fuel oil, gasoline and the other products it has scarcely suffered at all. All of the others have been forced lower during the past month, and ended the month without improvement.

The Bureau of Labor figures, October average based upon about 325 commodities, were 7 per cent below September, and 7.3 per cent below the May average. As compared with October, 1919, the table shows a decline in articles of food of 3¾ per cent, cloths and clothing nearly 18 per cent, and farm products 21 per cent. Bradstreet's table of consolidated prices is down 24.8 per cent from its peak, which occurred in February.

Industry and Trade

Industrial activity was generally well maintained throughout October, notwithstanding the reduced operations in the textile mills and shoe factories. Raw cotton consumption was the lowest for any month in the last four years. Building activity has declined, and unemployment has increased in the past month. The coal situation is improving and prices are declining, although dear coal is a serious factor in production costs.

Trade is reported light for this season of the year, and the railways having cleaned up for the most part the congestion which existed in the spring and summer, are having some falling off in traffic. The grain movement from the farms is light. Outside of New York City payments through banks are fairly well maintained, being reported by the Federal Reserve Bank for the week ending Nov. 24, as 6.7 per cent below the corresponding week of 1919. Including New York City, the falling off is 9.2 per cent, but business was very active and prices were high in November, 1919.

Evidently current conditions are not yet reflected in the volume of payments, for industry has slackened decidedly during November and wholesale trade is very slow. The business which should be going on now in orders for the retail trade of next spring is not being done. This is especially so of shoes, clothing, dress goods, underwear, knit goods and the textiles generally, but is true in all lines.

The Farmers' Losses

The fall in prices of farm products during the past month has given a more serious aspect to the entire business situation. Following the declines in September and October the cuts again have been very deep, and are of far-reaching influence. When the price recessions occurred in the months following the armistice and a general reaction in business seemed to be imminent, farm products were sustained by a heavy foreign demand, and with the buying power of the farm population sustained, a good general trade over the country was maintained, and the industries that had been disturbed were brough back into line. The expectations of continued prosperity during the coming year have been based upon the assumption that with Russian products still out of the competition the demands from western Europe would continue to sustain prices for farm products, and this expectation has been disappointed. It lets down practically one-half of the industrial organization and renders it unable to continue purchases of the other half on the same scale, without a readjustment of the basis on which the exchanges are made.

The farmer has suffered not only a great direct loss of purchasing power, but a shock which will affect his mental attitude toward expenditures for some time. He has debts to pay, more debts than at any previous time, judging from the volume of bank loans, and it will take a great many more products to pay them than it would have taken a year ago or three months ago. It is not to be expected that he will be the free spender in the near future that he has been during the last year.

There is no big surplus of wheat in the world. Allowing for the uncertain character of all crop estimates, for even the figures upon our own crops are only estimates, and allowing also for uncertainty about European consumption, the margin of safety is small. Nobody will really know until about next May or June whether all our wheat will be wanted or not. Meanwhile, the question with each holder or prospective purchaser is whether or not he wants to carry wheat over into the next crop year. The answer to that question determines his attitude. Market opinion is shown by the fact that wheat for March delivery is still about 5 cents per bushel below the December delivery.

The Swing of Business

This slump in business conditions has demonstrated again that the great movements in the business world which make good times or bad times are spontaneous and beyond control. They are due to mass action and mass psychology. The business of the country depends upon the purchases and policies of tens of millions of individuals, and when they become generally possessed of a spirit of confidence, and go ahead with their planning and spending under its influence, we have a period of prosperity. The difference between free spending and careful economy by all the people of this country means a vast difference in the volume of trade and the level of prices.

A state of full prosperity is seldom long maintained because it means a balanced state of industry, and the balance may be disturbed by many influences, originating at home or abroad. The war gave an enormous but unhealthful stimulus to the industries and brought on the rise of wages and prices. Following the war, there was another abnormal period, due to scarcity resulting from the war and the release of demands that had been in restraint. The actual scarcity was exaggerated in many instances, as in the case of clothing and sugar, by an insistent demand which would be supplied at any price. A market in which demand exceeds supply is commonly called a seller's market, on the theory that the seller names the price, but the prices upon many commodities in the latter part of 1919 and early part of 1920 were made by a scramble of buyers and the bidding of dealers eager to supply them. There was a shortage of cloth and of sugar, but the market was over-stimulated by the action of buyers, who in many instances tried to get more than they really wanted in the expectation that the limited supplies would be alloted, or to provide for the future. Nobody was more deceived than the dealers and producers. The price of raw sugar in Cuba went to 23½ cents per pound, and has since dropped to 4¾ cents. The sugar movement was

LD'S INDUSTRIAL FORGE
News Editor

an extreme one but that in textiles was of the same kind, and both illustrated the swing of mass purchasing power. It was at its maximum last fall and winter.

Price Structure Top-Heavy

But, as already said, a movement of this kind is not sustained because the buying abilities of all classes of the public do not remain in balance. In the great rise of prices all did not share alike. Those whose incomes did not keep pace with the rise of prices were obliged to curtail their purchases, and as prices went higher the support for them weakened. The spring months were unfavorable to trade, goods did not move normally, the jobbing trade fell off, and with production at a high rate goods were accumulating. Money was tight, middlemen had heavy obligations outstanding and more goods coming, bought for the fall trade. Then came the flood of cancellations and the cutting of prices. The price structure was top-heavy. As confidence in the future of prices was undermined the attitude of the trade and the public completely changed. Nobody would buy except to meet immediate wants, and goods came out from many quarters. When it developed that the orders for fall goods cancelled last May were not to be reinstated, and that Fall needs were readily satisfied in the open market at continually falling prices; and when as the fall advanced the usual buying for spring delivery did not develop, it became evident that confidence would not be restored or prices stabilized until a far-reaching, thorough readjustment of costs and prices had been accomplished.

When Will Confidence Be Restored?

The movement has gone too far in some directions for confidence to be restored or buying stimulated until it has gone farther in other directions. The situation as regards purchasing power is more disorganized and out of balance than it has been at any previous time. The farming population has suffered a loss of purchasing power amounting to somewhere between 30 and 40 per cent, or $6,000,000,000 to $8,000,000,000, as compared with last year. It would be very foolish for the people engaged in the other industries to think that they can go on making and selling goods as though this loss had not occurred, enjoying also the benefit of this reduction in cost of farm products.

Manufacturers, merchants, labor leaders, owners of stocks in railroads and industrial companies—everybody in business—are asking how long this depression which is spreading over industry is likely to last. Nobody can tell the length of time, but it is not difficult to name the principal condition necessary to a revival. The prices of what the farming population wants to buy must come down to correspond with the prices of what it has to sell. Until then the state of reciprocity which is necessary to full employment of labor and general prosperity cannot exist. The equilibrium must be restored. There will be no confidence in the situation until the equilibrium is restored. Merchants are not going to buy goods which they know their customers are unable to buy, railroads will not buy equipment to carry goods which will not be bought, construction work will be at a standstill, enterprise will be dead, until a basis of fair exchange for the products of the industries is reached.

This is not a matter of resolution, resentment, or concerted action. It results from the character of trade relations, from the fact that all business consists of an exchange of services. What one class of producers does not get, it cannot spend. With trade relations out of balance the circulation of goods must be curtailed.

Will Wage Reductions Be Made?

It is said that organized labor is going to stand for the present wage scales. That is a very natural resolution to make, off hand. Nobody likes to take the back track, and nobody should want labor to take the back track in any real sense. A reduction of wages which would put the general wage-level below the new price level would throw the situation out of balance in the same way that the fall of farm products has thrown it out. Neither the farms nor the towns can buy the products of the other except on a basis of fair exchange, and if the products or services of either are unfairly valued the entire industrial system will be disorganized. Wages and farm products went up fairly well together, and it is a mistake to think that they are not coming down together, for they are tied together by the economic law.

It is said that in the principal shoemaking centers of Massachusetts the labor organizations have passed resolutions against any wage reductions and that in the principal textile centers of the same state the mill companies and their employees have come to a similar understanding, for the present. But the news reports from the same cities say that the shoe factories and textile mills are running not over half time, which means a reduction in wages of fully one-half. It is mere fiction to say that wages are not reduced when such conditions prevail, even though wage rates are unchanged.

The shoe-makers and mill operators may think that at least they are better off in that they only work one-half the time, but they overlook their own interest and the interest of the entire laboring population in the cost of shoes and clothing. While they are not actually sustaining their own wages they are keeping up the cost of goods, and if other workers, all around the circle of the industries, do the same, the cost of living will stay up for everybody, with earnings reduced. Of course it will be only fair for the farmers to work half time also, and already they have counsels of this kind. It is impossible to run the industries of this country on half time and produce economically or supply the people with the comforts they want. Any such attempt is destined to break down, because it cannot produce the desired results.

Position of Wage-Earners

We do not believe the wage-earning class will be found obdurate when the situation is understood in all its relations. They do not want to lose any real gains, but there are many signs that they will accept lower pay if the purchasing power of their wages is not reduced. That gives a basis for agreement. An official of the American Federation of Labor is quoted as saying that there must be no reduction below the levels of 1914, with allowance for increases in the cost of living. That sounds all right, but it must be borne in mind that the cost of living is not something imposed upon the wage-earning class from above or from the outside; it is largely dependent upon the wages they insist upon having and their own attitude toward their work. They should not disclaim their proper share of responsibility for the cost of living, or think they can make someone else bear it. Nor can they, any more than any other class, escape their share of the results of ills and calamities that afflict the world. They may say that they are not responsible for the war or the disorganization of industry which has resulted from the war, but these costs must be borne by society as a whole, with every member bearing some share.

On the other hand there are the possibilities that lie in improvements in industry, by which it can be made more effective, production increased and costs reduced. Just as no one in society can escape some share of the effects of great calamities, however they may be caused,

so no one can fail to receive some share of the benefits which result from improvements in the arts and industries. A great corn crop does not benefit the growers or landowners alone; indeed they are thinking now that they have over-done their service to the community, and so it may be unless all the industries give the same honest effort for the general good. The improvement of industry and general increase of production is the true way of progress, and labor can play a great part in the advance. With respect to this also there are signs that it will not be wanting.

Retail Prices an Obstacle to Readjustment

Labor answers the claim that wages should come down to correspond with the fall of wholesale prices, by saying that retail prices, which determine the cost of living to wage-earners, have not come down to any such extent. That it true and on all sides it is being said that the situation is up to the retailer. He is the distributor and it is charged that he is blocking the flow of goods instead of helping it. His excuse is that he has goods which cost him high prices and he wants to work them off without loss before dropping to the new levels. It is to be said in his behalf that the price records of the Bureau of Labor show that retail prices generally lagged behind wholesale prices on the rising market, as they frankly do on the falling market. The report of the Federal Trade Commission on the flour industry, recently issued, shows that during the period 1913-1918 wheat rose 160 per cent, flour at wholesale 146 per cent, and flour at retail 118 per cent.

There was much discussion while prices were rising over the point whether a retailer was justified in basing his prices upon replacement costs, and popular opinion generally held that he was not. We have pointed out in comments upon war time profits that a dealer would need the profits of a rising market to meet the losses of a declining market. The proper basis for prices at all times is replacement costs, for there is no assurance that a dealer can control prices on any other basis. There is no certainty that he can sell goods at what they cost him.

But the fact that a retailer did not promptly follow prices on a rising market will not help him now. He cannot afford to block the procession. The producer has had to come down, regardless of the fact that his crops or his goods were produced on the high level, the jobber has had to take his loss, and the retailer who gets down to the new level as soon as possible will gain by doing so. He will be selling low-cost goods while his slow-going rivals are tied up with the old stocks. The best policy for the merchant at all times is to turn his stock as fast as he can replace it at lower prices. Furthermore, in times like these every man who is a link in the business chain should do his part to accomplish a speedy readjustment and a restoration of confidence. There can be no restoration of confidence until retail prices are in line with producer's prices. This is no time for recriminations about the blame for high prices or large stocks.

Changes in Retail Methods

The situation may result in permanent changes in the methods of retail distribution. The tendency has been toward chain stores and distribution on a large scale by people who buy direct of producers, or through agencies controlled by producers. The present deadlock and inability of producers to make their reductions effective to consumers will stimulate it. More shoe factories are going to have their own retail stores, for the sake of controlling prices to the public. The farmers are aroused over the failure of retail prices upon fruits and other products to come down, and thereby stimulate consumption when products are perishing. Possibly the retailer sometimes gets more blame than is coming to him, but this is a time when it behooves everyone to play the game of co-operation so openly that all can see what he is doing.

Elements of Strength in the Situation

The elements of strength in the situation which we have named heretofore remain, and will become effective when the conditions are right. The main condition is that all along the line costs must come down until confidence in prices is re-established. Confidence will not be re-established in prices that rest upon inflated costs, even though all profits have been eliminated. It will not be re-established in prices that rest upon any artificial support, for all such supports are temporary. Prices may go lower than can be permanently maintained; it is the usual thing in times of reaction that the momentum carries prices too low, just as in times of expansion they are carried too high.

This is pre-eminently a price situation. There is no lack of confidence in the future of business when a basis upon which it can go forward is found. Price fluctuations in recent years have been so wild that the public has become distrustful of all prices. For the moment buyers stand aside and there is little resistance to the downward movement, but of course this is a temporary situation.

The only prices that seem to be really authoritative are those that prevailed before the war, but it cannot be supposed, that in the present state of industry, this level will be generally reached or maintained. Prices that go too low will recover their proper place as the revival spreads.

Construction Work

Construction work has always led the way in recovery from business depression. The difference between good times is largely in the amount of construction work going on, and the strongest factor in the present situation is the amount of work needing to be done. The country by all reports is underbuilt. None of the deficit of the war time has been made good, but last year and this year the country has fallen farther behind, because there is no confidence that present wage rates for mechanics or prices for materials will be sustained in face of general business conditions. With great numbers of people out of employment, and the demand for office space and factory additions falling off, investors are not wanting to put their money into building operations at costs which they believe can be very much lowered a year or so later. But if wages and prices come down, so that building investments look to be safe against later competition there is a vast amount of work to go forward. There is no industry that holds such possibilities of help for the situation as housebuilding, for the materials required would give employment in a great variety of industries.

The railroads have a great amount of work to be done, and need only the encouragement of lower interest rates, which undoubtedly are on the way.

The manner in which the country has borne the great shrinkage in values, the comparatively few important failures, has shown that the business structure is essentially sound. The banks have carried the situation through the credit strain. There will be plenty of credit for a revival of business on a lower level of prices. The business organization is in working order and ready to resume normal operations when conditions are right, which, as we have indicated, will be when retail prices, wages and industrial costs generally have come down to the level reached by the basic raw products.

Why Industries Shut Down

When the mutual dependence which exists throughout industry is seen, the fallacy of the protest against the closing of factories will be understood. It is a superficial view that the shutdowns are simply to maintain or raise prices. The primary reason is that the goods cannot be sold, and that the proprietor either has no confidence in the future market or lacks the capital to pile up goods. In the present situation it is plain that a readjustment of all manufactured goods to a lower basis is necessary to bring them into line with raw materials, food products and the general level of prices. It takes time to accomplish such a readjustment. It cannot be expected that the manufacturer will go on making goods which he knows he will have to sell at a loss. There is a common rule of conduct in such matters, which everybody naturally follows and which is generally sound and in the public interest.

Few concerns have the capital to run long unless the goods are being concurrently sold. The volume of bank loans shows that business is borrowing great sums, much greater at this time than ever before, and it could not increase these loans for the purpose of piling up goods to be sold at a cer-

tain loss. The losses to proprietors are of staggering proportions now, with everybody striving to make them as small as possible. No one can gain in the long run by dissipating the capital which is engaged in carrying on industry, or breaking up established organizations. Bankruptcies mean that works are closed permanently, or until new capital can be found and new organizations are formed, and meantime labor is out of employment. The common interests are served by readjustments which keep all the factors of industry on a harmonious working basis.

The Industrial Court of Kansas has cited seven flour-milling companies before it to answer why they have been operating only part of the time. The markets give the answer. Throughout the present season wheat has been selling for the forward deliveries at heavy discounts below the spot deliveries, as much as 25 cents a bushel. This means that it has been impossible to buy cash wheat and make it into flour for future delivery without loss. Consumers and dealers have been buying flour for immediate needs only, and the mills have run only upon orders. If they had been running full time throughout recent months and storing flour in warehouses, they would all be bankrupt and shut down permanently by this time, and if the Kansas courts were to require that kind of management there would be no more flour-milling in that state.—*The National City Bank of New York.*

Export of Foreign Tools to Germany

(Special Correspondence)

At a recent sitting of the committee for economics of the preliminary "Reichswirtschaftsrat," or national industrial parliament, the application of an American firm with branch offices in Germany was under consideration. The company which had hitherto produced its machines (cash registers) in the United States only has decided to make Germany the center of production for Europe and with this view in mind had applied to the foreign-trade control bureau for a permit to import special American precision tools required for the manufacture of the machines. As the foreign-trade control bureau is chiefly composed of German manufacturers and workers' delegates it was not surprising that the application was flatly refused on the plea that the German industry was fully able to produce tools of the same precision and quality.

Renewed protests by the firm in question have induced the federal ministry for economics to refer this matter to the industrial parliament for consideration which, at the aforementioned sitting, eventually decided to grant the application while laying stress upon the fact that the decision should not be precedential to warrant the granting of import permits to other firms in similar circumstances. The representatives of the home industry drew attention to the fact that the only firm manufacturing cash registers in Germany before the war was the Anker Works at Bielefeld, while Krupps have now also taken up this line as one of their post-bellum products. A member of the government declared that political factors were in no way influencing the decision of the authorities and while the United States was considerably hampering the import of German products, this should be no reason for Germany to follow anything but a strictly internal economic policy in dealing with such questions. In a further statement by the German representative of the American firms a guaranty was given that all parts of cash registers will be made of German raw materials and by German machines and labor, only the above-mentioned precision tools to be imported. It was also stated that Germany was to become the center for manufacture and sales distribution in Europe, including, later on, England; for which country certain alterations of the machines, owing to the different currency, would become necessary.

It will be highly interesting to watch the results of this decision for it is fairly safe to assume that many American and other foreign firms having formerly catered to the German market or having had branch establishments in Germany prior to the war will be encouraged by the attitude of the German Government in spite of the reservations made at the sitting.

In the ensuing discussion on the pros and cons of imports of foreign machinery and other finished products, Privy Councilor Duisberg, director of Farbwerke Bayer & Co., delivered a violent outburst among the alleged unfair treatment of the German industry by Americans. The United States, he complained, is restricting importation of goods which they urgently need; at the same time taking illegal possession of the Bayer products and patents which are turned to competitive weapons against Germany in England.

Texas Co. Issuing "Lubrication" Monthly

The Texas Co. is issuing a monthly magazine called *Lubrication.* This periodical is interesting not only for the material contained in each individual issue but for the plan behind it.

It is the policy of that company to take up in turn the more important industries and after giving a brief outline of the manufacturing processes or the mechanical procedure, to describe the units involved and to discuss the particular or peculiar lubricating problems of these units or their parts.

Some of the industries taken up have been textile manufacture, metal cutting, refrigeration and ice making, cement, sugar refining, rubber manufacturing, compressed air and electric street railways. Other articles in view are on the paper industry, machine tools, hydro-electric developments, steam turbines, marine installations.

While this magazine is sent out free, the company makes a provision that the individual requesting to have this magazine sent to him be professionally interested in the use and selection of lubricants; that is, he must be an engineer, master mechanic, executive of a manufacturing or power using concern, a purchasing agent, or engaged in work of a similar nature. It is published from the New York office of the Texas Co., which is situated at 17 Battery Place, New York.

To Help Employees Build Homes

The Eastman Kodak Co., Rochester, N. Y., has undertaken the creation of a new organization in which the company and its employees will be mutually interested. Its aims are to encourage common-sense saving and home owning by employees. The practical effect will be that the employees will be furnished banking facilities for their savings and a method of obtaining capital to invest in homes. They also will be given the advantage of expert realty advice in the purchase of land. Before the scheme can become operative, it must be approved by the state superintendent of banking. It is understood that the superintendent has made himself thoroughly familiar with the project, and will grant the necessary permit within a few days.

Huston Thompson Chairman of Federal Trade Commission

Huston Thompson, of Colorado, became chairman of the Federal Trade Commission for a term of one year. Mr. Thompson, who was vice-chairman during the past year, succeeds to the chairmanship under the rule of the commission which provides for rotation in the office of chairman among the several commissioners.

Mr. Thompson was first appointed to the commission by President Wilson in December, 1918, to fill an unexpired term, and in December, 1919, was reappointed for a full term of seven years. He served as assistant attorney-general of the United States, in charge of the Court of Claims branch of the Department of Justice.

Australia Makes Own Leather Belting

In line with the enthusiasm at present prevalent in Australia over the program of making everything at home, leather belting is being made locally in sufficient volume, it is said, to take care of most of the demand. Duty on leather belting was increased by the tariff introduced last March from 25 to 40 per cent. Therefore, American belting would apparently have to sell in Australia on quality, in competition with the local product, which would have a price advantage. There is no resistance to the sale of imported articles which serve the purpose better than the local product, and, though probably costly at first, the introduction of American belting should eventually prove profitable.

New Smelting Plant at Rochester

Upon the completion of the addition to the plant of Sarachan & Rosenthal, Inc., Rochester will become a center of the red and yellow brass ingot industry in New York State. This addition, of brick and steel construction 40 x 100 ft., will be equipped with all modern foundry appliances including coke and electric furnaces of large capacity. The cost is estimated at $50,000.

Italy's Trade Situation

The world trade of Italy for the first seven months of this year shows total imports into Italy valued at 9,454,000,000 lire, a decrease of 631,000,000 lire compared with the same period in 1919; and total exports from Italy for the same period were 4,411,000,000 lire, which is an increase of 1,860,000,000 lire over the first seven months of last year. The United States furnished imports to Italy, out of the total, valued at nearly 3,000,000,000 lire; and the United Kingdom, imports to Italy to the extent of about 1,600,000,000 lire. The foregoing figures are based upon the normal rate of exchange for the lire—$0.193. While the Italian trade balance is showing steady improvement, the process is necessarily slow, just as in the situation with all the other countries whose exchange is at an abnormal discount in the United States.

The imports from Italy to the United States during September were valued slightly in excess of $4,000,000, and for the nine months ended September, at about $61,000,000; the imports from Italy to the United States for the corresponding periods of 1919 were valued at approximately $11,500,000 and $33,500,000, respectively. The exports from the United States to Italy were valued as follows: September, 1920, about $29,500,000; September, 1919, about $33,000,000; for the 9 months ended September, 1920, about $277,000,000; for the 9 months ended September, 1919, about $334,250,000.

Restrictions on the importation of motor trucks into Italy have been removed, effective Oct. 29.

At Capanelle, near Rome, the International Farm Tractor Exhibition opened on September 20. Nine types of American tractors were shown. For demonstration purposes, soil conditions, because of lack of rain, could scarcely have been worse. The American machines stood up pretty well, however, but the tests proved, beyond doubt, that light, low-powered tractors are not for Italy during the summer.

American tractors have acted in satisfactory fashion in Italy, but they have not been properly handled, owing to the lack of skill and experience of the soldiers who operated some of the 6,500 American farm tractors which were purchased by the Italian Government.

It is impossible for American tractors to hold their own in Italy without local service stations equipped for the instruction of operators and for supplying spare parts for repairs. The tractor best adapted for the severe soil conditions in Italy is a machine weighing about three tons, developing from 12 to 14-horsepower at the drawbar. Under ordinary conditions, this type should be equipped with three 14-inch plows.

The keenest competition for American tractors is furnished by machines built in Italy. Excellent tractors are made in Turin and Milan, the latter city turning out a tractor closely modeled after a well-known American machine.

There is a substantial market in Italy for American tractors. Out of the 40,000,000 population of the kingdom, 80 per cent get their living, directly or indirectly, from the cultivation of the soil. Increased production of food is the country's vital need, so that the purchase of our improved farm machinery for the cultivation of waste lands would go far toward relieving the food shortage and for providing for the permanent development of the kingdom's agricultural resources.—*Italian Discount and Trust Co. of New York.*

"Old Hickory" to Be Large Manufacturing Center

The Nashville Industrial Corporation, which is composed of business men of Nashville, Tenn., and which purchased from the government the "Old Hickory" Powder Plant at Jacksonville, Tenn., is developing this immense war undertaking into a large manufacturing center, having available immense housing and manufacturing buildings and facilities. The village had a population of 35,000 when the plant was closed in 1918, and is now completely equipped with all necessary public utilities, schools, banks, club houses, etc., and offers many attractive inducements to new industries or those desiring a change in their location.

Dr. John A. Mathews Head of Crucible Steel Co.

Directors of the Crucible Steel Co. of America have organized by the election of the following officers: Horace S. Wilkinson, chairman; Dr. John A. Mathews, president; George E. Shaw, vice-president and treasurer; Gilbert M. Black, vice-president in charge of operations; F. B. Hufnagel, vice-president; J. M. McComb, vice-president in charge of credits; R. H. Illingworth, vice-president; W. R. Joralemon, secretary and assistant treasurer; A. A. H. Niebaum, assistant treasurer; H. F. Kress, assistant secretary and treasurer; H. L. Gellinger, auditor, and D. C. Barry, comptroller.

Dr. John A. Mathews, who moves up from the position of first vice-president of the company to the presidency, has been identified with the company since 1902. His first connection was with the Sanderson Brothers Steel Co., a subsidiary, at Syracuse, N. Y., as metallurgist. Later he was made president of the Halcomb Steel Co., another subsidiary at Syracuse, going to Pittsburgh about a year ago, when he was elected first vice-president of the parent company.

Business Items

The Precision and Thread Grinder Manufacturing Co., manufacturer of the "Multi-Graduated Precision Grinder," has moved its office to 1 South 21st St., Philadelphia, Pa. At this new location it will maintain a machinery display department.

The Chicago Pneumatic Tool Co. announces the removal of its rock drill plant from 864 East 72nd St., Cleveland, Ohio, to the company's Boyer pneumatic hammer plant at 1301 Second Blvd., Detroit, Mich. Location of the company's "Little Giant" air drill plant at 1241 East 49th St., Cleveland, remains unchanged.

The Colonial Foundry Co. of Louisville, Ohio, has increased its capital stock from $50,000 to $235,000. A. Jackson has been elected secretary. A new 60 x 165-ft. brick addition to the present building is under way and with this addition the company expects to increase its output 150 per cent. The Colonial foundry is now making all kinds of gray-iron castings and general job work.

At the special meeting of the stockholders of the Westinghouse Electric and Manufacturing Co., at East Pittsburgh on Nov. 18, an increase in the indebtedness of the company by the sum of $30,000,000 was authorized. Also the stockholders in this meeting voted to authorize an increase in the capital stock of the company from $75,000,000 to $125,000,000.

The Cincinnati Section of the A. S. M. E. observed the fortieth anniversary of the formation of that society with a banquet in the Business Men's Club, Cincinnati. Julian A. Pollak presided.

The Society of Industrial Engineers held its annual convention in Carnegie Music Hall, Philadelphia, Pa., last week. An exhibition of factory equipment and industrial appliances was a feature of the affair.

The Skinner Chuck Co., New Britain, Conn., will shortly increase the capital stock of the company from $225,000 to $750,000.

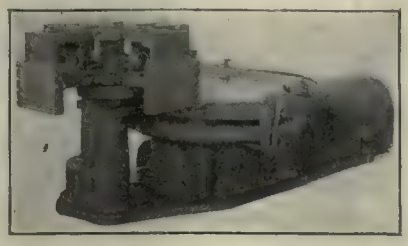
The St. Joseph Structural Steel Co. has moved into its new headquarters and plant, Ninth and Atchison Sts., St. Joseph, Mo., and has increased its capacity considerably by new equipment. Its plant now covers about five acres of ground and is modern in every respect. Most of its business consists of steel in connection with building construction and bridges.

The Louisville Machine and Manufacturing Co., Canton, Ohio, has increased its capital stock from $150,000 to $500,000. The increase was made necessary to take care of the increase in business, according to A. Rodgers, an official of the company. A reorganization will soon be effected in this company.

Condensed-Clipping Index of Equipment

Patented Aug. 20, 1918

Grinding Machine, Disk, Continuous-Feed, "No. 24"
Gardner Machine Co., Beloit, Wis.
"American Machinist," Nov. 4, 1920



The machine consists of a horizontal grinding disk, 53 in. in diameter, and four work-tables. The pressure of the work on the disk may be regulated by means of a compression spring. A micrometer screw stop permits grinding to fixed limits. The feeding mechanism can be arranged so that the work-table will make a complete revolution in 1, 2 or 4 min. It is controlled by a friction clutch which enables the operator to stop the feed without stopping the disk. The stand which carries the work-table can be adjusted over a distance of 6 in. The weight crated is 7,600 lb.

Winding Machine, Coil
Charles Eisler, 159 Clifton Ave., Newark, N. J.
"American Machinist," Nov. 4, 1920.



The machine is intended for winding the filament coils for gas-filled incandescent lamps and it is claimed that it is capable of winding coils from 25 to 900 turns per inch for lamps of 15 to 1,000 watts. The mandrels used are from 0.003 to 0.035 in. in diameter and can be dissolved in acid after completion of the coil. Coils can be wound close or with any desired spacing. The speed of the machine is from 500 to 3,000 r.p.m. according to the size of the filament to be wound. Coils of 5,000 ft. in one length can be wound and the filament can be electrically heated to a cherry red during the winding.

Grinding Machine, Pneumatic, Series-A
Roto Pneumatic Tool Co., 4700 Train Ave., Cleveland, Ohio
"American Machinist," Nov. 11, 1920



This machine is intended for light grinding and polishing work. The air enters it through the control handle and is applied to the pistons, which are integral with the rotating shaft. The air control is balanced, so that the throttle will stay in any position in which it is placed. The device is free from noticeable vibration and can be easily controlled. Proper lubrication is provided. Under average conditions the air consumption is 15 to 20 cu.ft. of free air per minute at a pressure of 80 lb. per square inch. Either a 6-in. or an 8-in. wheel can be used. The weight of the tool is 14 pounds.

Crane, Portable, "Never Slip" "Hammond"
Barrett-Cravens Co., 169-173 North Ann St., Chicago, Ill.
"American Machinist," Nov. 11, 1920



The hoisting gear consists of a bronze worm-wheel and steel worm inclosed in an oil-tight casing. Besides being locked at all points of travel, the worm gearing permits very close adjustment in the height of the load. Specifications: Made in 6 sizes. Lifting capacities, 2,000 to 7,000 lb. Heights, 6 ft. to 10 ft. 8 in. Amount of lift, 4 ft. 10 in. to 8 ft. 6 in. Overhang, 2 ft. 5 in. to 3 ft. 8 in. Floor space, 3 ft. x 3 ft. 6 in. to 4 ft. 3 in. x 4 ft. 10 in. Weight, 575 to 1,400 lb.

Drill Heads, Multiple-Spindle, Fixed A Center
Roberts Manufacturing Co., 152-56 Brewery St., New Haven, Conn.
"American Machinist," Nov. 4, 1920



The head shown is intended for light work. For heavy duty the case of the head is clamped to the quill of the drilling machine to prevent rotation. Each drill spindle with its driving gear is made of one piece of chrome-nickel steel, the gear having stub teeth. The spindles run in bronze bearings, ball bearings being used to take the end thrust. By using a friction chuck with the head, multiple tapping and stud-setting can be done. The head can be furnished with any desired number of spindles to hold drills up to 1 in. in diameter.

Grinding Machine, Cutter, "Curvex"
Pratt & Whitney Co., Hartford, Conn.
"American Machinist," Nov. 11, 1920



Two features of the machine insure the precision required for grinding formed cutters having helical teeth. The first is an indexing device for successively bringing the teeth in line for grinding instead of holding the back of each tooth against a spring stop. The second is the provision for grinding cutters of different sizes radially without resetting the head or table in any way except in elevation. An accurately mounted diamond tool is provided for dressing the beveled-edge grinding wheel to the correct shape. The machine can be used for either wet or dry grinding.

Drilling Machine, Upright, 22-In., Stationary-Head
Production Machine Tool Co., 629 E. Pearl St., Cincinnati, Ohio
"American Machinist," Nov. 11, 1920



This machine is intended for drilling, boring, tapping and facing holes up to and including 1¼ in. in diameter. The table-elevating worm is located on the right-hand side, and controls are all within easy reach of the operator. Specifications: Capacity, drills to center of 22-in. circle. Spindle speed; back gears in, 20, 33, 53, 88 r.p.m.; back gears out, 117, 196, 318, 530 r.p.m. Power feed per revolution of spindle, 0.006, 0.010, 0.015 in. Distance from spindle to base; maximum, 45 in.; minimum, 35 in. Distance from spindle to round table; maximum, 25⅜ in.; minimum, 9⅜ in. Diameter of round table, 18½ in. Spindle; diameter, 1⅞ in.; hole, No. 3 Morse taper; vertical traverse, 10 in. Column diameter, 6 in.

Cutters, Formed, Helical-Flute, "Curvex"
Pratt & Whitney Co., Hartford, Conn.
"American Machinist," Nov. 11, 1920



It is claimed that these cutters can be run at faster speeds and will take heavier feeds than will formed cutters with straight flutes; also that under all operating conditions they will produce a smooth surface free from chatters. The cutters are produced by a single-pointed tool following templet corresponding to the form of the work they are to produce. "Curvex" cutters are only made to order and can be cut with either right- or left-hand helices of practically any lead from 1.607 to 125 in. and with any helix angle up to 20 degrees.

Clip, paste on 3 x 5-in. cards and file as desired

Personals

L. R. FEDLER has been appointed district manager for the Keller Pneumatic Tool Co. in the Milwaukee district, with offices at 915 Majestic Building, Milwaukee. For the past twelve years Mr. Fedler has been associated with the sales organization of the Chicago Pneumatic Tool Co. in the Milwaukee territory.

ALBERT A. DOWD, former president of the Service Engineering Co., Inc., 25 Church St., New York City, has severed his connection with that company and formed a new organization to be known as the Albert A. Dowd Engineering Co., with offices and drafting rooms at 131 West 39th St., corner Broadway, New York City.

S. C. WILSON is now sales engineer in the Pittsburgh office of the Whiting Corporation, 1224 Fulton Bldg., Pittsburgh, Pa., succeeding C. H. Martin. Mr. Wilson has spent the last year and a half at the company's main office and works and is thoroughly familiar with every phase of the Whiting line of manufactures.

A. G. MANEY, assistant to President H. H. Franklin of the Franklin Automobile Co., has been appointed director of distribution, a new position just created. Mr. Maney previous to his connection with the Franklin company was affiliated with the Belleville Chemical Co., the Shaw Insulator Co. and the Wright-Martin Aircraft Corporation.

J. C. NELSON, who is president and general manager of the Empire State R.R., has been elected a vice-president of the Syracuse Washing Machine Corporation, Syracuse, N. Y. He will have charge of production, plant maintenance and purchasing, and will continue as president of the trolley corporation.

E. P. WILLIAMS, formerly with McJunkin Advertising Agency, and later director of field work, Bureau of Market Analysis, Inc., has joined the staff of the Independent Pneumatic Tool Co., manufacturer of "Thor" air and electric tools. Mr. Williams will be located in the general offices, 600 West Jackson Blvd., Chicago, and will have charge of the direct-by-mail advertising and sales promotion department.

C. SEYMOUR WILLIAMS is now southwestern division manager for the Franklin Automobile Co., and is located in Kansas City, Mo.

PETER M. KING, formerly mechanical engineer for the General Petroleum Corporation of Vernon, Cal., is now with the Continental Mexican Petroleum Corporation, Tampico, Mexico.

J. D. JAMES of the Whiting Corporation, Harvey, Ill., has taken up duties as assistant to the company's Buffalo representative, George F. Crivel, 430 Ellicott Square, Buffalo, N. Y. Mr. James has been in the employ of the Whiting Corporation for eleven years in various capacities and is well equipped for the duties of sales engineer.

F. W. TIMSON, who represents the Graton & Knight Manufacturing Co. in Leicester, England, and who has been on a visit to the factory during the month of October, sailed recently on the Carmania for England.

JOHN N. MOWREY, of Philadelphia, Pa., has recently been chosen as the new general manager of the Worcester Pressed Steel Co. of Worcester, Mass., and will assume his new duties Jan. 1.

D. W. FRASER, formerly general manager of the Montreal Locomotive Works, Ltd., is now located in New York City. Mr. Fraser is vice-president of the American Locomotive Co.

EDWARD H. RUCK, who was formerly chief engineer for the Automotive Corporation, Toledo, Ohio, is now general manager of the Mobile Tractor Co., Mobile, Ala.

DEWITT M. TAYLOR has been appointed instructor in mechanical engineering, Massachusetts Institute of Technology, Cambridge, Mass. He was formerly associate editor of *Power*, New York.

C. H. ISRAEL, who was works manager for the National Marine Engineering Works, Scranton, Pa., announces that he has been appointed Eastern representative for the Kingsford Foundry and Machine Works of Oswego, N. Y. Mr. Israel is located in the Philadelphia office of this company.

LEON H. JOHNSON has severed his connection as general manager with the Anderson Foundry and Machine Co. and will in the future be at the head of an engineering firm specializing on oil engine power plants at Anderson, Ind.

C. F. MEYER, assistant secretary of the Landis Machine Co., Waynesboro, Pa., will leave shortly for an extended trip to the Orient.

J. H. PENNINGTON, formerly with the Baltimore Copper Smelting and Rolling Co., Baltimore, is now general manager, McFarland Foundry and Machine Co., Trenton, N. J.

Obituary

LUCIUS J. KNOWLES, president of the Crompton & Knowles Loom Works of Worcester, Mass., largest makers of looms, etc., in the country, died at the Ritz Hotel in London, England, Friday morning, Nov. 26.

Catalogs Wanted

The Indian Tool and Supply Co., Inc., a new company with headquarters at Indianapolis, Ind., wishes to receive catalogs of machinery and equipment.

New Publications

The Practice of Lubrication, an Engineering Treatise on the Origin, Nature and Testing of Lubricants, Their Selection and Use. By T. C. Thomsen, B Sc. (Copenhagen), M I Mech E, formerly chief engineer of the Vacuum Oil Co., Ltd., London 607 pp., 6 x 9, illustrated. Published by McGraw-Hill Book Co., Inc., 239 West 39th St., New York, N. Y.

Mr. Thomsen has written a most comprehensive treatise on lubrication in all its phases and there is no doubt that the men he hopes to reach, according to his preface, will benefit from a careful study of his work. Those mentioned in this category are mechanical and electrical engineers in charge of plant and lubrication, and general consulting engineers, engine builders, oil chemists and manufacturers and chemists employed by oil consumers. There is a British flavor to Mr. Thomsen's book and consequently some American readers may be puzzled for the moment by some of his expressions, but the work as a whole reflects his cosmopolitan experience.

The following chapter headings give a good idea of the scope of the book: I, Mineral Lubricating; II, Fixed Oils and Fats; III, Semi-solid Lubricants; IV, Solid Lubricants; V, Testing Lubricants; VI, The Laws of Friction; VII, Lubricating Appliances; VIII, Bearings; IX, Ring Oiling Bearings; X, Electric Generators and Motors; XI Plain Thrust Bearings; XII, Ball and Roller Bearings; XIII, Steam Turbines; XIV, Bearing Lubrication of Stationary Open Type Steam Engines; XV, Bearing Lubrication of High-Speed Enclosed Type Steam Engines; XVI, Crank Chamber Explosives; XVII, Bearing Lubrication of Marvel Steam Engines; XVIII, Railway Roller Stock; XIX Electric Street and Rail Cars; XX, Transmission Shafting; XXI, Machine Tools; XXII, Textile Machinery; XXIII, Mine Car Lubrication; XXIV, Steam Engines, Cylinders and Valves; XXV, Blowing Engines and Air Compressors; XXVI, Refrigerating Machines; XXVII, Gas Engines; XXVIII, Gasoline Engines; XXIX, Kerosene Oil Engine and Semi-Diesel Engines; XXX, Diesel Engines; XXXI, Brief Notes on the Lubrication of Various Works and Machinery; XXXII, Oil Recovery and Purification; XXXIII, Oil Storage and Distribution; XXXIV, Cutting Lubricants and Coolants; XXXV, Static Electrical Transformers and Oil Filled Switches.

Elements of Engineering Thermodynamics. By James A. Moyer, Director of the Massachusetts Department of University Extension; James P. Calderwood, Professor of Mechanical Engineering in the Kansas State Agricultural College; and Andrew A. Potter, Dean of Engineering at Purdue University. 216 pp. 6 x 9, illustrated by drawings and diagrams. Published by John Wiley and Sons, Inc., 432 Fourth Ave., New York, N. Y.

This is a text-book for engineering schools and colleges and is well adapted for such needs. It is an enlargement of Moyer and Calderwoods's "Engineering Thermodynamics," most of the new material having been supplied by Dean Potter. The subject material is treated under ten chapter headings as follows: I, Thermodynamic Principles and Definitions; II, Properties of Perfect Gases; III, Expansion and Compression of Gases; IV, Cycles of Heat Engines Using Gas; V, Properties of Vapors; VI, Entropy; VII, Expansion and Compression of Vapors; VIII, Cycles of Heat Engines using Vapors; IX, Flow of Fluids; X Applications of Thermodynamics to Compressed Air and Refrigerating Machinery.

Forthcoming Meetings

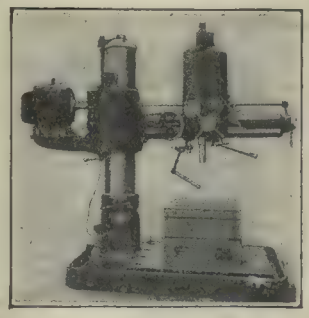
The American Institute of Weights and Measures will hold its annual meeting at 2.30 p.m. in the United Engineering Societies Building 29 West 39th St., New York, Dec. 10, 1920.

The Society of Automotive Engineers will hold its annual meeting on Jan. 11 to 13 inclusive at New York.

Condensed-Clipping Index of Equipment

Patented Aug. 20, 1918

Drilling Machine, Radial, 4-Ft., Motor-Driven
Alfred Herbert, Ltd., Coventry, England.
"American Machinist" (European Edition), Sept. 4, 1920



The motor of this machine is so mounted as to balance the arm; the drive is by a shaft which is a prolongation of the motor spindle. Specifications: Capacity, 2⅜ in. in diameter in cast iron and 2¼ in. in steel. Speeds, 16, ranging from 28 to 547 r.p.m. Feeds, 6, from 31 to 140 rev. per inch. Maximum and minimum spindle distances from baseplate, 5 ft. and 3 in. respectively. Traverse: arm on column, 2 ft. 8 in.; saddle on arm, 3 ft. 2 in.; spindle, 15 in. Minimum distance from spindle to column, 12 in. Spindle hole, No. 5 Morse taper. Baseplate, 4 ft. 4 in. x 3 ft. Floor space, 12 ft. 4 in. x 10 ft. 4 in. Height, 10 ft. 6 in. Weight, 7,500 lb.

Broaching Machine, "Vickers"
Charles Churchill & Co., Ltd, London, E. C., England.
"American Machinist" (European Edition), Sept. 4, 1920



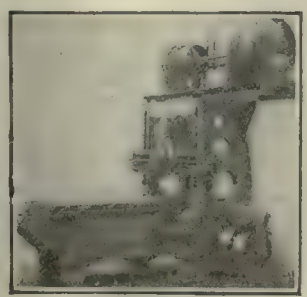
This machine has a capacity for keyways up to 1⅝ in. wide and to broach 3¼-in. square holes, the working length of the stroke being 54 in. The cutting speeds are 3 ft. and 6 ft. per minute with return at 35 ft. per minute. The thrust is taken on a roller bearing and the driving screw is 2⅜ in. in diameter by ½-in. pitch, the nut being 9½ in. long. The hole in the faceplate is 6 in. in diameter and the drawhead has a vertical adjustment of 2 in. The length of the stroke can be varied. A 7½-hp. motor is recommended; the floor space is 12 ft. 9 in. x 2 ft., and the weight of the machine, 2,410 lb.

Lathe, Gap, 7½-In. Center, with Quick-Change Feed Box
Colchester Lathe Co., Colchester, England.
"American Machinist" (European Edition), Sept. 4, 1920



This lathe swings work 15 in. in diameter over the bed, 10⅜ in. in diameter over the saddle and 26 in. in diameter by 7 in. wide over the gap. With a 7-ft. bed it admits 3 ft. 2 in. between centers. The bed is 11⅜ in. wide by 8½ in. deep. The spindle is bored 2 1/16 in. in diameter to admit a 2-in. rough bar. The lead screw is of ½-in. pitch. The feed box gives 32 thread pitches, ranging from 4 to 60 to the inch, and 32 feeds, ranging from 8 to 120 cuts to the inch. A two-speed countershaft is employed. Weight, 27 cwt.

Planer with Improved Belt-Striking Gear
Cunliffe & Croom, Ltd., Manchester, England.
"American Machinist" (European Edition), Sept. 4, 1920



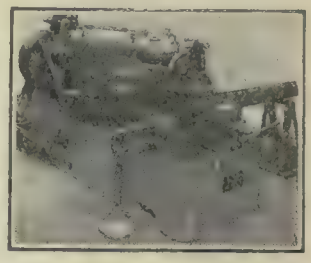
This planer is 6 ft. x 2 ft. 6 in. x 2 ft. 6 in.; the bed is 9 ft. long. The table is 6 ft. x 2 ft. and is traversed in both directions through the same train of gears, the return speed being 2.6 times the cutting speed. This ratio is obtained by suitable pulleys on the countershaft. The self-acting vertical travel of the tool is 7 in. The feed motion is obtained from a rack operated by a friction disk at the side of the machine. The cross-slide is raised or lowered by hand. The machine embodies improved rotary striking motion for reversing the belts silently and without shock.

Gear Generator, Spur
D. Brown & Sons, Ltd., Lockwood, Huddersfield, England.
"American Machinist" (European Edition), Sept. 4, 1920



The blank is mounted in this machine on a horizontal table while the cutter is mounted on a reciprocating vertical slide. The cutter has both reciprocating and rotary motions and as its angular velocity is the same as that of the gear blank the process of cutting the gear is one of generation. Capacity, external gears up to 18 in. in diameter by 6 in. face; internal gears up to 24 in. in diameter by 6 in. face; both cases up to 1¼ in. circular pitch or 2½ d.p. Only one cutter is necessary for generating a complete range of gears of any one pitch.

Sawing Machine, Circular, Cold
Alfred Herbert, Ltd., Coventry, England.
"American Machinist" (European Edition), Sept. 4, 1920



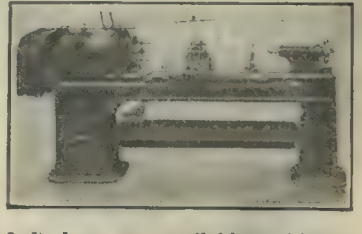
A special feature of this machine is a mechanical chip remover. The machine will cut round bars 6 in. in diameter, squares, 5½ in., and rectangles, 10 x 5 in., or equivalent. The saw is 20½ in. in diameter and has inserted teeth 1/16 in. wide. It runs at 12 r.p.m. The drive is by fast and loose pulleys, 22 in. in diameter for a 3¾-in. belt, and a bracket carries these pulleys and the belt-shifting mechanism. Floor space, 7 ft. 7 in. x 5 ft. 2 in. Weight, 3,360 lb.

Lathe, Combination Turret and Capstan, All-Geared, 7-In.
H. W. Ward & Co., Ltd, Birmingham, England.
"American Machinist" (European Edition), Sept. 4, 1920



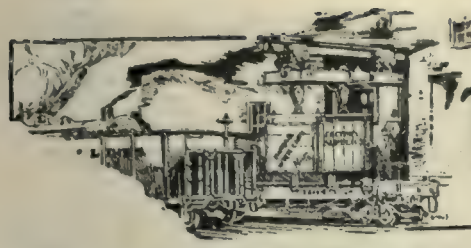
The headstock of this lathe has eight spindle speeds, with reversing motion to all. The spindle has a 2⅛-in. bore and the nose is threaded to take a patented or ordinary jaw chuck. The saddle has automatic sliding, surfacing and screw cutting motions, with stops, beside the usual hand motions. A quick-withdraw motion is provided in the saddle, whereby the nut is withdrawn from the lead screw and is applicable either to internal or external threading. The capstan rest is of the usual form and has ten automatic feeds.

Lathe, Screw-Cutting, Automatic
J. Lang & Sons, Ltd, Johnstone, England.
"American Machinist" (European Edition), Sept. 4, 1920



This lathe has a patent bed, and headstock. The tailstock can be set over for taper-turning. The bed is 11¼ in. wide on the face and 10⅜ in. on the body and if 6 ft. long admits 2 ft. 4 in. between centers. The height of centers is 6¼ in. The lathe is supplied with an adjustable roller stay and a duplex driver. The machine will swing 4 in. in diameter clear of the slides, and is suitable for threads up to 1/16 in. depth. Beds 6 ft. and 8 ft. long are available; with the smaller, the floor space occupied is 6 ft. by 2 ft. 8 in. and the total finished weight, 26 cwt.

Clip, paste on 3 x 5-in. cards and file as desired



THE WEEKLY PRICE GUIDE

IRON AND STEEL

PIG IRON—Quotations compiled by The Matthew Addy Co.:

CINCINNATI	Current	One Year Ago
No. 2 Southern	$46.50	$30.35
Northern Basic	40.00	27.55
Southern Ohio No. 2	47.00	28.55
NEW YORK—TIDEWATER DELIVERY		
2X Virginia (Silicon 2.25 to 2.75)	52.40	32.40
Southern No. 2 (Silicon 2.25 to 2.75)	49.16	35.20
BIRMINGHAM		
No. 2 Foundry	42.00	29.25
PHILADELPHIA		
Eastern Pa., No. 2x, 2.25-2.75 sil.	46.00	29.00-30.00
Virginia No. 2	46.25	33.10
Basic	44.00	26.75
Grey Forge	45.50	26.75
CHICAGO		
No. 2 Foundry local	45.00	26.75
No. 2 Foundry, Southern	48.67	28.00
PITTSBURGH, INCLUDING FREIGHT CHARGE FROM VALLEY		
No. 2 Foundry	44.00	28.15
Basic	38.00	27.15
Bessemer	42.00	29.35

* F.o.b. furnace. † Delivered.

STEEL SHAPES—The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses at the cities named:

	New York Current	New York One Month Ago	New York One Year Ago	Cleveland Current	Cleveland One Year Ago	Chicago Current	Chicago One Year Ago
Structural shapes	$3.80	$4.15	$3.47	$3.58	$3.37	$3.58	$3.47
Soft steel bars	3.70	4.15	3.37	3.34	3.27	3.48	3.37
Soft steel bar shapes	3.70	4.15	3.37	3.48	3.27	3.48	3.37
Soft steel bands	4.65	5.50	4.07	6.25			
Plates, ¼ to 1 in. thick	4.00	4.15	3.67	3.78	3.57	3.78	3.67

BAR IRON—Prices per 100 lb. at the places named are as follows:

	Current	One Year Ago
Mill, Pittsburgh	$4.25	$2.77
Warehouse, New York	4.75	3.37
Warehouse, Cleveland	3.52	3.27
Warehouse, Chicago	4.12	3.37

SHEETS—Quotations are in cents per pound in various cities from warehouse; also the base quotations from mill:

Blue Annealed	Large Mill Lots Pittsburgh	New York Current	New York One Year Ago	Cleveland	Chicago
No. 10	3.55-4.50	5.90@6.15	4.57	5.50	6.13
No. 12	3.60-4.55	5.95@6.20	4.62	5.55	6.18
No. 14	3.65-4.60	6.00@6.25	4.67	5.60	6.23
No. 16	3.75-4.70	6.10@6.35	4.77	5.70	6.33
Black					
Nos. 18 and 20	4.20-5.35	7.65@8.00	5.30	6.30	6.90
Nos. 22 and 24	4.25-5.40	7.70@8.05	5.35	6.35	6.95
No. 26	4.30-5.45	7.75@8.10	5.40	6.40	7.00
No. 28	4.35-5.50	7.85@8.20	5.50	6.50	7.10
Galvanized					
No. 10	4.70-6.00	8.05@8.25	5.75	6.75	7.25
No. 12	4.80-6.10	8.15@8.25	5.85	6.83	7.30
No. 14	4.80-6.10	8.15@8.35	5.85	6.85	7.45
Nos. 18 and 20	5.10-6.40	8.40@8.65	6.15	7.15	7.75
Nos. 22 and 24	5.25-6.55	8.55@8.80	6.30	7.30	8.15
No. 26	5.40-6.70	8.70@8.95	6.45	7.45	8.30
No. 28	5.70-7.00	9.00@9.25	6.75	7.75	8.60

Acute scarcity in sheets, particularly black, galvanized and No. 16 blue enameled. Automobile sheets are unavailable except in fugitive instances, when prices are 9.45c per lb. for No. 16; 9.50 for Nos. 18 and 20, and 9.55c for Nos. 22 and 24.

COLD FINISHED STEEL—Warehouse prices are as follows:

	New York	Chicago	Cleveland
Round shafting or screw stock, per 100 lb. base	$5.50	$5.80	$5.50
Flats, square and hexagons, per 100 lb. base	6.00	6.30	6.00

DRILL ROD—Discounts from list price are as follows at the places named:

	Per Cent.
New York	50
Cleveland	50
Chicago	50

NICKEL AND MONEL METAL — Base prices in cents per pound F. O. B. Bayonne, N. J.

Nickel	
Ingot and shot	43
Electrolytic	45

Monel Metal			
Shot and blocks	35	Hot rolled rods (base)	42
Ingots	38	Cold rolled rods (base)	56
Sheet bars	40	Hot rolled sheets (base)	55
Special Nickel and Alloys			
Malleable nickel ingots	45		
Malleable nickel sheet bars	47		
Hot rolled rods, Grades "A" and "C" (base)	60		
Cold drawn rods, grades "A" and "C" (base)	72		
Copper nickel ingots	42		
Hot rolled copper nickel rods (base)	52		
Manganese nickel hot rolled (base) rods "D" — low manganese	64		
Manganese nickel hot rolled (base) rods "D"— high manganese	67		

Domestic Welding Material (Swedish Analysis)—Welding wire in 100-lb lots sells as follows, f. o. b. New York: 5/32, 8½c. per lb.; ¼, 8c.; 5/16 to ½, 7½c Domestic iron sells at 12c. per lb.

MISCELLANEOUS STEEL—The following quotations in cents per pound are from warehouse at the places named:

	New York Current	Cleveland Current	Chicago Current
Openhearth spring steel (heavy)	7.00	8.00	9.00
Spring steel (light)	10.00	11.00	12.00
Coppered bessemer rods	9.00	8.00	6.75
Hoop steel	6.00	4.54	5.32
Cold-rolled strip steel	12.50	8.25	10.75
Floor plates	6.25	4.00	6.63

WROUGHT PIPE—The following discounts are to jobbers for carload lots on the Pittsburgh basing card:

Inches	Steel Black	Steel Galvanized	Inches	Iron Black	Iron Galvanized
BUTT WELD					
¼ to 3	54–57½%	41½–44%	⅛	15½–25½%	+1½–11½%
			¼	19½–29½%	1½–11½%
			⅜ to 1¼	24½–34½%	8 –18½%
LAP WELD					
2	47 –50½%	34½–38%	1½		
2½ to 6	50 –53½%	37½–41%	1⅝		
7 to 12	47 –50½%	33½–37%	2	20½–28½%	6½–14½%
13 to 14	37½–41 %		2½ to 6	22½–30½%	9½–17½%
15	35 –38½%		7 to 12	19½–27½%	6½–14½%
BUTT WELD, EXTRA STRONG PLAIN ENDS					
¼ to 1¼	52 –55½%	39½–43%	⅜ to 1¼	24½–34½%	9½–19½%
2 to 3	53 –56½%	40½–44%			
LAP WELD, EXTRA STRONG PLAIN ENDS					
2	45 –48½%	33½–37%	1½		
2½ to 4	48 –51½%	36½–40%	1⅝		
4½ to 6	47 –50½%	35½–39%	2	21½–29½%	8½–16½%
7 to 8	43 –46½%	29½–33%	2½ to 4	23½–31½%	11½–19½%
9 to 12	38 –41½%	24½–28%	4½ to 6	22½–30½%	10½–18½%
			7 to 8	14½–22½%	2½–10½%
			9 to 12	9½–17½%	5½–+2½%

	New York Black	New York Galv.	Cleveland Black	Cleveland Galv.	Chicago Black	Chicago Galv.
⅛ to 3 in. steel butt welded	38%	22%	39%	30%	54@40%	40½@30 %
2½ to 6 in. steel lap welded	33%	18%	41%	26%	50@40%	37½@27½%

Malleable fittings. Classes B and C, banded, from New York stock sell at plus 45%. Cast iron, standard sizes, plus 5%.

METALS

MISCELLANEOUS METALS—Present and past New York jobbers' quotations in cents per pound, in quantities up to car lots:

	Current	Month Ago	Year Ago
Copper, electrolytic	15.00	15 50	22.50
Tin in 5-ton lots	34 50	38 75	56.50
Lead	6 25	6 75	6.25
Zinc	7.00	7 00	7.60
ST. LOUIS			
Lead	6.25	7 25	6.00
Zinc	6.75	6.25	7.15

At the places named, the following prices in cents per pound prevail, for 1 ton or more:

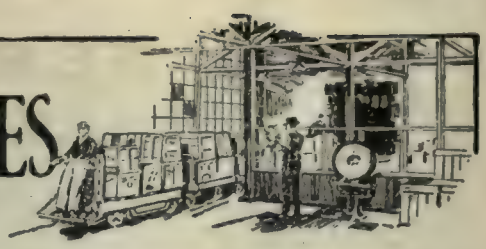
	New York Current	New York Month Ago	New York Year Ago	Cleveland Current	Cleveland Year Ago	Chicago Current	Chicago Year Ago
Copper sheets, base	22.50	23.50	33.50	26.50@29.00	35.50	36.00	36.50
Copper wire (carload lots)	20.00	20.00	30.75	24.00	30.50	29.00	26.00
Brass sheets	22.25	28.50	32.00	28.00	33.00	27.00	28.00
Brass pipe	25.00	28.00	36.00	30.00	39.00	34.00	37.00
Solder (half and half) (case lots)	27.75	29.00	45.00	29.00	41.00	38.00	38.50

Copper sheets quoted above hot rolled 24 oz., cold rolled 14 oz. and heavier, add 2c.; polished takes 5c. per sq.ft. extra for 20-in. widths and under; over 20 in., 7½c.

BRASS RODS—The following quotations are for large lots, mill. 500 lb. and over, warehouse; net extra:

	Current	One Year Ago
Mill	18.25	24.00
New York	19.50	28.00@29.75
Cleveland	25.00	29.00
Chicago	30.00	27.00

SHOP MATERIALS AND SUPPLIES



ZINC SHEETS—The following prices in cents per pound are f.o.b. mill + less 8% for carload lots 11.50

	Warehouse			
	—In Casks—		— Broken Lots —	
	Current	One Year Ago	Current	One Year Ago
Cleveland	15.30	12.50	14.70	13.00
New York	14.00	11.50	14.50	12.50
Chicago	14.50	16.50	14.95	16.00

ANTIMONY—Chinese and Japanese brands in cents per pound, in ton lots for spot delivery, duty paid:

	Current	One Year Ago
New York	6.50	9.50
Chicago	7.25	9.75
Cleveland	7.50	9.75

OLD METALS—The following are the dealers' purchasing prices in cents per pound:

	*New York			
	Current	One Year Ago	Cleveland	Chicago
Copper, heavy, and crucible	12.00	17.00	10.00	11.50
Copper, heavy, and wire	11.50	16.00	9.50	11.00
Copper, light, and bottoms	10.00	14.00	9.00	10.00
Lead, heavy	5.00	4.75	4.50	5.25
Lead, tea	4.00	3.75	3.00	4.00
Brass, heavy	7.00	10.50	7.00	11.25
Brass, light	5.50	7.50	5.00	6.00
No. 1 yellow brass turnings	7.00	10.00	5.50	6.00
Zinc	4.50	5.00	3.50	4.50

*These prices nominal because of dull market

ALUMINUM—The following prices are from warehouse at places named:

	New York	Cleveland	Chicago
No. 1 aluminum, 98 to 99% pure, in ingots for remelting (1-15 ton lots), per lb	$33.00	$26.00	$33.50

COPPER BARS—From warehouse sell as follows in cents per pound, for ton lots and over:

	Current	One Year Ago
New York (round)	28.00	32.00
Chicago	29.00	31.00
Cleveland	27.00	35.00

BABBITT METAL—Warehouse price per pound:

	—New York—		—Cleveland—		— Chicago —	
	Current	One Year Ago	Current	One Year Ago	Current	One Year Ago
Best grade	70.00	90.00	47.00	70.00	45.00	60.00
Commercial	30.00	50.00	18.00	16.50	11.00	13.00

NOTE—Price of babbitt metal is governed largely by formula, no two manufacturers quoting the same prices. For example, in New York we quote the best two grades, although lower grades may be obtained at from $16 to $20.

SHOP SUPPLIES

NUTS—From warehouse at the places named, on fair-sized orders, the following amount is deducted from list:

	— New York —		— Cleveland —		— Chicago —	
	Current	One Year Ago	Current	One Year Ago	Current	One Year Ago
Hot pressed square	+$1.25	$1.50	List net	$2.25	+1.15	1.85
Hot pressed hexagon	+ 1.25	1.50	List net	2.25	+1.15	1.85
Cold punched hexagon	+ 1.25	1.50	List net	2 25	+1.15	1.30
Cold punched square	+ 1.25	1.50	List net	2 25	+1.15	1.30

Semi-finished nuts, ⅝ and smaller, sell at the following discounts from list price:

	Current	One Year Ago
New York	30%	50–10%
Chicago	40%	50%
Cleveland	50%	55%

MACHINE BOLTS—Warehouse discounts in the following cities:

	New York	Cleveland	Chicago
½ by 4 in. and smaller	+10%	30%	20%
Larger and longer up to 1½ in. by 30 in.	Net list	30%	10%

WASHERS—From warehouses at the places named the following amount is deducted from list price:

For wrought-iron washers:
New York ..... list Cleveland ..... $2.50 Chicago $1.90

For cast-iron washers, ⅜ and larger, the base price per 100 lb. is as follows:
New York ..... $7.00 Cleveland ..... $4.50 Chicago $5.50

CARRIAGE BOLTS—From warehouses at the places named the following discounts from list are in effect:

	New York	Cleveland	Chicago
½ by 6 in. and smaller	+ 20%	30%	20%
Larger and longer up to 1 in. by 30 in.	+ 20%	25%	15%

COPPER RIVETS AND BURS sell at the following rate from warehouse:

	Rivets		Burs	
	Current	One Year Ago	Current	One Year Ago
Cleveland	25%	20%	10%	10%
Chicago	net	20%	net	20%
New York	30%	40%	net	20%

RIVETS—The following quotations are allowed for fair-sized orders from warehouse:

	New York	Cleveland	Chicago
Steel ⅞ and smaller	20%	40–5%	30%
Tinned	20%	40–5%	30%

Boiler, ½, ⅝, 1 in. diameter by 2 to 5 in. sell as follows per 100 lb.:
New York ..... $6.00 Chicago ..... $5.73 Pittsburgh $4.50

Structural, same sizes:
New York ..... $7.10 Chicago ..... $5.83 Pittsburgh $4.60

MISCELLANEOUS

SEAMLESS DRAWN TUBING—The base price in cents per pound from warehouse in 100-lb. lots is as follows:

	New York	Cleveland	Chicago
Copper	$26 00	33.00	35.00
Brass	25.00	30.00	34.00

The prices, of course, vary with the quantity purchased. For lots of less than 100 lb., but not less than 75 lb., the advance is 1 c.; for lots of less than 75 lb., but not less than 50 lb., 2½c. over base (100-lb. lots); less than 50 lb., but not less than 25 lb., 5c. should be added to base price; quantities from 10-25 lb., extra is 10c.; less than 10 lb., add .15-20c.

Double above extras will be charged for angles, channels and sheet metal mouldings if ordered in above quantities. Above extras also apply to brass rod other than standard stock sizes—stock sizes being considered as ⅛-2 in. inclusive in rounds, and ⅛-1½ in., inclusive, in square and hexagon—all varying by thirty seconds up to 1 in. by sixteenths over 1 in. On shipments aggregating less than 100 lb., there is usually a boxing charge of $1.50.

LONG TERNE PLATE—In Chicago No. 28 primes from stock sell, nominally, for $9.85 per 100 lbs.

In Cleveland—$10 per 100 lbs.

COTTON WASTE—The following prices are in cents per pound:

	New York			
	Current	One Year Ago	Cleveland	Chicago
White	15.00@17.00	13.00	15.00	15.00@17.00
Colored mixed	9.00@14.00	9.00–12.00	11.00	11.00@13.00

WIPING CLOTHS—Jobbers' price per 1000 is as follows:

	13½x13½	13½x20½
Cleveland	55.00	65.00
Chicago	41.00	43.50

SAL SODA sells as follows per 100 lb.:

	Current	One Month Ago	One Year Ago
New York	$2.00	$2.00	$1.75
Philadelphia	2.75	2.75	1.75
Cleveland	3.00	3.00	2.50
Chicago	2.00	2.75	2.00

ROLL SULPHUR in 360-lb. bbl. sells as follows per 100 lb.:

	Current	One Month Ago	One Year Ago
New York	$3.50	$3.90	$3.65
Philadelphia	3.65	3.65	3.87
Chicago	4.10	5.00	4.12½

COKE—The following are prices per net ton at ovens, Connellsville:

	December 6	November 29	November 22
Prompt furnace	$ 8.00@$10.00	8.00@$10.50	$11.50@$12.00
Prompt foundry	10.00@ 12.00	10.00@ 12.00	12.50@ 13.00

FIRE CLAY—The following prices prevail:

		Current
Ottawa, bulk in carloads	Per Ton	$8.00
Cleveland	100-lb. bag	1.00

LINSEED OIL—These prices are per gallon:

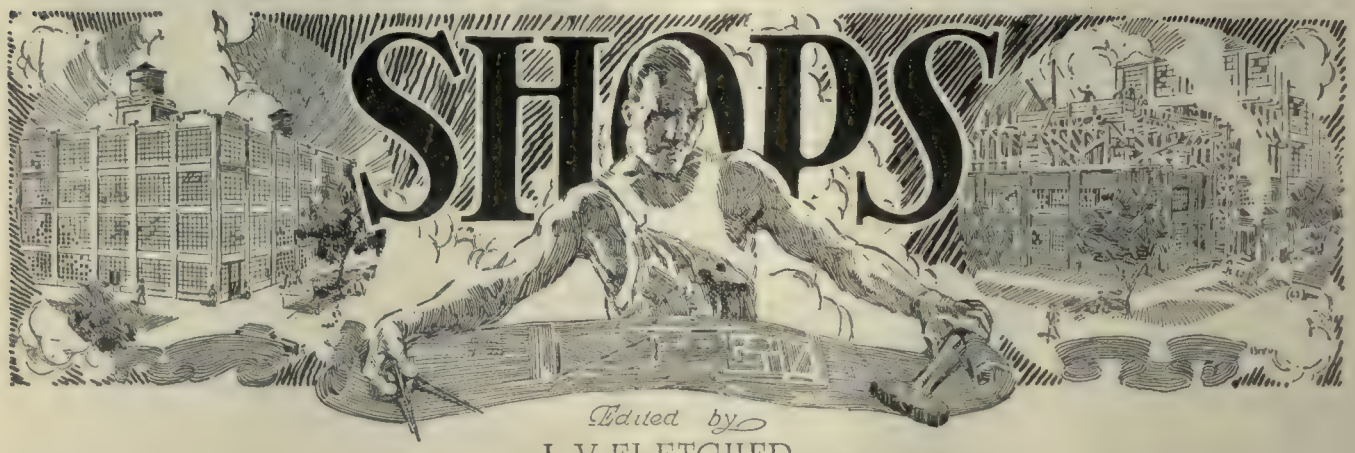
	—New York—		—Cleveland—		—Chicago—	
	Current	One Year Ago	Current	One Year Ago	Current	One Year Ago
Raw in barrels, (5 bbl. lots)	$0.90	$2.15	$1.05	$2.50	$0.97	$2.37
5-gal cans	1.05	2.30	1.30	2.75	1.22	2.57
1-gal cans (6 to case)	1.15	....	....	....	....	....

WHITE AND RED LEAD—Base price per pound:

	Red				White	
	Current		One Year Ago		Current	One Year Ago
	Dry	In Oil	Dry	In Oil	Dry and In Oil	Dry and In Oil
100 lb. keg	14.25	15.75	13.00	14.50	14.25	13 00
25 and 50-lb. kegs	14.50	16.00	13.25	14.75	14.50	13 [illegible]
12½-lb. keg	14.75	16.25	13.50	15.00	14.75	13.50
5-lb. cans	17.25	18.75	15.00	16.50	17.25	15.00
1-lb. cans	19.25	20.75	16 00	17.50	19.25	16.00

500 lb. lots less 1% discount. 2000 lb. lots less 10–20½% discount.

NEW *and* ENLARGED



Edited by
L·V·FLETCHER

Machine Tools Wanted

If in need of machine tools send us a list for publication in this column

D. C., Washington—The Bureau of Supplies & Accounts, Machinery Div., Navy Dept.—machine tool equipment for a new submarine destroyer.

N. Y., New York (Borough of Manhattan)—The International Nickel Co., 43 Exch. Pl.—automatic polishing machine for monel metal sheets.

N. Y., Schenectady—The General Electric Co., River Rd.—1 boring mill and 1 drill for its plant at Lynn, Mass.

Pa., Harrisburg—The Belmont Motors Corp., 29 North 2d St.—an adjustable spindle cylinder boring machine.

Pa., Philadelphia—J. G. Boggs, 1910 North 4th St.—one lathe with a 26 in. swing and one lathe with a 32 in. swing.

Pa., Philadelphia—The Pennsylvania Wire Glass Co., Pennsylvania Bldg.—machine tools.

Pa., Redington—The Redington Standard Fittings Co.—9 turret lathes, one 3 ft. radial drill, one 36 in. Bullard vertical boring mill and one No. 12 Grand Rapids grinder.

Va., Richmond — The Amer. Glass Co., Broad and Meadow Sts., C. F. Sauers, Purch. Agt.—lathe and drill press.

Va., Richmond—The Reed Tobacco Co., 21st St., W. F. Reed, Purch. Agt.—machine shop equipment.

Va., Richmond—The Virginia Machinery Well Co., 1319 East Main St.—portable pipe threading machine 4½ to 8 in. and 4½ to 6 in.

Ill., Chicago—The Chicago Metal Mfg. Co., 313 South Clinton St.—metal working equipment including tumbling barrel and nickel plating equipment, etc.

Ind., Connersville—T. A. Parey, 917 Conwell St.—complete machine shop equipment for modern machine shop practice.

Ind., Indianapolis—The Lafayette Motors Co—one horizontal boring mill, 18 in bed.
Two 42 in. x 8 in. table, 6 heads, planer type milling machine.
One 36 in. x 8 in. table, 6 heads, planer type milling machine.
One 24 in. or 28 in. lathe, 10 ft. bed.
Two vertical milling machines.
One horizontal milling machine No. 2.
Two 3 in. radial drill press with tapping attachment.
One 3 in. x 1½ in. radial drill press with tapping attachment.
One radial tapping machine.
One 22 spindle mill type spindle drilling machine.
One sensitive radial drill.
One 30 spindle multiple spindle drill press.
One 16 spindle rail drill.

Wis., Sheboygan— The Wald Mfg. Co., 18th St. and Martin Ave.—one ⅜ in. x 13 gauge or 38 in. x 15 gauge.

Mich., Detroit—The Amer. Machine Products Co., Howard and 18th Sts.—general machine tool equipment.

Mich., Detroit — The Curran Detroit Radiator Co., 558 Lafayette Blvd.—miscellaneous machine equipment for the manufacture of radiators.

Mich., Detroit—The Street Ry. Comn., 410 City Hall, c/o G. J. Finn, Comr. of Purchases & Supplies, Municipal Courts Bldg.—2 reciprocating rail grinding machines and 2 rotary grinders.

Mich., Detroit—The Zenith Fdry. Co., Miller Ave.—foundry equipment.

Wis., Boscobel—G. L. Hunt Mfg. Co., manufacturers of gear pulling devices, E. Spiegelburg, Purch. Agt.—machine tools.

Wis., Eagle River—F. J. Thrun—machirne shop equipment.

Wis., Janesville—The Bower City Machine Co., 211 East Milwaukee St., W. St. Clair, Purch. Agt.—machinery for auto truck repairs.

Wis., Milwaukee — The Amer. Rotator Valve Co., 9th and Chestnut Sts., H. Davischefsky, Purch. Agt.—drill presses, lathes and millers.

Wis., Milwaukee—The Wisconsin Bed Spring Co., 968 Oakland Ave.—additional wire-working machinery.

Ia., Ottumwa—The Wilson Tractor Mfg. Co., 210 East Main St.—milling machines and drill presses.

Ia., Yale—E. W. Child—one used bulldozer.

Que., Montreal—The United Press Co., Notre Dame St., W.—equipment for its proposed plant.

Que., Quebec City—P. A. Beaulieu, 37 Bourlarque St.—$19,000 worth of equipment for his proposed brass foundry.

Machinery Wanted

Conn., Bridgeport — The Connecticut Marine Boiler Wks., foot of Pembroke St.—1 traveling crane with a span of 12 to 20 ft. and a capacity of 6 tons.

Md., Emmitsburg — The Liberty Roller Mills—flour mill machinery to have a daily capacity of 40 bbl.

N. J., New Brunswick—The Arctic Ice Co., 56 French St.—ice machinery, etc.

N. Y., New York (Borough of Brooklyn)—The State Hospital Comn., Capitol, Albany, will receive bids until Dec. 15 for furnishing equipment for the laundry building at the Brooklyn State Hospital, here. Estimated cost, $25,000. L. F. Pilcher, State Archt.

Pa., Chester—The Chester Shipping Co.—one 10 ton steel jib crane.

Pa., Erie—K. O. Schulte, 525 French St., representative for several large manufacturing concerns in Germany, is in the market for the very best and most up-to-date line of machinery and tools for the manufacture of hay and manure forks, wooden handles for forks, ferrules for forks, cotter pins, taper pins, washers, finished and unfinished, and screw machine parts.

Pa., Lewistown—The Pennsylvania Wire Glass Co., Pennsylvania Bldg.—equipment for the manufacture of glass.

Pa., Reading—The W. G. Hollis Candy Mfg. Co., c/o F. Muhlenberg, Archt., Flanders Bldg.—machinery for the manufacture of candy.

Ga., Savannah—The Georgia Ice Co., A. M. Dixon, P. O. Box 1352, Mgr.—100 ton ice making machinery.

Ill., Chicago—The Chicago Wet Wash Laundry, c/o Ronneberg, Pierce & Hauber, Archts., 10 South La Salle St.—laundry equipment.

Ill., Chicago—The Weiland Dairy Co.—dairy machinery.

Mich., Detroit—N. B. Schermerhorn, 65 Moore Pl.—wood turning lathe, medium or large size (used preferred).

O., Cleveland—The Osborn Eng. Co., 2848 Prospect St.—tire making machinery for the plant of the Hudson Tire & Rubber Corp. at Yonkers, N. Y.

O., Columbus—The Crystal Ice Mfg. & Cold Storage Co, 397 West Broad St., C. M. Kinnaird, Genl. Mgr.—coal handling, loading and screening machinery to handle large tonnage.

O., Hooster—The Woodard Machine Co.—one 15 to 30 ton crane with a 40 ft. span or equivalent.

Wis., Jefferson—The Jefferson Rubber Co., C. R. Girton, Purch. Agt.—small traveling crane.

Wis., Kenosha—The Kenosha Ice Cream Co., 493 Elizabeth St.—ice cream and refrigerating machinery.

Wis., Menasha—The Menasha Woodenware Co.—woodworking machinery.

Wis., Oshkosh—The Fuller Goodman Co., City Natl. Bank Bldg., F. A. Fuller, Purch. Agt.—single band-saw mill with horizontal resaw for its planing mill.

Wis., Racine—The Ames Carburetor Co., 1508 Clark St.—1 sand blast machine.

Wis., Rice Lake—S. Hegna and K. Knudson—woodworking machinery.

Okla., Nowata—The Gunther City Coke & Coal Mining Co.—all kinds of machinery used in stripping coal.

Tex., Dallas—The Undertakers Co-operative Casket Mfg. Co., c/o C. F. Weiland Undertaking Co., 517 North Ervay St.—tools for the manufacture of caskets and burial devices.

Que., Montreal—I. Malo, 167 Dufresne St.—$16,000 worth of equipment for refrigeration plant.

Metal Working

NEW ENGLAND

Conn., Hartford—C. H. Leppert, Asylum and Spruce Sts., manufacturers of motors, etc., has awarded the contract for the construction of a 2 story, 41 x 63 ft. plant on Walnut St. Estimated cost, $20,000.

Conn., Windsor—A. W. Lovell has awarded the contract for the construction of a 1 story, 100 x 146 ft. garage on Central St.

Mass., Boston—The T. L. Harkins Machine Co., 44-54 Farnsworth St., plans to build a 2 story, 50 x 100 ft. manufacturing plant on Cambridge St., in the Allston section. Cost between $50,000 and $60,000.

Mass., East Boston (Boston P. O.)—V. Caputo, 121 Liverpool St., has awarded the contract for the construction of a 1 story garage on London St. Estimated cost, $25,000.

Mass., East Walpole—Bird & Son, Inc., plan to build a 1 story, 50 x 200 ft. factory for the manufacture of roofing material, etc. C. T. Main, 201 Devonshire St., Boston, Engr.

Mass., Lynn—A. Attbridge, Marblehead, plans to build a 1 story, 70 x 82 ft. garage on Chestnut St., here. Estimated cost, $35,000. E. E. Earp, 333 Union St., Archt.

Mass., Lynn—S. Ragosa, 16 Whiting St., will build a 1 story garage on Sheppard St. Estimated cost, $20,000.

Mass., South Boston (Boston P. O.)—Sampson & Coleman, 10 Hawley Blvd., Boston, will soon award the contract for the construction of a 1 story, 35 x 115 ft. garage on East 1st St., here. Estimated cost, $25,000. S S. Eisenberg, 15 Court Sq., Boston, Archt.

Mass., Worcester—N. Nore, 338 Plantation St., will build a 1 story garage on Pond St. Estimated cost, $10,000.

Mass., Worcester—Sleeper & Hartley, Inc., 335 Chandler St., plans to build a 1, 2 or 3 story addition to its wire-manufacturning plant on Chandler St.

R. I., Auburn—The General Fire Extinguisher Co., 275 West Exchange St., Providence, has awarded the contract for the construction of a 2 story, 44 x 60 ft. addition to its manufacturing plant. Estimated cost, $25,000.

R. I., Providence—The Autocar Sales & Service Co., 302 Pearl St., has awarded the contract for the construction of a 3 story, 46 x 79 ft. service station and sales building on Pearl and Rice Sts. Estimated cost, $50,000.

MIDDLE ATLANTIC STATES

Md., Baltimore — The Metal Package Corp., Wolfe and Thames Sts., has had plans prepared for the construction of a tinplate and lithographing plant.

Md., Baltimore—M. Resvito, Gwynn Oak and Liberty Heights Aves., will build a 1 story garage. Estimated cost, $7,000.

N. Y., New York (Borough of Bronx)—The Spring St. Garage Co., c/o F. J. Schefeick, Archt. and Engr., 4168 Park Ave., New York City, will build a 1 story, 100 x 225 ft. garage on Fordham Rd. and Hughes Ave. Estimated cost, $50,000. B. Neiburg, Pres.

N. Y., New York (Borough of Brooklyn)—R. Barman, c/o Springsteen and Goldhammer, Engrs. and Archts., 32 Union Sq., New York City, will build a 1 story garage on Coney Island Ave. Estimated cost, $25,000.

N. Y., New York (Borough of Brooklyn)—The E. W. Bliss Co., 17 Adams St., is constructing a 1 story, 50 x 180 ft. addition to its factory on 54th St. near 1st Ave., to be used as a finishing building for electrical motors. Estimated cost, $25,000.

N. Y., New York (Borough of Brooklyn)—R. Dunbar, c/o M. A. Cantor, Archt. and Engr., 371 Fulton St., will build a 1 story, 75 x 125 ft. garage on 17th St. near 3d Ave. Estimated cost, $35,000.

N. Y., New York (Borough of Brooklyn)—J. Polivnick, 267 Barrett St., will build a 2 story, 95 x 95 ft. garage on South 4th St. between Driggs Ave. and Roebling St. Estimated cost, $125,000.

N. Y., Poughkeepsie—The Walter Motor Truck Co., 243 West 61st St., New York City, has awarded the contract for the construction of a 1 story, 100 x 300 ft. factory on Fulton St. Estimated cost, $100,000.

Pa., Philadelphia—D. Montella, 718 Fulton St., has awarded the contract for the construction of a 2 story, 75 x 75 ft. garage at 625 Christian St. Estimated cost, $10,000.

Pa., Philadelphia — The Pennsylvania Sugar Co., 1037 North Delaware St., has awarded the contract for the construction of a 2 story, 50 x 75 ft. machine shop on Delaware and Shackamaxon Sts. Estimated cost, $25,000.

Pa., Pittsburgh — The Pittsburgh Truck Mfg. Co., 609 Neville St., will build a 2 story, 100 x 100 ft. garage and repair shop on 44th St. along the tracks of the Pennsylvania R.R. Estimated cost, $75,000.

Pa., West Brownsville—J. R. Herbertson, Brownsville, will soon award the contract for the construction of a 2 story, 67 x 73 ft. addition to his garage, here. Estimated cost, $50,000. E. R. Johnson, Uniontown, Archt.

Ala., Birmingham—The Continental Gin Co., 3330 10th Ave., has awarded the contract for the construction of a 1 story, 132 x 400 ft. foundry and a 1 story, 100 x 300 ft. machine shop. Estimated cost, $500,000.

Fla., Titusville — The Superior Motor Wks. is building a plant. J. Neff, Supt.

Ky., Louisville—The Kentucky Iron & Steel Co., Jones and N Sts., plans to build a steel plant. Estimated cost, $550,000. R. W. Tietjen, Pres.

Ky., Louisville — The Southern Wood Products Co., c/o L. Klarer, Jr., Secy. and Treas., 106 North Western Parkway, plans to build an auto body plant. Estimated cost, $100,000.

La., New Orleans—The Marine Iron Wks., 1008-1014 Magazine St., plans to construct a 2 story, 75 x 115 ft. building; first floor will be used as a stockroom, machine and forge shop and upper floor will be used for office purposes. Estimated cost, $75,000. A. J. Krail, Vice-Pres.

W. Va., Wheeling—The Wheeling Axle Co. has awarded the contract for the construction of a 2 story axle foundry on 27th St. Estimated cost, $6,500.

MIDDLE WEST STATES

Ill., Chicago—The Union Bed & Spring Co. has awarded the contract for remodeling a 3 story, 125 x 600 ft. warehouse into factory on 44th and Colorado Sts. Estimated cost, $150,000.

Ind., Indianapolis — The Pioneer Brass Wks., 424 South Pennsylvania St., has had plans prepared for the construction of a 1 story, 75 x 175 ft. machine shop. J. H. Brinkmeyer, Pres. C. Brossman, Engr.

Mich., Detroit—The Zenith Fdry. Co., Miller Ave., will soon award the contract for the construction of a 1 story, 90 x 200 ft. foundry. G. W. Graves, 43 John R. St., Archt.

Mich., Holly—The Wright-Fisher Bushing Corp., 3087 East Grand Blvd., Detroit, is building a 36 x 120 ft. plant, here, for drilling and reaming jig bushings. P. W. Wickson, Dir. of Purchases.

O., Cleveland—The Atlas Fdry. Co., 7275 Shaw Ave., has awarded the contract for the construction of a 1 story, 37 x 45 ft. addition to its foundry. Estimated cost, $25,000.

O., Cleveland—P. Kelley, 14408 Euclid Ave., has awarded the contract for the construction of a 1 story, 40 x 60 ft. addition to its laundry at 12408 Euclid Ave. Estimated cost, $10,000.

O., Cleveland—The Keystone Bolt & Nut Mfg. Co., c/o W. Krejci, 502 Ullmer Bldg., plans to build a 2 story, 50 x 100 ft. factory on East 93d St Estimated cost, $75,000. Private plans.

O., Cleveland—G. Myers, c/o H. W. Davis Co., 3400 West 122d St., has awarded the contract for the construction of a 1 story, 50 x 100 ft. garage on West 122d St. and Lorain Ave. Estimated cost, $25,000.

O., Cleveland—The Reliable Auto Top & Fender Co. 4310 Carnegie Ave., has awarded the contract for the construction of a 2 story, 88 x 100 ft garage at 8011 Lake Ave. Estimated cost, $60,000.

O., Cleveland—M. Singer, attorney, Ullmer Bldg., plans to build a 2 story garage and factory on Hamilton Ave. and East 14th St. Estimated cost, $35,000.

O., Warren—The Western Reserve Motor Car Co., Western Reserve Natl. Bank Bldg., has purchased a 200 acre site 3 mi. from here, adjoining the Erie R.R. and the Baltimore & Ohio R.R., and plans to build a plant for the manufacture of high-class automobiles. R. R. Johnson, Pres.

O., Warren — The Youngstown Steel Co. has purchased 425 acres 3 mi. north of here and adjacent to Mahoming Ave., and plans to build a plant for the manufacture of high-grade wrought iron. Estimated cost, $1,000,000. Ultimate cost, $5,000,000. H. Bixler, Realty Trust Bldg., Youngstown. Chief Engr.

Wis., Janesville—The Bowen City Machine Co., 211 East Milwaukee St., has awarded the contract for the construction of a 1 story, 60 x 172 ft. machine shop.

Wis., Milwaukee—P. J. Fischer, 241 Rusk Ave., has awarded the contract for the construction of a 1 story, 45 x 100 ft. garage on Walnut St. Estimated cost, $15,000.

Wis., Milwaukee—The Milwaukee Reliance Boiler Co., 1102 32d St., is having preliminary plans prepared for the construction of a 1 story, 100 x 125 ft. addition to its boiler shop on 32d St. A. D. Koch, Wells Bldg., Archt.

Wis., Milwaukee—The Wisconsin Bed Spring Co., 968 Oakland Ave., plans to build a 1 or 2 story factory.

Wis., Mineral Point—The Fiedler Motor Co., c/o E. C. Fiedler, Proprietor, is having plans prepared for the construction of a 1 and 2 story, 100 x 136 ft. garage on Main and Atwater Sts. Estimated cost, $80,000. H. Kleinhammer, Platteville, Archt.

WEST OF THE MISSISSIPPI

Col., Grand Junction—The Currie Canning Co. plans to rebuild its plant which was recently destroyed by fire. Estimated loss, $70,000.

Ia., Fort Dodge—The International Harvester Co., 606 South Michigan Ave., Chicago, Ill., has awarded the contract for the construction of a 1 story, 80 x 170 ft. motor truck and service station on 21st St. and 1st Ave., here.

Kan., Leavenworth—The United States Government, Quartermaster Dept., will soon award the contract for the construction of a 2 story, 100 x 250 ft. motor repair building. Estimated cost, $400,000. Private plans.

Minn., Albert Lea—C. C. and R. G. Lang plan to build a canning plant, to include a 3 story, 50 x 70 ft. main building and a 50 x 50 ft. corn husking house, etc.

Minn., Minneapolis—The Apt Investment Co., 225 Marquette Ave., will receive bids about Dec. 20 for the construction of a 2 story, 100 x 100 ft. garage on Nicollet Ave. and 19th St. Estimated cost, $50,000. L. C. Apt, Pres. S. J. Bowler, 617 Phoenix Bldg., Archt.

Mo., Kansas City—The White Co., East 79th St. and St. Clair Ave., Cleveland, O., has had plans prepared for the construction of a 3 story, 120 x 144 ft. auto service station on 28th and Warwick Sts. Estimated cost, $250,000. Watson Eng. Co., Hippodrome Bldg., Cleveland, O., Archts. and Engrs.

Mo., St. Louis—The St. Louis Paper Can & Tube Co., 4400 North Union Ave., will soon award the contract for the construction of a 1 story, 100 x 900 ft. factory on Big Bend Rd. along the tracks of the Missouri Pacific R.R. Estimated cost, $100,000.

WESTERN STATES

Wash., Tacoma—The city plans to build a 2 story, 100 x 200 ft. warehouse, supply and shop building for the Light and Water Dept. Estimated cost, $75,000. I. A. Davidson, Comr. of the Light and Water Dept.

CANADA

Que., Montreal—The United Press Co., Notre Dame St. W., plans to build and equip a plant. Estimated cost, $50,000.

Que., Montreal—The Can Welding Co., Amherst St. near Ontario St., plans to build a plant on St. Timothee St. Estimated cost, $60,000.

Que., Quebec City—P. A. Beaulieu, 37 Bourlarque St., will soon receive bids for the construction of a brass foundry. Estimated cost, $50,000.

General Manufacturing

NEW ENGLAND STATES

Mass., Natick—The Griess Pfleger Tanning Co. of Massachusetts, P. O. Box 271, plans to build a large addition to its leather manufacturing plant. Private plans.

Mass., South Boston (Boston P. O.)—The J. West Thread Co., 297 Congress St., Boston, has awarded the contract for the construction of a 3 story, 60 x 100 ft. addition to its thread manufacturing plant on Covington St. Estimated cost, $75,000.

Mass., Worcester—The Grocers Bread Co., 128 Vernon St., has awarded the contract for the construction of a 1 story, 100 x 125 ft. bakery. Estimated cost, $60,000.

R. I., Pawtucket—The Berry Spring Mineral Water Co., 3 Charlton Ave. has awarded the contract for the construction of a 2 story, 40 x 40 ft. addition to its plant. Estimated cost, $15,000.

MIDDLE ATLANTIC STATES

Md., Ameelle (Baltimore P. O.)—The Amer. Cellulose & Chemical Mfg. Co., Ltd., 681 5th Ave., New York City, has awarded the contract for the construction of a 1 story plant, here. Estimated cost, $200,000.

Md., Baltimore—The Duraflex Co., 213 Courtland St., manufacturers of flooring, has an option on an acre tract on Hollins Ferry Rd. and Eutaw St., and has awarded the contract for the construction of a plant. Estimated cost, $10,000. R. Bogiano, Pres. and Treas.

Md., Baltimore—W. E. Hooper & Sons Co., Parkdale Ave., manufacturer of cotton duck, has had plans prepared for the construction of an addition to its machine department

Md., Baltimore—The Maryland School for the Blind, Overlea, has awarded the contract for the construction of a 2 story, 50 x 94 ft. broom factory on Edmondson and Fulton Aves., here. Estimated cost, $30,000.

Md., Emmitsburg—The Liberty Roller Mills will build a 3 story, 30 x 50 ft. flour mill. Estimated cost, including equipment, $10,000. V. H. Bean, R. F. D. No. 3, Prop. and Constr. Engr.

N. J., New Brunswick—The Arctic Ice Co., 56 French St., has awarded the contract for the construction of a 3 story, 50 x 100 ft. storage plant. Estimated cost, $75,000.

N. Y., L. I., Jamaica—The Metropolitan Tobacco Co., 22 Bergen Ave., is having plans prepared for the construction of a 1 story, 80 x 115 ft. factory on Bergen Ave. and Bergen Pl. Estimated cost, $80,000. Koch & Wagner, 32 Court St., Brooklyn, Archts.

N. Y., New York (Borough of Brooklyn)—The Eclipse Box & Lumber Co., 425 Greenpoint Ave. has awarded the contract for the construction of a 1 story, 200 x 300 ft. factory on Russell St. Estimated cost, $100,000.

N. Y., New York (Borough of Brooklyn)—The Forest Box & Lumber Co., c/o Gilbert & Ashfield, Archts and Engrs., 350 Fulton St., has awarded the contract for the construction of a 1 story, 100 x 140 ft. factory at 420 Oakland St. Estimated cost, $50,000.

N. Y., Tonawanda—The Stanley Steel Welded Wheel Corp., 40 Court St., Boston, Mass., has awarded the contract for the construction of a 1 story, 90 x 200 ft. plant for the manufacture of wheels. Estimated cost, $100,000. Noted Oct. 14.

N. Y., Utica—The Utica Spinning Co., Whitesboro St., has awarded the contract for the construction of a 3 story addition to its factory. Estimated cost, $200,000.

N. Y., Yonkers—The Hudson Tire & Rubber Corp., Proctor Bldg., has awarded the contract for the construction of a 3 story factory on Nepperhan Ave. Estimated cost, $300,000. Noted Sept. 16

Pa., Cresson—The Penn Cress Ice Cream Co. has awarded the contract for the construction of a 50 x 90 ft. ice cream plant. Estimated cost, $50,000. Noted Nov. 11.

Pa., East Liberty (Pittsburgh P. O.)—The Reick McJenkin Dairy Co., 1345 Forbes St., Pittsburgh, has awarded the contract for remodeling and altering a 3 story, 100 x 130 ft. brewery into a dairy plant. Estimated cost, $25,000.

Pa., Lewistown—The Pennsylvania Wire Glass Co., Pennsylvania Bldg., is having plans prepared for the construction of a 1 story, 175 x 600 ft. glass plant. F. A. Hayes, Pennsylvania Bldg., Archt.

Pa., Nanticoke—The General Cigar Co., c/o A. Freeman, Archt. and Engr., 29 West 34th St., New York City, has awarded the contract for the construction of a 3 story, 90 x 155 ft. factory, here. Estimated cost, $140,000.

Pa., Reading—The W. G. Hollis Candy Mfg. Co., c/o F. Muhlenberg, Archt., Flanders Bldg., is having plans prepared for the construction of a 4 story, 20 x 80 ft. candy factory on Plum and Franklin Sts.

SOUTHERN STATES

Fla., Palatka—The United Sugar Corp., 1512 Walnut St., Philadelphia, Pa., will soon award the contract for the construction of a sugar refinery, etc. Estimated cost, $1,000,000. G. P. Anderson, 1512 Walnut St., Philadelphia, Pa., Engr.

Ga., Lafayette—The Consolidated Textile Corp., 11 Thomas St., New York City, plans to build a 2 story addition to its mill. Estimated cost, $150,000. J. E. Sirrine & Co., Greenville, S. C., Archt. and Engr.

Ga., Savannah—The Georgia Ice Co. plans to build a 2 story, 60 x 150 ft. addition to its ice plant. Estimated cost, $35,000. A. M. Dixon, P. O. Box 1352, Mgr.

Ga., West Point—The West Point Mfg. Co., manufacturers of cotton goods, plans to construct a picker building, opener room and machine shop to cover 60,000 sq.ft. of floor space. Estimated cost, $200,000. L. W. Rabert, Candler Bldg., Atlanta, Engr.

Ky., Louisville—The Natl. Candy Co., c/o Brodes & Theens, 829 South Flyod St., plans to build an addition to its plant. Estimated cost, $1,000,000.

La., New Orleans—G. B. Matthews & Son, 412 South Front St., wholesale dealers in feed, are having plans prepared for the construction of a mixed feed factory and a warehouse on the square bounded by Cortez, Telemachus and Scott Sts. Estimated cost, including equipment, $250,000. M. H. Goldstein, 305 Baronne St., Archt.

N. C., High Point—The city plans to build an abattoir. Estimated cost, $25,000.

N. C., Raleigh—J. L. Dorming, c/o The Raleigh Ice & Cold Storage Co., plans to build a wholesale ice manufacturing plant and cold storage house on West Hargett St. Estimated cost, $100,000.

S. C., Beaufort—The Seacoast Packing Co. has awarded the contract for the construction of a 3 story, 85 x 110 ft. packing plant. Estimated cost, $100,000.

MIDDLE WEST

Ill., Chicago—The Chicago Wet Wash Laundry, c/o Ronneberg, Pierce & Hauber, Archts., 10 South La Salle St., has awarded the contract for the construction of a 2 story, 64 x 152 ft. laundry. Estimated cost, $65,000.

Ill., Chicago—The Turner Mfg. Co., 1444 South Sangannon St., manufacturer of picture frames, plans to build a 2 story, 100 x 180 ft. factory on 42nd and Ogden Sts. Estimated cost, $200,000. A. S. Alshuler, 28 East Jackson St., Archt.

Ill., Chicago—The Weiland Dairy Co. has awarded the contract for the construction of a 1 and 2 story, 140 x 150 ft. dairy at 3014-28 5th Ave. Estimated cost, $125,000.

Mich., Detroit—The Bd. Educ., 50 Bway., will receive bids until Dec. 21, for the construction of a 5 and 7 story, 250 x 350 ft. technical high school, on 2nd Ave. and High St. Estimated cost, $2,500,000. Malcolmson, Higginbotham & Palmer, 405 Moffat Bldg., Archts.

O., Cleveland—The City Ice Delivery Co., Cadillac Bldg., plans to build a 1 story ice manufacturing plant on Saranac Rd. Estimated cost, $50,000. C. C. Coneby, c/o owner, Archt. and Engr.

O., Cleveland—The Cleveland Folding Bed Co., 2554 East 55th St., has awarded the contract for the construction of a 2 story, 70 x 70 ft. factory at 3740 Central Ave. Estimated cost, $40,000.

O., Cleveland—H. Horben, 4918 Denison Ave., has awarded the contract for the construction of a 1 story, 23 x 25 ft. bottle cleaning plant. Estimated cost, $5,000.

O., Cleveland—The Natl. Carpet & Rug Mfg. Co., 1971 West 50th St., will soon award the contract for the construction of a 2 story, 40 x 120 ft. factory on Lorain Ave. Estimated cost, $75,000. Whitworth & Johnson, 413 Engineers Bldg., Archts. Noted Dec. 2.

O., Cleveland—The Telling Belle Vernon Co., c/o W. E. Telling, 3825 Cedar Ave., plans to alter its dairy plant on Eagle Ave. Estimated cost, $100,000. Christian Schwarzenberg & Gaede, 1900 Euclid Ave., Archts. and Engrs.

O., Cleveland—The Jennings Sanitary Milk Bottle Co., 5110 Detroit Ave., is building a 1 story, 20 x 30 ft. factory at 5115 Tillman Ave. Estimated cost, $5,000.

O., Cleveland—A. Kovacks, 2641 East 130th St., is building a 1 story, 30 x 34 ft. sausage factory at 11105 Buckeye Rd. Estimated cost, $5,000.

O., Cleveland—The Natl. Carpet & Rug Mfg. Co., 1971 West 50th St., is having plans prepared for the construction of a 2 story, 40 x 123 ft. factory on Lorain Ave. Estimated cost, $50,000. Whitworth & Johnson, 413 Engineers Bldg., Archts.

O., Dayton—The Miami Ice Delivery Co., Ludlow Bldg., has awarded the contract for the construction of a 1 story, 60 x 60 ft. ice plant. Estimated cost, $50,000.

Wis., Appleton—The Fox River Paper Co. has awarded the contract for the construction of a 2 story, 26 x 165 ft. paper mill.

Wis., Glidden—The Northern Wood Products Co. plans to build a 2 story, 85 x 110 ft. factory on Main St. for the manufacture of brooms. Estimated cost, $55,000. W. A. Thomas, Pres.

Wis., Kenosha—The Kenosha Ice Cream Co., 493 Elizabeth St., is having plans prepared for the construction of a 2 story, 46 x 75 ft. factory on Grand Ave. C. Augustine, Kenosha, Archt.

Wis., Kewaunee—The Wisconsin Shipbuilding & Navigation Co. plans to construct additional buildings. Estimated cost, $200,000. J. W. Barber, 345 35th St., Milwaukee, interested.

Wis., LaCrosse—The Mathews Mfg. Co., c/o W. Matthews, Rocky River, O., plans to build a 2 story, 125 x 300 ft. veneer factory, here. Estimated cost, $100,000. Private plans.

Wis., Sheboygan—The Hand Knit Hosiery Co., 14 Huron St., plans to build a 2-4 story 60 x 250 ft. addition to its factory on 14th St. Estimated cost, $100,000. H. Chesebro, Pres.

WEST OF THE MISSISSIPPI

Col., Denver—W. N. Bowman Co., Archts., Central Savings Bank Bldg., is preparing plans for the construction of a 6 story, 125 x 150 ft. physicians building and a 2 story garage and filling station on East 17th Ave. and Bway. Estimated cost, $1,000,000. Owner's name withheld. Simm Finance Co., leasee.

Col., Wellington—The Du Pont Sugar Co., 627 19th St., Denver, has awarded the contract for the construction of a sugar factory, here, to have a daily capacity of 600 tons. Estimated cost, $1,000,000.

Kan., Baxter Springs—The General Amer. Oil Co., 604 New 1st Natl. Bank Bldg., Tulsa, Okla., will build a 1 story oil refinery and lubricating works, here. Estimated cost, $100,000.

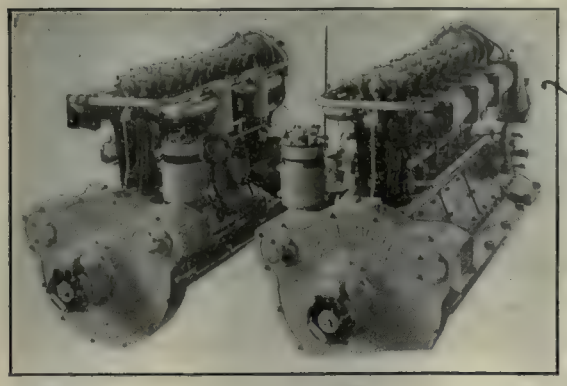
Mo., Aurora—The Juvenile Shoe Co., Advertising Bldg., St. Louis, has awarded the contract for the construction of a 2 story, 40 x 125 ft. factory. Estimated cost, $35,000. Noted Sept. 2.

Tex., Dallas—The Undertakers Cooperative Casket Mfg. Co., c/o C. F. Weiland Undertaking Co., 517 North Ervay St., is having plans prepared for the construction of a coffin factory. Estimated cost, $300,000.

SEE SEARCHLIGHT SECTION

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December 16, 1920 American Machinist Vol. 53, No. 25



Building Motors on the Pacific Coast

By Fred H. Colvin
EDITOR-AMERICAN MACHINIST

THE Hall-Scott Motor Car Co., so named from its building of motor driven passenger cars for the steam railways and not from automobile manufactures, has a plant at Berkeley, Cal., across the bay from San Francisco. The concern was a growing one before the war and so prominent was it in the pioneer work of developing aircraft motors that E. J. Hall, its vice-president and general manager, was called into government service in connection with the design of the Liberty motor. The present plant is particularly attractive in many ways and is built to secure a maximum of light and convenience of which evidence will be seen in some of the illustrations that are to follow. Although we do not look for much motor manufacturing on the Pacific coast, the Hall-Scott Plant is an exception which is well worth noting. In comparing its methods with others, the difference in production must always be considered and it will be found that the tools, jigs and fixtures shown herewith are particularly well adapted for work under the conditions of this shop. The cylinders shown herewith are for marine engines, and are made of cast iron instead of steel as in the case of the Liberty motor cylinders, which they closely resemble.

The methods to be illustrated in this series differ somewhat from those used in the larger automobile shops, but they are none the less interesting. In fact it frequently takes a better engineer to devise methods and design fixtures for economical production where the output is limited than where almost any amount of money can be spent for special machinery.

The cylinders are first annealed in the furnace shown in Fig. 1, Fig. 2 being a closer view and showing more details of the tool used for handling them. The tool consists of a handle of sufficient length, divided into two prongs which first curve downward to act as a support and then turn upward as shown at *A*. Near the bottom of these prongs a yoke *B* is welded, this being so proportioned as to fit around the projection or "spigot" on the end of the cylinder casting as shown at *C*. This tool enables the furnace man to pick up the cylinders, when they are cold, and place them in any desired position in the furnace. In the same way it makes it easy for him to reach into the furnace for them when they are hot and remove them.

The first machining operation is that of boring as can be seen in Fig. 3 which shows a cylinder clamped in the chuck of a Libby lathe and also shows the substantial proportion of the boring bars. The pilot wheel *A*, controls the movement of a back-facing bar, which is shown in Fig. 6.



FIG. 1. ANNEALING CYLINDER CASTINGS

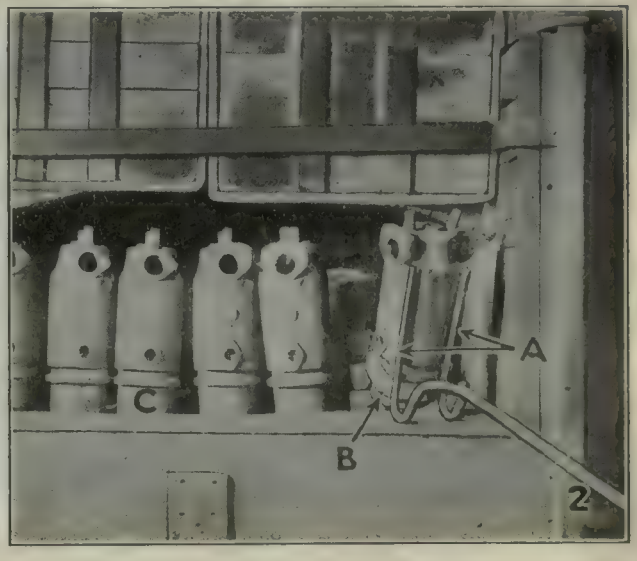


FIG. 2. THE TOOL USED FOR HANDLING THE CYLINDERS

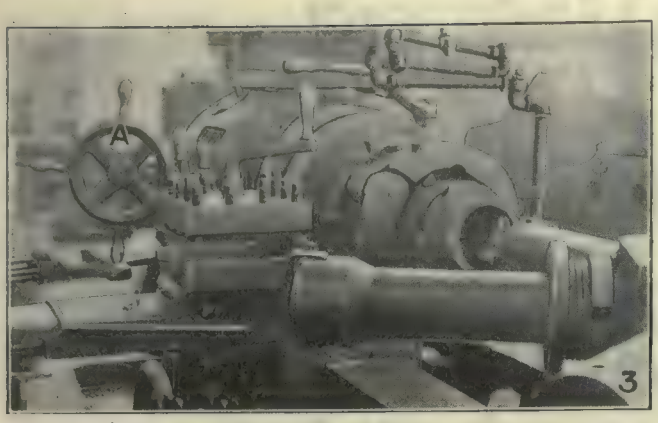


FIG. 3. THE FIRST MACHINING OPERATION

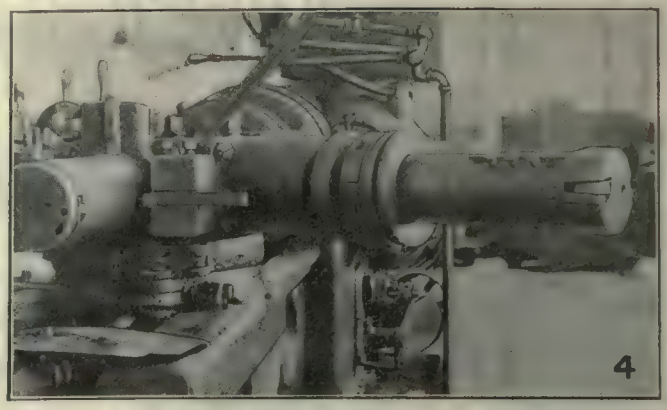


FIG. 4. PART OF THE TOOL SET-UPS

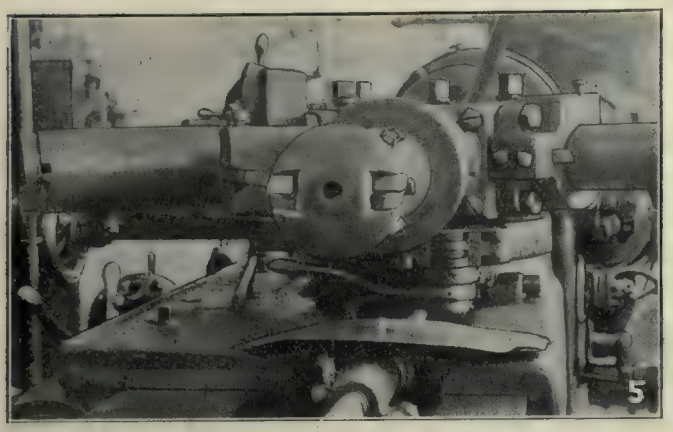


FIG. 5. SOME OF THE BORING BARS

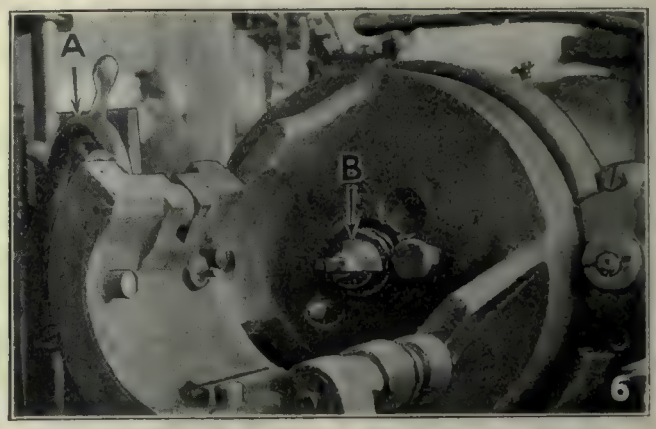
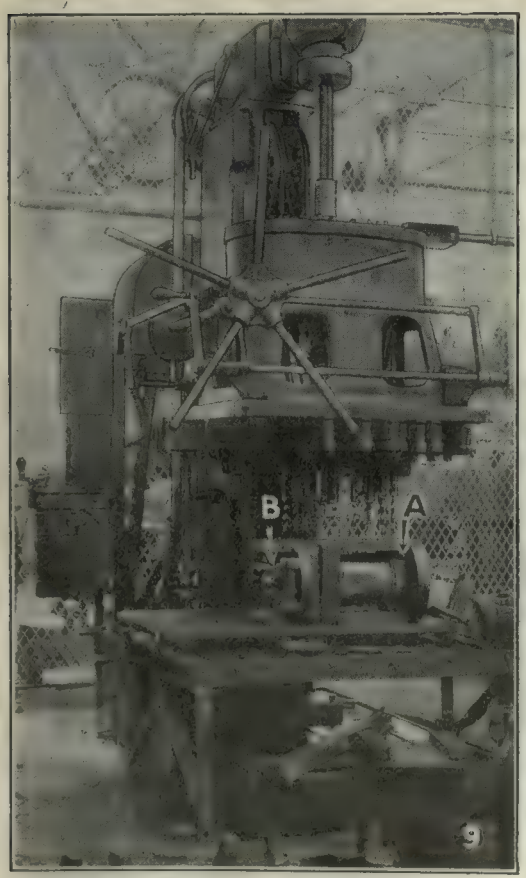
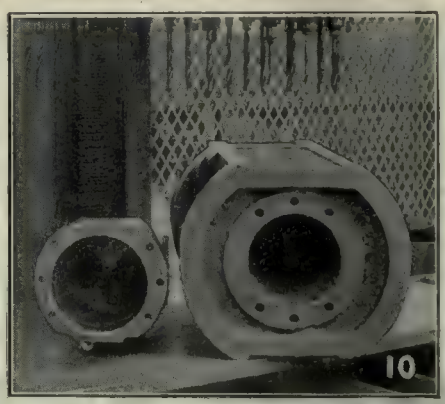
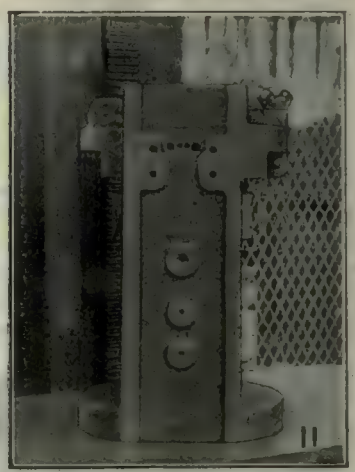


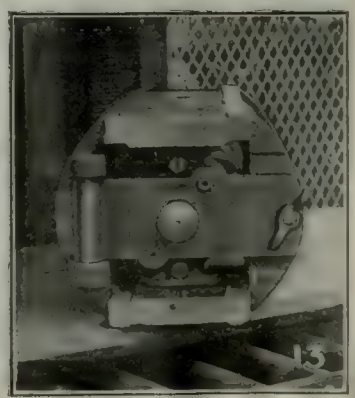
FIG. 6. THE CHUCK AND BACK-FACING CUTTER











FIGS. 9 TO 13. DRILLING OPERATIONS AND THE JIGS

Fig. 9—The multiple drill set-up. Fig. 10—Drilling bolt flanges. Fig. 11—Drilling the exhaust side. Fig. 12—Drilling intake holes. Fig. 13—The top of the fixture.

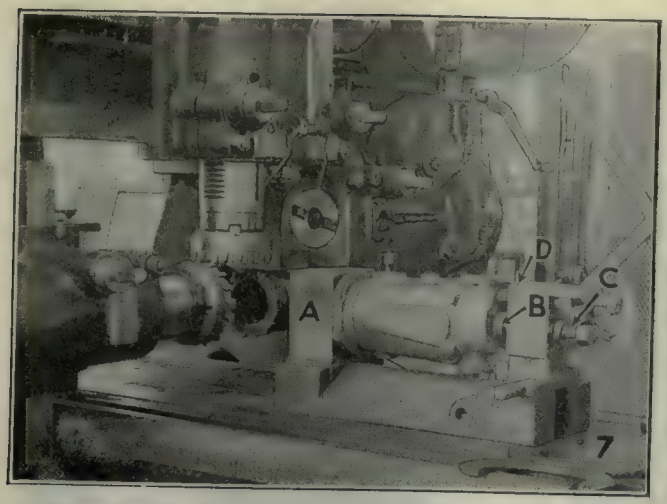


FIG. 7. MILLING THE SIDES

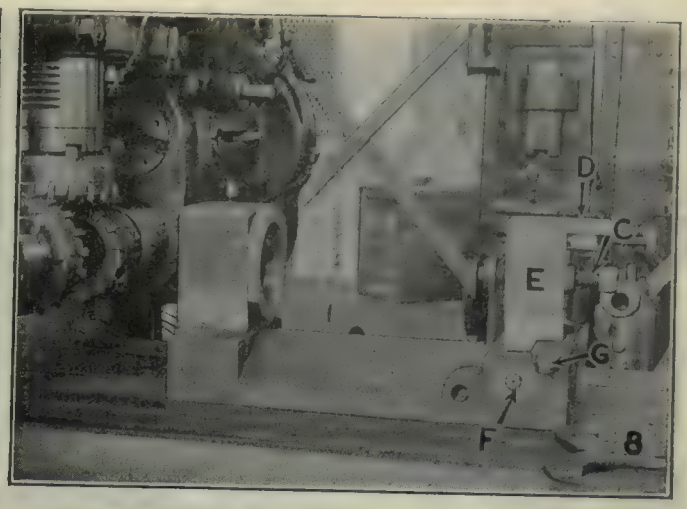
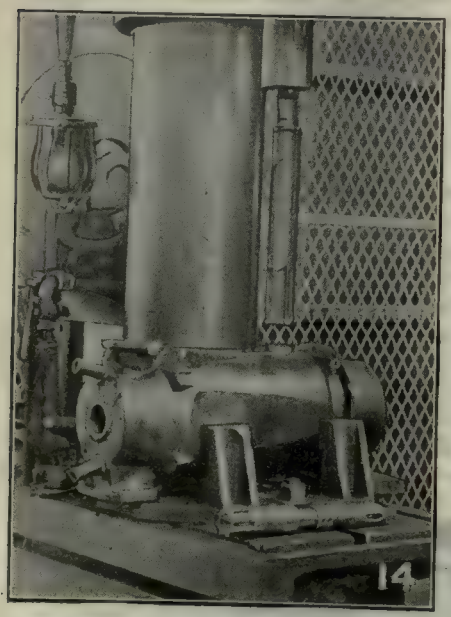


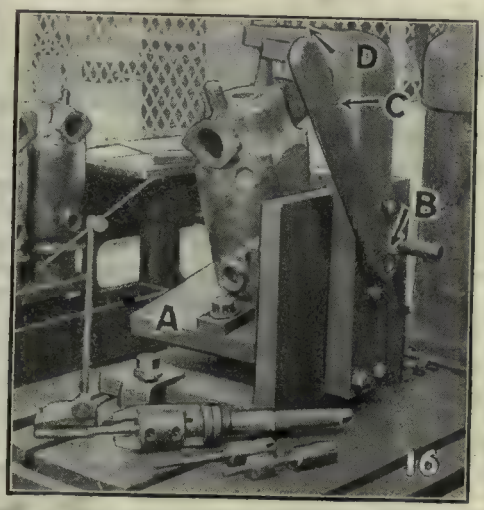
FIG. 8. THE MILLING FIXTURE

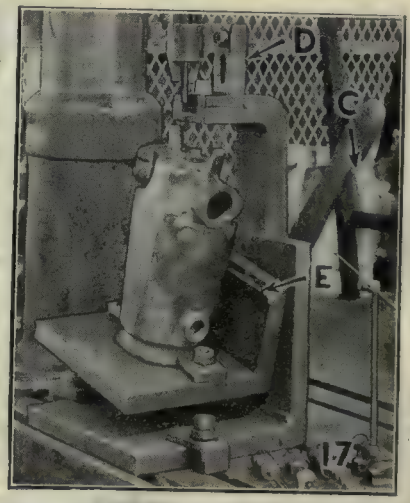
Figs. 4 and 5 show more of the tooling for cylinder boring and together with Fig. 3, give a good idea of the complete tool equipment for this job. Fig. 6 shows the chuck opened so that the various locating points can be seen. It also shows the wheel *A* and the back-facing cutter *B*, which it controls.

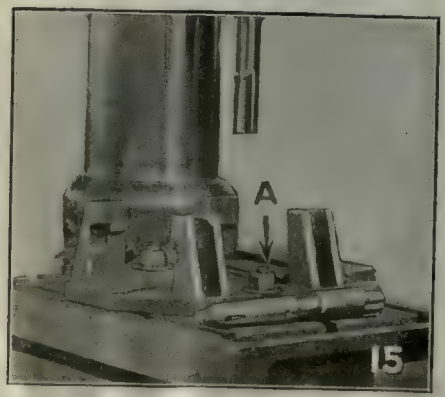
After boring and turning the projection, the cylinder goes to the milling machine shown in Fig. 7. The turned end which fits the projection goes into a bushing at *A*, while the pad *B* on the end of the screw *C* fits into the hole made by the back-facing tool previously referred to and holds the cylinder firmly and squarely in place. The cylinder is further supported and steadied by the block *D*. Only three spindles of the milling machine are utilized for this job after which it is necessary to reverse the cylinder so that the opposite flange and water outlet can be milled. Fig. 8 shows the fixture with the cylinder removed so that its construction can be clearly seen.

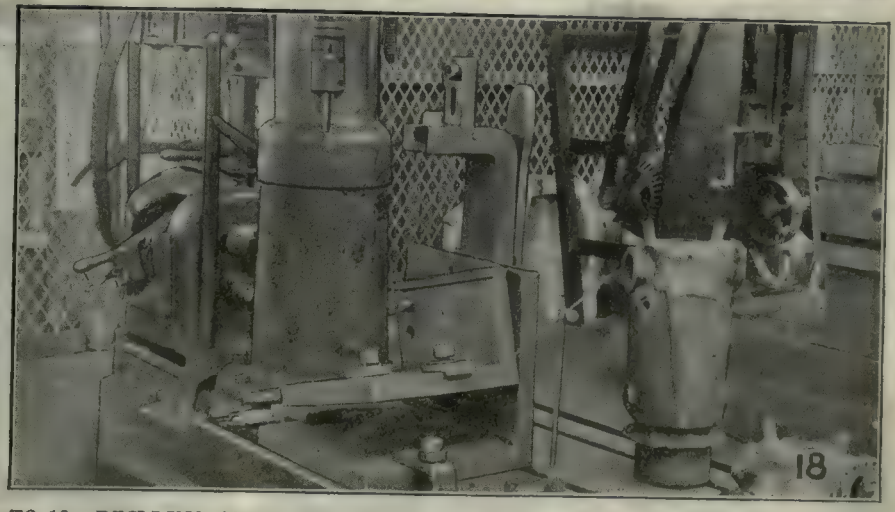
It will be noted that the block *E*, which carries the











FIGS. 14 TO 18. DRILLING OPERATIONS AND THE JIGS
Fig. 14—Drilling water jacket holes. Fig. 15—The drilling fixture. Fig. 16—Drilling the valve stem guide.
Fig. 17—Another view of fixture. Fig. 18—The fixture without the cylinder.

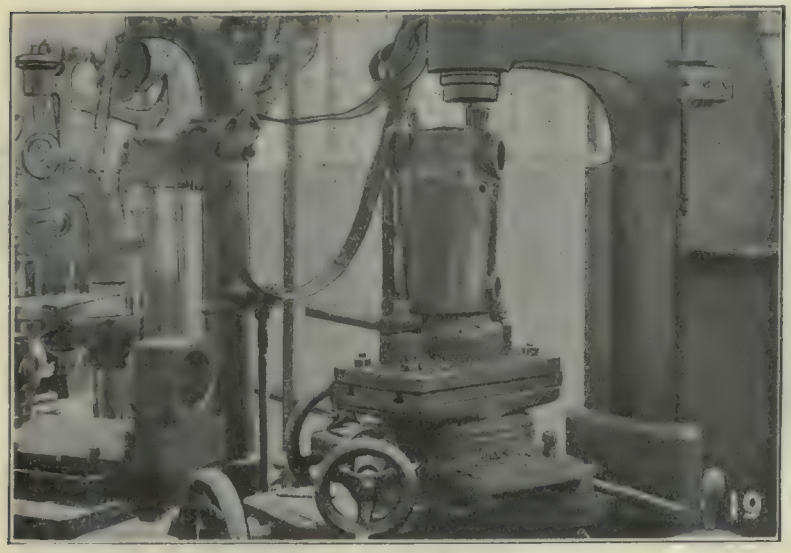


FIG. 19. PROFILING FOR CAM SHAFT HOUSING

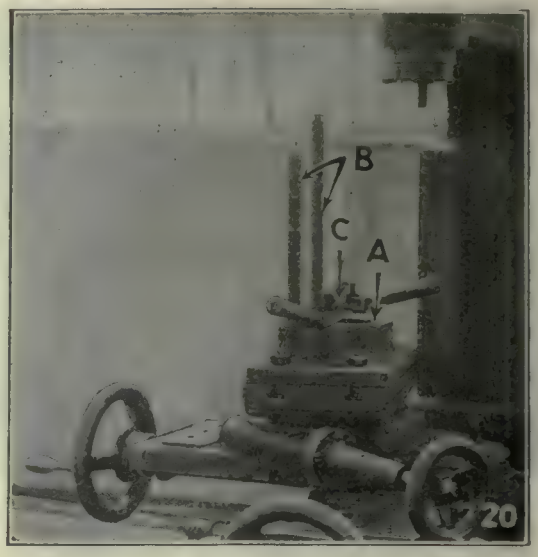


FIG. 20. THE FIXTURE USED

screw *C* and the slide *D* is pivoted at *F*, the lever *G* locking it in the upright position shown. After the cylinder has been milled the lever is swung around to the other side, the block *E* tipped back out of the way so that the cylinder can be easily removed and a new one put into place.

A Combination Drill Jig

Drilling comes next, Fig. 9 showing a Natco drill set up for drilling 21 holes in five operations. This view shows the type of box drilling jig used. The projection on the lower end of the cylinder fits into a suitable bushing at *A*, while the latch *B* holds it in place. Fig. 10 shows the end of the jig in which the six holes in the bolt flange are drilled and also a drilled cylinder at the left. Fig. 11 shows the jig used in drilling the 11 holes in the exhaust side, while Fig. 12 shows the jig for the bolt holes for the inlet flange. The bushings for the two holes in the top of the cylinder are carried in the swinging lid shown in Fig. 13.

Next comes the drilling and tapping of the cored holes into the water jacket as shown in Fig. 14, while Fig. 15 shows the drilling fixture with the cylinder removed. This fixture, as will be seen, is simply a base with four uprights, all planed square with each other, so that the cylinder can be readily placed in it without special clamping, it only being necessary for the bolt flange to be placed against the raised edge of the block *A*.

Drilling for Valve Stems

Drilling and forming the valve stem guide is shown in Fig. 16. As the valve stem holes are radial from a point well within the cylinder, it is necessary to swing the casting from this point in order to drill both holes at the one setting. The table *A*, on which the cylinder rests is pivoted at *B*, the lever *C*, affording an easy method of swinging the cylinder from one position to the other. The plate *A* has a hole to accommodate the cylinder projection so that the flange can be easily clamped to the plate. The drill bushing is held in the swinging arm *D*, which is shown swung up out of the way in Fig. 17. This view also shows the tongue *E* that acts as a guide for the side of the cylinder in which a mating groove has been previously milled. Fig. 18 gives a view of the fixture without the cylinder in place and shows more details of its construction.

Milling or profiling the bosses for the cam-shaft housing pad is shown in Fig. 19, this operation being done on a Pratt & Whitney machine. The construction of the milling fixture is perhaps shown more clearly in

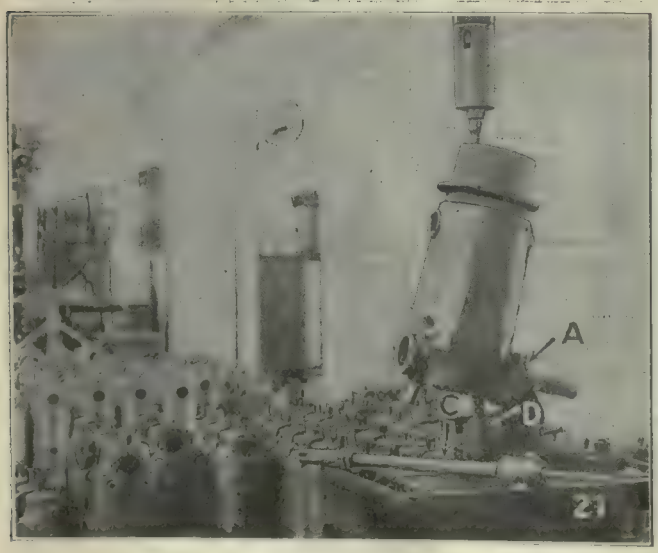


FIG. 21. MACHINING THE VALVE SEATS

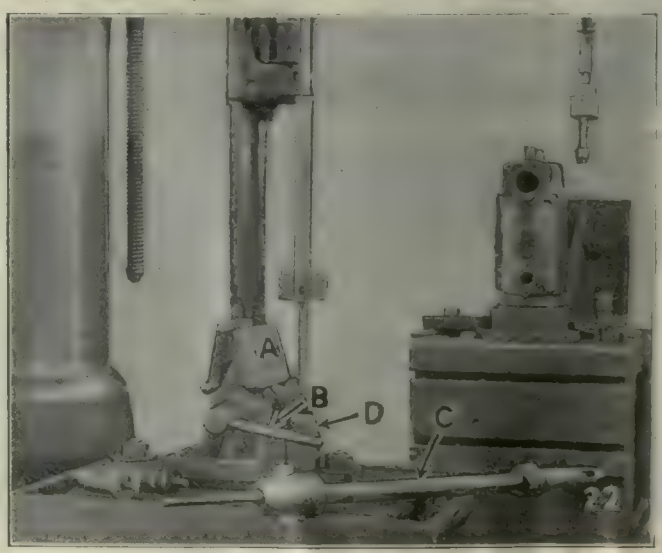


FIG. 22. THE FIXTURE AND TOOLS

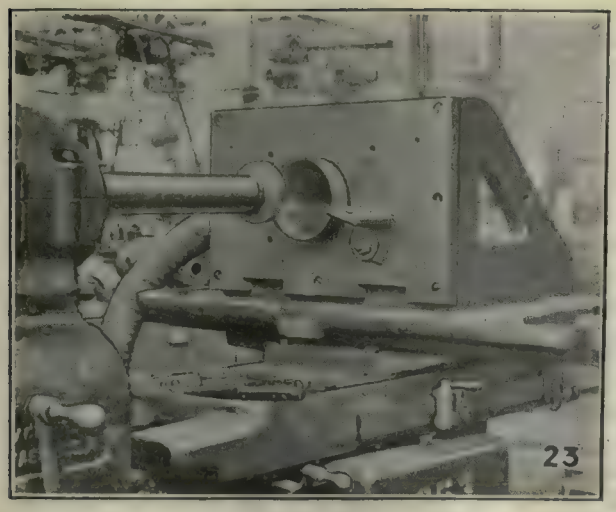


FIG. 23. GRINDING THE CYLINDER

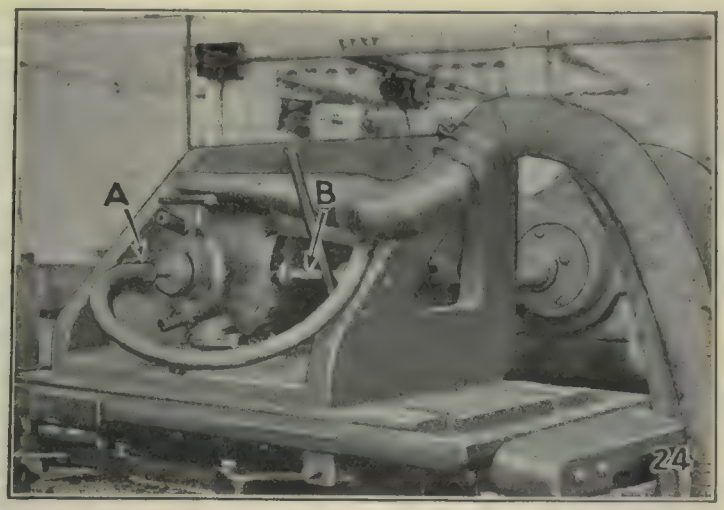


FIG. 24. EXHAUST PIPE CONNECTION FOR REMOVING DUST

Fig. 20, where may be seen the bushing *A* for the cylinder projection, the rods *B* and the swinging cams *C*, which lock the cylinder flange into position.

Boring Valve Seats

The method of boring the valve seats as well as the fixture on which this is done is shown in Figs. 21 and 22. The first shows the cylinder in position, located and supported by the pad *A* which turns on a central stud and can be locked by the handle *B*, Fig. 22. The valve seating tool is shown at *C*, this having a pilot which enters the guiding bushing *D*. The pad *A* holds the cylinder by means of the inlet and exhaust flanges, it being necessary to change its position for the second seat.

The final major operation is the finishing of the cylinder on the Heald grinding machine shown in Figs. 23 and 24. The first shows the lower end of the cylinder projecting through the angle plate, while Fig. 24 shows the method of connecting the exhaust pipe to the side flange so as to remove all the grinding dust from the vicinity of the machine. This view also shows the construction of the angle plate and the way in which the upper end of the cylinder is supported against side motion by the small jack screws *A* and *B*.

The methods used in machining the crankcase, piston and connecting rod will be shown in later articles.

Increasing Output of Labor

By George F. Kuhne

On page 591 of the *American Machinist* J. E. Bullard writes: "It is going to be necessary to greatly increase the output of labor if we are not to meet disaster. There is however not much opportunity of doing this along the line of introducing more machine methods. About all that can be done along that line has already been done."

The latter reference is somewhat erroneous, for improvements in mechanical or industrial processes are part of us and what is new today is primitive tomorrow. The thought "impossible" has steadily lost ground, for many of the so called impossibilities have been accomplished. The thinker should always bear in mind the following: All is here that we desire, we have but to recognize it and find the means of accomplishment for our purpose. This I dare say, has indeed been demonstrated over and over again; we have but to look about us to realize its truth.

Unfortunately, all employers are not in a position financially to provide the modern idea of gymnasium, lunch rooms, hospitals, etc. as additions to their plants, yet modern times demand that so far as is consistent with finances such improvements be made as an investment representing increased efficiency of the workers and dividends. Proper light and air regulation is carried on by most progressive concerns.

Another important item relative to labor output is—Know your man. Fit the man to the job and the job to the man. Not so long ago the foreman would hire a man, later fire him, reason—no good; then another man. Now this is not accepted, for personal prejudice and hasty judgment are detrimental to the success of any concern or department (likewise the foreman). This labor turnover is investigated and reveals perhaps that all conditions as to light, air, hours, wages, etc. are in some instances better than in other concerns in the locality. The result therefore, may be due to improper selection of help, or the foreman's not knowing his men.

Keeping men on the job will send the curve of increased output upward. This may be accomplished by the department foreman being a different kind of a foreman than he used to be. He should study the human as well as his mechanical problems, for perchance the loss of men can be attributed directly to himself. Jumping to hasty conclusions should be averted and a study of his man may reveal that he would fit in somewhere else in the plant. Therefore, the foreman should familiarize himself with the work done in other departments in order to recommend a judicious transfer.

It behooves the plant executive to permit the foremen to become familiar with the nature of work done in the various departments, but such inspection should be done during working hours. This enables the foreman to gain increased knowledge of the product and the sequence of the operations, which is important in manufacturing and will place him in a better position to recommend a transfer.

There will be no great advance in production unless the human machine is studied and ways and means devised and incorporated for consistent and harmonious operation with the mechanical or industrial improvements. Much is required in order to obtain the desired result.

Wave Transmission of Power

The practicability of the theory of transmitting power through a column of liquid, known as the "Wave Transmission of Power," was proved during the war by its application in the C. C. gear for the automatic firing of airplane guns. More recently the wave method of transmitting power has been applied to rock-drills, jackhammers, riveting hammers and riveting machines. The accompanying article on the theory of wave transmission of power is from the inventor's technical treatise. It is taken from a booklet published by W. H. Dorman & Co., Ltd., Stafford, England.

ONE of the fundamental problems of mechanical engineering is that of transmitting energy found in nature, after suitable transformation, to some point at which it can be made available for performing useful work.

The methods of transmitting energy known and practiced by engineers are broadly included in two classes: Mechanical, including hydraulic, pneumatic and wire-rope methods, and electrical methods.

The present brochure deals with a new method—the general principles of which have been enumerated by the inventor, G. Constantinesco—by which the problem has been solved.

All methods of transmitting power through liquids, known as hydraulic methods, as hitherto applied, depend on the continuous transmission of pressure through a liquid so that pressure generated at one end of the line is utilized at the other end. The liquid in this form of transmission merely acts as an incompressible flexible connecting rod.

The known pneumatic methods involve a flow in the pipes always in one direction, pressure being generated at one end of the system and utilized at the other end, but in this case the elasticity of the air employed is sometimes taken advantage of in the power utilizers.

In the wire-rope methods the motive power is, as it were, attached by a string, as near as possible inextensible, to the power utilizers; the system depends on the longitudinal motion of the wire as a whole.

In all these known methods of applying mechanical means to the transmission of power from one point to a distant point elasticity has no direct function and is generally ignored.

The author's system depends on the elasticity of the medium through which the energy is transmitted. The essential feature of the system is that the particles of the medium employed, whether solid, liquid, or gaseous, are in a state of vibration about a mean position.

According to the new system energy is transmitted from one point to another, which may be at a considerable distance, by means of impressed periodic variations of pressure or tension producing longitudinal vibrations in solid, liquid, or gaseous columns. The energy is transmitted by periodic changes of pressure and volume in the longitudinal direction, and may be described as wave transmission of power or mechanical wave transmission.

There are many instances in nature of transmission of energy by vibrations; wave motion may almost be said to be the natural method of transmitting energy.

Let us consider some known phenomena of vibrations of particles of matter:

The transmission of sound through air is due to a vibratory motion set up by the source in the surrounding air; each particle of air in the neighborhood of the source is put into a state of vibration about a mean position.

A common method of producing sound is to cause an elastic diaphragm to vibrate, impressing its vibrations on the surrounding air. By isolating the air to which the vibrations are transmitted, as, for instance, by means of a speaking-tube, the sound can be directed and a given quantity of energy of vibration produced can thus be transmitted over great distances.

Consider what is taking place in the tube when the contained air is set in motion by a diaphragm in a plane normal to the axis of the tube and vibrated about a mean position.

The first movement of the diaphragm in the direction of the tube displaces some air in the tube; this displacement is resisted by the still air further along the tube, so that a zone of compressed air is produced in the immediate neighborhood of the diaphragm. At the same time the moving diaphragm is giving velocity to the particles of air in its immediate neighborhood, and these particles communicate their velocity to those beyond them, and thus any disturbance once produced by the diaphragm must travel forward along the tube. On the return movement of the diaphragm the compressed air in its immediate neighborhood, being elastic, expands, and we have then a zone of low-pressure air in contact with the diaphragm.

The continuing vibrations of the diaphragm produce alternate zones of high and low pressure, and the disturbances so produced travel forward along the tube until the whole of the air particles in the tube are in a state of vibration; it has been found that the zones of high and low pressure travel along the tube with a definite velocity of about 330 meters per second, this velocity varying slightly with the diameter of the tube.

In a similar manner sound energy travels through other elastic media. The velocity through water has been found to be about 1,435 meters per second.

As hitherto employed for the transmission of power in hydraulic and telpherage systems liquid and solid connections have been considered as movable *en bloc*, and for practical purposes incompressible and inextensible. Both liquid and solid columns, however, are elastic, and this property can be made use of to transmit energy by vibrations of the particles of matter of which they are built up. We will first consider the case of liquid columns.

Assume that we have 150 meters of wrought-iron steam pipe, of 2.5 cm. diameter and 0.5 cm. thickness of metal, closed at one end and filled with water; and suppose a fluid-tight piston is forced into the pipe under a steady pressure of 35 kg. per square centimeter. If the liquid were incompressible the increase in volume of the containing pipe under the pressure would allow the piston to enter about 1.5 cm.

If the pipe were absolutely inexpansible the pressure would compress the water to an extent that would allow the piston to enter about 26 cm.

It is seen, therefore, that the compression of the water in a wrought-iron steam pipe of the size considered is the chief factor in the changes of volume which take place under pressure, and that the expansion of the containing pipe is almost negligible.

On removing the pressure from the piston the water will again expand to its original volume. With other liquids similar results will be obtained. Assume now that the pipe, instead of being closed rigidly at one end, is closed by a light floating piston held always in contact with the liquid column, but free to move with the liquid; assume further that the working piston, instead of being slowly pushed into the pipe, is connected to a rapidly rotating crank, so that it moves with a simple harmonic motion, and that in addition to the piston impulses a steady pressure acts on the liquid column at both ends. The only resistance to the movement of the piston is then the inertia of the liquid column, and if the column is short the liquid will move as a solid mass. If, however, the column is of considerable length the motion of the layers of liquid nearer the working piston is resisted by the inertia of the more remote layers, and on the in-stroke of the piston the liquid in its neighborhood will be compressed and its volume diminished; it follows that the motion of the layers of liquid remote from the piston will be less than that of layers nearer to it.

At any given speed of rotation of the crank there will be a point in the liquid column at which, on the completion of the in-stroke of the piston, no movement of the liquid has occurred. The liquid between this point and the piston will at this moment be in a state of compression varying from a maximum at the piston to zero.

At the moment of maximum velocity of the piston the velocity of the layer of liquid in contact with it will necessarily be greater than the velocity of the more remote layers, and the kinetic energy of the layers nearer the piston will, therefore, be transmitted in the forward direction along the column. The energy expended by the piston in its forward stroke at the end of this stroke is present in the liquid column, partly in the form of potential energy due to the decreased volume of the liquid under compression and partly as kinetic energy.

On the return stroke of the piston the compression of the layer of liquid in contact with it decreases, and expansion of the liquid takes place between the piston and the point in the column at which the pressure is a maximum. As the point of maximum pressure moves away from the piston at the commencement of the return stroke the velocity of the layer of liquid in contact with the piston is reversed, while the pressure of this layer diminishes until the piston is at the end of its out-stroke. At the end of this out-stroke the layer of liquid in contact with the piston is instantaneously at rest.

As the crank continues rotating there are thus impressed on the liquid column a series of impulses sending a series of changes of pressure and volume along the column, the particles of liquid each vibrating about a mean position.

The considerations dealt with above as regards vibrations in liquid columns apply also to solids; this may be shown by considering the case of a long helical spring, one end of which is subjected to periodic shocks in the longitudinal direction. At each shock the end of the spring will be compressed and will again expand when the impulse is removed; the effect of the impulse, however, will travel along the spring in the direction of the shock with a definite velocity. The inertia of the coils of the spring remote from the end provides the resistance necessary to compress the first coils, but on the removal of the impulse expansion takes place in both directions, so that the wave of pressure and displacement travels along the spring.

An example of this occurs in practice in the case of the recoil springs of heavy ordnance, in which it has been noticed that pulses in the movements of the gun take place, due to the zones of compression in the recoil springs produced by the sudden shock of firing.

Consider now a very long steel wire connected to a crank so that the end is given a simple harmonic motion in the longitudinal direction, and suppose that the tension given by the crank is superposed on a steady tension in the wire so that no part of the wire is ever in state of longitudinal compression.

As the crank rotates the end of the wire will be subjected to alternate maximum and minimum tensions occurring periodically; under certain conditions the wire, being elastic, will not move *en bloc*, but the periodic changes of tension will produce periodic displacements of the particles of the wire in the longitudinal direction, each particle vibrating about a mean position as in the case of the fluid columns discussed above.

In the transmission of sound through air we have seen that a series of vibrations is imparted to the air particles, causing them to move about a mean position; and thus a series of waves of alternate compression and rarefication travels forward from the source. If these waves fall on a sensitive receiver, such as the drum of the human ear, the receiver is set in vibration and the sound is heard. This is, in fact, an example of the transmission of energy by mechanical wave motion. Similarly, sound is transmitted through liquids and solids.

In order that a receiver may be able to respond to the vibrations falling upon it certain conditions are essential. The part of the receiver which is to be put in motion must be capable of vibrating at the periodicity of the vibrations which fall on it.

In the case of the human ear very sensitive receivers are found, which are tuned to or capable of adapting themselves readily to vibrations of different periodicity within certain limits of frequency. When, however, we come to the problem of detecting vibrations by mechanical means, and still more so when it is desired to transmit power economically by means of these vibrations, it is necessary that the part moved should be designed so that it can respond to the particular periodicity of vibration by which the power is transmitted. It is further necessary, if the part moved has to perform useful work, that the work should be performed in such a manner that the ability of the receiver to vibrate in unison with the impressed vibrations is not interfered with.

Although in some cases in which energy has been heretofore transmitted by vibrations in matter—as, for instance, the case of a tuning-fork made to respond to sound waves of its own frequency—the question of the

period of vibration of the receiver has been considered; in no case, up to the present, has the tuned receiver been adapted to the performance of work. For the transmission of power by mechanical wave motion it is therefore necessary to devise means by which the vibrations in the transmission line may be received and converted to use.

Let us now consider further the case of a rapidly

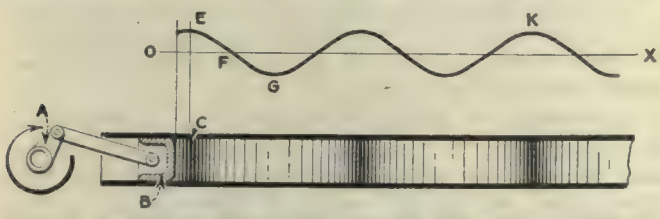


FIG. 1. RAPIDLY ROTATING CRANK CAUSING A PISTON TO RECIPROCATE AT THE END OF A LONG PIPE CONTAINING LIQUID

rotating crank causing a piston to reciprocate at the end of a long pipe containing liquid. We have seen above that a series of zones of high pressure and compression of the liquid alternating with zones of low pressure and expansion of the liquid are produced, and that these zones travel forward along the pipe.

In Fig. 1 suppose the crank A to be rotating uniformly, causing the piston B to reciprocate in the pipe C, which is full of liquid. At each in-stroke of the piston a zone of high-pressure is formed, and these zones of high pressure (shown by shading) travel along the pipe away from the piston; between every pair of high-pressure zones is a zone of low pressure shown light in the figure. The pressure at any point in the pipe, therefore, will go through a series of values from a maximum to a minimum, and these values will repeat periodically. Let the line OX represent the value of the mean pressure, then, with the piston in the position illustrated, the instantaneous pressures at different points along the pipe may be represented by the ordinates of the sine curve $EFG \ldots K$. As the rotation of the crank is uniform it will be evident that the distances between successive points of maximum pressure will be equal. This uniform distance along the pipe at which the values of the pressure are repeated is the wave length of the vibrating movement of the liquid.

If v is the velocity with which these waves travel along the pipe, and n is the number of revolutions in unit time of the crank A, it will readily be seen that the wave length y must be $\frac{v}{n}$.

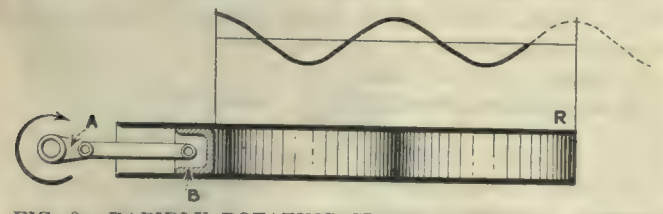


FIG. 2. RAPIDLY ROTATING CRANK CAUSING A PISTON TO RECIPROCATE AT THE END OF A PIPE OF FINITE LENGTH CLOSED AT THE POINT R

Assume now that the pipe is of finite length, Fig. 2, and is closed at the point R at a distance from the piston B equal to an exact multiple of the wave length, and suppose that the stroke of the piston is small compared with the wave length.

The wave of compression will be stopped at R and reflected, and the reflected wave will travel back along the pipe.

If the crank continues its rotation at uniform speed, with the length of pipe and speed of rotation we have taken—*i.e.*, with the distance from the piston B to the stop R an exact multiple of the wave length—a zone of maximum pressure will be just starting from the piston at the instant the reflected zone of maximum pressure reaches it; so that we shall have a wave of double the original amplitude traveling forward along the pipe. The next revolution of the crank will again add to the amplitude of the wave sent forward; and so on with successive revolutions. The result of this continual pouring in of energy is that the maximum pressure increases without limit till ultimately the pipe bursts.

It should be noticed that in a wave of greater amplitude the maximum pressures are increased, and the maximum velocities and distance of travel of the oscillating particles are also increased.

Suppose now that instead of closing the pipe rigidly at R we have at R a piston M connected to a crank N similar to A as shown in Fig. 3.

Suppose that the crank N is rotating at the same angular velocity and in the same phase as the crank

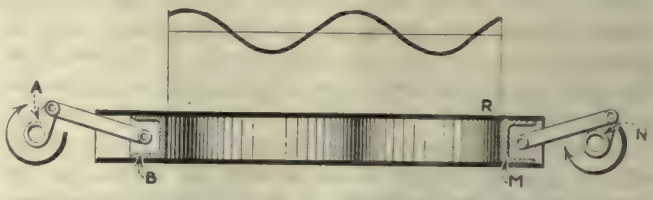


FIG. 3. SAME CONDITIONS AS IN FIG. 2 EXCEPT THAT INSTEAD OF CLOSING THE PIPE R, A PISTON AND CRANK ARE SUPPLIED AT THAT POINT

A. If the liquid column were continued beyond the piston M it is evident that the movement of the piston would produce in this column a series of waves which would be exactly similar to and a continuation of the waves between B and M.

The piston M, therefore, if moving synchronously with B, will be able to take up the whole energy of the waves produced by B and traveling along the pipe.

It will be seen further that the piston will be able to take up and utilize the whole of the energy of the waves traveling to it if placed at any point of the pipe, provided its time period of reciprocation is the same as that of the piston A, and provided that the phase of its movement is such as would produce a continuation beyond it of the impinging waves; that is to say, provided the piston movement is in phase with the movement of the layer of liquid in contact with it.

In the transmission of power by wave motion in this example the maximum pressure in the pipe will at no point exceed the maximum pressure in the neighborhood of the working piston, however long the transmission line may be; and will be the same whether the line is a single wave length or any number of wave lengths. Also the two pistons may be moving in the same or in opposite directions, and their motions may differ in phase by any angle according to the relation between the distance from one to the other and the wave length.

In the example above discussed the whole of the energy put into the liquid column by the piston B can be taken up by the piston M. If more energy is put in by B than is taken up by the piston M, assuming

no frictional losses, it is obvious that reflected waves must be formed as the direct waves fall on the piston *M*. The result of this will be that the surplus energy will remain in the liquid and the continuation of the rotation will continually pour in energy, increasing the maximum pressure indefinitely till ultimately, as in the case of the closed pipe, the pipe will burst.

Suppose that, in the case of a closed pipe having a length of several wave lengths, a vessel *A* completely filled with liquid, of considerable volume in proportion

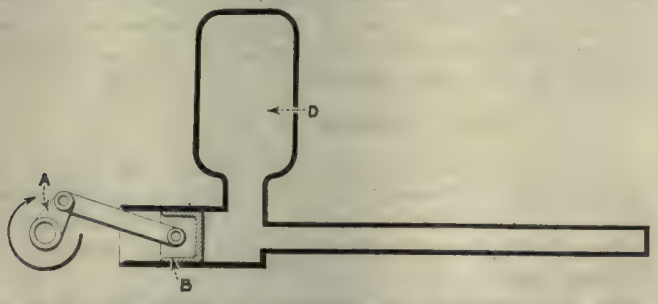


FIG. 4. ADDITION TO CLOSED PIPE, HAVING A LENGTH OF SEVERAL WAVE LENGTHS, OF A VESSEL OF CONSIDERABLE VOLUME IN PROPORTION TO THE STROKE VOLUME OF THE PISTON

to the stroke volume of the piston *B*, and with rigid walls, is placed in communication with the pipe in the neighborhood of the piston, as shown in Fig. 4. At each in-stroke of the piston a flow will take place through the entrance to the vessel *D*, and the liquid in this vessel will be compressed, and at each out-stroke of the piston the liquid in the vessel will again expand. According to the volume of the vessel more or less liquid will flow into it and out of it at each revolution of the crank. The capacity *D* will thus act as a spring, taking up the energy of the direct and reflected waves when the pressure is high, and giving back this energy when the pressure falls; the mean pressure in the vessel *D* and in the pipe will be the same, so that when the successive reflected waves in the pipe have been produced and have reached a certain amplitude equivalent to this mean pressure the piston will merely exert energy in compressing the liquid in the vessel *D* on its in-stroke, and the liquid acting as a spring will restore this energy to the piston on its out-stroke. The result of this is that when the reflected waves have been produced there will be a series of *stationary* waves in the pipe, and no further increase of energy in the liquid will take place and the pressures in the pipe will never exceed the fixed limit.

By using a vessel such as *D*, therefore, the pipe can be completely or partially closed. It is therefore possible to place at the far end or other point of the pipe apparatus for utilizing only part of the energy of the wave, and the rotating crank *A* will only require to perform work to the extent of the energy utilized.

Consider now a case (Fig. 5) in which waves are transmitted by a reciprocating piston *A* along a line *EEE* provided with branches. Assume that the pipe *E* is closed at *P* at a distance of one complete wave length from the wave generator *A*; and that there are branches *BCD* at the half, three-quarter and full wave length distances respectively. We know from the cases discussed above that if the cock *P* is closed and the cock *D* opened, leading to a motor *L* rotating at the synchronous speed, the motor *L* will be able to take up the whole of the energy put into the liquid by the generator.

We also know that if all the cocks are closed stationary waves will be produced in the pipe *E* having maximum variations of pressure at the end *P* and at the half wave length *B*. At these points the flow will always be zero, while the pressure will alternate between maximum and minimum values determined by the capacity *F*, consisting of a closed vessel filled with liquid. At the quarter and three-quarter wave length *G* and *C* respectively the flow will alternate between maximum and minimum values, but the variation of pressure will remain zero.

In this case the points of maximum pressure and maximum movement do not travel along the pipe, but are fixed in position, and theoretically no energy flows from the generator. At the points of maximum movement no variation of pressure will occur; and at the points of maximum pressure variation there will be no movement of the liquid.

It is evident, therefore, that if the cock *B* leading directly to a motor M be opened the motor M, running at the synchronous speed, will be able to take up all the energy given to the line. The stationary half-wave between *A* and *B* will therefore disappear, its place being taken by the forward traveling wave, while between *B* and *P* the stationary wave will persist. If the cock *C* leading to the motor *N* at the three-quarter wave length be opened, all other cocks being closed, since at the point *C* the variation of pressure is always zero, no energy can be taken up by the motor, and the stationary wave will persist in the whole length of pipe.

If the motor be connected at any intermediate point part of the energy will be taken up by the motor, while the stationary wave will persist but will be of reduced amplitude between the generator *A* and the motor. The state of the liquid between the generator *A* and the motor may be considered as the resultant of two superposed waves; one a stationary wave and the other a traveling wave of flowing energy.

Assume now that the motor is not capable of taking up all the energy which can be transmitted to the line

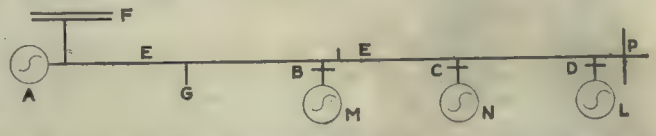


FIG. 5. WAVES TRANSMITTED BY A RECIPROCATING PISTON ALONG A LINE PROVIDED WITH BRANCHES

by the generator *A;* then we shall have superposed in the pipe a system of stationary waves and a system of waves traveling along the pipe, so that there will be no point in the pipe at which the variation of pressure will always be zero, consequently a motor connected at any point of the pipe will be able to take up and utilize a portion of the energy which is transmitted to the line.

We see, therefore, that if we have a number of motors all connected to the line every one of them will be able to take some energy and do useful work. It is only when no energy is being utilized that points at which the variation of pressure is *permanently* zero can exist.

It is seen from the preceding discussion that periodic variations of pressure and volume can be impressed on columns of gases, liquids or solids; and can be made to travel along such columns, causing the several particles to be set in vibration about their mean positions.

It is further clear that under certain conditions the mechanical energy so transmitted can be made available for the performance of useful work.

Early Traces of the Toothed Wheel—I

By H. H. MANCHESTER

In the author's series of articles on the "Evolution of the Workshop," he touched upon a number of subjects which deserve separate treatment. One of these is the toothed wheel, the history of which is here discussed.

THE origin of the toothed wheel has been accredited to both Egypt and Babylonia. The reason for assigning its discovery to the Egyptians is because toothed wheels have been used on the water-wheels of the Egyptians since time immemorial; but in making a rather careful search through thousands of Egyptian tomb pictures, the writer has failed to discover any gearing of this nature.

The evidence both for and against its discovery by the Babylonians is very slight. Babylonian pictures of perhaps 700 B. C. show the use of pulleys and levers, but not of toothed wheels. We know that a wheel with rays was used in raising water in Babylonia in early times, but there is no evidence that these spokes were combined in gearing.

First Known Mention of Friction Gearing

Probably the first known mention of wheels used in gearing is by Aristotle about 330 B. C. In the first chapter of his "Mechanical Problems," he wrote, that if one circle touches another circle, the diameter of the first circle being moved, the second circle will be moved in a direction contrary. Aristotle made no mention of teeth, however, but described only friction gearing. By this time one machine had come into use, with which it is conceivable that some kind of gearing might have been employed. This was the windlass, which was extensively adopted for the moving of heavy materials, especially in building.

It seems likely also that the Archimedian screw for raising water followed, rather than preceded, the use of the screw for other purposes. This suggests that the worm and rack had already been known, but is far from being proof.

Gearing Known to Ancient Greek Mathematicians

There is no doubt, however, that the toothed wheel was known to the ancient Greek mathematicians. Otesibius, who lived about 250 B. C. and who is credited with the construction of the siphon, hand bellows, fire engine and water organ, is said by the Roman architect, Vitruvius, to have constructed a water clock in which a gearing of toothed wheels was used to disclose the passing of time. This clock was said to have, "a rack and revolving drum, both fitted with teeth at regular intervals, which, acting upon one another, induce a measured revolution and movement." The clock had various fanciful features, for, according to Vitruvius, "Other racks and other drums, similarly toothed and subject to the same motion, give rise by their revolution to various kinds of action by which figures are moved, cones revolve, pebbles or eggs fall, trumpets sound, and other incidental effects take place."

About 230 B. C. Philo of Byzantium, according to ancient tradition, made use of a wheel with spokes acting upon a rack for the purpose of raising water. Almost nothing of the works of Otesibius or Philo is extant, but a number of their inventions seem to have been included by Hero of Alexandria, who lived in the second century B. C., in his various treatises which he states contained the devices of others as well as his own, though he does not differentiate the sources.

Hero's Treatise on Mechanics

In his treatise on mechanics, Hero shows how a weight may be raised by toothed wheels and pinons, Fig. 1. He also illustrates the use of the endless screw with a toothed wheel and rack, and gives an example of inclined teeth.

In his writings on pneumatics, Hero describes a toothed wheel with a rack, toothed wheels at right angles, and a cam action. The cam action mentioned by Hero, while not particularly striking in itself, was used in connection with a windwheel to blow an organ, which is proof that the windwheel, as a philosopher's toy, dates back more than a thousand years before its employment for practical purposes in Europe.

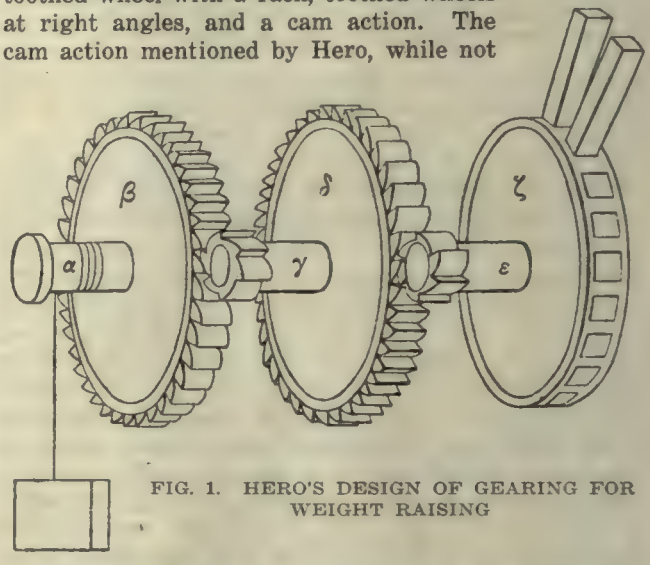


FIG. 1. HERO'S DESIGN OF GEARING FOR WEIGHT RAISING

Early Use of Iron Teeth

The toothed wheel with a rack is used in a self-trimming lamp, which, as the oil sinks lower, would push the wick along to make up for the part burned. This is shown in Fig. 2 and is important, as it expressly states that the rack should be of iron.

This is one of the very few ancient notices of iron teeth or teeth that fit into one another. There is no doubt that the regular usage in ancient times was to make teeth by extending the spokes of the wheel, or by setting oblong wooden blocks into either the circumference or face of the wheels. The statement can hardly be made too sweeping that in ancient times toothed gearing was regularly of the spur and pinwheel type, or if in the same plane, consisted merely of one flat block striking against another. The drawings of Hero are probably more typical of a period when the copy was produced than of the time of Hero himself. While they diagram in general the propositions as annunciated

by Hero, the teeth of the wheels probably represent the knowledge of a later period, and, simple as they are, are nevertheless more advanced than those of Hero's time. This is no doubt true of the cut, Fig. 3, of the worm gearing, which required a comparatively advanced form of teeth.

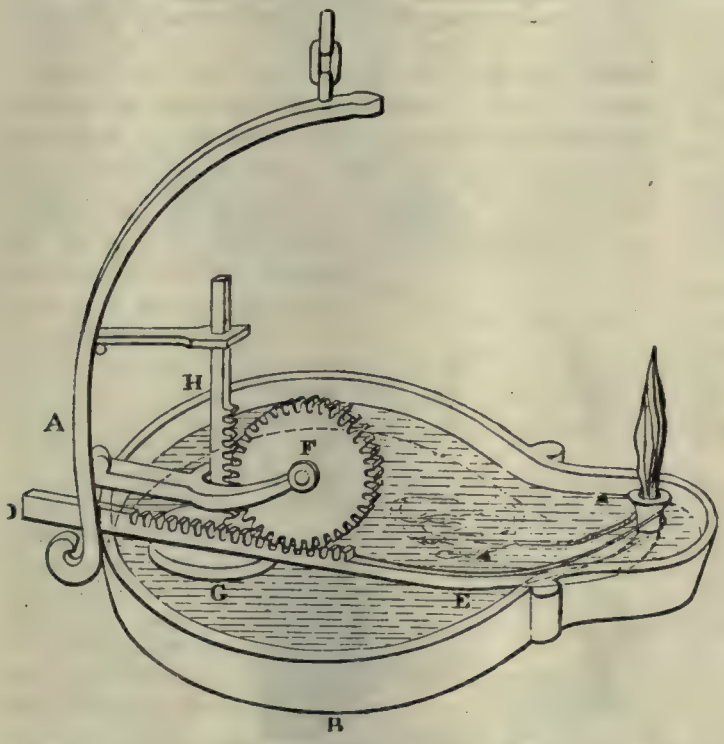


FIG. 2. EARLY SELF-TRIMMING LAMP WITH IRON-TOOTHED RACKS

The Roman architect, Vitruvius, who wrote about 200 B. C., seems to have made use of the toothed wheel in his water mill for grain, although the text of his description is somewhat doubtful.

Use of Paddle Wheels on Ancient Ship

One very curious use made of the toothed wheel by Vitruvius was in connection with paddle wheels on a ship, but the most curious part of it is that the paddle wheels were not used to drive the ship, but to measure the speed at which the ship was moving. The paddles were at the side of the vessel, much as in the case of a side-wheel steamer. On the center of the axis between them was a drum with one cam. This struck in turn 400 teeth on another drum. These in turn were geared with the teeth of still another drum, each revolution of which released a small stone, and the distance was measured by counting the stones.

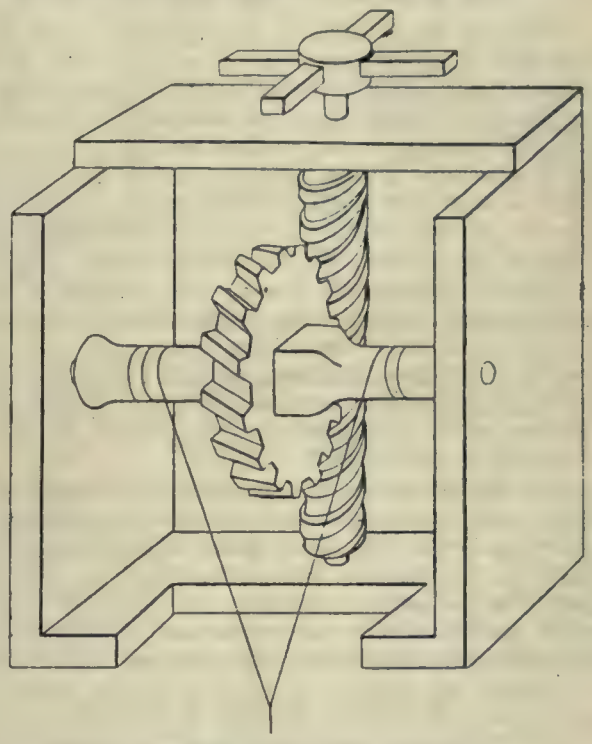


FIG. 3. HERO'S ADVANCED DESIGN ON WORM GEARING

Later, when the Roman Empire was overrun by successive hordes of barbarians, learning fled to the Eastern Empire of Constantinople. In Western Europe the knowledge of the Greek and Latin thinkers was forgotten, and only those mechanical inventions were retained which were in constant practical use. Even in the East the overshadowing of the Greek philosophy by Christianity tended to let the old Greek thinkers be neglected and forgotten. For this reason many ideas were lost, and not rediscovered until after several centuries. As a consequence there was little progress made in gearing during the first part of the Middle Ages.

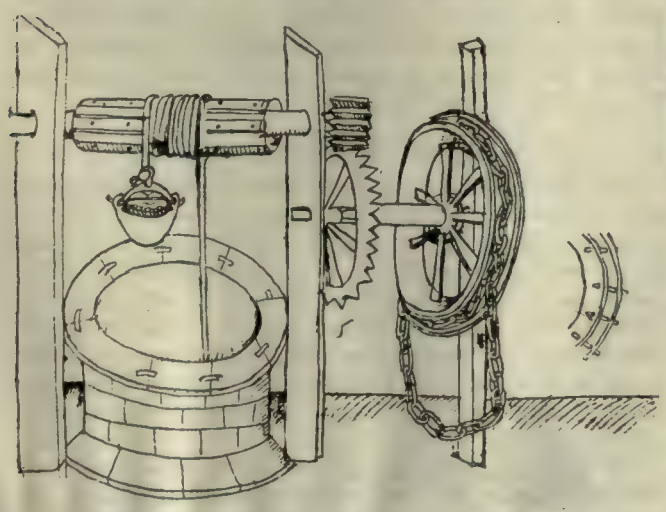


FIG. 4. GROTESQUE SKETCH OF BUCKET CONVEYOR

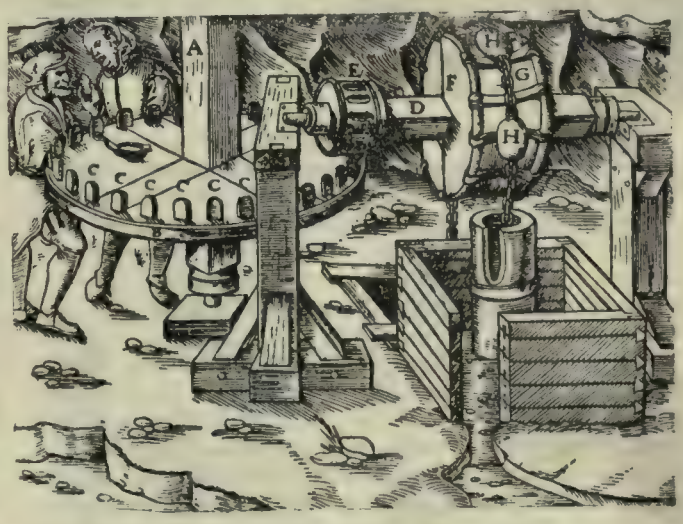


FIG. 5. AGRICOLA'S IMPROVED LANTERN AND FACE WHEEL

An illustration of a water mill of the twelfth century, although much distorted in the drawing, shows on the axis of the waterwheel a vertical pin wheel which is geared to a small vertical lantern on the axis of the lower mill stone.

The Invention of the Lantern Pinion

Crude as the lantern is, the evidence points to the fact that it was an improvement over the spur and pinwheel of the period, and that it was invented some time in the early Middle Ages—in fact, the construction of the lantern is such that it might well have been devised at first to give greater stability to the pins by fixing them at both ends in the face of a wheel. At all events, the use of the lantern is the most characteristic feature in the gearing of the Middle Ages.

Several examples of gearing are included in a military engineering book, the author of which is unknown but which probably dates from about 1430. An interesting but rather grotesque sketch, Fig. 4, represents a wheel with saw teeth on its face geared to an endless screw, and used for the purpose of winding a bucket up from a well.

Another picture of the same date represents a wind mill with a pinwheel and lantern arrangement for grinding grain. A third sketch shows a shaft with cams to lift and let fall pestles for the purpose of pounding saltpeter. Gearing is also pictured on a boat with paddle wheels, but while the paddle wheels in this are interesting, the gearing is not very clear.

Da Vinci's Sketch of Gearing

Among the numerous sketches by Leonardo da Vinci, which are apparently of even more interest today than at the time they were produced, are several illustrating types of gearing. One is of a number of wheels with different sorts of cogs among which is probably the earliest known sketch of a wheel with cogs inside the rim. Here the teeth are of triangular shape, with one side nearly parallel to the radius.

Another of Leonardo's designs shows a gear turned by a water turbine, and used for drawing flat iron rods while they were rolled by another wheel.

Gearing with toothed wheels was also sketched by Leonardo in a press, a crane, a boring machine, and a file cutter. It was ilkewise employed in a road measurer and paddle boat, which were perhaps suggested by the description of Vitruvius already noted. The designs of Leonardo were of course more or less suggestions, and but few of them were ever put into actual practice.

Agricola's Gearing

About the middle of the sixteenth century, George Agricola, in his "De Re Metallica," described the gearing in use in his day, and probably for many years previous. The great majority of his gearing consists of lanterns with rundles combined with either spur or pinwheels. Fig. 5 shows his improved lantern and face wheel.

How a toothed wheel was constructed at that time is explained in Agricola's description of a machine for raising water by chains and dippers: "The teeth of each wheel are fastened in by means of screws, the threads of which are screwed into threads in the wheel, so that when teeth are broken they can be replaced by others. Both the teeth and rundles are made of steel."

Shop Kinks from the "Milwaukee" at Tacoma

By Fred H. Colvin
Editor, *American Machinist*

The shops of the Chicago, Milwaukee & St. Paul Railway at Tacoma, Wash., handle not only the steam equipment but also the huge electrical locomotives which now haul its trains over the two mountain ranges. This is developing a new kind of railway mechanic, for electrical connections are all important and a second's carelessness in making a joint may lay out an important train and cause heavy loss. The results, however, have been very gratifying and the men are as proud of the big electrical equipment as the officers. Steam locomotives still predominate, of course, but the electrical equipment is growing and the electric locomotives can barely be handled on a 105-ft. turntable. In common with nearly all railroad shops, the machine equipment is largely old and inadequate. It is kept up as well as may be and is clean and well painted. The great, and perhaps the only, advantage of inadequate equipment is that it develops ingenuity on the part of men and brings out devices which to a great extent overcome the handicaps imposed. A few of the kinks are shown herewith and others are to appear at a later date.

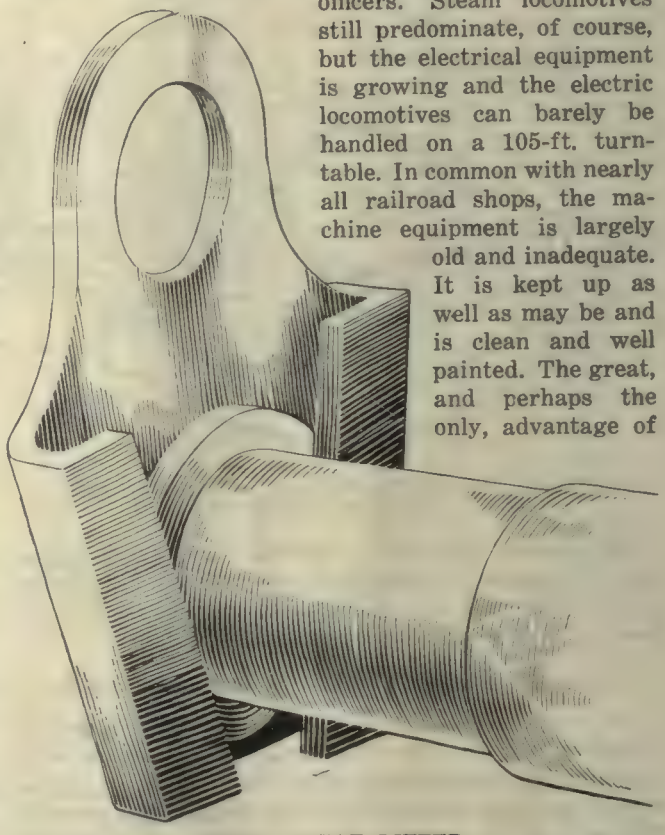


FIG. 1. AXLE LIFTER

Hook for Car Axles

For handling car axles in and out of the wheel press and elsewhere the hook or clamp shown in Fig. 1 is used. The collar on the end of the axle is utilized to prevent any possibility of slipping endwise. The lamp is a piece of flat stock, shaped and bent up to form the V-shaped pocket shown. This is simply hooked over the end of the axle, which tends to wedge itself in position, and holds it firmly against end slippage. These clamps cannot, of course, be used on collarless axles.

For planing or truing up crossheads after they have been overhauled the two supports *A* and *B*, Fig. 2, are used. They support the piston rod and clamp it in proper position during the planing. Turning the whole

rod assembly 180 deg. allows the other side of the crosshead to be planed parallel with the first.

The electric locomotives drive through a sort of spring connection, or shock absorber, as shown at *A*, Fig. 3. Heavy coil springs, mounted between suitable end blocks, transmit the power between gear and axles and take up part of the shock. Removing these springs

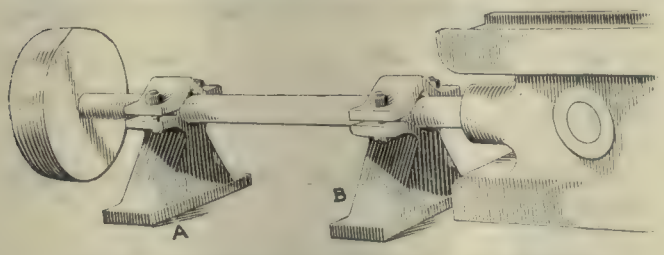


FIG. 2. FIXTURE FOR PLANING CROSSHEADS

is not an easy job without special tools and some are said to cut them out with an oxyacetylene torch, replacing them with new springs, as springs are easier to put in than to take out.

But the ingenuity of the railroad shop man got busy and made the tool shown in Fig. 3. The body *B* is a heavy piece of bar steel with a hole bored in each end to receive the pins *C* and *D*. These pins carry projections *E*, turned eccentrically to the bodies of the pins, and which fit into the holes in the blocks at the ends of the spring.

Turning the pins so these projections come in the right position, about as shown in the illustration, the projections are placed in the holes in the blocks. Then the pins are turned until the spring is compressed and can be easily removed.

The other end of the pin *C* has a place for a heavy wrench as at *F*, and is also provided with a ratchet and pawl at *G* to prevent the pin being turned by spring pressure. This is not usually needed but is an additional safeguard to prevent accidents.

Rod Length Gage

A rod length gage, which is always accessible and prevents mistakes and misunderstandings, is shown in Fig. 4, and is credited to general foreman Pentecost. Just who is responsible for the other devices is not a matter of record.

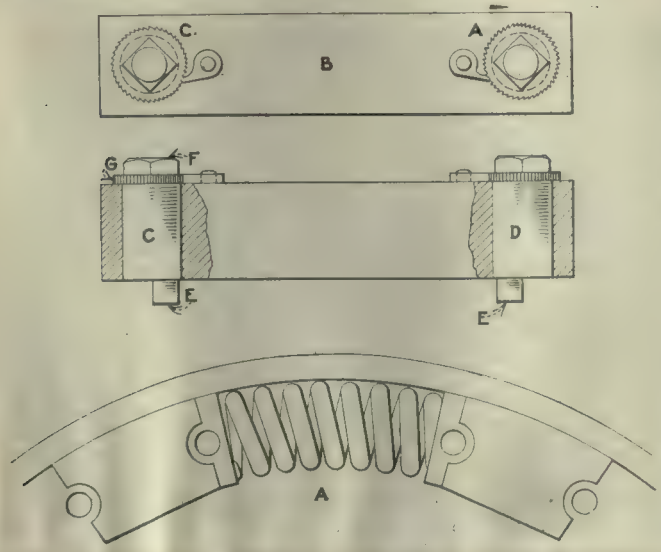


FIG. 3. TOOL FOR REMOVING SPRINGS FROM ELECTRIC LOCOMOTIVE WHEELS

This gage consists of a square steel bar *A*, about 2 in. on a side and perhaps 15 ft. long, mounted in three rollers *B*, *C* and *D*, which in turn are supported by three legs made of piping, suitably braced, and carrying the rollers as shown. The gage is about 4 ft.

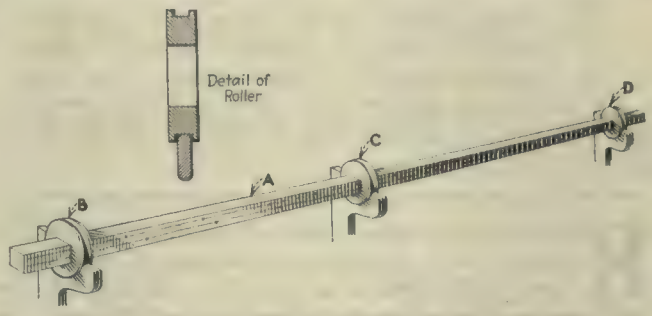


FIG. 4. STANDARD GAGE FOR ROD LENGTHS

above the floor so as to be easily inspected and used, and to keep it out of the way of dirt and damage.

The Graduations

The sides of the bar carry lines which are plainly marked at intervals to show the center distance of every connecting rod and every side rod used on the division. In addition, one side is graduated in inches from 44 to 80, to aid men on the tire lathes getting their sizes. These dimensions cover the range which comes in for repairs. The introduction of this gage has helped the men and also reduced the number of errors in laying out, and in boring and fitting rods and rod brasses.

The blacksmith shop is full of interesting devices, more of which will come later. These will show how machines are improvised and methods devised for making forgings at low cost.

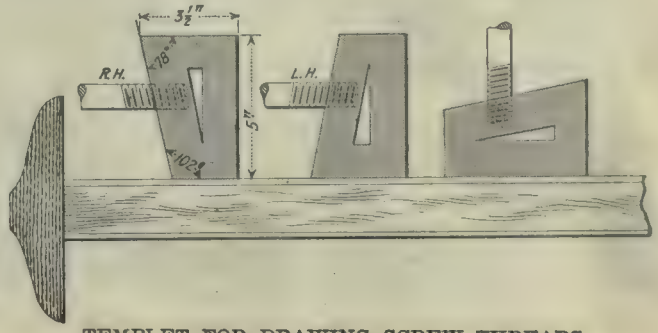
Drafting Room Kinks

By John J. Thompson

Regarding the suggestion of L. Weare, on page 564e of *American Machinist*, of a 12-deg. triangle for drawing screw threads; I would suggest for this purpose a templet made as shown in the sketch herewith.

As nearly all screw threads on drawings are right hand, it will be found that in using Mr. Weare's triangle that one must use the right-hand edge in drawing the threads on the horizontal view of a screw, thus bringing the short side of the angle against the T-square, where it will tip easily, as the base is not long enough to slide well.

With the templet shown herewith a long base is always against the T-square in any position and, being larger, it is easier to use.



TEMPLET FOR DRAWING SCREW THREADS

Calculation of Stresses in Winding-Drum Flanges

By JOHN S. WATTS

The strain imposed by the rope, on the flanges of a winding drum carrying a number of coils, is, generally speaking, much greater than one would expect, and frequent failures can be traced to a lack of appreciation of this strain by designers.

REFERRING to Fig. 1, the pull on the rope which is tangential to the drum as the rope is wound on, must be resisted by a radial force P, equal to the pull on the rope. For all coils after the first coil, the reaction P, is furnished by two component forces R, whose amount will be $\frac{P}{\sqrt{3}}$ each, the included angle between the resultants R being 60 degrees.

Referring now to Fig. 2, and assuming that the ropes in the inside coils are still under the original tension, it is obvious that the resultant force R on each rope is transmitted diagonally down through each coil, and that coil adds its own resultant to the preceding ones. The total force along line A will then be equal to $= 88 \times R$ the number of coils being nine, and the first coil not, of itself, exerting any side pressure.

It may be well to state here, that while it seems to be the consensus of opinion, that the inner coils must be relieved of at least a part of their original tension and that also, on the other hand, these inner coils have stiffness sufficient to carry a portion of the compression, and so relieve the drum of some part of the load. However, no authoritative tests have yet been made to determine just exactly what action takes place under the circumstances.

Personal knowledge of some failures of drums leads me to believe that, at any rate, a large percentage of the strain is actually carried by the drum, and the only safe plan is to assume that all of the coils are under the original tension, and that the resultant strain must not cause a stress in the drum casting in excess of the minimum breaking stress of the material.

In the example shown in Fig. 2 if the pull on the rope is uniform throughout the whole wind, the resultant diagonal force along the line A will $= 8 \times R$.

$$\text{But as } R = \frac{P}{\sqrt{3}}$$

$$\therefore A = \frac{8P}{\sqrt{3}}$$

This force A is in turn resolved into two forces, the horizontal one of which B is carried by the drum flange and as the angle between resultant B and force A is 60 deg. the resultant B will equal $\frac{A}{2}$.

$$\text{But } A = \frac{8P}{\sqrt{3}}$$

$$\therefore B = \frac{4P}{\sqrt{3}}$$

At B_2 we have the diagonal thrust of six coils, numbers 4 to 9 inclusive, which totals $\frac{6P}{\sqrt{3}}$ and as in this case the resultants of this force are at 60 deg. each side of the force, the resultant along B_2 due to these six coils equals the force $= \frac{6P}{\sqrt{3}}$. In addition to this we have the resultant from the rope next to the flange in coil 3, which is also equal to $\frac{P}{\sqrt{3}}$ making a total for B_2 of $\frac{7P}{\sqrt{3}}$.

From the same reasoning we have the horizontal reactions at

$$B_3 = \frac{5P}{\sqrt{3}},\ B_4 = \frac{3P}{\sqrt{3}},\ B_5 = \frac{P}{\sqrt{3}}$$

The total horizontal thrust against the drum flange will be

$$B + B_2 + B_3 + B_4 + B_5$$

$$= \frac{4P}{\sqrt{3}} + \frac{7P}{\sqrt{3}} + \frac{5P}{\sqrt{3}} + \frac{3P}{\sqrt{3}} + \frac{P}{\sqrt{3}} = \frac{20P}{\sqrt{3}} = 11.5P.$$

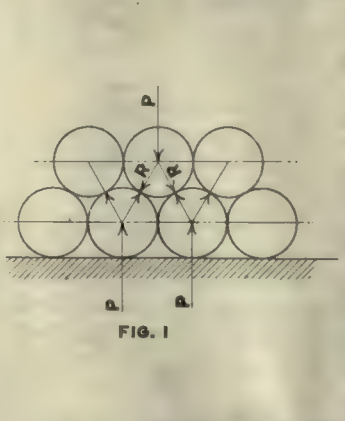
A sufficiently close approximation can be had with less calculation by counting all the ropes which exert pressure sideways against the flange, that is all ropes on or to the left of line A, in Fig. 2, except the one next to the shell of the drum in coil one. As each rope exerts a resultant force of $\frac{P}{\sqrt{3}}$ in a horizontal direction, and we have two ropes held up by the flanges, the total side pressure will be approximately $24 \times \frac{P}{\sqrt{3}} = 13.8\ P$, which is larger than the more correct method. A closer approximation would be to multiply $P \times$ half the number of ropes.

Taking this as being a uniformly increasing load, and the flange being regarded as a cantilever we have

$$\text{Bending moment} = \frac{13.8\ P \times L}{3}$$

or if we take the load as $P \times X$ where $X =$ half the number of ropes exerting pressure on the flanges, we get

$$\text{Bending moment} = \frac{x \times P \times L}{3}$$



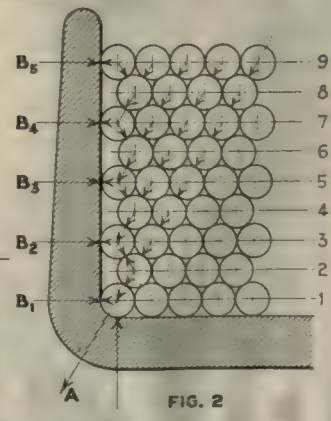


FIG. 1. DIAGRAM SHOWING TANGENTIAL FORCES.
FIG. 2. DIAGRAM SHOWING RESULTANT FORCES TRANSMITTED DOWNWARD THROUGH EACH COIL

As the load will be practically uniform around the whole circumference of the drum, we take for calculation a strip of the drum flange one inch wide. The moment of resistance of this strip will $= fZ$.

Where f = safe working stress

Z = modulus of section $= \frac{bh^3}{6}$

$$Mr = fz$$

$$\therefore = f \times \frac{bh^2}{6}$$

But $b = 1$ in.

$$\therefore Mr = \frac{f \times h^2}{6}$$

$$\therefore \frac{f \times h^2}{6} = \frac{x \times P \times L}{3}$$

$$N^2 = \frac{x \times P \times L}{2 \times f}$$

As the load is gradually applied, taking the whole time of winding to rise from zero to its maximum, and as the calculated load is certainly in excess of the actual load, we may use a stress nearly equal to the breaking stress. Experience has shown that for cast iron as high as 15,000 lb. is safe provided that we are sure that the rope pull we have assumed will not be exceeded, and that the number of coils will not be increased because of uneven coiling.

When a large number of coils are to be wound on the drum, it will be necessary to rib the flange in order to gain the required strength, as the strain increases very rapidly with deep coiling.

Cam Cutting in A Jobbing Shop

By E. A. Dixie

An old Phœnix engine lathe which was fixed up many years ago as a cam cutter and which is still on the job is shown in Figs. 1, 2 and 3. Fig. 1 is looking toward the tailstock, Fig. 2 looking toward the headstock and Fig. 3 a view from the back of the lathe. The reference letters are the same in all figures.

The shaft *A*, Fig. 1, is driven by the spindle of the lathe. It is provided with universal joints and a sleeve so that it can follow the movements of the slide which carries the follower *B*, the latter being moved by the master cam *C*, seen in Fig. 2. The quill *D*, Fig. 1, carries the cutter and is provided with the usual thrust bearing. The lathe has a four-stepped cone which, with the back gears affords eight speeds for the cutter spindle. The wormwheel *E*, shown in all three views, is keyed upon the same shaft with the master cam and is driven by a worm on the shaft with the large pulley *F* which is belted from an independent countershaft.

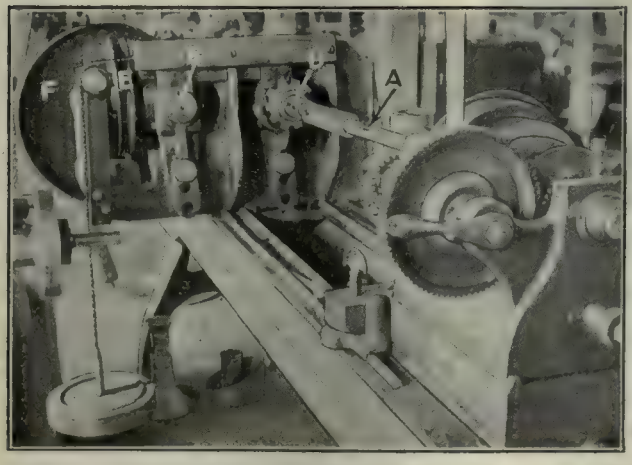


FIG. 1. VIEW OF CAM-CUTTING FIXTURE LOOKING TOWARD THE TAILSTOCK

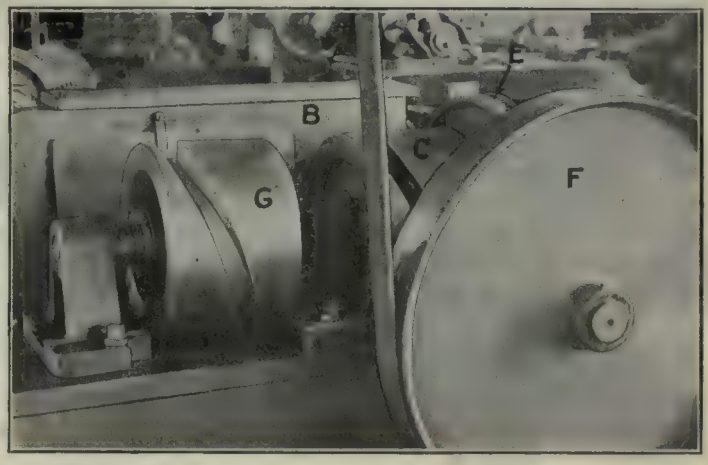


FIG. 2. VIEW LOOKING TOWARD THE HEADSTOCK

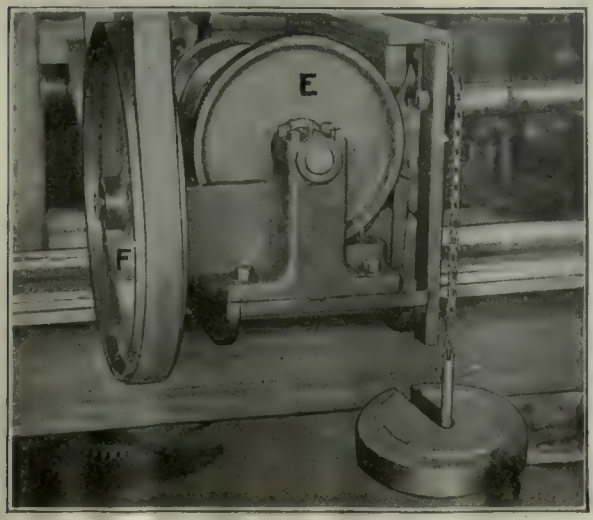


FIG. 3. VIEW FROM THE BACK OF THE LATHE

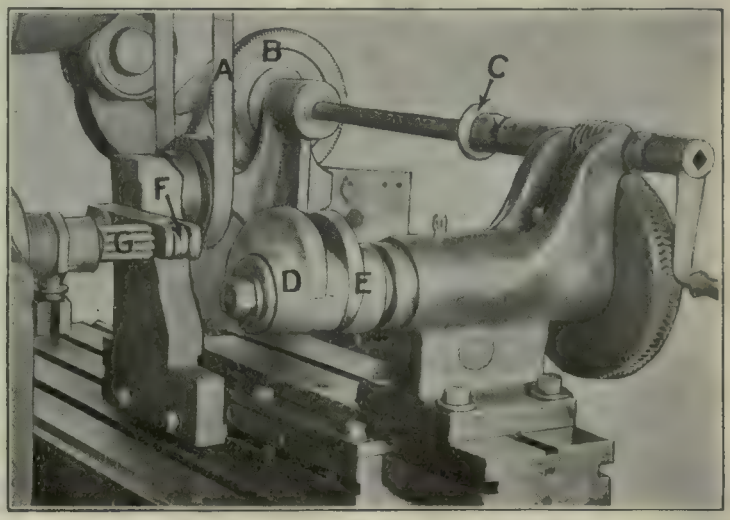


FIG. 4. SMALL CAM-CUTTING FIXTURE

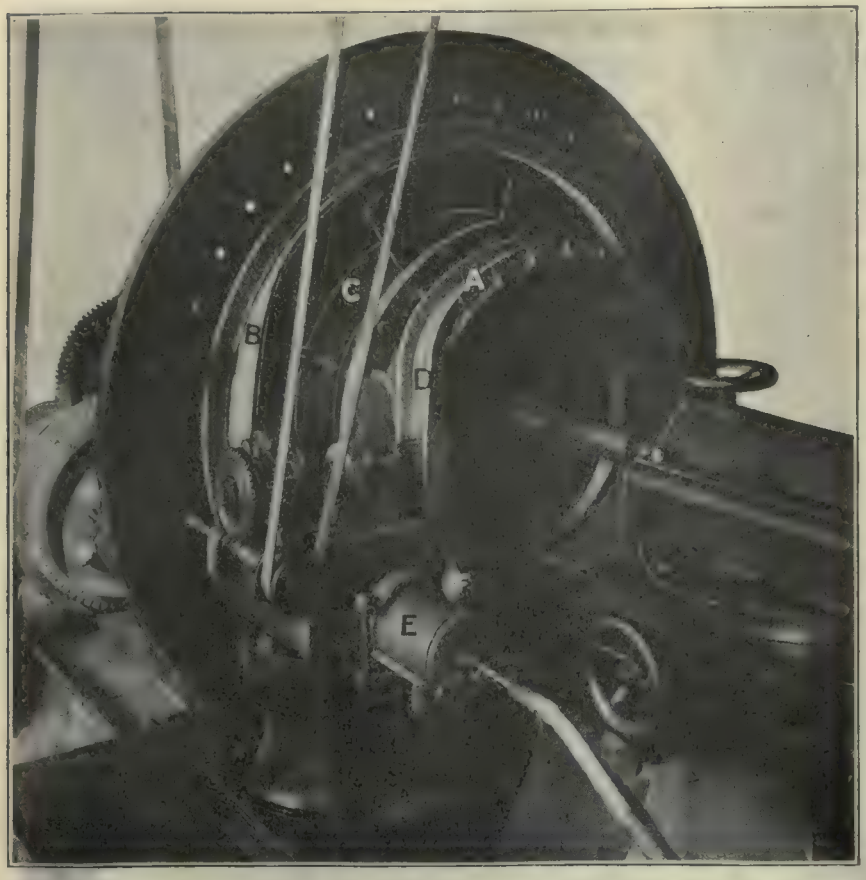


FIG. 5. CAM-CUTTING FIXTURE WITH AIR-OPERATED HOLDBACK

The fixture is heavy and looks to be out of proportion to the lathe. It is, however, self contained and the lathe merely supports it and drives the cutter, which does not require much power.

The work *G*, Fig. 2, is a drum cam 9 in. in diameter by about 6 in. long with a cam groove 1⅛ in. wide and deep, milled from the solid. Two cuts were taken to finish each cam and 25 of them were cut in 30 hours.

The small cam cutting fixture shown in Fig. 4 is used on a plain milling machine for cutting a variety of cams. The drive for the work is from the belt *A* to a pulley on a shaft which carries a worm engaging with the wormwheel *B*. This is mounted on a shaft having a jaw clutch *C* which can be slid out of engagement so that the work spindle can be rotated by the crank handle. The work *D* and the master cam *E* are mounted side by by side, as shown. The follower roll *F* and the cutter *G*, mounted in the spindle of the milling machine, are approximately in line when the work is being machined.

Figs. 5 and 6 show a very interesting cam-cutting operation. The machine is a lathe built about 1856 and still in use. All the big cam-cutting is done upon it besides a great deal of turning, up to about 7 ft. in diameter.

A number of the large cams *A* were to be cut. The master cam *B* was made somewhat larger in diameter than the work. The cams were all faced and the bolt holes laid off and drilled. When all the cams were thus turned a fitting *C* was strapped to the lathe faceplate within the master cam. Its face was squared off and one of the cams bolted to it. The outside of the cam was then turned to the correct diameter and before removing it from the lathe the cam cutting attachment was placed in position and the cam groove *D* was cut.

A slow motion is provided for the lathe spindle when engaged on cam cutting. In the case shown the spindle speed was one turn in two and a half hours.

A rather unusual feature about this fixture is the holdback. There are no weights used but in their place the designer made use of an air cylinder *E* which is shown in both views. The shop has air service at 80 pounds. The air cylinder is 5 in. in diameter and is provided with a pressure gage *F* as shown, so that the operator can see at a glance how much pressure he has in the cylinder behind the piston. By throttling the inlet the air pressure in the cylinder can be regulated from zero up to nearly the full 80 lb. per square inch. Owing to slight leakage past the piston pressure regulation is possible, which would not be the case if the piston were perfectly air tight and no by-pass of the air were provided. The cam *A* is 48 in. in diameter and has a groove *D* 4 in. wide by 2 in. deep. When the follower *G* is "climbing" practically no air pressure is used, merely enough to keep the roll in contact with the master cam. When the follower is going "down hill" from 5 to 10 lb. of air is used which gives a pressure of from 100 to 200 lb. of the follower roll on the master cam face.

A talk with the operator elicited the fact that he had cut many kinds of cams on many varieties of machines, but that the air cylinder gave steadier pressure and less trouble than any of the others.

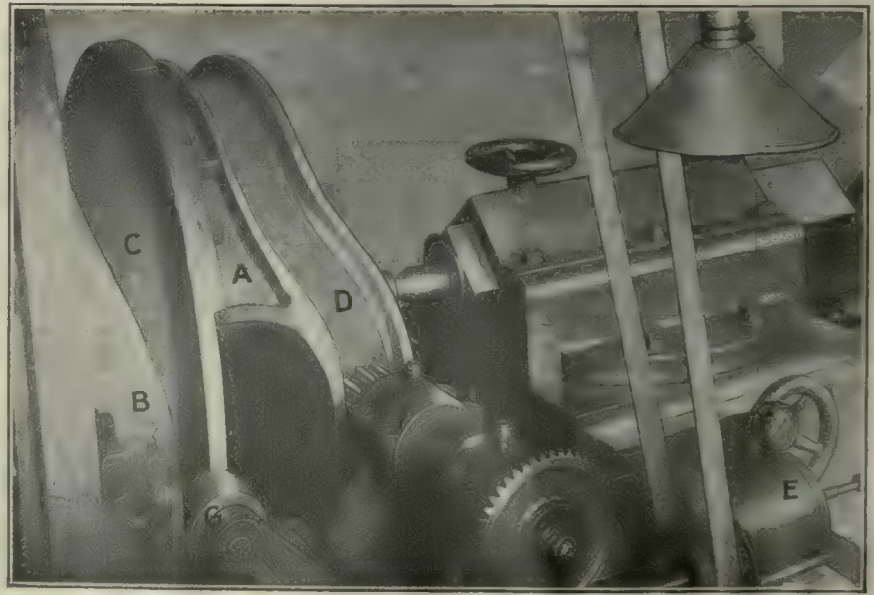


FIG. 5. CAM-CUTTING FIXTURE WITH AIR-OPERATED HOLDBACK

SEVEN CENTURIES of BRASS MAKING



By O. A. KENYON
ENGINEER RAY D LILLIBRIDGE, Inc.,
NEW YORK*

V. Sheet Brass—Extruded Rods and Wires

Here is taken up the production of sheet brass, which is made by rolling the cast iron bars, "an art that up to the present time has never been successfully divorced from the human element of the operator." The extrusion process of making rods and wires is also described. The information is presented chiefly by illustration, a method to which these subjects are well adapted.

(Part IV was published in the Dec. 2 issue.)

IN THE manufacture of sheet brass, bars are delivered from the electric casting shop to the rolling mills where the gates are cut off in an alligator shear as shown in Fig. 53. An expert examines the piece cut off to determine whether or not the cut is deep enough to eliminate the pipe. He is also able to judge the quality of the casting by examining the metal disclosed by the cut.

Having trimmed the bars, they are inserted into a breaking-down roll after which they are straightened by passing through a series of rolls as shown in Fig. 54. After being straightened, the surfaces of the casting are removed in a milling machine as shown in Fig. 55. This is done to remove mechanical flaws and surface impurities from the bar before rolling it to smaller sizes. The bars are now ready for another pass through the breaking-down rolls as shown in Fig. 56.

Since mechanical working of brass or copper hardens the metal, it is necessary to anneal it at various stages in the rolling process. In Fig. 57 is shown an annealing furnace from which an annealing charge has just been withdrawn. These furnaces are so arranged that the hard brass is drawn in at one end by the same operation by which the annealed brass is drawn out of the other. The temperature in these furnaces is accurately controlled by electric pyrometers, facilities being provided for reading

*Booklet published by the Bridgeport Brass Co., Bridgeport, Conn.



FIG. 53. BITING OFF THE GATE OF A BRASS BAR



FIG. 54. STRAIGHTENING ROLLS

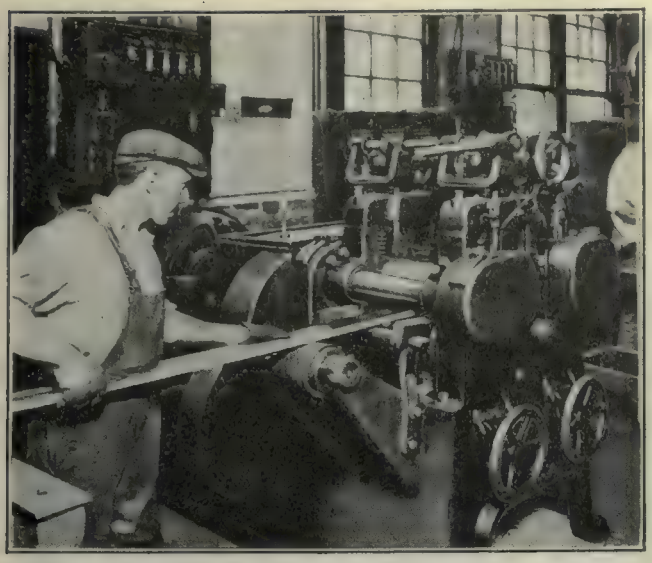


FIG. 55. MILLING THE SURFACE OF STRAIGHTENED BARS TO REMOVE MECHANICAL FLAWS AND SURFACE IMPURITIES

the temperatures at both ends and in the middle of the furnace. One of the indicating instruments is shown in Fig. 58. A recording pyrometer was previously shown, Fig. 45.

Some years ago the Bridgeport Brass Co. originated the practice of using tandem rolls in the production of sheet brass, and protected the process by a series of patents. Fig. 59 shows a set of these rolls in operation.

Rolling brass is an art that up to the present time has never been successfully divorced from the human element of the operator. The process as a whole can be planned and controlled according to a definite program but the rollers themselves must be men who have had thorough training and long practical experience. This company has been in the business since 1865 and has produced rollers who are second to none in the country.



FIG. 58. TEMPERATURE INDICATOR

Several of these men have been with the company for more than 30 years and one man shown in Fig. 60 has been with them for 47 years. In Fig. 61 is illustrated the cold rolling of copper sheets.

Sheet brass is marketed in various forms, depending upon the thickness of the metal and also upon the purpose for which it is to be used. It may be in straight flat bars, in wide coiled strips, or in narrow coiled strips.

Rods and Wires—Extrusion Process

The Bridgeport Brass Co. uses the extrusion process for the manufacture of brass rods, while bronze, copper, and phono-electric rods are made by the rolling process as described in Part IV.



FIG. 56. MILLED BARS PASSING THROUGH THE BREAKING-DOWN ROLLS



FIG. 57. ANNEALING FURNACE FROM WHICH CHARGE HAS JUST BEEN WITHDRAWN

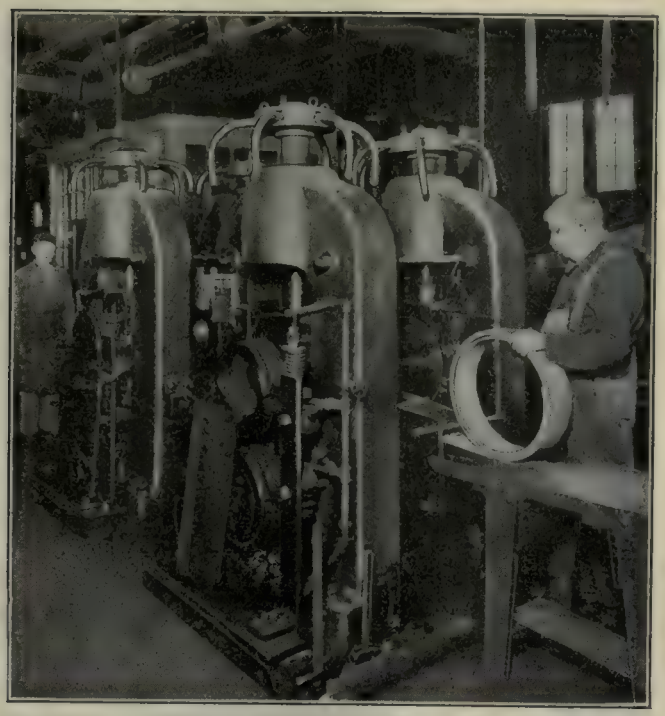


FIG. 59. A SET OF TANDEM RUNNING-DOWN ROLLS

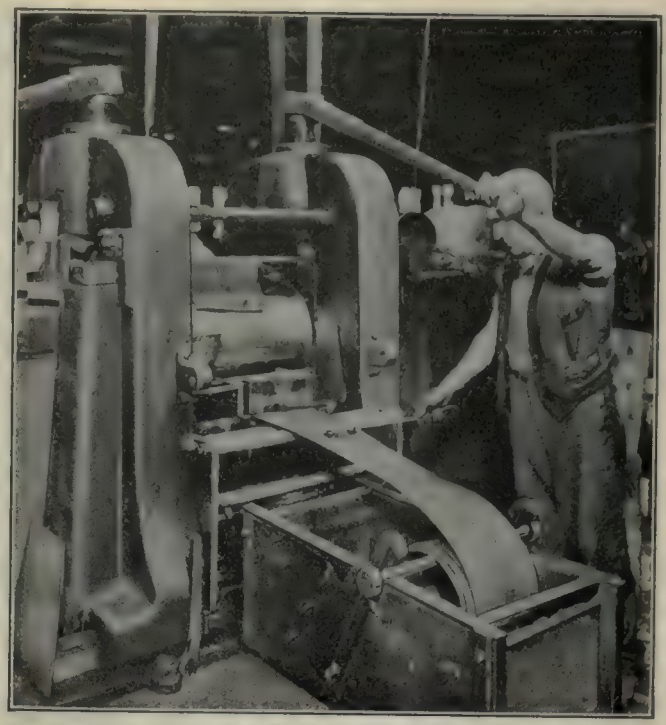


FIG. 60. ROLLING BRASS

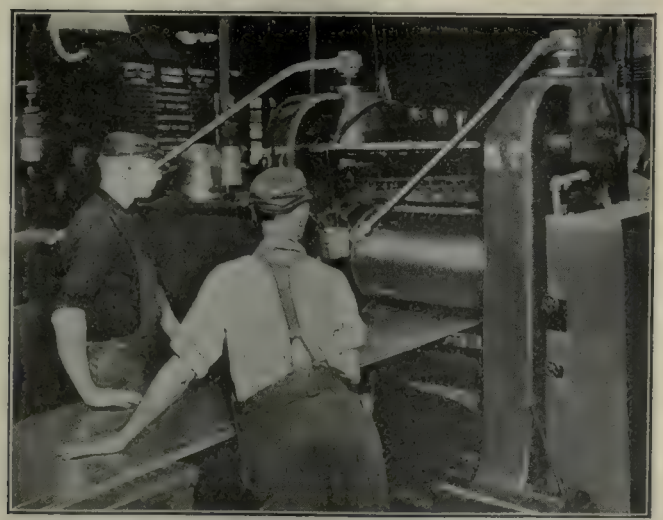


FIG. 61. COLD ROLLING COPPER SHEET



FIG. 62. SAWING OFF THE GATES OF BRASS BILLETS

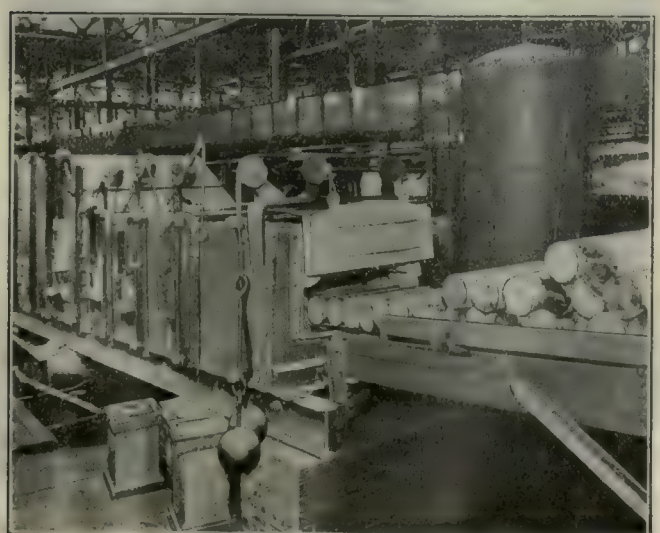


FIG. 63. BRASS BILLETS ON THEIR WAY INTO THE HEATING FURNACE OF THE EXTRUSION MACHINE

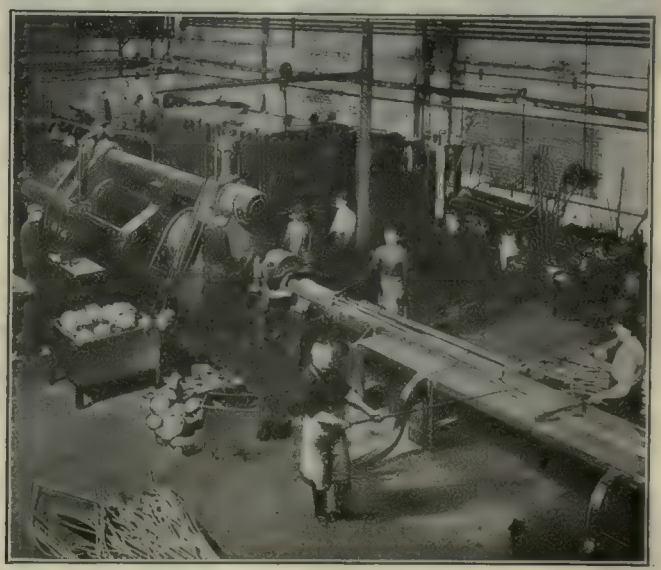


FIG. 64. THE EXTRUSION MACHINE IN OPERATION

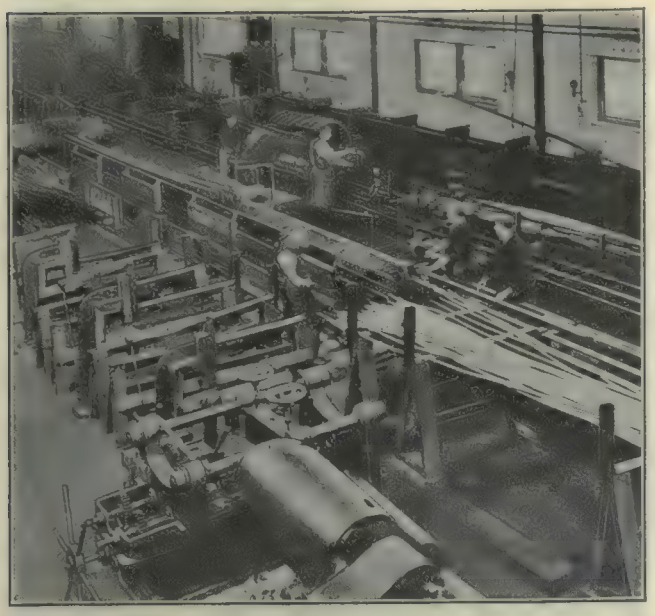


FIG. 65. DRAWING RODS FOR THE EXTRUSION MACHINE

The brass billets from the electric casting shop are delivered to the saws, one of which is shown in Fig. 62. From here they go to the heating furnace as shown in Fig. 63 where they are brought to such temperature as will render the metal plastic.

The plastic billet is then inserted into the cylinder of

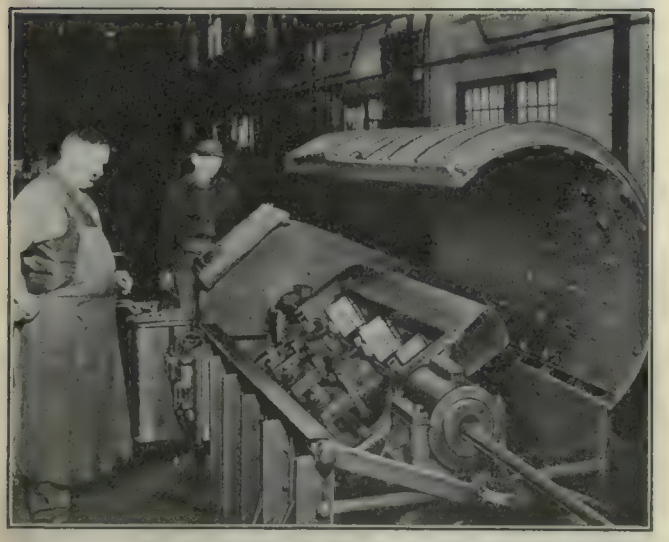


FIG. 66. STRAIGHTENING RODS BY PASSING THEM THROUGH THREE SETS OF SPIRALLY MOUNTED ROLLS

the extrusion machine and pressure applied to one end of it by means of an hydraulically operated plunger. The metal, being forced out through holes in a die at the other end of the cylinder, emerges from the machine as rods. In Fig. 64 the rods are seen coming from the machine and lying in the trough extending from its mouth. The cylindrical cakes in the center foreground are the ends of the billets removed from the machine after the main portion has been extruded. The muffle which feeds this machine is seen in the background at the right.

These rods are drawn to size and straightened for shipment, or wound on reels and delivered to the wire

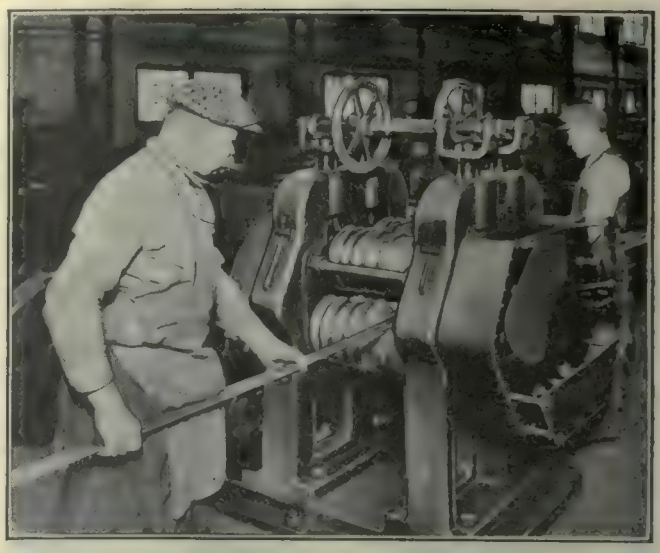


FIG. 67. SPRINGING MACHINE FOR REMOVING STRAINS FROM BARS AND RODS

mills where they are drawn to size in the draw blocks.

In Fig. 65 is shown the operation of drawing rods from the extrusion machine. This draw-bench operates on the endless chain principle, with reversing motors. Rods are straightened by passing them through three sets of spirally mounted rolls, which manipulate them in such a way as to relieve mechanical strains left by the drawing process. The cover of the machine, Fig. 66, is thrown up so as to show the method of mounting the rolls. In operation, the frame, containing the roll sets, rotates around the rod.



FIG. 68. STRAIGHTENING ROD OF SMALL DIAMETER

The matter of mechanical strains in drawn bars is of the greatest importance, since their elimination largely determines the service characteristics of the material. This detail of tube and rod manufacture has been scientifically studied by this company, and the manufacturing technique so worked out as to eliminate practically all unbalanced strains. This result is obtained by properly choosing the various factors that enter into the annealing, pickling, lubricating, drawing and straightening processes, all of which have a bearing on the strains in the metal. A springing machine for removing strains from bars and rods is shown by Fig. 67, and Fig. 68 shows the method of straightening rods of small diameter.

A Suggestion to Machine-Tool Builders

By T. F. GITHENS

The slogan of the modern successful manufacturer is "Service." The sale of a machine to a customer is only the beginning of the opportunities the seller has for selling his service to aid in the customer's business. The better the service received from the machine and the manufacturer, the more securely is the machine sold, and the more chances are there for obtaining additional business.

IN order to secure the most effective output from a machine, it must be given proper operating conditions and correct installation. The correct installation of a machine is the next important point to be considered by the buyer after the selection of the machine; in fact, quite often the selection of a given machine depends upon installation questions, such as the floor space occupied, the weight, and how the machine is to be driven.

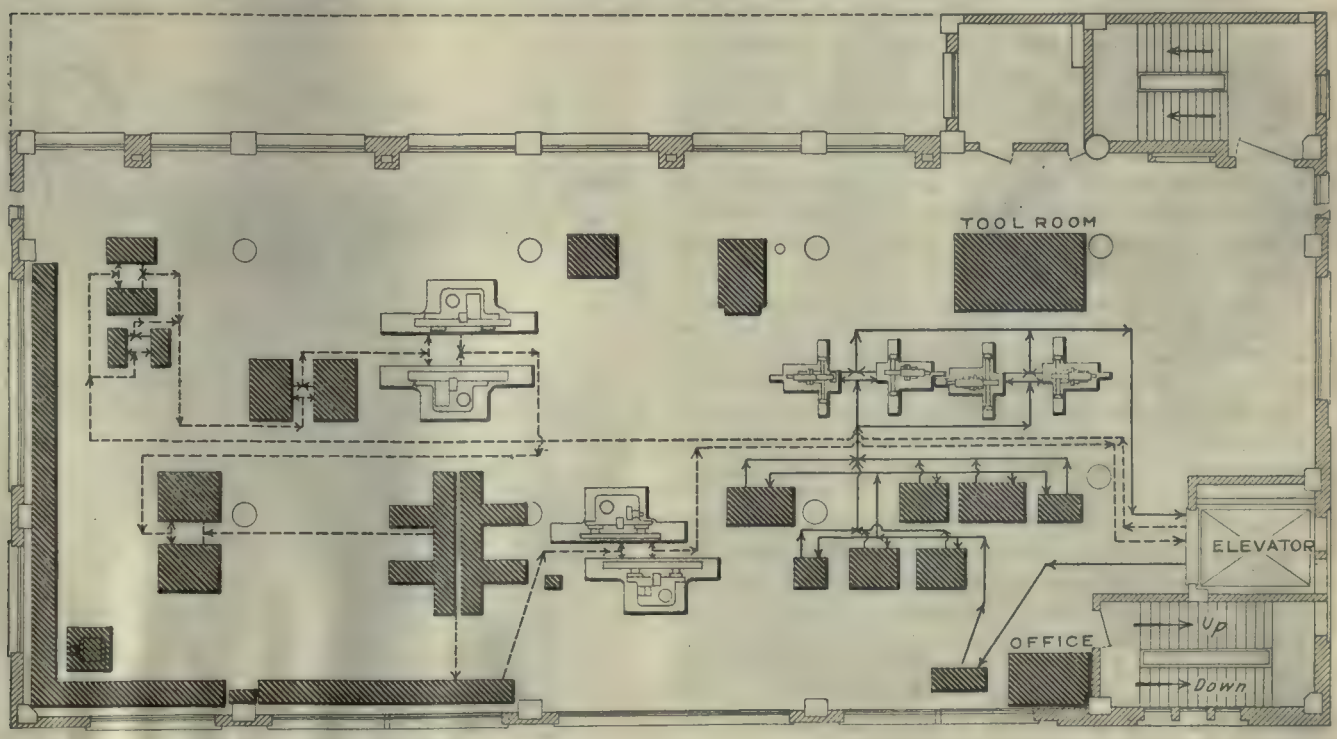
In making the layout of a new factory department, the approved method is to make a plan of the building to some convenient scale. For average size buildings, it has been found that a scale of ¼ in. per foot is the size which will give a plan covering a suitable size drawing sheet, 26 x 40 in. Windows, doors, columns, radiators, piping, and other stationary details must be shown to scale in their proper places, as they often interfere with or determine a layout.

The next step is then to cut out pieces of cardboard representing the floor plans of the different machines to the same scale as the building plan. These cardboards are then placed on the room plan in their most efficient combinations. It is usually most economical to have the product follow a straight line routing and move from one machine directly to the next operation machine, having these machines as near to each other as possible. This straight line routing will save enormously on the cost of trucking work from operation to operation and will reduce the quantity of stock in progress through the factory, and in many cases save money by reducing the amount of money paid out as interest on investment due to having valuable stock in transit through the works in larger quantities than necessary.

The location of the machinery is influenced by another factor than that of the most economical routing, namely: the method of driving. Machines driven by individual motors may in most cases be placed independent of this factor, but for most plants it has been found most economical to run machines by the "group drive" method, one motor driving a line shaft and this in turn driving several machines, from two to thirty. Machines which are "direct driven" should be located under the line shaft or a jack shaft to eliminate the expense of a countershaft. Machines requiring countershafting must be placed so that their drive pulleys on the line shaft will not interfere and so that where more than one row of machines is driven from a line shaft all the pulleys and belts will be given sufficient clearance.

This locating of the countershafting is an important and difficult question, and the only way to answer it so as to be sure that pulleys, hanger boxes and couplings are all correctly located is to make a detailed layout to scale.

It is right here that the writer wishes to bring home the point of his suggestions. The time and labor of making this detailed layout, and the shifting of one machine base here and a countershaft there, would all



PHOTOSTAT OF MACHINE LAYOUT

be saved *if the manufacturer would send out* with his machine, or his machine description, upon request, *a brown print showing the floor plan and countershaft plan* (where a countershaft is required) *to a scale of ¼-in. per foot.*

The customer could make a print from this brown print, cut around the outlines of the machine, paste it on cardboard for ease in handling, and have a far superior representation of the machine to a scale than a mere cardboard outline. These "cardboard machines" can be placed on the floor plan and clearances between machines accurately seen. The prints of the countershafting can be pasted on cardboard and their best location determined so as to most efficiently locate all the pulleys on the main line shaft.

Photostat Brought Into Use

When the small cardboard prints of machines have all been located to the satisfaction of all concerned, they can be pinned to a print of the floor plan held on a regular drawing board and a photostat made of the layout. This photostat can be made to any convenient size, such as ⅛, ¼, or ½ in. per foot.

These photostats will have three main uses:

(1) The engineering department can use them for designing structural work and the planking for holding countershafting to the ceiling. This is quite an item in concrete buildings, and one which must be considered in the design of the building. Materials must be ordered in advance for this purpose as well as pulleys for the line shafting. A machine may be delayed in being started because of lack of information concerning countershaft speeds and pulley dimensions.

(2) A photostat can be given the millwright and is a valuable aid in instructing him regarding the correct location of each machine which may be numbered or otherwise identified.

(3) A photostat is useful to the foreman, who will operate the department, and the production superintendent, as it will enable them to visualize the machines in a department and give them concise information of machine location, number, type, size, and appearance. It will also, when the routing for various products is drawn in different colored inks, show up the efficiency or weak spots as the case may be, in the handling of material from machine to machine.

In factories where there are many departments, it would be awkward and expensive to store away a drawing board for each department showing the machine cardboards pinned on a print of the floor plan. Therefore, when a layout has been completed, all machines have been installed and there is no reason to believe there will be any extensive changing of the layout in the near future, the cardboards may be pasted to the print of the floor plan and all filed away in a drawer occupying no more space than an ordinary tracing, and capable of being reproduced for use any time by means of the photostat machine.

It may be noted that most manufacturers now send upon request excellent prints showing floor plans of their machines and countershafting, but the point is they are all to different scales such as 1, 1½ and 3 in. per foot, etc. They are also to scales which are too large for the purpose of the draftsman who has to make a layout of the machinery for a department or entire floor. Also, they are mostly blueprints which do not admit of reprinting as brown prints do.

In answer to these points, the writer suggests a "standardized" floor plan of machinery and countershafting which shall fulfill the following specifications:

(1) It must be to a scale of ¼ in. per foot.

(2) It must be a brown print capable of printing brown or blue line prints.

(3) It must show the machines in normal and also in extended positions.

(4) It must show the countershafting and machine plans and speeds so that they may be cut out independently and pasted on cardboards.

The illustration herewith is from a photostat made of a department according to the above scheme with the exception that it was not possible to obtain brown prints of machine layouts to required scale. The machine layouts shown were photostats from prints of 1 in. per foot scale. The cross-hatched rectangles are cardboards merely showing floor space already occupied by machines.

Tool-Setting Gage

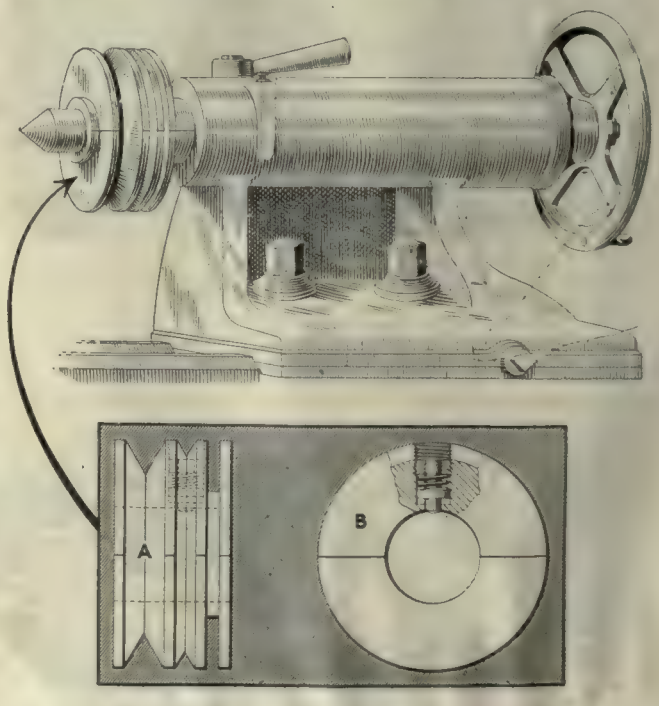
By Harry Moore

The drawing shows at *A* a ring I have made to facilitate the setting of lathe tools.

It is made of tool steel bored out to fit the tailstock spindle, turned, and cut with a large and small *V*; also grooved with a regular parting tool.

I have scribed a center line on the tailstock spindle; also the sides and periphery of ring. It is very convenient then to set a threading tool central to the line and in correct position at the same time, without having one hand tied by holding the thread center gage. The groove comes handy to set the parting tool central and square, thus eliminating guesswork and consequent binding. I set all my regular tools central by the line on the ring.

I made the ring plain at first but have since added an improvement in the shape of a spring plunger shown at *B*, which drops into a drill spot on the spindle and lines up the ring with the scribed line central.



TOOL-SETTING GAGE

A Mechanism for Graduating Dials of Optical Instruments

By J. V. HUNTER
Western Editor, *American Machinist*

The graduating of dials can be performed in various ways, the method used depending upon the character and amount of work to be done. The machine described here seems to be satisfactory for use on optical instruments, it being adaptable to work of different sizes and shapes where accuracy is important.

THE S. A. Rhodes Manufacturing Co., Chicago, Ill., had to overcome a number of difficulties in developing a machine for graduating the different styles of dials used in the construction of optical instruments. Samples of the many forms of dials which must be graduated are shown in Fig. 1. The work ranges from graduating the flange of the cup-like piece at the left of the illustration, to graduating the beveled portion of the disk at the right, or even the special knurling on the thumb-nut shown in the center.

The requirements of the work have been met by the construction of the special graduating instrument shown in Fig. 2. All parts of the machine are not new, for many were taken from old machine tools which were available when the device was constructed. The top of the plate A, which serves as a base, is carefully finished, and on it the dove-tailed base *B* of the spindle-head for

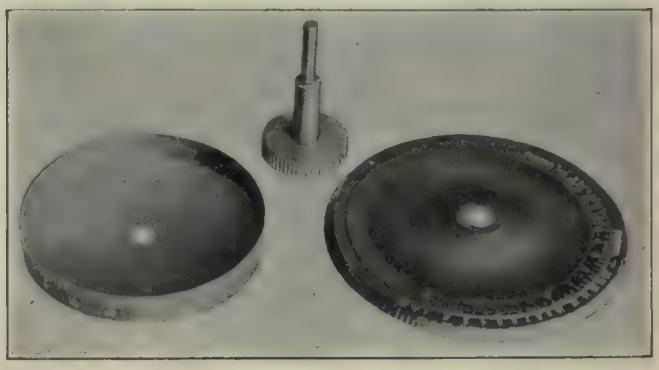


FIG. 1. SAMPLES OF WORK GRADUATED ON MACHINE

holding the work is fixed. The mechanism at the right carrying the engraving tool can be set and bolted in any one of several positions on the plate, so as to take care of the different forms of dials which have to be graduated.

Head for Holding the Work

The spindle head, Fig. 3, consists of the base *A* provided with two slides at right angles carrying the vertical upright and the slide *B*. The upright is provided with a graduated base *C* and may be swiveled to any

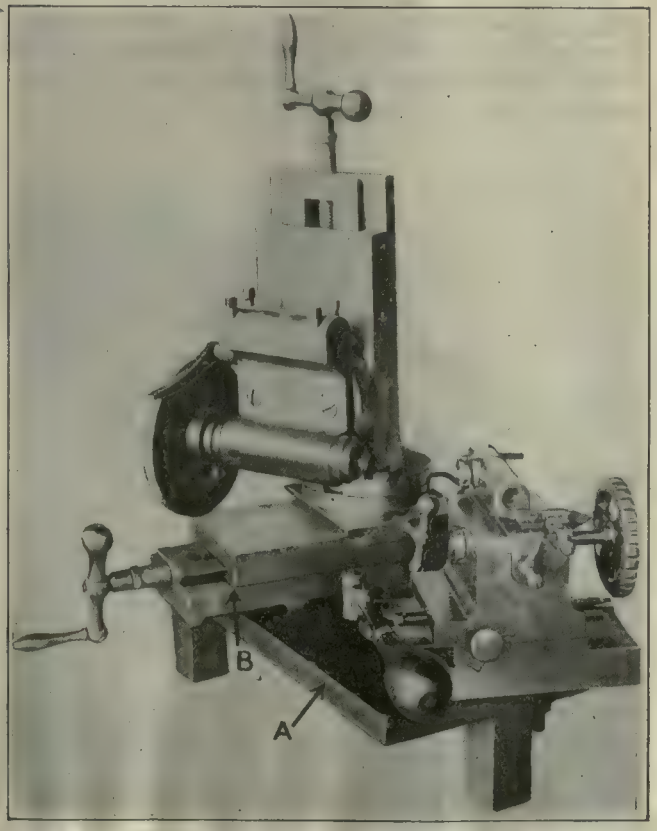


FIG. 2. A GRADUATING MACHINE FOR WORK ON INSTRUMENT DIALS

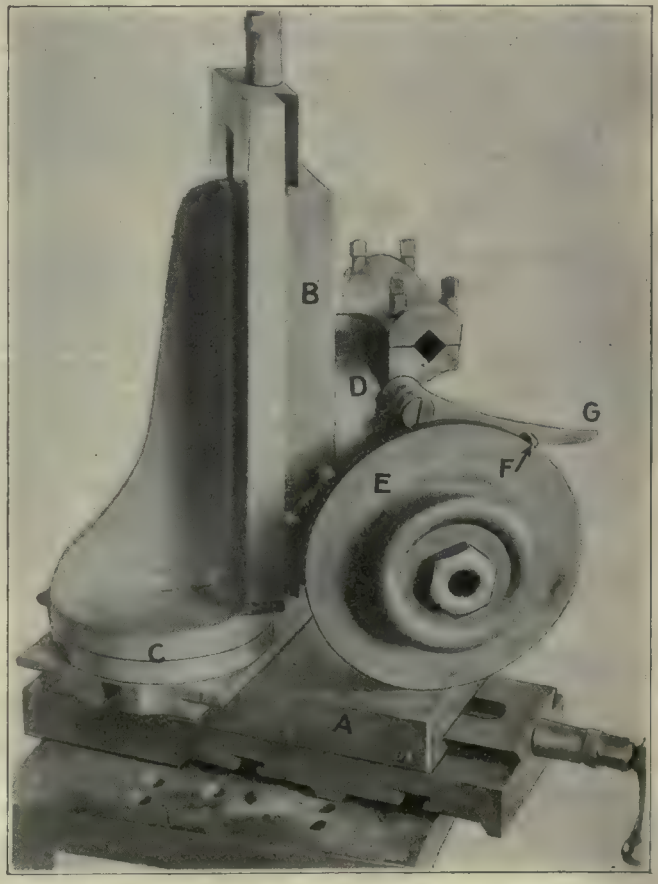


FIG. 3. ADJUSTABLE HEAD FOR HOLDING DIALS IN POSITION FOR GRADUATING

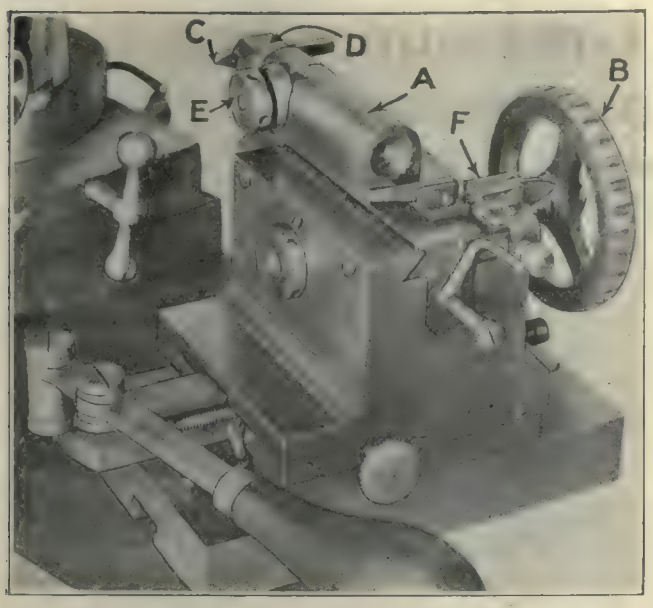


FIG. 4. HEAD FOR HOLDING RECIPROCATING TOOL

angle. The vertical slide *B* also holds a graduated base *D*, so that the spindle-head can be set at any angle with respect to the horizontal. The spindle has an index plate *E* to control its rotation, so that the desired spacing of graduations can be placed on the work.

The index plates or master graduating dials, such as the one shown at *E*, are made up in many cases for special series of graduations, although one dial is provided with angular graduations for the full 360 degrees. In other cases, the graduations are in the nature of those on a slide rule, and constantly vary in value as they run from zero up to the maximum. It will be noted that the special dial shown in the illustration has graduations for only 180 deg. of its circumference. Each graduation is marked on the periphery of the dial, and the indexing point *F* on the trigger *G* governs the amount of shifting of the spindle position after each mark has been cut on the work.

The Toolhead

The portion of the device which carries the tool for cutting the graduations is shown in detail in Fig. 4. The tool slide *A* can be moved forward and back by the handwheel *B* at the right, thus causing the tool *C* to cut the graduation lines in the work. The tool *C* is carried in a clapper-box *D*, which is held in place by a spring, so that the tool can relieve itself from the work when returning for each fresh graduation. The position of the tool in the toolpost can be adjusted after loosening the nut *E*.

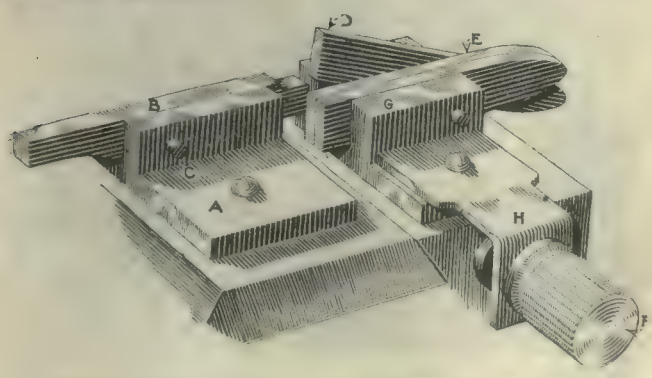


FIG. 5. STOPS ON TOOLHEAD USED FOR VARYING THE LENGTH OF THE GRADUATIONS

A means for limiting the length of the different graduations, so that every fifth or tenth cut, as is desired, may be indicated by a longer line, is obtained by the small device *F* which has been arranged on the rear of the housing of the toolslide. This device is more clearly indicated by the line drawing, Fig. 5. The small bracket *A* is fastened to the toolslide and carries an arm *B* which is pivoted at C. When it is not desired to use a stop for the toolslide the left-hand end of *B* can be tilted up, thus throwing down the extended portion at the right so that it passes beneath the plates *D* and *E* that serve as stops on the body of the toolhead. There are three of these stops, each approximately $\frac{1}{8}$ in. in thickness.

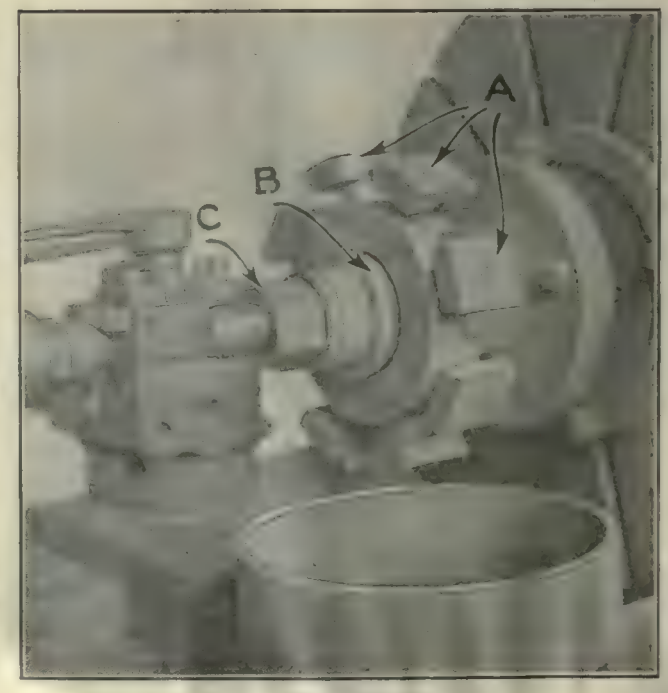
In the illustration the first stop *D* has been raised, thus permitting the slide to travel back a little further before the arm *B* strikes the stop *E*, and so make a longer line on the work. This stop would then be lowered and for the next four or nine strokes would serve to limit the graduated line to a shorter length. When a still longer stroke is desired for possibly a tenth division, both the stops *D* and *E* can be raised, letting the arm *B* come back against the last stop of the series. In order to adjust this device for proper position on different dials, the thumb-nut *F* is provided and connected to the stop bracket *G* by means of the angle *H*. This permits the stop to be set forward or back in order to place the graduations where they are wanted on the work.

An Expanding Chuck

By E. A. Thanton

A very good chuck to be used where large castings must be chucked from the inside, is shown in the illustration.

The expanding jaws *A* are moved outward to the work by forcing the cone *B* inward. This is done by screwing in nut *C*. As the cone is withdrawn, springs at the back of the jaws pull them toward the center, making it easy to lift off the work.



AN EXPANDING CHUCK

The Law in Regard to Strikes—II

By CHESLA C. SHERLOCK

This second article of the series treats of the legal liabilities, responsibilities and duties imposed on the employer by reason of a strike at his shop or plant. Just how the compensation and the common laws apply in these cases is clearly defined.

(The first installment was published last week.)

ASIDE from questions arising out of the right to work, the right of society to the uninterrupted enjoyment of the service of workers, which was treated in the previous discussion, there is another very important problem in regard to strikes particularly interesting to employers at this time. It is the legal liabilities, responsibilities and duties which a strike at his shop or plant imposes upon him. Must the employer, in case his workmen enter into a strike, refrain from the operation of his business until the workmen return? Must he refrain, under the law, from the importation and use of strikebreakers? In case of injury or death, either to the strikers or the strikebreakers, what is the employer's liability? Does the employer owe anything to a strikebreaker? Are professional strikebreakers to be considered as employees within the meaning of the law? Can the employer be sued for damages by a strikebreaker?

These are a few of the many perplexing questions which are bound to arise in any employer's mind just as soon as he finds a strike on his hands. And, oftentimes, a little previous knowledge on the subject will stand him in good stead.

The employer's liability to a strikebreaker for injuries must necessarily arise out of either (1) the common law, or (2) the workmen's compensation acts. If the basis of recovery under either of these two measures of the employer's liability be satisfied in a given state of facts, then the strikebreaker may recover for the injuries sustained.

The Compensation Laws as Applied to Strikes

The workmen's compensation acts, as everyone knows, places the employer's liability upon the basis of the relation of employees. Third persons have no right of action against the employer under these acts. Injuries, as they generally arise in the case of strikes, are caused by the strikers seeking to prevent strikebreakers from carrying on the employer's business or trade.

Unquestionably, a strikebreaker is an employee and entitled to relief under the compensation acts in the majority of cases. In fact, the strikebreaker and the employer usually recognize the hazards and some extra stipulation is made in the contract of employment seeking to compensate the strikebreaker in some specified sum in case of injury.

There is a provision in the compensation acts, however, which states that if the employee is injured as the result of a wilful attempt on the part of another employee to cause injury, then the employer shall not be liable for the payment of compensation. If a striker hurls a brick through the factory window with a malicious intent to injure a strikebreaker, is the striker still an "employee" within the meaning of the Acts sufficient to deprive the injured strikebreaker of his right to compensation?

It is problematical as to what the courts would say upon this proposition, but if we analyze the matter carefully we cannot fail to agree that when the Acts were written this proviso was not inserted with the subject matter of strikes in mind, but rather with the matter of private disputes between employees in mind.

The common wording is: "No compensation under this act shall be allowed for an injury caused by the employee's wilful intention to injure himself or to wilfully injure another."

Injuries, in order to be compensated under the compensation acts, must arise out of and in the course of the employee's work. An injury to a strikebreaker caused by the violence of a striker, when such strikebreaker is busy in his employer's place of business, unquestionably arises out of such employee's work. We do not feel that the courts, especially in view of the present temper of public opinion, would feel disposed to hold that a striker was still an employee in a sense sufficient to deprive the strikebreaker of compensation relief. Indeed, if the ruling of the Federal Court in the Iowa case mentioned in the previous discussion should apply, the strikers could not be considered in any sense as employees, but as men who had severed all connection with the employer under their contracts of employment.

Where the strikebreaker was assaulted and injured while off the employer's premises, another situation and basis of liability would arise. An employer is not liable for injuries sustained by workmen while they are going to and from the place of work, except in two cases, under the workmen's compensation acts: (1) When, by the contract of employment, the employer must transport the workmen to and from work; (2) where the employment increases the normal "street hazards" experienced by others in the community.

We are again unprepared to say what the courts might do, especially in the latter instance, inasmuch as cases have not been reported touching on the proposition of whether employment as a strikebreaker increases the hazard sufficiently to afford protection under the compensation acts. We are inclined to think that the courts might be widely divided on this point.

In either of the above instances mentioned, if the courts were to hold that the employer was not liable under the workmen's compensation acts, he would not be entirely freed from liability. The injured man would still have recourse to the common law, and if he had a basis for action might sue the employer for damages.

What the Common Law Allows

The common law is much more strict than the workmen's compensation system and the chance of a strikebreaker recovering damages for injuries sustained would have to depend clearly upon the contract relations between him and his employer. If it depended merely upon the status of employment, the chance of the strikebreaker securing damages would be extremely remote, as in that case the injury would have to result from the negligence of the employer and if touched by any of the three "common law defenses" of assumption of

risk, contributory negligence or the negligence of fellow-servants, on the part of the employee, then the employer would not be liable.

But in cases where special contracts have been entered into by and between the employer and the strikebreaker, it seems to be the concensus of opinion that the employer must stand by his contracts and fulfill them. The strikebreaker, for instance, cannot be held to have assumed the risk of injury from strikers when he enters the employment and such has been the subject-matter of a special contract between the parties. If no contract has been made between the parties, other than a mere contract of employment, and the strikebreaker enters the employment having full knowledge of the situation, he may be held to have assumed the risk of injury.

At common law it is the duty of the employer to inform his employees of any facts which he may know which have any bearing on the work to be done that might prove dangerous to the workmen. The employer, by reason of his superior knowledge about the work and the special conditions applying to it does have this knowledge from time to time and if he fails to impart it to his employees, he cannot later be heard to say that the employees assumed the risk along such lines. If an employer has a strike at his shop or factory and engages a new force on ordinary contracts of employment and fails to tell them that there is a strike at his plant, then he cannot escape liability under the common law, in case some of the strikebreakers are injured, by saying that they assumed the risk of injury by going to work.

One cannot, even under the harsh common law, assume a risk of which he has no previous knowledge. Rather, the blame is placed upon the employer for failing to impart the benefits of his superior knowledge concerning conditions, tools, appliances, and the like, to the employee at the time he went to work.

Concerning Inducements to Strikebreakers

Everyone knows that it is exceedingly hard to obtain men to work at a plant where there is a strike in progress. This is not only due to the fact that union men will seldom "scab" or place themselves in counterposition to other union men, but because of the fact that strikers are generally dead in earnest and do not hesitate to go to long measures to enforce their demands upon the employer. They walk out, hoping to cripple the employer and prevent the turning of a wheel until he comes to a common understanding with them. They do not take kindly to efforts on the part of the employer to proceed as usual, and they do not hesitate, as a rule, to resort to violence, to intimidate, to "beat up" or forcibly eject those who do go to work for the employer.

The result is that under ordinary circumstances the employer cannot secure men to act as strikebreakers unless some sort of special inducement is held out to them. And that is why the courts will, first of all, look to the contract between the parties to ascertain what the basis of liability may be if the workers were injured.

The contract liability is the important liability and if the parties have specifically agreed upon a certain sum as the basis of recovery, the employer will not be permitted to escape payment, the agreement among the parties being considered by the courts as a proper basis of damage, unless other circumstances familiar under the law of contracts enter in.

But no contract liability, as we have pointed out before, can be binding upon the parties unless it is well grounded in the law, as found either in the statutes or the old common law. Special contracts may be entered into creating greater rights for strikebreakers than they would hold as mere employees, but we must not lose sight of the fact that these contracts must be made for a legal and legitimate purpose. If they are made for an illegal purpose, they will be void in the very beginning and the special rights recognized will perish and the workers operating under them will have no greater rights than those conferred upon ordinary employees. An employer will not be permitted by the law, even in a time of great stress and crisis, to hire men to "beat up" former employees on a strike or generally to do violence to them. The courts will countenance no such purpose.

Employers as a rule do not bother themselves so very much about the sorts of inducements held out to the men at the time they are seeking strikebreakers. The important thing just then in the mind of the employer is to get men to work and he does not particularly care what kind of an inducement is offered just so long as he can get them to work.

He has a tendency to minimize the danger and to feel that there will be no disastrous results, no violence, no injuries, no deaths. Oftentimes, he will go to unreasonable lengths to pacify the fears of timid men in order to get them to work. He may make unusual and lavish promises, simply because in his anxiety to get the plant operating again he loses sight of important considerations—the fact that he may be called upon to make good these promises in a court of law.

He may even resort to fraud and deceit. Anything, in his mind, will justify the end just then. But when the violence has taken place and the strikebreaker has been killed or seriously injured, then the matter has a very different complexion. The one thing that he wants to know and to know to a certainty is whether he is bound by the special contracts which he made and by the special inducements offered.

Liability of Employer for Injuries to Strikebreaker

A case arose in New York which offers a splendid example of what usually happens under such circumstances. It seems that an employer had entered into a contract with a workman employed as a strikebreaker in which he agreed to indemnify the man or his family in case he were injured or killed while at work in that capacity.

The strikers succeeded in catching the strikebreaker one night and they used him so severely that he died. The family of the deceased promptly demanded the indemnity which the employer had promised under his agreement. The employer evidentally had a fair knowledge of law, for he refused payment, claiming that he was not legally liable.

The matter went to the courts and the court looked first to the contract, then turned back to the common law to ascertain whether such a subject-matter could properly be the subject of a contract between employer and employee. It was found that there was no such thing as a strike in the common law. It recognized no such situation or that a binding contract could be entered into on such a subject-matter. The court then said that if the contract was to be binding that it would have to arise under a statutory right; in other

words, there would have to be a special statute recognizing that such a situation would legalize any special measure of liability mentioned in the contract. Since there was no such statute on the books, then the contract failed and the employer was held not liable.

It was found, however, that there was a statute under which the employer was liable for the death of a workman caused by the employer's negligence. Since the death of the workman in this case was clearly not the result of the employer's negligence, the case did not apply.

Employers who, having a knowledge of the law and their measure of liability, enter into an agreement with a workman to act as a strikebreaker, knowing all the time that they can never be held to pay the indemnity in case it is called for, cannot be too severely censured. They are, in fact, leading innocent men to their death; certainly, they are laying them open to violence and injury under a false assumption of facts.

If the employer deliberately sets about to do this, and his intention can be proved, he will not fare so well in court. In fact, he may find himself being tripped up, rather than the reverse being the case. Deceit and fraud are never countenanced by the courts and they will oftentimes override precedents and established rules of procedure in order to bring an offender to terms.

One of the most common forms of deceit under these cases is to hire workmen from remote localities as strikebreakers, but not to acquaint them with the true situation. Nothing is said about a strike being in progress and it is figured that after the workmen come to the plant, often without means, they will continue at work even after they know the true facts, in order to earn money to get away.

Such a case arose in a Western state. A man was hired by the employer and put to work. He did not know there was a strike in progress. Nothing was said or done to acquaint him with the facts. A few days later while he was at work he was fired upon by the strikers and severely injured.

The court said that no employer had a right to hire a man and fail to acquaint him with the fact that a strike was in progress; that if the employer had a knowledge of facts or circumstances affecting the safety of the employee that it was his duty to impart that knowledge to the employee at the earliest possible moment. Failing in that, his concealment operated as fraud and deceit upon the unsuspecting workman and that was sufficient to render the employer liable in damages for the injury received.

Another leading case, turning upon a slightly different state of facts, is often cited to chart the employer's liability in such instances. It seems that a workman was hired by an employer who failed to say that there was a strike in progress at the plant.

A few days after the man went to work a committee of strikers waited upon him and acquainted him with the fact that a strike was in progress and stated that they could not permit him to work at the plant. They further warned that if he continued to work there would, in all probability, be violence.

The workman immediately went to the employer and told him what had taken place. The employer endeavored to persuade the man there was no danger and even promised to provide a guard for him if he would continue at work. Upon this promise, the man went back to work, but the employer failed to provide a guard. The result was that a few nights later the strikers caught him at his home and gave him such a slugging that he died.

The dependents of the deceased immediately brought action relying on two facts: (1) That the employer had failed to tell the deceased that there was a strike in progress at the plant, and (2) had failed to provide a guard in accordance with his agreement.

The court examined the statutes and stated that there was nothing in them permitting one to bring an action against another due to his negligence or wrongful act for death. So the family of the deceased could not recover against the employer.

The majority of instances where the employer will be liable for injuries caused by strikers must, of necessity, arise under rights conferred by the statutes. The common law, as a general proposition, is silent on the subject of strikes, they being unknown to it. But out of ordinary relationships of employment, a liability may arise under the common law, as we have already indicated.

But there is no liability on the part of an employer, as a rule, for damages for the death of a strikebreaker. The reason why the statutes have not conferred this right to third parties is due to the feeling that it would be against public policy to permit the death of another to become subject-matter for an action for damages.

Where the employer practices fraud and deceit, however, under a contract of employment, the courts have granted relief to the dependents of injured strikebreakers as they cannot countenance any such action on the part of employers.

So far as the workmen's compensation acts are concerned, they are statutes conferring a right for compensation for the death of a workman but under certain limitations. The decedent must have met his death by reason of an "accident" arising out of and in the course of the employment.

An English case has held that where a strikebreaker is injured by strikers that his injury is not an "accident" within the meaning of the compensation acts. This decision, however, implies certain facts which would not cover all cases. It implies that the workman was injured while going to and from work and not while on the employer's premises; further that the workman had knowledge of the fact that there was a strike in progress and that there was no fraud or deceit on the part of the employer. It does not apply to instances where the workman is injured while at work on the employer's premises.

Moral Obligations of Employers

In conclusion, we cannot help but call attention to the moral obligation which attaches to the employer in these cases. The employer should not be encouraged to study the legal situations arising under this subject for the purpose of finding out where he may invoke the protection of the law to work hardship and misunderstanding upon his employees, even though they be strikebreakers.

There is a moral obligation upon every employer which is growing stronger as the days go by, and that moral obligation has impelled employers to do things they never did under the common law. Our recreation centers, our model housing, our special educational measures and Americanization projects which we are witnessing in the industrial world every day, are the result

of a growing moral obligation which has eventually found its way into the laws of the land.

Public opinion is needed to solve the industrial tangle. It cannot react to the benefit of all classes, particularly to the benefit of the employer, if he is to continually keep merely the letter of the law and shirk the spirit thereof in these matters. So long as the employer takes advantage of the men he employs and fails to meet his agreements when they meet death or violence, merely because the law permits him to escape in the majority of cases, so long will he find himself at odds with the laboring classes and with the public.

Strikes and walkouts present a trying problem, none the less to the courts than to the employer. In the past the courts have sought to wash their hands of the matter in so far as possible. Public opinion is forcing a change. And it must also force better behavior from all parties concerned. Indeed, it will, if a real adjustment is to come.

Precision Gages

By H. F. Irons

The article by M. E. Kenek on page 884 of *American Machinist*, entitled "Precision Gages," contains some statements which in my judgment are misleading.

For instance, near the bottom of first column on page 885 the author refers to "the fact that all makers of gages . . . have settled upon an alloy having 1.35 per cent chromium and 1.0 per cent carbon." It may be of interest to know that analyses of several different Johansson gages of recent delivery show no chromium. The analysis of at least one block made by the Bureau of Standards two years ago (of which analysis the writer has a copy), also shows no chromium. I may perhaps be permitted to express a doubt that steel containing not more than one per cent carbon can be made hard enough to give satisfactory service in a gage block.

In suggesting a set of thirty blocks in which the odd thousandths and ten-thousandths are built upon the 0.010 base instead of on the 0.100 base as in the 81-block sets, the author says "this set can be made for half the cost of the 81-block set." It is my belief that it could not be made for twice the cost of an 81-block set because of the extreme difficulty in lapping gages as thin as 0.010 in. Aside from the difficulty in lapping these very thin sizes without causing them to curl from the peening action of the laps, the author himself makes the illuminating statement in the third paragraph, second column, page 885, "with thin flat gages there will be found after a very few days a noticeable convexity on the sides of largest area."

After all manufacturing and seasoning difficulties had been overcome, there would remain the flexibility which, in the hands of the user, makes these thin blocks difficult to handle and to keep flat.

The author's statement at the top of the last column, page 885, "from this it would appear that the aging process seems to affect hard gages more permanently than the softer ones" seems to be based on his preceding statement that he has seen one hard gage which was permanent. I doubt if this proof will be accepted as conclusive.

Mr. Kenek in his article refers quite justly to the difficulty in setting to exact parallelism the two plugs at opposite ends of a stack of gage blocks when used for measuring holes.

The company with which I am connected has appreciated and met this condition by making the end measuring attachments slightly wider than the gage blocks, and with two sides finished accurately parallel with the semi-cylindrical ends. Hence, by laying the stack of blocks on a surface plate, the measuring ends are easily made parallel. This is found more accurate than the channel for use in assembling stacks to which Mr. Kenek refers.

New Form of Industrial Insurance

A new form of group health and life insurance, which from present indications bids fair to outdo all other forms in popularity with workmen, has been established by the Life Extension Institute, Inc. This latest addition to industrial welfare associations is headed by ex-President Taft and its directors include some of the foremost figures in the technical life of the country.

What impresses us most about the insurance offered by this association is the group policy, in which the employer and the employee enter into the contract on a fifty-fifty basis, each paying one-half of the yearly payment, the working man getting the financial benefit and the employer getting better and steadier service as his dividend on the investment. Besides the regular sick benefit and life insurance there is another phase—health improvement. This provides physical examinations by competent doctors and the proper medical attention to correct an employee's affliction and restore him to his proper degree of efficiency.

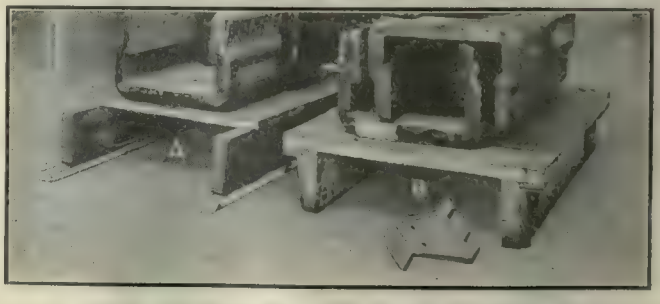
As an example, by the payment of 25 cents a week each by employer and employee the latter is granted $1,000 life insurance, $10 a week benefit and accident insurance and the annual health service of the institute.

This is a somewhat different plan from most other industrial insurances because of the joint participation of both company and workman.

Restoring a Truck Platform

By F. C. Wood
Plant Engineer, Heald Machine Co.

A cause of failure in the ordinary truck platform is shown in the illustration at *A*. The wear and shrinkage of the side pieces soon makes it impossible to insert or remove a truck without blocking up, as shown; also



OLD AND IMPROVED TRUCK PLATFORMS

the end top boards are the first to become loose after which the platform soon becomes useless.

The remedy is shown at *B*. The cast-iron foot shown requires no machining and maintains the correct height and also holds the end boards which should be made of hard wood.

Foundations for Machinery*

By N. W. AKIMOFF

Vibrations arise either from lack of balance or from other causes. The proposed theory contemplates the latter, the problem of balancing being considered as capable of complete solution by suitable treatment. After briefly considering the nature of possible displacements of the foundation as acted upon by various causes leading to vibrations, the author introduces, by way of illustration, a double pendulum, a few experiments with which form the basis of his theory. Means for localizing the expected vibration and of controlling the resulting periods are then illustrated in a working sketch of the proposed arrangement.

THE weight of the Great Pyramid is approximately 5,274,000 tons, its base is 764 ft. square, and its height about 486 ft. It is built on leveled rock. The Washington Monument rests upon a bed of fine sand, 2 ft. thick. The piers of Brooklyn Bridge are founded 44 ft. below the bed of the river upon a layer of sand 2 ft. thick which rests upon bedrock. The massive St. Isaac's Cathedral, Petrograd, is built on a swamp, and the piling has been so carefully proportioned that the exceedingly heavy doors of the cathedral swing easily, whereas the slightest lack of uniformity in settling would doubtless lock them. These well-known structures are here mentioned by way of illustrating the obvious purpose of the foundations upon which they rest. The object of such foundations is double: (1) To distribute the load in as nearly uniform a manner as possible; and (2) to secure uniformity in settling, it being a well-known fact that all heavy structures settle, some to a considerable extent, 6 to 12 in. and sometimes even more.

Just how all this applies to foundations for all sorts of machinery, and in particular to rotative machinery, is not easy to say. Indeed, the weight, say, of a large pumping engine or of a turbo-generator outfit is generally much lower per square foot of floor space occupied than the limits prescribed by municipal laws or building ordinances, and furthermore, uniformity of settling of a relatively small volume of this nature (substructure plus engine, etc.) can be secured without going to the extremes usually observed in designing footings for buildings.

What, then would be the general governing idea in proportioning a foundation, say, for an engine of a given type? Should it be heavy or light? Should it be deep, resting on rock or sand if possible? Should it be independent of the footings of the building, or would it be desirable to tie it to the latter?

By examining the existing records we can find a great variety of rather contradictory answers to each question, but the predominant idea in the mind of the designers appears to be somewhat as follows: Since the engine is likely to vibrate, let us tie it as firmly as we can to the earth itself. The mass of the earth being practically infinite, the amplitude of the resulting vibration will probably be zero. The designer may be utterly unconscious of this reasoning, but he applies it through instinct or "horse sense" and gets results which sometimes are satisfactory and sometimes exceedingly poor.

It is especially interesting to see how the same designer, having decided to provide as solid a foundation as practical considerations allow, will often unconsciously neutralize his whole theory by such means as: (*a*) resting the foundation upon a layer of rubber, cork, felt, or other yielding material, as shown in Fig. 1, *A* and *B*; (*b*) providing a space between the foundation and the walls of the building and filling it with sand (if the foundation is so heavy and so deep as to secure immunity from vibrations, why fear its contact with the walls?); (*c*) using various pads, buffers, cushions, etc., see Fig. 1, *C* and *D*, which, if at all yielding, of course tear to the ground the very idea of solidity of the foundation with the earth.

Causes of Vibration

A rational basis on which to work is thus seen to be lacking and it is accordingly the object of this paper to point out some definite lines along which a rational theory of substructures for engines and moving machinery can in general be built up. To begin with, it is important to realize that vibrations are caused by two distinct orders of agencies: (1) Those due to unbalance, or, more correctly, lack of running balance; and (2) those due to causes other than unbalance.

As regards unbalance, it may be said that this can be so easily corrected in the construction of machinery that all specifications should invariably call for perfect running balance at all speeds, that is, complete absence of tremor or of "periods" under all conditions. The writer feels that such a complete practical solution of this problem of balancing has been offered by him for bodies of all kinds that there is now absolutely no excuse for the manufacture of unbalanced machinery. However, there are many causes quite independent of bal-

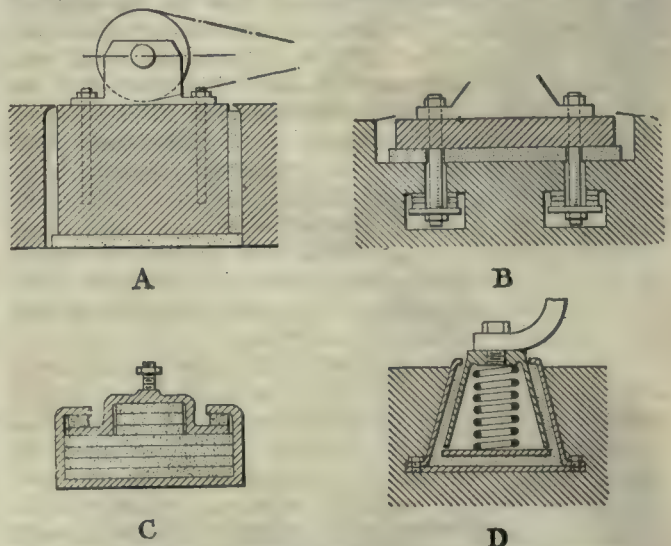


FIG. 1. SOME COMMON METHODS OF NEUTRALIZING VIBRATION

*Presented at the annual meeting, December 7-10, 1920, of The American Society of Mechanical Engineers, 29 West 39th St., New York City.

ance, each of which is likely to result in vibration, as for instance, "whipping" of a slender body (crankshaft, armature, turbine rotor, etc.); water in a steam turbine; peculiarities of the reciprocating mechanism—for instance, a 4-cylinder or an 8-cylinder V-type engine where certain forces do not cancel out and where running

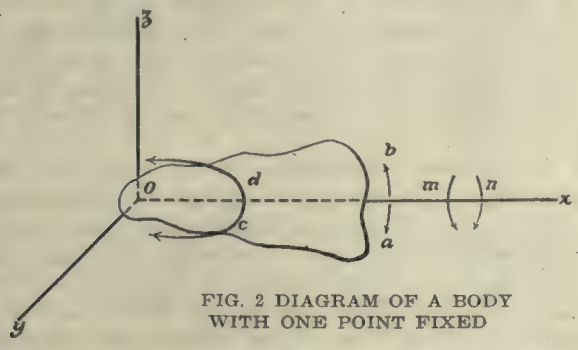


FIG. 2 DIAGRAM OF A BODY WITH ONE POINT FIXED

balance alone is not conducive to perfect results; or torsional vibrations, which under certain conditions produce an effect very similar to that of unbalance. Our problem, then, is to analyze the effect of these various causes, with the view of designing a substructure for a given machine that will be *least responsive* to these causes, for this is what the "relative" freedom from vibrations really means.

But whatever may be the cause of vibrations, it is safe to say that in general they are always due to *forces*, acting in a plane or planes, perpendicular to a certain axis; also to centrifugal *couples*, located in a plane, rotating about a certain line, usually the axis mentioned just above. We know from elementary mechanics that any motion of a body can be resolved into six distinctly separate motions: three *along* the three mutually perpendicular axes drawn through any point, within or without the body, and three *about* these same axes. A free body, capable of a displacement in any of these six modes, is said to possess six degrees of freedom.

Vibration as Affected by Degrees of Freedom

If the body is rigidly locked so that no displacement of any kind is possible, we say that all six degrees of freedom have been suppressed. By fixing two points in the body we have the effect of rotation about an axis, and only one degree of freedom, that is, the angular displacement about the axis, characterized by these two points. By fixing one point we suppress all bodily motion along any three axes through this point, but we still have three degrees of freedom, that is, freedom of angular displacement about any or all three axes. Fig. 2 shows a body whose point O is fixed. Such a body can have only three kinds of displacement: (1) about the axis y, as shown by the arrows a or b; (2) about the axis z, as shown by arrows c or d; and (3) about the axis x, as shown by arrows m or n. It makes absolutely no difference what the forces are which act on the body, no other motion is conceivable.

On the other hand, placing a body upon a thick sheet of yielding material, or for that matter on four springs, means freedom in all six directions; and of course the same applies to cushions or pads. For this reason it appears to be of extremely questionable value to interpose layers of such material between a massive subfoundation and the foundation proper of a machine, even if isolated examples are on record where such an arrangement actually *happened* to give satisfactory results.

With the foregoing in mind, let us digress for a moment. Stability with regard to our subject is a somewhat relative term. Why was the Great Pyramid built upon level rock, even, we are told, dovetailed therein? To insure stability. Why is a ship's compass or barometer mounted in gimbals? To secure stability. Why build a massive foundation for an engine? To secure stability. Why provide a layer of yielding material or springs or rubber pads? To secure stability. In other words, it is quite necessary to define in a more rational way the purpose of a foundation for an engine of a given type. We shall attempt to do this, first stating, however, the well-known effects of vibrations on various types of apparatus.

Effects of Vibration

In large power plants where the main units are of the modern turbo-generating type the steam mains have been known to burst, and subsequent investigation has often revealed no defect either in material or in general arrangement of piping. The accident can thus only be explained as due to "rough" running, that is, vibrations. What, then, would be the remedy? To anchor the unit still firmer, or place it on more yielding substance, thus encouraging the effect commonly known as "flopping around"?

The operation of a printing plant or of a leather-working factory is often extremely unpleasant for adjoining dwellings, and sometimes even for buildings located at a rather considerable distance. Inspection often reveals that machinery in such plants is firmly secured to extremely massive foundations, and the owners are at loss as to how to remedy the trouble.

Within the building itself, irrespective of the effects of neighboring properties, the action of machinery is often felt and has been known to cause a great deal of annoyance and dissatisfatcion. In addition to the printing press and the leather-surfacing machine, the types of machinery usually apt to cause trouble are as follows: triplex pumps, ice machines, air compressors (direct-driven), and various types of purely rotative machinery, such as blowers, centrifugal pumps, etc.

An internal-combustion engine often exhibits a certain amount of vibration which can be felt all over the understructure. In fact, owing to violent vibrations some of the tie rods, lamp brackets, etc., on automobiles have been known to snap in two, and in aircraft some of the instruments to drop off the board, yet these were parts of the understructure, to which they, as well as the engine itself, were firmly secured. The point we wish to emphasize is that in an understructure too much rigidity is as harmful as too much freedom to yield.

Stability Defined

We are now ready to formulate the new criterion of "stability" for foundations. Stability is here characterized by remoteness of the operative speed from any one of the several synchronous speeds at which the frequency of the operative speed would be nearly, or exactly, equal to the frequency of the free oscillation of the system, if displaced from natural state of rest and let go.

How many distinct synchronous speeds a system is capable of having depends upon the number of degrees of freedom. An absolutely free system, for instance,

placed upon an elastic sub-foundation, may have six independent synchronous speeds, or "critical" speeds, as they are sometimes called. A massive foundation resting upon rock is likewise often apt to be, in the larger sense, free in all six degrees, since it occasionally *does* vibrate and propagate the vibration to other buildings, etc. A system with one fixed point may have only three such synchronous speeds, while a system mounted to rotate about an axis can have only one such speed or "period," as it is often termed. If we could control these synchronous speeds, so as to make sure that none comes anywhere near the actual speed of operation of the machine, we would then have a fairly complete solution of our problem.

Vibration in a Body with One Degree of Freedom

In order to understand clearly the foregoing as well as the broad methods here proposed, let us consider the following experiment and the general consequences manifestly derived therefrom: Imagine a pendulum, as in Fig. 3-A, consisting of a platform P rigidly connected to the member Q by means of the side members N. The system is free to swing about the axis A in the plane of the figure. A small motor M fastened on the platform P operates a countershaft carrying an off-center weight W. The motor is fed through a suitable flexible connection and it is always possible to adjust the speed of the countershaft carrying the weight W so that the number of revolutions per minute of the former will be equal to the number of double oscillations per minute of the pendulum system, if the latter is slightly displaced from its vertical position of equilibrium and let go. The effect of this adjustment of speed will be the so-called "synchronism," and the extent of swing (amplitude) of the pendular system, in general very slight for arbitrary values of the rotative speed of the weight W, will now become violent, in fact, out of all proportion to the magnitude of the weight W itself.

This phenomenon of synchronism of cause and effect has been well studied. The amplitude at the exact condition of synchronism should theoretically be infinite, but of course in practice resistances of various kinds are always present, so that instead of *infinite* we have *large* amplitudes. The most curious fact is that in the vicinity of synchronous speed, both above and below, the amplitude drops down to a value almost insignificant, so that if the weight W is small the system appears to be practically at rest. Furthermore, any further increase of speed will not produce any effect, contrary to the current opinion of those not very well versed in the matter. For the sake of illustration let this synchronous speed be 100 r.p.m.

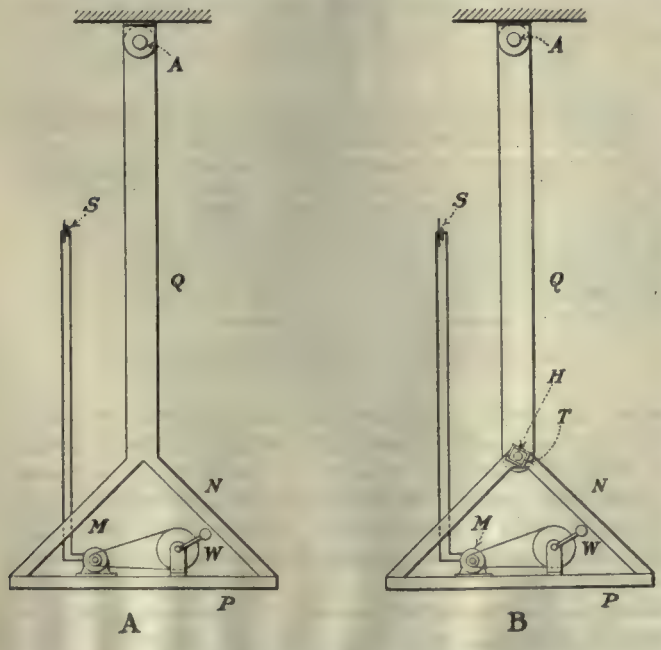


FIG. 3 A—SYSTEM WITH ONE DEGREE OF FREEDOM; B—SYSTEM WITH TWO DEGREES OF FREEDOM, ONE OF WHICH MAY BE SUPPRESSED

Vibration in a Body with Two Degrees of Freedom

As a modification of the experiment let us now provide another system, shown in Fig. 3-B, identical with the first except that the platform P is not solid with the member Q but is pinned thereto at H, the pin used being both frictionless and at the same time so arranged that it can be tightened up by means of the nut T, so as to lock the joint, thereby securing the exact effect of the rigid pendular system of Fig. 3-A. Providing the pin H, in the language of dynamics, is the *introduction of an additional degree of freedom*, thus securing a system with two degrees of freedom; while the tightening of the nut T amounts to *suppressing one of the degrees of freedom*, thus converting a two-degree into a one-degree system. In experimenting we shall first deal with the system of one degree of freedom, tightening the nut T and thus converting the pendulum into a system exactly similar to that discussed above, the synchronous speed being, say, 100 r.p.m. The pendulum will oscillate violently. We now loosen up the nut T, introducing an additional degree of freedom, with the apparently surprising result that the amplitude decreases practically to zero. If we reduce the speed considerably, say to 50 r.p.m., violent oscillations of the whole system will reappear, as will likewise be the case in speeding up the countershaft, say to 150 r.p.m. These figures are purely illustrative; whether they will actually correspond to facts will depend upon the characteristics of the system.

In other words, by introducing an additional degree of freedom we have accomplished this double result: (1) What was synchronous speed for a system with a single degree of freedom is no longer synchronous speed for the same system provided with an additional degree of freedom; (2) the new system has two frequencies of oscillation, at which it is sensitive to disturbing influences (such as centrifugal action of the weight W), one being below and the other above the value corresponding to that of the same system with the additional degree of freedom suppressed.

It should especially be observed that the oscillations were thus reduced practically to zero, not by steadying the system by something without it, but by some sort of an adjustment wholly within the vibrating system itself. Furthermore, what we did was to increase in a measure the flexibility of the system by breaking it in two; and although at first glance this might have increased the effects of the disturbing agency (rotation of off-center weight W), the actual effect was practically to bring the system to rest. It is still more important, however, to note the fact that we introduced the additional degree of freedom precisely in the sense of action of the disturbing agency, that is, in the sense of the plane of the figure and not at right angles thereto; or, say, in an up-and-down sense, as for instance by providing a coil spring instead of joint H.

This, then, will be taken as basis for our further discussion: In contemplating the design of a foundation we shall always separate those directions, or axes of instantaneous rotation, about which the system cannot, or at least is not likely to oscillate from those directions, or instantaneous axes, about which the system is more or less certain to vibrate. We next shall select a "steady" point from purely practical considerations, and

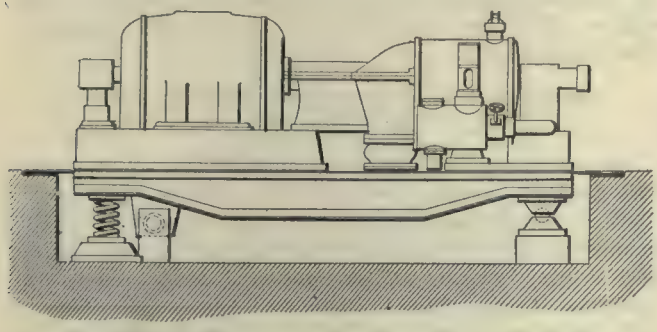


FIG. 4. APPLICATION OF THE AUTHOR'S DESIGN TO A TURBO-GENERATOR

finally devise such means of controlling the "free periods" of the system as will secure the desired degree of remoteness from synchronism under the actual operative speed. Such means of course will be springs, exceedingly heavy, and not in the least calculated to allow of any free wabbling of the system. They will also be adjustable so that the desired periods may be readily varied within wide limits; and in general structurally arranged to introduce as few changes as possible in the arrangement as a whole.

The author feels that to submit too many particulars as regards the detailed designs of such an arrangement would certainly defeat the purpose of this paper, which is merely to introduce the broad idea and not any one of the scores of individual designs which might readily suggest themselves to the engineer confronted with the problem of designing a foundation for a given machine. Considering, therefore, only one type of apparatus, a turbo-generator, shown in Fig. 4, we must start out with the selection of the steady point. We will naturally place it as near the steam main as possible (not to the exclusion, of course, of a suitable expansion joint), as under all conditions, should there be a choice of position, preference should be given to that point as far as possible from the center of gravity of the system, so that any static unbalance (whipping, etc.), would be made to act not as a force *upon*, but as a moment *about* that steady point. Such point should actually be made as steady as possible and no trouble should be spared in providing suitable piling or digging down to the solid ground and constructing suitable footings.

The next problem is to design a substructure adapted to receive the bedplate of the apparatus and made stiff enough so as to eliminate any "periods" of its own. This bedplate may be made of structural steel or of reinforced concrete, in which latter case the ends thereof may be made of cast iron. The substructure is supported upon the steady point either by a ball-and-socket arrangement, or is simply bolted at that point to the floor plate underneath by a bolt, which need not necessarily be very light but which must be arranged in a manner to secure the minimum area of actual contact. Remembering that in apparatus of this sort the tendency to oscillate about the axis x, referring again to Fig. 2, is always rather negligible, we have practically only two degrees of freedom and only two periods to adjust so as to have them well out of the limits of the operative speed. Hence the two sets of springs, one to take care of the period corresponding to oscillation in the vertical plane, the other to control motion in the horizontal plane. It should not be imagined, however, that these springs will necessarily be very light; they will always have considerable stiffness, but their function is that of being the only members that *can* yield and the whole situation is controlled by the proper choice of these yielding elements.

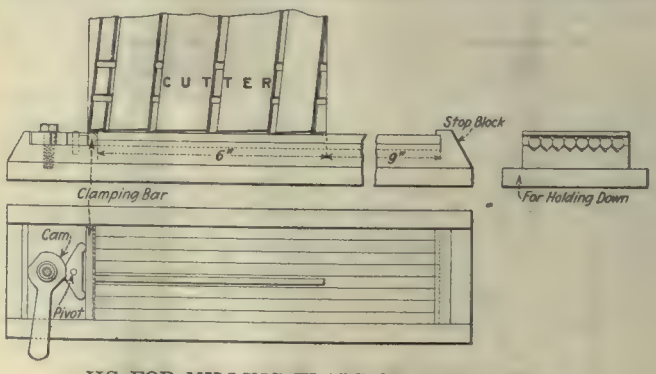
Cutting Flats on Wire Rods

By S. A. Inscoe,
Wolverhampton, England

The question opened by F. C. Hudson on page 1267, Vol. 52, of *American Machinist*, is one of many such to be constantly met with in production work. It is tantalizing in that while the operation is insignificant in itself and the whole cost of the job should be negligible, to carry it out in a workmanlike manner much scheming and sometimes expensive equipment must be used.

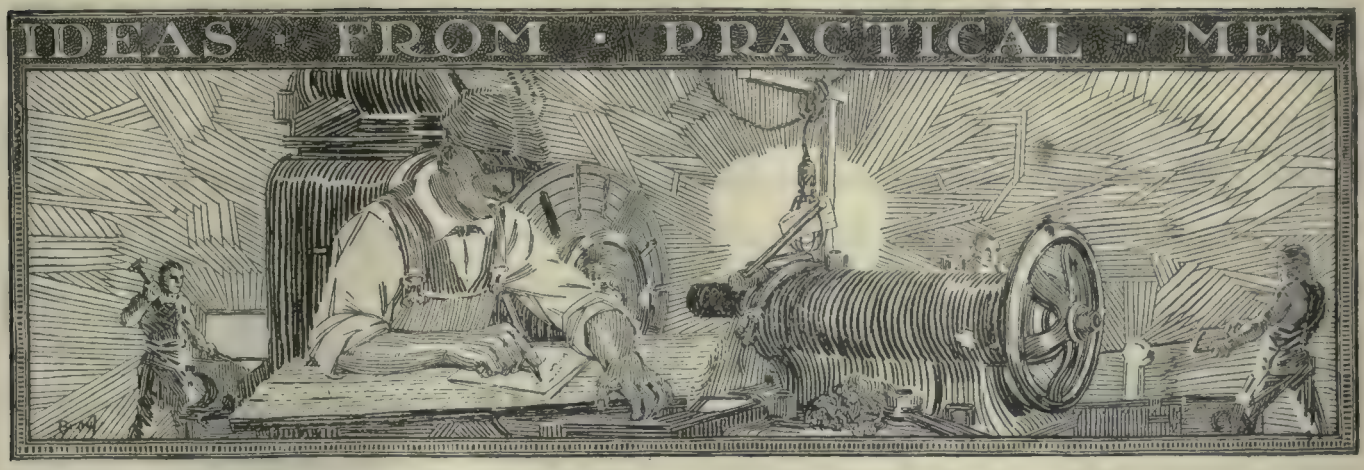
The punching method may be successful, although one would think that punching or shearing a flat on round work would not be conducive to accuracy, as the metal removed would leave a burr, and the pressure of the punch squeeze the wire somewhat out of round; also, the operation would be slow. It might be possible to make a die with a flat shaving cutter let into one side, and moved back by a cam actuated by the punch when the 6-in. mark was reached; but here again only one could be done at a time, and it would necessitate a press with a very long stroke.

An operation very similar to the one required may be seen in almost all shops engaged in the manufacture of gear box details for motor cars. The bars carrying the forks for moving over the sliding gears have either a flat, or a series of grooves or countersinks, along one



JIG FOR MILLING FLATS ON ROUND RODS

side. A sketch of the method used is shown herewith and is almost self-explanatory; being a jig base having a series of V-grooves to carry the work, which is placed under and against the stop block, and clamped by end-pressure with a cam-operated clamp. Two such jigs, having a number of grooves each, could be used on a vertical milling machine; one being loaded while the other is passing under the cutter. The only arbitrary condition is that the wires must all be of the same length so that they can be securely and accurately clamped in the jig.



Avoid Trigonometric Solutions Where Geometry Will Do

By Francis W. Shaw

Didsbury, Manchester, England

The problem contained in the accompanying diagram is one of many connected with triangles and circles, in solving which our old friend Euclid found little difficulty without calling to his aid those expedients of more modern geometricians—the angular functions. "Expedients," I have said; "hindrances" would oft be the better term—a term that would fit the case in point.

Ernest T. Goodchild, on page 32 of the present volume of *American Machinist*, in solving the problem of locating the center of the circle which shall pass through the points A, B and C and in determining its radius, has first of all set himself to find the angle A. That has involved the use of the well-known formula: D (diameter) $= a \div \sin A$. To determine A required in solving this equation, he has had to employ the formula $\cos A = (c^2 - b^2 - a^2) \div 2cb$ and to insure sufficient accuracy the angle has been determined to a decimal part of a minute.

Had A B been much closer to O as indicated by the thin lines in the illustration, the angle A would have had to be calculated even more exactly.

Now, a formula applicable to this problem (I do not purpose to show its derivation) is

$$R = \frac{abc}{4\sqrt{s\,(s-a)\,(s-b)\,(s-c)}}$$

where

$$s = \frac{a+b+c}{2}$$

For a case involving simple numbers I should proceed first to express the sides of the triangle in the simplest form possible. In this case we might divide the sides by 6, getting: $a = 1$, $b = 1\frac{1}{2}$, $C = 2$. R will, of course, become $R \div 6$.

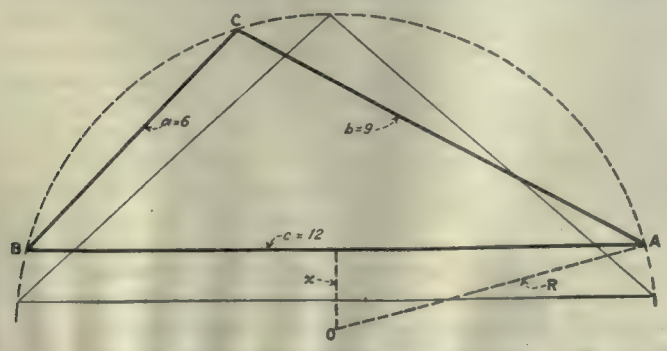
Thus:

$$\frac{R}{6} = \frac{1 \times 1\frac{1}{2} \times 2}{4\sqrt{2\frac{1}{4} \times 1\frac{1}{4} \times \frac{3}{4} \times \frac{1}{4}}} = \frac{3}{4\sqrt{\frac{135}{256}}}$$

whence

$$R = \frac{72}{\sqrt{135}} = \frac{72}{11.619} = 6.1968$$

x can now readily be determined from the small right-angle triangle. The square root of 135 appears in tables in most hand books.



FIND x AND R GEOMETRICALLY

Converting Micrometer Readings Into Metric Measure

By Chester E. Josselyn

The following table facilitates the operation of converting micrometer readings into metric measure.

Example: A micrometer reading is 0.672 in., which shows six 0.1-in. divisions, two 0.025-in. divisions and twenty-two 0.001 divisions. Six 0.1-in. divisions = 15.24 mm.; two 0.025-in. divisions = 1.270 mm.; and eleven 0.001-in. divisions = 0.5588 mm. The total is 17.0688 mm. Proof: 672 ÷ 0.03937 — 17.0688 mm. (0.03937 = 1 mm.). When using a larger micrometer, add 25.40 mm. for each inch measured.

TABLE FOR CONVERTING MICROMETER READINGS INTO METRIC MEASURE

One-tenth-In. Divisions	Metric Equivalent in Millimeters	Twenty-five One-thousandth-In. Divisions	Metric Equivalent in Millimeters	One-thousandth-In. Divisions	Metric Equivalent in Millimeters
1	2.54	1	0.635	1	0.0254
2	5.08	2	1.270	2	0.0508
3	7.62	3	1.905	3	0.0762
4	10.16			4	0.1016
5	12.70			5	0.1270
6	15.24			6	0.1524
7	17.78			7	0.1778
8	20.32			8	0.2032
9	22.86			9	0.2286
10	25.40			10	0.2540
				11	0.2794
				12	0.3048
				13	0.3302
				14	0.3556
				15	0.3810
				16	0.4064
				17	0.4318
				18	0.4572
				19	0.4826
				20	0.5080
				21	0.5334
				22	0.5588
				23	0.5842
				24	0.6096

EDITORIALS

Are You Sure of Your Cost Figures?

COST accounting is a modern business tool that is too little understood and too little used. Business conditions in the last five years have been such that this attitude of manufacturers toward the matter of accurate costs is not to be wondered at. When a man is unable to accept all the orders offered to him and prices are high and rising still higher, it is only natural that he is more interested in getting the goods out than in keeping close track of the cost of every operation.

But with a falling market and no orders in sight the situation is different. When the present readjustment is complete and the manufacturers of the country go after business on a competitive basis, the prizes are very apt to fall to the man who knows what it costs him to manufacture an article and who can figure his bids accordingly. The man who overbids through overestimating his costs naturally gets few orders, while the fellow who underbids soon reaches the bankruptcy court.

Now, if ever, is the time to push any practical means of bringing home to the man who needs it most, the value of determining his costs accurately. What appears to us to be an eminently practical plan is the organization of the Industrial Cost Association which was announced in our news pages recently.

The objects of the new association are praiseworthy. As stated by the founders they are:

(a) To stimulate the interest of all manufacturers in accurately determined costs.

(b) To standardize cost and accounting nomenclature; to establish governing principles; and to simplify cost accounting.

(c) To educate the members in the use and advantages of graphic charts and other modern methods of cost analysis and control.

(d) To assist members of the association who are identified with cost committees of trade organizations in formulating uniform cost methods, and to recommend to members the adoption of such uniform methods.

(e) To facilitate the elimination of unintelligent competition by encouraging the interchange of cost data among members engaged in similar lines of industry.

(f) To provide a forum for the discussion of cost problems and practices through general and local meetings; and to gather and disseminate news of interest to members.

(g) To establish a library of cost literature, and to maintain a bureau of information through which members may be assisted in the solution of their individual cost problems.

(h) To co-ordinate the efforts of members to the end that cost of production may be considered in its proper relation to the complex problem of industrial management.

A valuable use for the accurate knowledge made available by an accurate cost system was indicated in the leading article in last week's issue where the perils of over-expansion in boom periods were brought out most convincingly. While a thorough knowledge of his manufacturing costs might not protect a man from the effects of his own enthusiasm, it would certainly make him think twice before rushing into a wild campaign of expansion. And if the second thought took account of the inevitable slowing down that follows every period of prosperity it would have been a thought worth thinking.

There are many other situations where the services of such an association would be of real value. Among them is that existing among the various local cost associations and trade associations with standardized cost accounting methods of their own. It is not to be wondered at that no two of the systems evolved are at all alike. Most of them have their good points but to get the maximum benefit from their efforts they should be co-ordinated and simplified so that a uniform practice may be developed. Steps have already been taken in this direction.

The present membership of the new association includes some of the best-known and best-managed companies in this country. We hope their lead will be followed by many more.

The Increasing Safety in Aviation

A SIGNIFICANT and interesting sidelight on the development of aviation may be seen in the Army air race which took place on Thanksgiving Day on Long Island. There were over forty entrants and the fastest speed was about 178 miles an hour in a 160-mile race. Nearly all finished and there was no serious accident of any kind.

An automobile race was held in Los Angeles on the same day. The speed was less than half that of the air race and there were fewer entrants. Yet there were three fatalities and a fourth is probable.

This does not argue against automobiles or automobile races. It simply means that we must revise some of our notions as to the dangers of aviation. There is still much to be done and flying still has its dangers.

It seems likely that the development problem must be solved by the Army and the Navy. Administration policies in aviation matters have resulted in the practical starvation of private enterprise and one big company after another has shut up shop or filed a petition in bankruptcy.

The recently issued report of the Director of the Air Service indicates that the Army, at least, is fully alive to its responsibilities. The Director says, "This office has allotted to the Engineering Division for expenditure in the design, development and test of aviation material, every dollar that could be spared from other activities. It was deemed best that the Air Service should worry along with what equipment it had in order that the Engineering Division might be permitted to purchase for its own purposes the few airplanes that the appropriations of the past year would permit to be procured." The Director is to be commended for his stand and it is to be hoped that he will be encouraged in his work by increased appropriations for this very necessary development work.

WHAT to READ —for the man in a hurry



Suggested by the Managing Editor

IN THIS issue we announce the change of one more *American Machinist* editor from journalistic work to another field. Ethan Viall, whose likeness appears below, ended ten years of service on the staff on the fifteenth of this month. He leaves to take over the management of a Middle-Western manufacturing plant in which he has been financially interested and the growth of which demands his entire time. His new work will enable him to spend a greater portion of his time out-of-doors and thus to build up his health which has suffered from the confining nature of the positions which he has recently held.

What to read was not a difficult matter to decide two hundred years ago when books were few and magazines unheard of. It is far different now when so much reading matter is offered to pass the time pleasantly or profitably as the reader chooses. We are doing our utmost to make the "American Machinist" not only profitable but indispensable as a clearing house of ideas and news of the machinery world. This page is the editors' advertisement of their section of the paper. It gives the high spots

After two years as associate editor in the old New York office, Mr. Viall went to Cincinnati as western editor. He was recalled to New York in 1917 to serve as managing editor until he was made editor just a year ago. His successful fight against the compulsory adoption in this country of the metric system of measurement was a feature of the editorial policy of the *American Machinist* for 1920. Mr. Viall's cheery presence will be greatly missed by the members of his staff. It is no small honor to earn the appellation "the whitest man I ever worked with."



Mr. Viall's place is taken by K. H. Condit, the former managing editor, whose job descends to his former assistant, L. C. Morrow. The new line-up appears at the top of the Contents page.

This unpleasant duty disposed of—farewells are never pleasant—we turn to the contents of the current issue. The leading article is the first of a short series describing the methods in use in the Hall-Scott motor shop on the Pacific coast. On page 1122 is the beginning of a brief technical discussion of the theory of transmitting power by waves in a column of liquid.

The best-known application of the theory is the "C. C." gear used in the war to fire airplane guns shooting through the propeller path. A British company has undertaken to apply the same principle to rock drills, riveting hammers and similar devices.

The fifth part of "Seven Centuries of Brass Making" takes up the production of sheets and the extrusion of rods and wire in a modern manufacturing plant. It starts on page 1133.

The annual meeting of the American Society of Mechanical Engineers is in progress as this is written. The papers presented have in many cases been of unusual interest. On page 1145 we have one by N. W. Akimoff, presenting a theory for the design of machinery foundations. Mr. Akimoff's work in the field of machine balancing is well known and serves as a basis for this particular theory. Our account of the events of the meeting is on page 1156. The first meeting of the new Machine Shop Section was well attended and brought out two very interesting papers and a lantern-slide talk that was well received. We are running the first half of one of these papers starting on page 1152. It is by W. H. Chapman of the Norton Co. and comprises a study of the laws involved in cylindrical grinding. The other paper, by Major Buckingham of the Pratt & Whitney Co., is based on two years of investigation of the side-cutting action of thread-milling hobs, and will be published next week.

Cylindrical Grinding in 1920*

By W. H. CHAPMAN

This paper comprises a study of the laws involved in cylindrical grinding and an analysis of grinding action (1) for draw-in cuts and (2) for traversed cuts. Grinding efficiency is usually considered as (production) ÷ (wheel wear). Accordingly formulas are derived for wheel wear in terms of grain size of wheel, work speed, wheel speed, feed, etc. By calculating values for wheel wear for different conditions and comparing them with production figures calculated under the same conditions, a proper selection of wheels may be made. The paper concludes with a discussion of production costs and with a series of practical conclusions, one of the most important of which is that increase of traverse speed increases production without increase of wheel-wearing action.

INDUSTRIAL engineers have long realized the value of the application of science to the operation of machine tools. One has but to consider the work of Taylor and others to appreciate this. As the grinding machine has come to be an important production machine only within a relatively short period, there has not been a large amount of accurate information available with regard to its operating features, more especially from the standpoint of obtaining the most economical grinding conditions. It is the purpose of this paper to report some recent developments along these lines.

Theoretical Considerations

In December, 1914, Professor George I. Alden presented a paper to the Society setting forth his theory of "Grain Depth of Cut." A formula was developed involving the velocities of the wheel and work surfaces, the grain size of the wheel (number of cutting particles per unit length of circumference) and sine functions of the angle formed by tangents to the work and wheel circles at their point of intersection. This work was a pioneer of its kind in this country. It clearly showed that the kinematic relations between the cutting grains and the work surface were of the greatest importance during cylindrical grinding operations, and that wheel wear and production rates would vary according to the mathematical laws involved.

In his book "Grinding Machinery," published in England, J. J. Guest develops expressions to indicate the mathematical relationships between the cutting grains and the work surface. He calculates what he terms "Normal Velocity of Material," "Controlling Factor," and "Maximum Output," and he finds that a change of work speed has an effect upon wheel wear far greater than a change in depth of cut. This agrees with Professor Alden's conclusions. Mr. Guest deduces a formula for Controlling Factor, in which the work speed enters as a squared function and depth of cut or feed enters as a first power.

*Presented at the annual meeting, New York, December, 1920, of the American Society of Mechanical Engineers, 29 West 39th Street, New York.

The operator must know how to select wheels of the proper abrasive, grain and grade for the piece to be ground. This he will determine by experimenting until he learns what to choose in any particular case.

The variables which must be controlled by the operator, once he has chosen his wheel and set up for the job, are:

(*a*) Wheel speed—usually constant r.p.m. with surface speed decreasing as wheel wears;
(*b*) Work speed—variable r.p.m. provided over a large range;
(*c*) Traverse speed—variable from about 3 to 36 ft. per min. in the latest machines;
(*d*) Depth of cut—controlled by graduated feed mechanism, graduated in units of 0.00025 in. on work diameter;
(*e*) Rate of feed—uniform in-feed for non-traversed work, in-feed at end of traverse zone for traversed work;
(*f*) Ratio of traverse per work revolution to width of wheel face.

We will assume the wheel speed to be constant, since a well-designed machine will be sufficiently powered to maintain its speeds, even under reasonably heavy cuts. Theoretically, the traverse per revolution should be sufficient to allow the wheel face to just cover the lead and not present the same work surface to the cutting face more than once per traverse. This condition can be brought about by computing the lead of the work for the various combinations of work and traverse speeds, or from inspection of the work itself while grinding is in process. In the following mathematical considerations the exact coverage of the lead by the wheel face is assumed.

The rate of feed should theoretically be one increment per revolution for non-traversed cuts and one increment per traverse for traversed cuts. A traverse is considered to be a single stroke between the traverse limits, and may therefore be either left to right or right to left. Where one traverse limit is at the driven end and the wheel cannot be allowed to overtravel the end of the work, a non-traversed cut should be taken down to very nearly the finished size, and then the traverse limit established so that the wheel will not strike the shoulder on the limit side of this cut, but will overtravel the opposite side of the cut for part of the wheel width. This practice saves the edge of the wheel on the side toward the work dog.

Having established our method of grinding, we are now prepared to study the scientific laws involved and their operation under these conditions.

Mathematical Analyses

In order to analyze the grinding action we must visualize just what occurs as the grains pass through the arc of contact with the revolving work piece. This may be done by imagining a cross-section through the wheel and work, and by studying action in the section plane, the entire wheel action being the integration of all section planes normal to the axes of rotation of the wheel and the work. We may also greatly magnify the size of the grains and the dimensions of the rotating

members, for the same mathematical relations obtain regardless of actual dimensional values. Therefore, in the accompanying diagrams the dimensions are not in proportion to those actually existing, but have been distorted for the purpose of exaggerating the conditions within the arc of contact. The depth of cut, size of chip, and size of grains are all greatly exaggerated. This, however, should not result in any confusion as to the proper illustration of the theoretical grinding action.

Analysis of Grinding Action for Draw-in (Non-Traversed) Cuts

We will first consider the case of draw-in cuts where the zone to be ground is of a length equal to the width of face of the wheel. Theoretically, the feed increment should occur once per work revolution to maintain uniform action. The work revolves in a direction opposite to that of the wheel.

Considering the two intersecting circles, the wheel and work peripheries, the wheel travels at a much

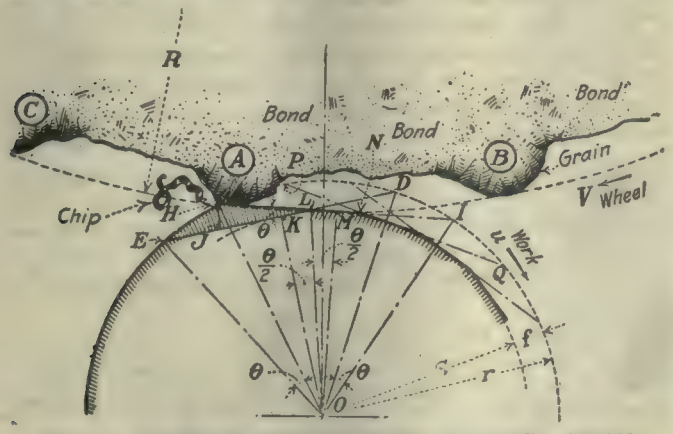


FIG. 1. DIAGRAM ILLUSTRATING CUTTING ACTION

higher rate than the work. A point on the wheel periphery describes a path within the point of intersection. It is the form of this path traced upon the work itself in which we are interested, for the shape of the chip removed by a cutting point on the wheel is an area bounded by the work periphery and by two successive grain paths. (The third dimension, width of chip, is unimportant in so far as cutting action is concerned.) An analysis of the motion of the wheel relative to the work (consider the work not moving) shows that the wheel is rolling around the work surface but revolving at a higher rate than that required to accomplish pure rolling. The grain path, therefore, is in the nature of an epicycloid, but extended because of the slip between work and wheel surfaces.

The criterion of wheel wear is the maximum depth of the chip removed, this depth being measured at right angles to the path of the cutting grain. We will therefore develop an expression for this depth, the variables of which are controlling factors of grinding action, as follows:

N = r.p.m. of wheel;
V = surface speed of wheel;
u = work speed in ft. per min.;
R = wheel radius in inches;
r = work radius in inches;
f = depth of cut, inches on work radius;
μ = interval between grains in fractions of an inch.

Other symbols used are:

S = feed circle $= r - f$, inches;
G = maximum depth of chip, inches.

The value G corresponds to Professor Alden's Grain Depth of Cut. The grain interval μ is the quotient of the number of cutting particles on the wheel periphery and the circumference of the wheel in inches (considering the wheel width equivalent to a single grain). This value may be determined for various wheels by actual count and measurement. It varies with both grain size and grade of wheel.

Refer to Fig. 1 in which greatly enlarged section of wheel and work is shown. The grain paths across the work are indicated and a shaded area indicates the shape of a single chip. The grain paths are shown as straight lines tangent to the feed circle. Actually these paths are not straight lines but are the epicycloidal form of curve above mentioned. However, within the limits of probable dimensions which are actually involved in any cylindrical grinding operation, a graphical layout of the grain paths on a large scale (say $\frac{1}{4}$ in. = 0.0010 in.) will show that these curves are so nearly straight lines that the error is negligible. The mathematical relations are greatly simplified by this assumption. By actual trial it was found that there was seldom over 2 per cent difference in the values of maximum chip depth obtained by the use of the *actual* and the *assumed* forms of grain path.

Within the limits of reasonable working stresses, the wear of any cutting tool is roughly proportional to the total work done. The grain cuts until it is so dulled that impact tears it from its setting of bonding material or causes fracture, exposing fresh cutting points. The frequency with which the grain is applied, the average grain depth of cut as indicated by the chip dimensions, and the kinetic energy of the grain due to its mass and velocity, are the three factors which are to be considered as determining the wheel-wearing action. Frequency of application depends upon the revolutions per minute of the wheel. Work done is measured by the dimensions of the chip removed by each grain and the total number of chips removed. Kinetic energy is proportional to the mass and square of the velocity of the cutting particles.

Frequency of application of the grain $= N = \frac{12V}{2\pi R}$, and volume of wheel wear $= \frac{12V}{2\pi R} \times 2\pi R$. Therefore wheel wear is directly proportional to $12V$; or dropping the constant, is directly proportional to V.

Wheel-wearing action is also proportional to grain depth of cut G, for it is this factor alone which controls the actual depth to which the grain penetrates, and therefore the rate at which the bond is worn away by mechanical rubbing against the work surface. In making this statement it is assumed that the grain and grade of the wheel are such that the true grinding action of the wheel is taking place, that is, that the grain does not wear appreciably but dulls until the cutting becomes a rubbing and the grain is torn out from the setting of bonding material, which has been weakened by the wearing away due to contact with the work surface.

In Fig. 1 path QNP is generated by grain C; grain A follows at the arc distance μ and generates path ILH and is removing the chip of area PNH. The ground surface is made up of the successive paths and is not truly cylindrical, as small projections are left

of the form *KLM*. These are immeasurably small. The grain *B* will generate *DLE* and cut chip *EHL*. The depth of this chip normal to the path *DLE* is *JH*, which we designate as *G*, grain depth of cut.

Formula for Determining Depth of Cut. To find an expression for *G* in terms of the variables already enumerated, we have:

HLI is tangent to circle of radius *S at M*; $(S = r - f)$

EJL is tangent to circle of radius *S* at *K*

HLI and *ELD* intersect and form angle θ

DI (arc) is the distance through which the work moves while the wheel moves through the distance μ between grains.

$$EH = \frac{\mu u}{V}$$

Other necessary nomenclature has been already given.

Drop perpendiculars to *ELD* and *HLI* from *K* and *M*. Then

$$KO = MO = S = r - f$$
$$Angle\ KOM = \theta$$
$$\text{Angle } KOL = LOM = \frac{\theta}{2}$$
$$G = JH = HL \sin \theta \qquad (1)$$

Angle θ is very small and where expressed in radians is very nearly equal to its sine. Therefore

$$G = JH = HL \times \theta$$

But

$$\theta \text{ (in radians)} \times r = \text{arc } EH = \mu\frac{u}{V}$$

or
$$\theta = \frac{\mu u}{Vr} \qquad (2)$$

Therefrom, from (1)

$$G = JH = HL\frac{\mu u}{Vr} \qquad (3)$$

In triangle *OHM*, $HO = r$ and $MO = S = r - f$, therefore

$$r^2 - (r - f)^2 = \overline{HM}^2$$

and
$$f(2r - f) = \overline{HM}^2$$

But $(2r - f) = 2r$ (very nearly), as f is rarely over one or two thousandths of an inch and is very small compared to $2r$. Therefore,

$$2rf = \overline{HM}^2 \quad \text{and} \quad HM = \sqrt{2rf} \qquad (4)$$

LM is very nearly equal to arc of radius $(r - f)$ of angle $\frac{\theta}{2}$. Assuming it to be equal, $LM = \frac{\theta}{2}(r - f)$.

As before, f may be neglected, due to its extremely small effect upon r. Then, from (2),

$$LM = \frac{\theta}{2}r = \frac{\mu u}{2V}$$

Since $HL = HM - LM$, we have from (4),

$$HL = \sqrt{2rf} - \frac{\mu u}{2V}$$

and from (3),

$$G = JH = \left(\sqrt{2rf} - \frac{\mu u}{2V}\right)\frac{\mu u}{Vr} \text{ (very nearly)} \qquad (5)$$

The above represents the grain depth of cut very closely, and is expressed in the terms which were previously chosen.

Formula (5) may be rewritten as

$$G = \frac{\mu u}{V}\sqrt{\frac{2f}{r} - \frac{\mu^2 u^2}{2V^2 r}}$$

By inspection, bearing in mind that μ is always small, say 0.05 in., u is seldom over 200, f is seldom over 0.001 in. and V usually about 6,000, and r, say 1 in. to 4 in., we are justified in further reducing the expression mathematically by dropping the term $\frac{\mu^2 u^2}{2V^2 r}$ as being insignificant compared with the other two terms. Therefore

$$G = \frac{\mu u}{V}\sqrt{\frac{2f}{r}} \text{ (approximately)} \qquad (6)$$

This enables us to deduce approximate statements as follows: Grain depth of cut varies directly with grain interval, work speed, and square root of radial feed; inversely with wheel speed, and square root of work radius.

The relationship between work speed and feed is as determined by Mr. Guest in his Controlling Factor. The value of *G* also tallies with Professor Alden's results within the usual speed and dimensional limits found in cylindrical grinding.

Wheel-Wearing Action. The kinetic energy of the cutting particles increases with the square of the velocity.[1] For a certain depth of cut the resistance of the work to the grain is very nearly proportional to this depth, as the cuts are very small, even when compared to the total size of the grain. Theoretically, for some low velocity the kinetic energy of the grain should just equal the energy required to remove the chip (the feed would be reduced to maintain constant grain depth of cut under reduced wheel-velocity conditions) and wheel wear would be caused without any chip being removed up to this point. Actually the bond strength is always sufficient to prevent this condition. Our assumption is then clear:

Wheel wear varies inversely with the *surplus* kinetic energy of cutting particles and is inversely proportional to *effective* wheel surface velocities (wheel speed minus work speed).

We are now prepared to combine our factors.

a Wheel wear is proportional to the wheel speed, or to V.

b Wheel wear is proportional to the grain depth of cut, as expressed in Formula (6).

c Wheel wear is inversely proportional to surplus kinetic energy of the cutting particles, or proportional to $1/(V - u)^2$. The term u is usually negligible as compared with V and it may therefore be assumed that $1/V^2 = 1/(V - u)^2$.

From these relations, *a*, *b* and *c*, an index of wheel-wearing action (WW_I) due to grinding (where the wheel face is free-cutting) may be expressed as follows:

$$WW_I = V\frac{\mu u}{V}\sqrt{\frac{2f}{r}} \times \frac{1}{V^2}$$
$$= \frac{\mu u}{V^2}\sqrt{\frac{2f}{r}} \qquad (7)$$

Laws of Grinding for Draw-in Cuts

From this expression we may derive the following laws of cylindrical grinding, operative *within the usual limits of speeds and dimensions.* For straight-in (draw-in) cuts a free-cutting wheel will wear according to the effect of wheel-wearing action as outlined below:

a Wheel-wearing action increases directly as:

1. Grain interval (grain size—inversely as grade)
2. Work speed (surface)
3. Square root of diametral cut (feed).

[1] See "Selection of Grinding Wheels for the Foundry," *Grits and Grinds*, January, 1915, the Norton Co., Worcester, Mass.

b Wheel-wearing action increases directly as the following are decreased:

1. Square of wheel speed (surface)
2. Square root of work radius.

A soft wheel is more susceptible to wheel-wearing action than a hard wheel and will more nearly follow the theoretical conditions. It is therefore more free-cutting and will cut more nearly the full chip than a hard wheel. There is consequently a gain in production as wheels of softer grades are used, all other conditions remaining constant, up to the point where the chips are geometrically perfect for a given condition of speeds and dimensions. It is clear from this standpoint that the softest possible wheel should be used. High wheel speeds up to the safe limit are of course necessary if the soft wheels are to perform in a satisfactory manner.

To show the practical application of Formula (7) for wheel-wearing action (Index of Wheel Wear), derived above, Table I is given.

In column 1 of the table are the work speeds provided on a recent grinding machine, given in order so that actual values can be experimentally obtained to check with the theoretical.

In the succeeding columns are two series of values as follows:

(1) Following the term "Production" are *approximate* values for cubic inches of metal removed per minute for a wheel 1 in. wide. These were calculated by the formula, Production = nominal work diameter $\times$ π $\times$ r.p.m. $\times$ depth of cut (assumed to be 0.0005 in.), which gives values slightly less than the true values.

(2) Following the terms "Wheel Wear" are values of the *actual* wheel wear obtained by multiplying the Index of Wheel Wear, calculated by Formula (7), by a constant derived by experiment. This constant is for convenience expressed in the form $1{,}800 \times 10.^{4}$

Sample Calculation. In Formula (7) assume:

$u = 53$ r.p.m. $= 13.9$ ft. per min.
$r = \frac{1}{2}$ in. (work diameter 1 in.)
$f = 0.0005$ in.
$V = 6{,}000$
$\mu = 0.05$
$R = 9.0$ in. (wheel radius).

Substituting,

$$WW_I = \frac{0.05 \times 13.9}{36{,}000{,}000}\sqrt{\frac{0.001}{0.5}}$$
$$= 0.0000000196 \times 0.047 = 9{,}212 \times 10^{-13}$$

Multiplying by constant $1{,}800 \times 10^{4}$ (see Par. 31),

$WW_I = 0.0166$ cu.in. per minute for wheel 1 in. wide.

The corresponding "Production" in Table I is, 0.0835 cu.in.

It will be seen that the wheel-wear values increase rapidly as work speed increases. The value 0.0166 for work of 1 in. diameter at 53 r.p.m. becomes 0.1040 for work of 4 in. diameter at 167 r.p.m. The same wheel cannot be properly used for both cases, as one sufficiently soft to cut freely in the first case would wear so fast as to be nearly useless in the second case. However, where wheel-wear values are nearly the same we may expect the same wheel to act properly. For instance, a wheel suitable for 1-in. work at 138 r.p.m. wears at the rate of 0.0433 cu.in. per min.; and one suitable for 4-in. work at 72.5 r.p.m. wears at the rate of 0.0450 cu.in. per min. In all probability one wheel would serve for both.

Selection of Wheels for Draw-in Cuts

From Table I, and by experimental tests with various wheels, certain ranges of wheel-wear values may be found which correspond to definite grades of wheels of suitable grain size and abrasive for the material to be ground. Once this is done, the selection of proper wheels is no longer a question of guesswork, as wheel-wear indices may be computed for any set of conditions and the proper wheel selected. The question of the variation in wheels has been reduced to a point where it no longer can be a very large factor, and we may always change our speeds or feeds to correct the action in the proper direction if we understand the laws which have been previously pointed out. As an example of the possibilities of wheel selection, it has been found that for a certain machine the following wheels (Norton system of grade) are suitable for straight-in cuts on mild steel:

TABLE I. COMPARISON BETWEEN WHEEL WEAR AND QUANTITY OF METAL REMOVED AT DIFFERENT WORK SPEEDS

Work Speed in R.P.M.		Work Diameters 1 in.	2 in.	3 in.	4in.
53	Production	0.0835	0.1670	0.2500	0.3340
	Wheel wear	0.016›	0.0236	0.0290	0.0334
72.5	Production	0.1140	0.2280	0.3420	0.4560
	Wheel wear	0.0226	0.0319	0.0390	0.0450
87	Production	0.1370	0.2740	0.4110	0.5480
	Wheel wear	0.0273	0.0387	0.0475	0.0546
101	Production	0.1586	0.3172	0.4758	0.6344
	Wheel wear	0.0316	0.0448	0.0540	0.0635
138	Production	0.2160	0.4320	0.6480	0.8640
	Wheel wear	0.0433	0.0612	0.0645	0.0865
167	Production	0.2620	0.5240	0.7860	1.0480
	Wheel wear	0.0522	0.0740	0.0910	0.1040

Wheel diameter 1° in.; surface speed, 6,000 ft. per min.; diametral feed per work revolution (automatic feed), 0.001 in.; grain of wheel, 6,646 Alundum; material, mild machinery steel.

Wheel Designation		Wheel-Wear Values, Table 1
36 or 46 J	for values from	0.0150 to 0.0250
36 or 46 K	for values from	0.0250 to 0.0350
36 or 46 L	for values from	0.0350 to 0.0450
36 or 46 M	for values of	0.0450 and higher

Use no wheels harder than M. For hard materials use a grade softer and No. 60 grain. These values are for straight-in cuts only.

Influence of Feed. As an example of the effect of doubling the feed, let us assume the conditions as above, except that the feed is increased to 0.001 in. (on radius).

$$WW_I = \frac{\mu u}{V^2}\sqrt{\frac{2f}{r}} = \frac{0.05 \times 13.9}{36{,}000{,}000}\sqrt{\frac{0.002}{0.5}}$$
$$= 1{,}240 \times 10^{-13}$$

Wheel wear $= 1{,}800 \times 10^{4} \times 1{,}240 \times 10^{-13} =$ 0.0224 cu.in. per min. per inch of wheel face. Production is approximately doubled and

$$\text{Wheel-wear increase} = \frac{0.0224 - 0.0166}{0.0166} \times 100 = 35 \text{ per cent.}$$

This indicates how advantageously an increase of feed operates to obtain increased production (up to the limit of grain penetration). If we had doubled work speed we would simply have doubled both production and wheel wear.

(*To Be Continued in Next Week's Issue*)

Forty-First Annual Meeting of the American Society of Mechanical Engineers

THE forty-first annual meeting of the American Society of Mechanical Engineers got under way Tuesday morning, Dec. 7, with the opening of headquarters and registration bureau in the Engineering Societies Building, New York. Following the registration there was a meeting of the council.

The afternoons of Tuesday, Wednesday and Thursday were allotted to simultaneous sessions for consideration of two or three subjects each on the general topics, Fuel, Forest Products, Machine Shop Management, Design, Railroads, Research, Transportation, Power and Textiles.

There were two evening meetings, one devoted to the presidential address and reception and the other to an oration on "John Brashear as Scientist and Humanitarian," in memory of the late Dr. John A. Brashear, past-president A. S. M. E., by Dr. Henry S. Pritchett, president of the Carnegie Foundation for the Advancement of Teaching.

Wednesday and Thursday mornings were given over to a business meeting and a session on transportation. At the business meeting Calvin W. Rice, secretary, commented upon the reports of standing and special committees, including those on a Code of Ethics, Power Test Codes, Weights and Measures, Education and Training, Feedwater Heater Standardization, Standard Tonnage Basis for Refrigeration, Fluid Meters and Bearing Metals. The following membership for the 1921 Nomination Committee was approved, this committee having been elected by the local section delegates: Elmer Smith, Boston, Mass. (alternate J. A. Hall, Providence, R. I.), G. K. Parsons, New York, N. Y. (alternate W. Herman Greul, New York, N. Y.), W. W. Varney, Baltimore, Md., B. S. Hughes, Buffalo, N. Y., W. M. White, Milwaukee, Wis. (alternate J. D. Cunningham, Chicago, Ill.), F. E. Bausch, St. Louis, Mo. (alternate D. E. Foster, Tulsa, Okla.), and E. O. Eastwood, Seattle, Wash. (alternate H. L. Doolittle, Los Angeles, Cal.). The student prize was awarded to Howard G. Allen, of Cornell University, for his paper, "Wire Stitching Through Paper."

By the amount of discussion regarding the code of ethics it was made evident that the code in its present form is not acceptable to a great many of the members, the faults found being chiefly with its wording, not with the spirit. A motion was passed to refer it back to the committee for further consideration.

Presidential Address and Reception

The address of President Miller was concerned chiefly with human relations in industry. He quoted in the beginning of his paper from Herbert Hoover's address as president of the Federated American Engineering Societies, the paragraph in which he said, "The engineers should be able to take an objective and detached point of view. They do not belong to the associations of either employers, or of labor, of farmers, of merchants, or bankers. Their calling in life is to offer expert service in constructive solutions of problems, to the individuals in any of these groupings. There is a wider vision of this expert service in giving the group service of engineers to group problems." The ideas expressed and suggested were developed by Mr. Miller. He explained that "the engineer must increase the effectiveness of labor by the application of brains and management of men as well as of materials." Speaking of employer and employee he said, "The improvement of the human race that is always going on takes many different directions and goes forward in many fields. The engineer shares, with his fellow beings, the results of the efforts of others and his own peculiar contribution to the cause of human progress must always continue to be an increasing power to control the forces and modify the materials of Nature for the benefit of mankind. A very important part of this work is what we term the problems of industrial relations; which, it is certain can never be satisfactorily solved except by the methods of the engineer and it is equally certain that it can never be settled until settled right; that is to say, not until all concerned—the employee, the employer, and the public—are convinced that substantial justice has been secured and is being maintained.

"Of course, there are and always have been employers who have been fair toward their employees; have been real leaders of men, able to arouse and maintain enthusiastic co-operation. Notable successes have been founded mainly upon this human ability or quality. In too many cases, however, the most profound thought that seems to have been applied to an industrial problem has led to the conclusion that industrial management consists in hiring as cheaply as possible and driving as hard as possible.

"The day for that sort of thing is passing and industry generally is beginning to be conducted upon a much higher plane of intelligence. It is being recognized that there is a science of industrial management. Engineers have, so far, developed and formulated it, must go on with it, and conduct the country's industries in accordance with it, recognizing that the old order has passed away. Management of an industrial group is not a matter of brute force, but of intelligent skill, fairly and sympathetically applied with a view to getting the best possible results, not only for the employer, but for the workers and for the public as well.

"If research is important in physics and in chemistry it is at least equally important in the domain of industrial science and when fundamental facts or laws have been made known by such research we must face them; not to do so may mean disaster.

"In general, the engineer bases his opinion and his acts upon definitely ascertained and carefully studied facts. We must do the same in our industrial management problems, and when we do, most of our industrial difficulties disappear."

Mr. Miller also said: "We are hearing constantly more about service as constituting the only just claim to rewards. Certainly the engineer need not fear comparison with others on that score. Yet there are those, who, with the best intentions, I am sure, charge a large share of our industrial and social difficulties to features of modern industry that have been created and are maintained by the work of the engineer.

"Especially do they charge that, doing things by machinery instead of by hand, and the multiplication of large manufacturing establishments in which the work is minutely divided, have had a bad effect—have, indeed made men and women slaves of the machines.

"I think that we may claim that there is a misapprehension about this and that machinery and large industrial establishments do not, nor can they, by themselves, enslave or oppress human beings.

"It is easily demonstrated by reason and by human experience that division of labor, machinery for increasing man's productive capacity and the use of capital in production all tend, by themselves considered, to help the worker—to release him from burdensome tasks and from the necessity of working too hard, or too many hours per day for too little money."

Conferring of Honorary Memberships

After the presidential address honorary memberships were conferred upon Lord William Weir, Glasgow, Scotland; Hon. Sir Charles Algernon Parsons, London, England; Commandatore Pio Perrone, Genoa, Italy; Rear Admiral R. S. Griffin, U. S. N.; Captain Robert W. Hunt, Chicago, Ill.; and Dr. Samuel M. Vauclain, Philadelphia, Pa.

President-elect Edwin S. Carman was introduced to the society by President Miller. In acknowledging the introduction Mr. Carman expressed his great appreciation of the high honor paid him. He also said that it was time for the engineer, who has been content to deal with purely professional matters, to undertake the solution of the greater problems of industrial relations, and to deal with them as he has with other problems by getting at the truth.

A reception was tendered to the president, president-elect, ladies, members, and guests by the society. The reception was followed by dancing.

Among the many important papers read before the society were the following, of particular interest to the machinery industry: "Side Cutting of Thread-Milling Hobs," by Earle Buckingham; "Cylindrical Grinding in 1920," by W. H. Chapman; "Mechanical Engraving and Die Sinking," by J. F. Keller; "Foundations for Machinery," by N. W. Akimoff; "Rational Design of Hoisting Drums," by E. O. Walters; "Design of Flywheels for Reciprocating Machinery Connected to Synchronous Generators or Motors," by R. E. Doherty and R. F. Franklin; and "The Armor Plate and Gun-Forging Plant of the U. S. Navy Department of South Charleston, W. Va.," by Roger M. Freeman.

Buyers with Vision—or Graft

By John R. Godfrey

"There's a great difference in business concerns as well as in people," remarked an experienced machine-tool sales engineer, as he settled down for an all-night run on the Pennsylvania Limited. "But I've almost always found that the firm which was right mechanically finally won out. It may have a hard fight to get capital at first, but it gets there.

"Now there's the Blank Automobile Co. as an example. Lots of people laughed at it and knew it couldn't succeed. But it had real mechanics, with visions of the future and nerve enough to bank on it.

"I remember a case some years ago that opened my eyes. We'd designed a new machine for mass production and this company bought the first three we built. They were fine—when they ran. They'd turn out pieces in almost unbelievable time, and the next thing you knew, something would break.

"I'd been out there and watched them work in great shape and when I came back from lunch, all three were torn apart to fix some little thing that had let go. And I was sure discouraged. I went home expecting to get a call down any minute.

"Hadn't been home but a few days when I got a wire to come out again. I had visions of an exasperated shop superintendent who wanted to get a lot of 'peeve' out of his system. So I started prepared to be the goat, and take my medicine like a little man, though it meant several thousand dollars and loss of prestige to my firm.

"I wasn't feeling very cheery when I blew in the next morning. And I wasn't over-anxious to open the exercises. But he didn't seem inclined to, and as something had to be said, it was up to me to start the ball rolling.

" 'How are the machines going?'—knowing the answer before he spoke it.

" 'They aint—that's the trouble,' he said.

" 'I'm mighty sorry to hear that, Mr. Blank; hadn't you better send them back and let us get the bugs out of them? They seem to have a few still.'

" 'Oh, they've got bugs all right, but I'm not going to send them back. You can work the bugs out here. They're a damn nuisance so far, but you've got a big idea in that machine and we want the benefit of it first. I sent for you to talk over an order for a lot of fifty more to suit some of our other work. We'll help you get the bugs out and we want the saving made possible by those machines before anyone else.'

"Was I relieved? And happy? I'll say I was, and you can bet we tore our shirts to exterminate those bugs in the shortest possible time.

"But how many firms would have the vision, the patience and the nerve to do such a thing? For it meant thousands of dollars. Most shops would have thrown them out long before. But by nursing them along, the Blank Co. had about two years' start on the methods which they could develop with this machine."

A Different Story

"Some different from a motor outfit I know," chimed in another traveler. "You first go and see the super and get turned down, cold. Then you invite him down town to dinner that night. After dinner you propose cards or pool, preferably pool.

"You let him beat you of course. Any greenhorn would know enough for that after he saw the man. But the real fine work is in the side plays.

"First you make a little bet on the game—which of course he wins. Then you get real sporty and bet on plays, always managing to lose. If you see his ball within a reasonably easy shot of the pocket, you get excited and bet him a fifty that he can't make it. That gets his sporting blood up and he wins—and pockets the fifty. Two or three such bets put him in good humor and when you drop around next morning there is a long chance you get an order.

"I don't need to tell you that neither the product nor the equipment is up to standard. And you probably won't be surprised to know that this particular plant is sailing close to the wind, with breakers ahead.

"You're right about the necessity of having the mechanical end of a concern right. And that means having it know what real, old-fashioned honesty is when they see it. Some of 'em don't."

Improved Type of Optical Projection Apparatus Designed and Built by the Bureau of Standards*

By Louis A. Fischer
Chief, Division of Weights & Measures, Department of Commerce, U. S. Bureau of Standards

The extensive use of the projection lantern in the inspection of screw threads has lead the Bureau to devote considerable attention to the improvement and adaptation of this apparatus.

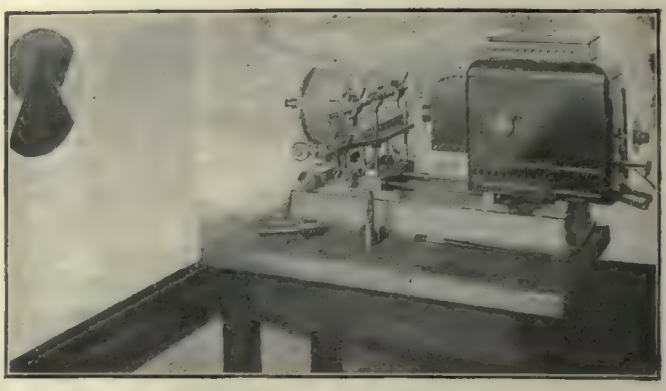
During the war a projection outfit similar to that of the National Physical Laboratory of England was built by the Bureau[1]. That apparatus has been used to some extent in the industries as well as in government laboratories, and has given excellent service. It contains certain features, however, which render it expensive to build and somewhat difficult to keep in adjustment, especially in a factory where vibrations are excessive. For this reason it was considered desirable to make certain changes of design. Accordingly, in the new type of apparatus, illustrated herewith, the right-angle prism and the mirror have been eliminated and the protractor for measuring the thread angle has been made a component part of the apparatus.

In the new apparatus the image is projected horizontally, and the lens system is such that with three different objectives having focal lengths of 48, 32, and 16 mm., magnifications of 50, 100 and 250 are obtained at a screen distance of about 5 ft. Excellent illumination and sharpness of image are obtained, and the screen distance is such as to give the best of seeing conditions for the operator at the lantern.

The standard angle is located in the microscope tube and its projected image is matched against that of the thread to be measured. Adjustment of the positions of the thread and the standard angle is accomplished by means of the elevating screw, micrometer, and the milled and graduated head. Readings of the angle, to one minute, are made on the graduated handwheel by which the position of the standard angle is controlled.

In addition to the measurement of angles, the apparatus lends itself well to the measurement of the pitch of thread plug gages and other threaded work. It is both rapid and accurate; a combination as rare as it is desirable. In the measurement of pitch, precision gage blocks are used in conjunction with the micrometer. First a setting is made with the image of one edge of the standard angle in coincidence with one side of the thread. A gage block equal in thickness to an integral number of threads is then inserted between the micrometer spindle and the ball end of the center on which the work is held. The work is thereby displaced laterally at right angles to the axis of the lens system by an amount equal to the thickness of the block. If the lead is correct the edge of the standard angle will again be just in contact with the side of the thread. If not in exact coincidence, the amount by which the micrometer must be turned to bring it into coincidence is the error in lead in the number of threads over which the standard angle has been moved.

In actual use of the apparatus a block is inserted between the micrometer and the center before the initial setting as well as at the second setting. For example, to obtain the error in a half-inch interval the 0.1-in. and 0.6-in. blocks would be used instead of no block for the first setting and the 0.5-in. block for the second.



IMPROVED TYPE PROJECTION APPARATUS

After some practice with the lantern it will be found practicable to use it in the measurement of profiles and templates; and by the substitution of a cradle or other suitable holder in place of the centers, and a notched template representing the tolerance, to use it on production work as is done with the Hartness Screw Thread Comparator.[2] Six of these lanterns have been built for the Ordnance Department, U. S. A. Most of the work of development of the apparatus here described was done in the laboratories of the Gage Section, Bureau of Standards, by D. R. Miller and D. R. Carter.

*Published by permission of the Director, Bureau of Standards.

[1](a) Communication B510, Gage Section, Bureau of Standards. (b) Mechanical Engineering (Journal A. S. M. E.), Nov. 1918.

[2]Mechanical Engineering (Journal A. S. M. E.), Feb., 1919.

Applying Magnetic Chucks to Best Advantage

By Amos Ferber

C. A. Macready, on page 706 of the *American Machinist*, takes issue with I. A. Hunt, whose article appears on page 267 of the same journal, for the reason that his statements may "mislead prospective buyers who wish to use the magnetic chuck for holding work as accurately as possible."

I am interested in magnetic chucks. I use them to "hold work as accurately as possible;" and I supposed everybody who used them at all did so for the same purpose. I read Mr. Hunt's article with care and it did not mislead me, but, having given the same careful attention to Mr. Macready's statements, I must admit that I am puzzled.

Mr. Hunt states that "a solid auxiliary top plate defeats its purpose;" while Mr. Macready states that he "never made a top plate with the poles insulated . . . ." Does he mean that Mr. Hunt is wrong and a solid top plate is practical? I wish he would tell me what kind of a chuck he uses that will get magnetism enough through half-an-inch of solid cast iron to hold work on top of it; *I* can't do it.

Mr. Macready says: "If one happens to be using a chuck that is not true, a flat piece of cast iron placed on the face of the chuck and trued off will be the quickest way of obtaining a true seat, *if one is able to make use of a pole opposite to the ones in the center of the chuck.*"

All of the chucks that I know (and I thought I knew them all) have both positive and negative poles in the center as well as everywhere else on the holding surface; each alternate pole being of like polarity and the intervening ones of opposed polarity. If Mr. Macready now makes use of a third pole that is opposed to both of them I would like to know about it.

SHOP EQUIPMENT NEWS

-Edited By-
S. A. HAND

SHOP EQUIPMENT • NEWS •
A weekly review of modern designs and ▫ equipment ▫

Descriptions of shop equipment in this section constitute editorial service for which there is no charge. To be eligible for presentation, the article must not have been on the market more than six months and must not have been advertised in this or any previous issue. Owing to the news character of these descriptions it will be impossible to submit them to the manufacturer for approval.

• CONDENSED • CLIPPING INDEX
A continuous record of modern designs ▫ and equipment ▫

"Ideal" Pneumatic Chip Separator

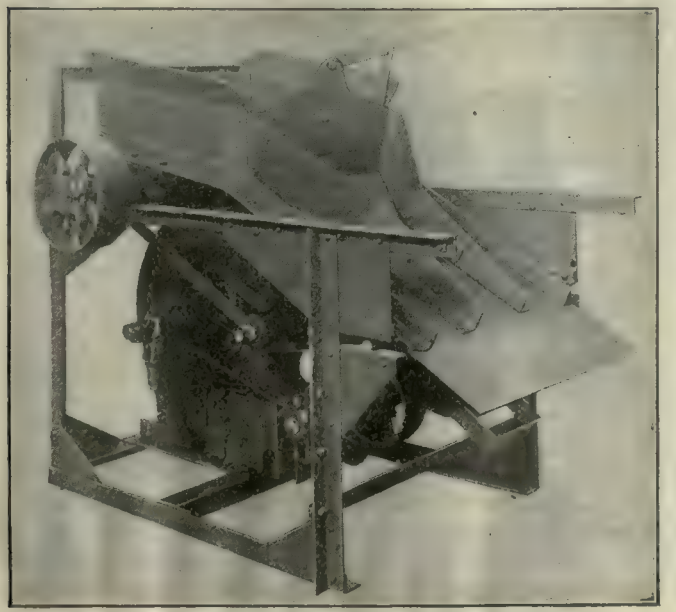
The pneumatic chip separator shown in the illustration has recently been placed on the market by the Ideal Concrete Machinery Co., Cincinnati, Ohio. It is intended chiefly for separating small work, such as screw-machine products, from the chips.

The work is placed or discharged into the hopper on the top of the machine, both the hopper and the incline riveted to it being given a compound vibratory motion. When the control gate is opened, the work slides down the incline to an opening. There the blast from the centrifugal blower floats the chips over the opening, while the machined parts drop through into tote pans. The chips continue down the slide and are collected in suitable boxes.

It is claimed that the separation of the chips by merely floating them across the opening in the slide makes it possible to operate the machine with much less pressure than if the chips were blown up into the air.

Low pressure enables the separation of the chips from small as well as large work. The chips do not pass through any restricted passages, so that clogging is not apt to occur.

The frame is made of angle iron, riveted, and reinforced at the corners by gusset plates. The bearings are lubricated by grease cups or sight-feed oil cups.



"IDEAL" PNEUMATIC CHIP SEPARATOR

Rohde Solders

The Rohde Laboratory Supply Co., 17 Madison Ave., New York City, has recently placed on the market a line of solders, each one intended for use on a certain class of work or material.

For work on sheet aluminum, lap joints, seams and general repairs in aluminum, "Al-Solder" is used. This solder comes in the form of white, deliquescent sticks and contains all of the flux necessary for its use. The parts to be joined must be heated to a temperature between 500 and 600 deg., and then rubbed with the solder, which melts and makes the joint. A chemical action occurs, indicated by the giving off of white smoke, the weld being homogeneous, so that the seams may be made invisible by polishing. The joint is said to resist electrolytic corrosion because of the fact that it consists of almost pure aluminum.

For heavier work on aluminum, or where considerable volume must be filled by the solder, a filler, in the form of metallic sticks, can be used in conjunction with the "Al-Solder," which acts as the flux. The filler is made in six grades, so as to suit different requirements of heat-resistance, strength and material.

A general utility solder is sold under the name of "Tensil" solder, being intended for lapping and joining iron, brass, lead, nickel, tin and zinc. The joined parts must first be tinned with "Al-Solder," and then the sticks of "Tensil" applied either directly or with a soldering iron.

For work on aluminum castings "Nuflux" solder is intended, it being a metallic rod containing its own flux in suspension. It is especially adapted for filling up blowholes and pittings in castings, or for joining cast parts.

For cleaning and de-oxidizing molten aluminum, "Clean-Al" is intended. When it is stirred into the molten metal it partly volatilizes and leaves a gray, dry powder on the surface, which can be easily removed.

For soldering cast iron "Rolasco" solder can be furnished. It can be used either in the granulated or in the stick form with a special flux, there being five grades, so as to suit different conditions and kinds of iron.

The solders vary in melting point from 650 to 1,250 deg. F., the color and the tensile strength also varying. It is claimed that homogeneous joints of great strength are made.

"Silva" solder is of gray color and can be furnished either granulated or powdered. It can be used on non-ferrous copper alloys and is especially intended for work on german silver. It can be altered to obtain the proper

melting temperature and color. The parts to be joined must be heated and the solder applied with a soldering iron, using a special flux.

For use on jewelry and scientific instruments a sterling silver solder is also made, being a white amorphous powder containing its own flux. It is applied directly to the surfaces to be joined, and at a red heat the solder melts and a chemical action yields the metallic silver. The joint is said to have unusual tensile strength.

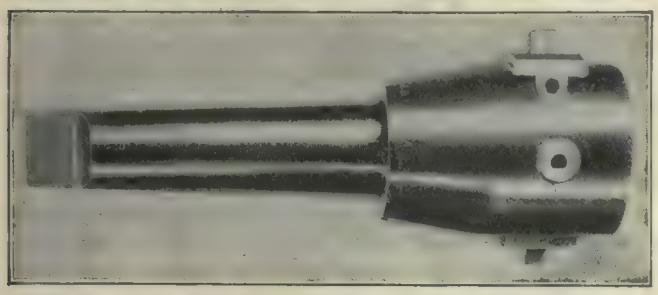
"V V" Expanding Boring Bar

H. A. Hopkins & Co., Inc., La Salle West and La Porte Aves., South Bend, Ind., has placed on the market an expanding boring bar.

This device is known as the "V V" bar because of the shape of the ends of the adjusting screws, one being an external and the other an internal V.

The bar is made in two styles, type "A" being used for holes from 1 to 2⅛ in. in diameter and type "B," shown in the illustration, for holes from 3 to 12 in. in diameter. It can be furnished with either straight or taper shank and either plain or with a pilot bar.

Square toolbits are used. For the bars boring holes 3 in. in diameter or larger, regular commercial toolbits



"V V" EXPANDING BORING BAR

can be utilized, so that worn cutters can be easily replaced.

To change the boring diameter the conical-pointed screw is adjusted. The screw opposite it is then tightened to clamp the cutters in place. It is claimed that the tool is capable of heavy-duty work. Tools requiring a number of cutters can be furnished for special jobs.

Cadillac Bench Centers

The Cadillac Tool Co., 268 Jefferson Ave., Detroit, Mich., has put out a line of bench centers of the type shown in the illustration, the device being built in seven sizes. The bed is a ribbed casting of box-form construction, the ways being scraped.

Both stocks may be moved to suit different lengths of work, and when adjusted can be clamped in place



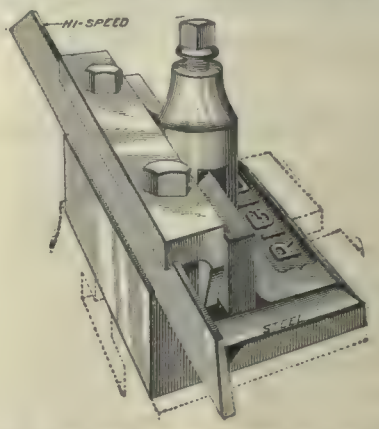
CADILLAC BENCH CENTERS

Specifications: Made in seven sizes: 6 x 18 in., 6 x 36 in., 9 x 36 in., 9 x 48 in., 12 x 36 in., 12 x 48 in., and 12 x 60 in.

by means of levers. The right stock has a spring-actuated spindle that engages the work with sufficient pressure to eliminate play or lost motion between the centers. A fixture for holding a dial indicator is fitted to the bed. The 9- and 12-in. swing bench centers are furnished with stock rests also.

Rigid "Back-Stroke" Cutting-Off Tool

The Rigid Tool Holder Co., Washington, D. C., has recently placed on the market the cutting-off tool and holder shown in the illustration. The device consists



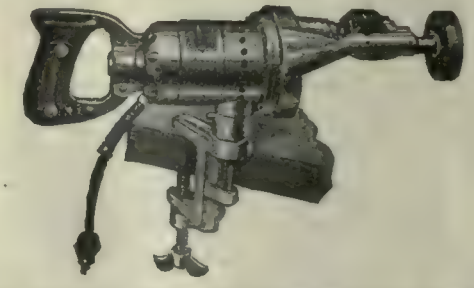
RIGID "BACK-STROKE" CUTTING-OFF TOOL

of a narrow tool of high-speed steel held by a hardened steel clamp on the base of the holder, which is a steel casting.

The tool can be held by the toolpost of a lathe and swung to cut on either the right or the left, the cut being made from the rear. It is claimed that the blade is always held erect and that it can work very close to a chuck or steadyrest.

Grinder Attachment for Arnold Portable Drill

The Arnold Electric Tool Co., Inc., New London, Conn., and 114 Liberty St., New York City, has placed on the market a grinder attachment for its type-B portable electric drill. The frame carrying the wheel spindle is clamped to the body of the drill, a belt



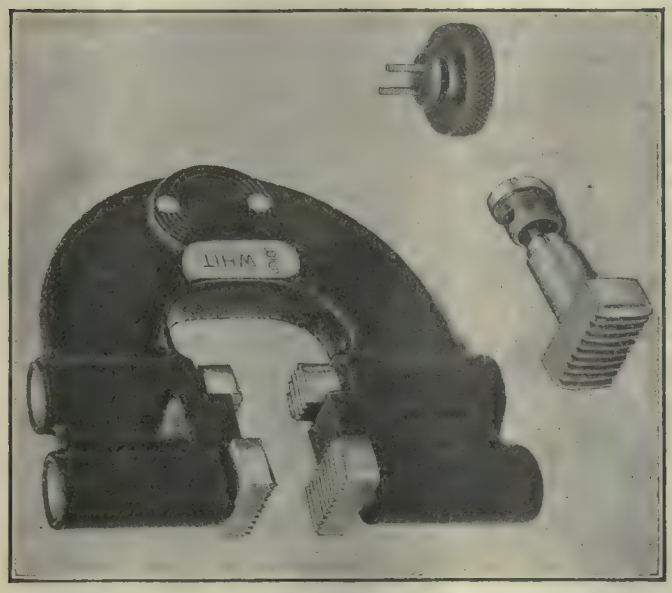
ARNOLD TYPE-B DRILL WITH GRINDING ATTACHMENT AND CLAMP

running on the sleeve of the chuck transmitting the power to the spindle.

The tool can thus be used as a portable grinder, or it becomes a small bench grinder by clamping in position by means of a bracket, as shown in the illustration. The use of the attachments is said to greatly increase the field of application of the tool.

Wickman Adjustable Thread Snap Gage

Alfred Herbert, Ltd., Coventry, England, and 54 Dey St., New York City, has recently placed upon the market the Wickman adjustable snap gage for measuring threads. The body of the gage is the same as used for plain snap gages, the U-shaped frame being made of cast iron and ribbed to prevent deflection. The heads



WICKMAN ADJUSTABLE SNAP GAGE FOR THREADS

are bored on a special fixture and finish lapped to insure alignment.

The anvils are grooved to suit the pitch which is to be measured, two sets of them being used at a time. Since the gages are adjustable for diameters, the straight teeth of the anvils have to be correct only in the form of the thread and in the pitch. The anvils are cut with a hob, and then lapped to a finish, testing for form being done by projection.

The front and the rear anvils are different in form. The teeth of the front set are made to conform exactly to the profile of the screw thread. They insure that work which passes between them will assemble in a hole in which a standard plug screw gage will fit. One way of setting the anvils the proper distance apart is to fit between them the tap with which the threads in the hole being fitted are made. The gage can be held up toward the light in order to determine how accurately the thread on the screw fits the teeth of the gage, which is a "go" gage.

In case the work has a slight error in pitch and yet passes the front gage, due to having an effective diameter smaller than standard, the thread will be thinner than normal. As it is necessary that a limit be placed on this thinning, the second or inner set of anvils is used to detect thin threads. These anvils have clearance on the tops and roots of the threads so that they test only the flanks of the thread and the effective diameter of the screw. By spacing these anvils some predetermined amount below standard size, it is possible to set a limit to this thinning of the thread. The inner anvils then form a "no-go" gage, because the work is rejected if it passes between them. Testing in this way is thus much more complete than by merely using a ring gage on the screw.

The gap between the anvils can be adjusted with an accuracy of 0.0001 in., each anvil having an adjustment of $\frac{1}{8}$ in. Sets of frames are thus made in $\frac{1}{4}$-in. steps, the anvils for all pitches being interchangeable in them. It is thus possible to gage screws of any diameter and with any limits required. The distance from the top of the thread to the pitch diameter is marked on the "no-go" anvils, so that, with the help of plugs or gage blocks, it is possible to accurately determine and set the pitch diameter of the gage.

The anvils are prevented from turning by the lug between them. No screws or pins are exposed, the adjusting screws being underneath the locking screws, which are covered by lead seals. The seals are put in place by a special press, which monograms them.

A Pair of Old Pulleys

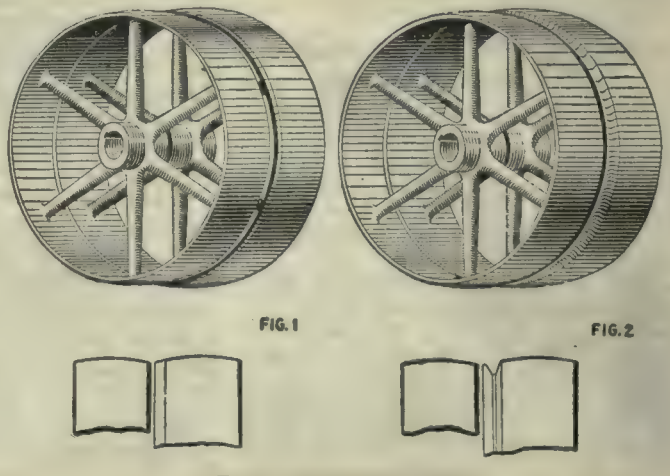
By W. Burr Bennett

The writer recently ran across the remains of an old machine of unknown origin in a junk dealer's yard. Idle curiosity prompted him to look it over and the design of the tight and loose pulleys on the relic was something new to him.

Although practically nothing of the machine remained except a leg and the bracket with the attached shaft and pulleys, something in the general design suggested that the machine was one used in textile work of some sort.

Fig. 1 shows a sketch of the common tight and loose pulley arrangement with the tight or driving pulley slightly larger than the loose pulley so as to take up the slack belt. Usually this tight pulley has a slight incline or bevel for the belt to run up on when shipping. However on this old machine the arrangement was as shown at Fig. 2; that is, a deep groove has been turned in the tight pulley and so formed as to have a comparatively sharp edge at the low part of the crown of this pulley.

The writer can see no particular value to the design as the belt would have to climb the bevel the same as in the later designs and it certainly increases the amount of machine work and the weight of both this pair as well as the driving pulley. The floral and other artistic work on the spokes as well as the climbing arbutus design on the bracket supporting the shaft would indicate that the parts were made anywhere from fifty to a hundred years ago, and this may account for the peculiar groove. Each pulley had a 2-in. driving face and the total width of the tight pulley was about 3 in. The diameter was slightly less than 10 in.



A PAIR OF OLD PULLEYS



Many U. S. Companies Represented in Spain by H. S. Moos

Henry S. Moos, M.E., has returned to Spain to present to Spanish users American machine tools and machinery. While in America Mr. Moos, in behalf of his associated companies, the American Machinery Corporation, S. A. E., Madrid, and the Sindicato de Maquinaria Americana, Bilbao, made arrangements to represent, among others, the following manufacturers: American Tool Works Co., American Woodworking Machinery Co., American Broach & Machine Co., Avey Drilling Co., Anderson Die Machine Co., Barnes Drill Co., Cincinnati Electric Tool Co., Cincinnati Machine Tool Co., Colburn Machine Tool Co., Detroit Electric Furnace Co., Foster Machine Co., Davis Machine Co., Heald Machine Co., Hercules Machine Co., E. Horton & Son Co., Hoefer Mfg. Co., Macleod Co., Newton Machine Tool Works, Oesterlein Machine Co., McMyler Interstate Co., Jos. T. Ryerson & Son, Rouillard Tool Co., Robertson Machine & Foundry Co., Standard Engineering Wks., Standard Tool Co., D. H. Stoll, J. D. Wallace Machine Co., Watson Stillman Co., Willard Machine Co., Webster & Perks Tool Co., Wilmarth and Morman Co., U. S. Light and Heat Corporation, Atlas Car and Manufacturing Co., American Manufacturing Co., American Road Machinery Co., Wardwell Manufacturing Co., Curtain Supply Co., Globe Electric Co., Universal Abrasive Products Co., High Speed Hammer Co.

Mr. Moos and the engineers associated with him will attend to the inquiries and engineering needs of the Spanish industry. American machines will be demonstrated in practical operation in the showrooms of the two companies and important stocks of machines and tools will be carried in order to give service to customers.

Metric System Not Wanted in British Optical Industry

The metric advocates have always claimed the optical industry as thoroughly standardized on the metric system. The grinding of lenses especially was claimed to be done exclusively on the millimeter basis of the metric system.

This erroneous contention is positively refuted in the report of the Department of Scientific and Industrial Research, 16 and 18 Old Queen St., Westminster, London, S. W. I.

This report, dated August, 1920, is the result of investigations made by a committee representing the following organizations: The British Optical Instrument Manufacturers' Association, the British Admiralty, the British War Office, the British Air Ministry, the National Physical Laboratory and the Imperial College of Science and Technology.

Limited space allows us to give only the following quotations:

The first matter considered by the committee was the fundamental question of unit of measurement of length.

The statement that changing from inch to metric measurement would facilitate foreign trade was considered by the committee, but the evidence of manufacturers showed that foreign trade was affected but little by the unit of measurement used in manufacturing.

The established practice of British lens makers has generally been to manufacture lenses on the inch basis, but, when selling them to metric countries, to quote focal lengths and diameters in millimeters, and this satisfies practical requirements.

Substantially, all materials are made and sold in terms of the inch. The same is generally true of tools.

The standards of the British Engineering Standards Association applicable to optical instrument making, with the exception of B. A. screw threads, are all based upon inch measurement.

So far as optical work is concerned, computations are generally made, in the first instance, in terms of unity and not in terms of any specific unit of measurement and can be translated into terms of the inch or the meter with equal facility.

But in order to avoid the confusion which would result from employing a mixed system of units the committee decided that the unit used for optical work must be the same as that used for mechanical work

The committee therefore recommends that the British inch should be retained as the unit of length for the purpose of standardization and manufacture of all parts of optical instruments.

Sale of Decapod Locomotives

The Director of Sales, War Department, announces that forty-four decapod locomotives, a portion of those originally built for the Imperial Russian Government, 100 of which already have been purchased and now are in operation on American railroads, are to be sold at a fixed price of $25,000 each. They are to be sold to Americans for use on American railroads. The decapods have been altered to operate on a standard gage track.

The decapods are located at Tullytown Arsenal, Tullytown, Pa. The purchase price may be divided into ten annual instalments, with 6 per cent on deferred payments.

Who Can Answer This One?

We are in receipt of a letter of inquiry from a correspondent who desires important information. Here it is:

If you have any idia how it is posible to make a perpetul motion machine it will be gratly apreciated. Any charge to be made charge to the writer if you can't answer these question let me know who does it.

Resp. ———

[We haven't! We can't! We hate to confess our ignorance but we must pass the buck to our readers.—Editor.]

Chamber of Commerce Bulletin on Cancellations

A summing up of the so-called "cancellation evil" and its possible remedies is contained in a final bulletin on this subject issued today by the Fabricated Production Department of the Chamber of Commerce of the United States.

An exhaustive study of the practice of cancellation of orders and repudiation of contracts in almost every division of business has been made by the Fabricated Production Department, as a result of which study it groups opinions as to possible causes under these three heads:

"First: That the practice is the result of war-time irregularities and will pass as we return to a normal basis.

"Second: That we are now reaping the results of the loose business practices inaugurated before the war, when many lines were in a state of overproduction and the measures taken to unload this surplus were demoralizing. Those entertaining this belief feel that the remedy is in a general reformation of our system of order taking, making each order a contract enforceable by law.

"Third: That we have been drifting away from the fundamentals of sound business and the 'Golden Rule,' and that we must return to a stronger belief in the rights of others and a higher regard for our own integrity if the change is to be permanent."

In suggesting the possible remedy for this cancellation evil the bulletin says: "There is a strong feeling that this thing must end and to that end many trade organizations have met and formed committees and bureaus to deal with it.

"The Credit Co-operative and Credit Methods Committee of the National Association of Credit Men has met twice to consider it, and it suggests truly that there seems to have been a dulling of public conscience. Should one who habitually repudiates his contrats and orders be given a higher credit rating than he who lets his notes and drafts got to protest? They also feel that one remedy, and as a safeguard against the unscrupulous, would be that each line of trade should at once examine its contract making and order taking methods to bring them strictly within legal lines. This is practical and can be immediately applied.

"We feel, however, that perhaps the most effective remedy must be the one that will call us back to 'first principles,' to where we can 'point with pride' to our house as one that 'fills its orders and keeps its contracts.'

LD'S INDUSTRIAL FORGE
News Editor

American Engineering Standards Committee Elects Officers

At the annual meeting of the American Engineering Standards Committee held in New York on Dec. 4, A. A. Stevenson, a representative of the American Society for Testing Materials, was re-elected chairman for 1921, and George C. Stone, a representative of the American Institute of Mining and Metallurgical Engineers, was re-elected vice-chairman.

The following were also elected to represent the respective member-bodies on the Executive Committee: Comfort A. Adams, American Institute of Electrical Engineers; Martin Schreiber, American Society of Civil Engineers; Fred E. Rogers, American Society of Mechanical Engineers; A. H. Moore, Electrical Manufacturers Council; Dana Pierce, Fire Protection Group; A. Cressy Morrison, Gas Group; N. A. Carle, National Electric Light Association; Albert W. Whitney, National Safety Council; Coker F. Clarkson, Society of Automotive Engineers; Thomas H. MacDonald, U. S. Department of Agriculture; E. B. Rosa, U. S. Department of Commerce; O. P. Hood, U. S. Department of the Interior; Francis J. Cleary, U. S. Navy Department; J. H. Rice, U. S. War Department; American Electric Railway Association (official representative not yet designated).

There are now forty-seven members of the committee, representing seventeen member-bodies. Twenty-four organizations in all are represented on the committee, as three of the member-bodies are groups of organizations.

"There are many in all lines who have through all this upheaval stood steady and right—preferring to take loss rather than mar a lifetime record of good performance.

"The advertising men redeemed their line from discredit by standing for 'clean advertising'—it means a loss of business and money to those who pioneered it, but the fight was won and it paid.

"What shall the 'slogan' be that can be used in a countrywide campaign to clean up unjust cancellations, broken contracts and bad faith? We will have one, but you have an opportunity to suggest it now.

"Before we legislate for the other fellow let there be a pause for self examination—will we do what we expect our customers to do? The department in this matter feels it is representing the best interests of the chamber membership in placing this situation before them and asking for their direction."

E. C. Morse Awarded Distinguished Service Medal

For his work in connection with disposing of the hundreds of millions of dollars of surplus war stocks Ernest C. Morse, Director of Sales, War Department, who retires from the service on Dec. 31, has been awarded the Distinguished Service Medal. The award was made to Mr. Morse and the medal presented to him by Secretary of War Baker in Washington on Dec. 7.

During Mr. Morse's term of office as Director of Sales more than $1,750,000,000 worth of supplies have been disposed of. The percentage of recovery was greater by far than that of any country or government—63 per cent.



ERNEST C. MORSE

The official order issued by the War Department regarding the award says: By direction of the President, the Distinguished Service Medal is awarded the following named civilian:

"Ernest C. Morse, Director of Sales, Supply Division, General Staff, for exceptionally meritorious and distinguished service. Charged with the very important duty of organizing and training a competent force for the entirely novel functions of supervising, co-ordinating and directing the disposal, according to law, of the vast War Department surplus of supplies, materials and properties of every description, and with the formulation and development of sales policies, he performed his manifold duties with marked ability, energy and judgment, with the result that the United States disposed of great quantities of supplies at exceptionally advantageous prices."

National Museum Gets Early Automobile

The National Museum at Washington, D. C., has just received and placed on exhibition in the Arts and Industries Building, the second gasoline automobile designed and constructed by Charles E. Duryea, between September, 1892, and September, 1893, at which latter date the machine was successfully operated. The acquisition of this most interesting object was made possible through the generosity of Inglis M. Uppercu, president of the Detroit Cadillac Motor Car Co. of New York City. Although the machine on exhibition is not the first car made by Duryea (the first being designed and built between August, 1891, and September, 1892, and successfully operated) it is a duplicate of it except in having a more powerful motor and correspondingly heavier and stronger parts.

Just as in the very beginning of railroad transportation, the passenger coaches used were simply stage coaches mounted on wheeled trucks, so Duryea's first and second automobiles were simply converted horse-drawn carriages, the particular style chosen being the lady's low phæton. Every part of the carriage was used, simply adding to it the engine and propelling and control mechanisms.

The motive power of the vehicle is a single cylinder, four cycle, water-cooled gasoline engine designed by Duryea. The engine, whose piston rod and crankshaft are both exposed, lies horizontal with its head toward the rear of the carriage and the crankshaft and flywheel located at the center of the vehicle below the seat. The engine is fired by a make-and-break spark, a pin attached to the center of the piston head striking a pivoted arm which in turn is in contact with an insulated connection through the cylinder head to the source of the electric current (dry batteries). The carburetor is of the spray type but without a float such as is generally used today and fuel was fed into the float chamber at a rate which would give maximum power at the desired speed, the motor being operated at a constant speed as it was thought at that time that a gasoline engine could not be throttled. There is an overflow line in this so-called carburetor, so that if the speed of the engine slowed down, the excess gasoline would flow out into a tank below from which it could be returned to the supply tank by means of a hand pump. The starting crank projected at the rear parallel to the engine cylinder and turned the crankshaft by engaging a pair of bevel gears on the upper face of the flywheel.

Attached to the center of the under face of the flywheel is a bevel gear which engages two gears on a horizontal shaft. Through small friction clutches this horizontal motion is transferred through rawhide gears to a jack shaft, at the ends of which are small sprocket wheels, which are connected by bicycle chains to large sprocket wheels secured to the inside of the spokes of the rear wheels of the carriage. In addition, on this jack shaft there is a small differential enclosed in a housing, being almost a miniature of the modern differential. There are two clutches attached to the main driving shaft, one for forward motion, and one for reverse. They are controlled by an up-and-down motion of the steering tiller, through wires over pulleys controlling a sliding cam, which engages and disengages the clutches.

The steering mechanism is of the tiller type, the left and right motion being transferred through a radius rod to C-type steering knuckles. The pivot line of these knuckles intercepts the plane of the wheels at the ground, a feature which is still found in the designs of modern automobiles. The whole power plant is supported on a chassis, the rear end of which is held by two rods attached to the extremities of the rear axle and the forward end supported at a single point on the front axle, forming a sort of pivot and resulting really in a three-point suspension.

This machine was used about Springfield during the winter of 1893 and spring of 1894 and, in the meantime, another machine was being built—this one to be a real automobile. This third machine was running late in 1894 and won the first American Automobile Race, Thanksgiving Day, 1895, at Chicago.

Four California Firms Join $5,000,000 Machine Merger

Formation of a $5,000,000 corporation for the manufacture of machinery for canners and dried fruit packers is announced by the Berger & Carter Co. interests of San Francisco. The new company will be known as the Berger, Fleming & Brown Co., and will have its main offices and factories at San José.

The new corporation absorbs the following companies: Berger & Carter Machinery Co., of Hayward, Cal., manufacturer of fruit and vegetable canning machinery; Smith Manufacturing Co., San José, Cal., manufacturer of machinery and equipment for packers of dried fruit; Wonder Dehydrator Co., San Francisco, manufacturer of "Wonder" portable and custom dehydrators, operating under the Hammond process patents; National Axle Corporation, San José, Cal., manufacturer of auto-truck axles.

Really big men love to lock arms with difficulties that would floor weaklings. They find joy in heroic effort.—*Forbes Magazine* (N. Y.)

Export-Trade Combinations Now Operating

The Federal Trade Commision today announced that forty-five export associations, or combinations organized for the purpose of export trade, are now operating under the Export Trade Act (Webb-Pomerene law), of which law the commission has administration.

The far-reaching effect of the Export Trade Act upon national industrial life may be seen from the fact that these associations comprise a total of 772 members, whose plants and factories, numbering about a thousand, are distributed over forty-two states of the Union. In some of the larger plants thousands of workmen are employed; others are so small that exportation would be impossible without the advantages of co-operation derived under the act.

The products exported include a wide range of commodities, from clothespins to locomotives, and are shipped from both Atlantic and Pacific ports to every part of the world.

Industrial Machinery in France and Belgium

"Europeans have overestimated their capacity for rehabilitating their industries; American co-operation applied to the reconstitution of essential producing industries would provide a considerable market for American industrial machinery and at the same time would insure raw materials and more work for European machinery factories; more needs to be done to gain the confidence of European industrialists." The foregoing are the expressed opinions of Trade Commissioner Charles P. Wood in a report on industrial machinery in France and Belgium just published by the Bureau of Foreign and Domestic Commerce of the Department of Commerce.

The report is published in answer to the many inquiries received in the Bureau of Foreign and Domestic Commerce from American machinery manufacturers, engineers and contractors concerning the probable requirements of European countries that would seek to rehabalitate their industries and resume their former status in the peace-time markets of the world Every important industrial center and such other places as would contribute to a broad estimate of the situation were visited by Mr. Wood during the course of his investigation.

The report discusses industrial conditions after the war. The industrial needs of the two countries are classified for the convenience of the manufacturer and exporter. Application of American methods, credits and trade methods generally are covered at some length.

The publication is known as "Special Agents Series No. 204—Industrial Machinery in France and Belgium." Copies can be purchased from the Superintendent of Documents, Government Printing Office, Washington, D. C., and from the district and co-operative offices of the Bureau of Foreign and Domestic Commerce located in different cities.

Engineers Hear of Deep Sea Diving

At a joint meeting of the Harvard, Yale and Princeton Engineering Associations held at the Yale Club in New York on Dec. 9, John F. O'Hagan, formerly of the United States Navy, told of the development of the art of deep sea diving from the days of Homer to the present day. He had a complete modern diving suit with him and explained its workings in detail, assisted by Frank Crilley, the holder of the depth record of 306 feet made at Honolulu in his endeavor to rescue the crew of the submarine F-4. The engineers were willing to accept the classification of diving as an extra hazardous occupation after listening to Mr. O'Hagan's description of the fatal "squeeze" of hydrostatic pressure and the tortures of caisson disease, or the "bends."

Obituary

Horace E. Dodge

Horace E. Dodge, millionaire automobile manufacturer, died unexpectedly on Dec. 10 at his winter home in Palm Beach, Fla., where he had gone, apparently in good health, from Detroit a few weeks ago. He was fifty-two years old.

Mr. Dodge has been sole head of the Dodge automobile interests since his elder brother, John Dodge, died in New York at the Ritz-Carlton last January of pneumonia. At that time Horace E. Dodge also was seriously ill with pneumonia. The brothers were attending the New York automobile show together, where they were both stricken.

On completing their apprenticeship in the parental shop the brothers worked as journeymen machinists in several Michigan cities until the year 1901, when they started their own place in Detroit. They employed only eleven men and used machinery taken in payment of a debt. They then began to specialize—John becoming the business executive and Horace the technical expert on gas engines.

When Henry Ford organized his company in 1902 he took the Dodge brothers in with him for a combined interest of $10,000, the stock to be paid for by their manufacture of 650 chassis. In 1916 they won an action against Mr. Ford to restrain him from what they considered misuse of the company's profits. They then started to manufacture their own cars.

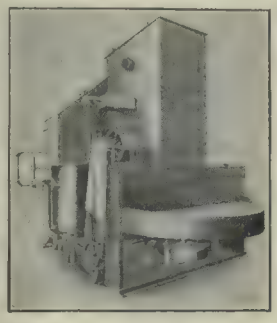
A few years ago the brothers gained a rapid success in the manufacture of the Dodge car. They were popular with the 18,000 men who worked for them; the day after the death of John Dodge the organization paid him the tribute of breaking all production records for the plant.

Mr. Dodge is survived by his wife and two children.

Condensed-Clipping Index of Equipment

Patented Aug. 20, 1918

Sandblast, Rotary-Table, Direct-Pressure-Type
Pangborn Corporation, Hagerstown, Md.
"American Machinist," Nov. 18, 1920



This machine is used for work difficult to clean and of large size. It is equipped with an elevator and a separator, using both mechanical means and circulation of air for reclamation and separation of the abrasive. The reclaimed abrasive is accumulated in storage bins, from which the tank for the blast can be quickly refilled by operating a valve, thus making the operation of the machine practically continuous. The machine is made in two sizes, with table diameters of 70 and 90 in. and a clearance of 15 in. between the table top and the nozzles.

Sandblast, Rotary-Table, Gravity-Feed-Type
Pangborn Corporation, Hagerstown, Md.
"American Machinist," Nov. 18, 1920



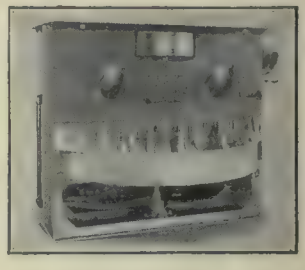
This type of machine is intended for work not difficult to clean or where the intensive action of the direct-pressure blast is unnecessary. The machine is self-contained. Both mechanical and draft action are used for reclamation and handling of the abrasive, which is fed by gravity in a continuous cycle to the nozzles. The machine is made in but one size with a table diameter of 84 in., and it has an adjustment of the nozzle arms that permits a clearance of either 10 or 15 in. between the table top and the nozzles.

Sandblast, Rotary-Table, Suction-Feed, 42-In.
Pangborn Corporation, Hagerstown, Md.
"American Machinist," Nov. 18, 1920



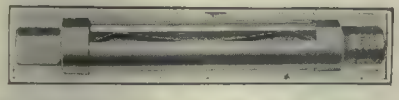
The self-contained suction-feed machine is intended for the cleaning of light work and refinishing. The used abrasive is reclaimed through screens and handled without the use of an elevator. The cleaned abrasive is carried continuously by suction to the nozzles. The machine is made in two sizes, the one shown having a table 42 in. in diameter and one nozzle with a vertical adjustment allowing any distance from 5 to 12 in. between the table top and the nozzle.

Sand-Blast, Rotary-Table, Suction-Feed, 70-In.
Pangborn Corporation, Hagerstown, Md.
"American Machinist," Nov. 18, 1920



This is the largest size of suction-feed machine of the series. It has a table diameter of 70 in. with a clearance of 12 in. between the nozzles and table top, allowing the handling of reasonably large work or a large quantity of small pieces.

Mandrel, Self-Gripping
Eastern Tube and Tool Co., Inc., Brooklyn, N. Y.
"American Machinist," Nov. 18, 1920



The mandrel shown holds bushings, gears and similar parts while turning or grinding, the parts being slipped on or off it by turning them slightly to the left. The body has three grooves, each of which contains a roller in the proper position for gripping by means of flat springs. The collars at each end retain the rollers and springs. When the cut is applied to the work on the mandrel the rollers are caused to wedge and grip the work rigidly. The body is ground 0.0002 in. undersize. Due to the action of the rollers, the mandrel will grip work 0.005 to 0.015 oversize. The mandrel is made in a range of sizes from ¼ to 2 inches.

Gage, Taper-Measuring, "Precision"
Doyle-Wall Machine and Tool Co., 318-24 Pearl St., Syracuse, N. Y.
"American Machinist," Nov. 18, 1920



The device consists of a double sine bar and angle-measuring gage. Tapers from 0 to 4 in. per foot can be measured. A chart, figured to four points of decimals, is supplied with each gage to show the values of tapers from ⅛ to 4 in. per foot. The gage can be set up more quickly than a sine bar, and no high degree of skill is required for its operation, because only one measurement is necessary. The parallels and pins are hardened, ground and lapped, an accuracy to within 0.0001 in. being guaranteed. The tool is regularly made in two sizes with parallels having 12 or 6 in. center distances, but gages for any desired size of taper can be furnished.

Hub Plate, Self-Locking
J. P. Finerty & Co., Dunmore, Pa.
"American Machinist," Nov. 18, 1920

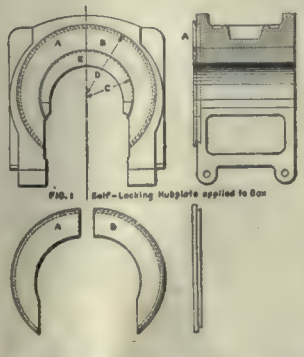


FIG. 1 Self-Locking Hubplate applied to Box

This self-locking hub plate has been designed to replace the methods of putting in hub liners which are now in use. It does away with the method of casting the hub plate into the driving box and also of fastening it in by screws or similar methods. Hub plates of this type are in use on about forty locomotives of a well-known railroad and are giving satisfactory service at a considerably lower cost than the plates formerly used.

Motor Drive, Lathe, Wood-Turret
Wood Turret Machine Co., Brazil, Ind.
"American Machinist," Nov. 18, 1920



Designed for use on the company's tilted-turret lathe and screw machines, the motor base or cabinet leg of this machine is so arranged that the motor may be easily removed for cleaning or repair. Power is transmitted from the motor to the large driving pulley on the spindle by means of a double belt passing through the pan and lightened by a double-acting idler. This motor-drive arrangement is being supplied on the Nos. 2, 3 and 4 back-geared type of machine, d.c. variable-speed motors being used.

Clip, paste on 3 x 5-in. cards and file as desired

Personals

MAX MAAG of Zurich, Switzerland, inventor of the gears and machines that bear his name, sailed for home on Dec. 4 after several weeks in this country spent in looking after his gear interests here. He expects to return in the spring.

J. C. KOPF, formerly manager of the engineering department of the Duff Manufacturing Co., Pittsburgh, Pa., has been appointed research engineer and placed in charge of a newly established research department. F. W. SCHWERIN has been promoted to manager of engineering.

HARVEY A. HIGGINS, JR., who was connected with the Committee on Public Information during the war and who has recently been doing editorial work in New York City, has returned to his position as advertising manager of the Standard Tool Co., Cleveland, Ohio, from which he had a leave of absence.

JOHN B. MATTHEWS, consulting engineer and surveyor, San Francisco, is now designing the first large turbo-electric driven passenger and cargo steamer to be built on the western coast, and will have entire supervision of its construction.

LEE H. BENSON has been appointed president and general manager of the Amery Manufacturing Co. of Amery, Wis., recently organized by him and other business men of Amery. The company has taken over the entire stock of the Western Machine Manufacturing Co. of Eau Claire, Wis., and will manufacture the line of engines, pump jacks, wood saws, engine trucks, etc., formerly manufactured by that company.

WILLIAM R. MILLER has left the employ of the Hooven, Owen, Rentschler Co., Hamilton, Ohio, and is now with the New York Shipbuilding Corporation, Camden, N. J.

W. R. WEBSTER has resigned his position as assistant chief engineer for the Cambria Steel Co., Johnstown, Pa., to become general engineer of the Semet-Solvay Co., of Syracuse, N. Y.

F. G. B. ALLAN, of Toronto, has been appointed general manager of the Pressed Steel Metals Co. of Canada, Ltd., and American Bushings Corporation, in succession to J. W. Leighton, who is now chief engineer and supervisor of works. In addition Mr. Leighton will devote a portion of his time to the development of the patented bushings and tube processes.

CHARLES SMITH, chairman of the board of directors of Landers Frary & Clark, arrived in New York Saturday on the Aquitania from England. He said that conditions in London are at the present time far from encouraging due to the lack of employment.

W. A. MAXWELL, JR., of Westmont, Pa., assistant general superintendent of the Cambria Steel Co., Johnstown, Pa., resigned, effective Nov. 22, to accept the position as general superintendent of the Inland Steel Co. plant at Indiana Harbor, Ind. H. A. Berg, also of Westmont, superintendent of the blast furnace operations of the Midvale Steel and Ordnance Co., succeeds Mr. Maxwell.

BENJAMIN C. JONES has been selected as general manager of the new porcelain plant division of the General Electric Co. at Pittsfield, Mass.

E. E. HARKNESS has recently been appointed production manager of the C. J. Root Co., of Bristol, Conn, manufacturers of automatic counters, wrought brass hinges, etc.

W. W. ALEXANDER, who has been vice-president and general manager of the Syracuse plant of the John Deere Plow Co., has been promoted to be vice-president and general manager of the company in St. Louis. Upon leaving, Mr. Alexander was presented with a solid gold watch and chain by the employees of the Syracuse factory. Previous to coming to Syracuse in 1910 Mr. Alexander had charge of the Indianapolis branch of the company.

JOHN C. PANGBORN, vice-president, Pangborn Corporation, Hagerstown, Md., manufacturer of sand-blast and allied equipment, sailed on Nov. 27 for Southampton.

J. GRADY ROLLOW has resigned his position with E. I. duPont de Nemours & Co., and is now connected with the Los Angeles Gas and Electric Corporation as consulting engineer.

C. C. LANCE, formerly shop engineer for the Seaboard Air Line Railway Co., is now with the National Boiler Washing Co., Chicago, Ill.

ALBERT R. DISMUKES has resigned his position with Joseph E. Lowes, Inc., Dayton, Ohio, and become associated with the Safe-Cabinet Co., of Marietta, in the capacity of industrial engineer.

RAY MAYHEW, recently motor engineer with the American Hoist and Derrick Co., St. Paul, has taken a position with the Clyde Iron Works, Duluth, Minn.

EDWARD PAYSON BULLARD, JR., president of the Bullard Machine Tool Co., Bridgeport, Conn., has been awarded the Howard N. Potts Gold Medal by the Committee on Science and the Arts of The Franklin Institute for his invention of the Mult-Au-Matic Machine Tool.

FRANK THORNTON, JR., chief engineer of the Westinghouse Electric Products Co., has been appointed manager of the electric heating engineering department of the Westinghouse Electric and Manufacturing Co.

Federal incorporation of American companies doing business locally in China, with exemption of such companies from income and excess profits taxes, is being advocated by American Chambers of Commerce in China, especially those at Shanghai and Tientsin.

Business Items

The consolidation of Whiting Foundry Equipment Co. of Harvey, Ill. and the American Foundry Equipment Co. of New York City, recently announced, has not been consummated and the two companies will continue as separate concerns the same as heretofore.

The Western Reserve Motor Car Co., Leavittsburg, Ohio, has been incorporated for the purpose of manufacturing complete high-class automobiles. R. K. Johnson is president. The Western Reserve National Bank, Warren, Ohio, is the temporary headquarters.

The Production Equipment Co. has opened a showroom at 39th St. and Broadway, New York City, displaying an assortment of rifles, guns, micrometers and other products of the Birmingham Small Arms Co. It also exhibits some interesting small lathes and milling machines made by the Drummond Co. of England.

The Yougstown Steel Co., Warren, Ohio, has been formed for the purpose of manufacturing a high-grade wrought iron by a new process.

A syndicate, composed of Charles Michaels and other Bucyrus capitalists, has purchased the electric crane department of the Toledo Bridge and Crane Co., of Toledo, and a new company known as the Toledo Crane Co., of Bucyrus, will be organized with an authorized capital of $500,000 to operate the business. The plant will be moved to Bucyrus within 60 days.

The Marine Iron Works, New Orleans, La., is quartered temporarily in three old buildings and contemplates the erection of a modern structure on the present site.

The White Manufacturing Co., Goshen, Ind., has recently been incorporated in that state and has purchased the shop and business of the Alford Motor and Machine Co. and the Goshen Motor Works.

Forthcoming Meetings

The Society of Automotive Engineers will hold its annual meeting on Jan. 11 to 13 inclusive at New York.

The Engineering Institute of Canada will hold its thirty-fifth annual meeting in Toronto, King Edward Hotel, on Feb. 1, 2 and 3.

A triple convention of the National Supply and Machinery Dealers' Association, the Southern Supply and Machinery Dealers' Association and the American Supply and Machinery Manufacturers' Association will be held in Atlantic City, N. J., May 16, 17 and 18, 1921, with headquarters for all three associations at the Marlborough-Blenheim. F. D. Mitchell, 4106 Woolworth Building, New York, is secretary of the last-named association.

The Spring Convention of the National Machine-Tool Builders' Association will be held on Thursday and Friday, May 19 and 20, at Hotel Traymore, Atlantic City, N. J. Chas. E. Hildreth, care of the Association, Worcester, Mass., is general manager.

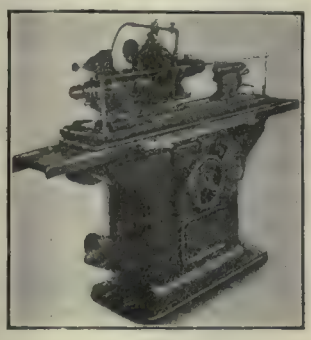
Condensed-Clipping Index of Equipment

Patented Aug. 20, 1918

Grinding Machine, Internal and Spindle

Jones & Shipman, Ltd., Leicester, England.

"American Machinist" (European Edition), Sept. 4, 1920.



This machine is intended for all kinds of cylindrical work. External grinding can be done up to 24 in. between centers and 12 in. in diameter and holes from $\frac{3}{8}$ in. up to 5 in. in diameter and $3\frac{1}{2}$ in. deep. Eight spindle speeds can be obtained. To give a wider range of speeds on the workhead a new sectional pulley is fitted.

Grinding Machine, Surface, Vertical-Spindle

Lumsden Machine Co., Gateshead, England

"American Machinist" (European Edition), Sept. 4, 1920.

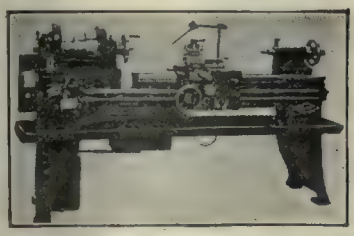


The table of this machine has a working surface of 15 x 72 in.; it is driven by rack and spiral gear. The traverse speeds are 8 ft. and 13 ft. per minute, the reverse motion being automatic. The 16 in. in diameter grinding wheel is built up of eight segmental blocks held by taper dogs in a chuck; the segments protrude from the chuck about $\frac{1}{4}$ in. The minimum feed of the wheel is 0.0005 in. and the maximum, 0.008 in., both hand and automatic feed being provided. Weight, $6\frac{1}{2}$ tons; floor space, 16 x 7 ft.

Lathe, 13-In.

Selson Engineering Co., Ltd., London, E. C., England

"American Machinist" (European Edition), Sept. 4, 1920.

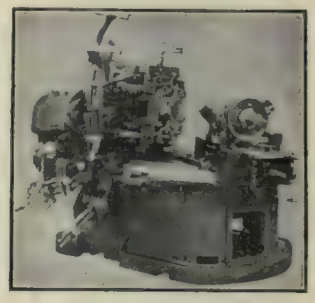


The swing over the bed of this lathe is $13\frac{1}{4}$ in. and in the gap 20 in. by $6\frac{1}{4}$ in. from the faceplate, the swing over the carriage being 8 in. With a bed $6\frac{1}{2}$ ft. long the maximum distance between centers is 3 ft. 3 in. The spindle is bored $1\frac{5}{16}$ in. to admit $1\frac{1}{8}$-in. bars. Three feeds and ten spindle speeds are provided, the latter ranging from 14 to 450 r.p.m. The tailstock sets over for taper-turning. A square turret carries tools of $\frac{3}{4}$-in. section. Weight, 1,650 lb.

Planer, Spiral Bevel Gear

Smith & Coventry, Ltd., Manchester, England

"American Machinist" (European Edition), Sept. 4, 1920.



This machine has been designed to produce correct spiral bevel gears, the geometry of the spiral produced being of the same accuracy as the spiral spur gear or the involute curve used for the wheel tooth. The teeth produced are symmetrical at every section and the spiral of the teeth on the pitch cone is a correct geometrical figure having a uniform lead spiral. The "spiralty" is produced by imparting an angular movement to the wheel blank during the cutting operation.

Axle-Ending and Centering Machine

Tangyes, Ltd., Birmingham, England

"American Machinist" (European Edition), Sept. 4, 1920.

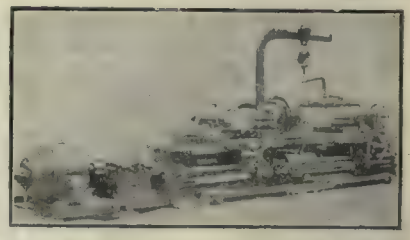


This machine turns end collars, faces to length and centers axles 4 ft. 9 in. to 9 ft. 6 in. long up to 9 in. in diameter. The headstocks have large spindles, each with a $10\frac{1}{2}$-in. diameter hole. The main gear box is arranged for four speeds and is driven by a 15-hp. motor. The spindle speeds are 28 to 63 r.p.m. Each headstock engages the quick-power traverse screw, the speed being 5 ft. per minute. The centering spindle is driven at 360 r.p.m. by its independent $1\frac{1}{2}$-hp. motor. The floor space is 24 ft. by 4 ft. 6 in.

Lathe, Axle-Turning, "Tangyes"

Alfred Herbert, Ltd., Coventry, England

"American Machinist" (European Edition), Sept. 4, 1920.



This lathe is designed for turning simultaneously both ends of a locomotive, carriage or wagon axle. The bed is 14 ft. by $25\frac{1}{2}$ in. on top; lengths up to 8 ft. 6 in. can be taken between centers. The headstock has a large spindle with an 11-in. diameter hole. The four-speed gear box is coupled to a 15-hp. motor and a total of eight spindle speeds, from 12 to 80 r.p.m., can be obtained. The three feeds are 6, 12 and 22 revolutions per inch. A 9 x 9-in. turret carries four tools.

Grinding Machine, Tool, Curved-Lip

Lumsden Machine Co., Ltd., Gateshead, England

"American Machinist" (European Edition), Sept. 11, 1920.

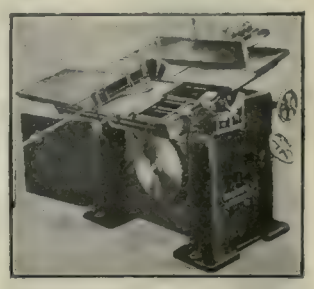


The curved-lip mechanism consists of a horizontal traversing slide mounted on a column having vertical adjustment. This slide is pivoted on the column and can be swung at any desired angle in the horizontal plane to the wheel. Mounted on the slide is a cross-slide carrying a swiveling vise, the base of which is mounted at an angle of about 40 deg. to the slide. All controls are hand operated. The end of the machine taking the 12-in. cup wheel carries a toolrest and wheel dresser.

Saw, Double Dimension, 16-in.

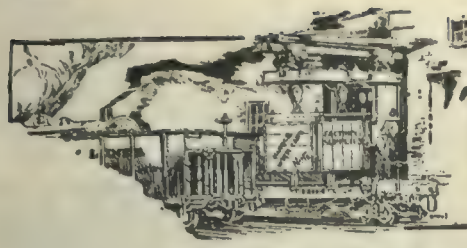
Wadkin & Co., Leicester, England.

"American Machinist" (European Edition), Sept. 11, 1920



This saw is suitable for such work as ripping, cross-cutting, beveling, tonguing, grooving, mitering, cutting compound angles, roughing-out coreboxes, etc. The entire table tilts by worm gearing up to 45 deg., the angle being indexed. The ripping fence has a front fence plate which cants from the vertical to 45 deg. and swivels 30 deg. either way. A cutting-off gage swivels right and left hand, the angles being shown on the sliding table surface. Miter gages are mounted on each side. Weight 1 ton.

Clip, paste on 3 x 5-in. cards and file as desired



THE WEEKLY PRICE GUIDE

IRON AND STEEL

PIG IRON—Quotations compiled by The Matthew Addy Co.:

CINCINNATI	Current	One Year Ago
No. 2 Southern	$44.50	$30.35
Northern Basic	40.00	27.55
Southern Ohio No. 2	42.00	28.55
NEW YORK—TIDEWATER DELIVERY		
2X Virginia (Silicon 2.25 to 2.75)	51.26	32.40
Southern No. 2 (Silicon 2.25 to 2.75)	48.26	35.20
BIRMINGHAM		
No. 2 Foundry	40.50	29.25
PHILADELPHIA		
Eastern Pa., No. 2x, 2.25-2.75 sil.	42.50	29.00-30.00
Virginia No. 2	46.25	33.00
Basic	38.25	26.75
Grey Forge	40.25	26.75
CHICAGO		
No. 2 Foundry local	40.00	26.75
No. 2 Foundry, Southern	46.66	28.00
PITTSBURGH, INCLUDING FREIGHT CHARGE FROM VALLEY		
No. 2 Foundry	41.96	28.15
Basic	38.00	27.15
Bessemer	38.00	29.35

* F.o.b. furnace. † Delivered.

STEEL SHAPES—The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses at the cities named:

	New York			Cleveland		Chicago	
	Current	One Month Ago	One Year Ago	Current	One Year Ago	Current	One Year Ago
Structural shapes	$3.80	$4.15	$3.47	$3.58	$3.37	$3.58	$3.47
Soft steel bars	3.70	4.15	3.37	3.34	3.27	3.48	3.37
Soft steel bar shapes	3.70	4.15	3.37	3.48	3.27	3.48	3.37
Soft steel bands	4.65	5.50	4.07	6.25	.....	.....	.....
Plates, ¼ to 1 in. thick	4.00	4.15	3.67	3.78	3.57	3.78	3.67

BAR IRON—Prices per 100 lb. at the places named are as follows:

	Current	One Year Ago
Mill, Pittsburgh	$4.25	$2.77
Warehouse, New York	4.75	3.37
Warehouse, Cleveland	3.52	3.27
Warehouse, Chicago	4.12	3.37

SHEETS—Quotations are in cents per pound in various cities from warehouse; also the base quotations from mill:

Blue Annealed	Large Mill Lots Pittsburgh	New York Current	New York One Year Ago	Cleveland	Chicago
No. 10	3.55-4.50	5.20@6.15	4.57	5.00	6.13
No. 12	3.60-4.55	5.25@6.20	4.62	5.05	6.18
No. 14	3.65-4.60	5.30@6.25	4.67	5.10	6.23
No. 16	3.75-4.70	5.40@6.35	4.77	5.20	6.33
Black					
Nos. 18 and 20	4.20-5.35	6.50@8.00	5.30	5.60	6.90
Nos. 22 and 24	4.25-5.40	6.55@8.05	5.35	5.75	6.95
No. 26	4.30-5.45	6.60@8.10	5.40	5.80	7.00
No. 28	4.35-5.50	6.70@8.20	5.50	5.90	7.10
Galvanized					
No. 10	4.70-6.00	8.00@8.25	5.75	6.25	7.25
No. 12	4.80-6.10	8.10@8.25	5.85	6.35	7.30
No. 14	4.80-6.10	8.10@8.35	5.85	6.35	7.45
Nos. 18 and 20	5.10-6.40	8.35@8.65	6.15	6.65	7.75
Nos. 22 and 24	5.25-6.55	8.50@8.80	6.30	6.80	8.15
No. 26	5.40-6.70	8.65@8.95	6.45	6.95	8.30
No. 28	5.70-7.00	8.95@9.25	6.75	7.25	8.60

Acute scarcity in sheets, particularly black, galvanized and No. 16 blue enameled.

Automobile sheets are unavailable except in fugitive instances, when prices are 9.45c per lb. for No. 16; 9.50 for Nos. 18 and 20, and 9.55c for Nos. 22 and 24.

COLD FINISHED STEEL—Warehouse prices are as follows:

	New York	Chicago	Cleveland
Round shafting or screw stock, per 100 lb. base	$5.50	$5.80	$4.84
Flats, square and hexagons, per 100 lb. base	6.00	6.30	5.34

DRILL ROD—Discounts from list price are as follows at the places named:

	Per Cent.
New York	50
Cleveland	50
Chicago	50

NICKEL AND MONEL METAL — Base prices in cents per pound F. O. B. Bayonne, N. J.

Nickel	
Ingot and shot	43
Electrolytic	45

Monel Metal			
Shot and blocks	35	Hot rolled rods (base)	42
Ingots	38	Cold rolled rods (base)	56
Sheet bars	40	Hot rolled sheets (base)	55
Special Nickel and Alloys			
Malleable nickel ingots	45		
Malleable nickel sheet bars	47		
Hot rolled rods, Grades "A" and "C" (base)	60		
Cold drawn rods, grades "A" and "C" (base)	72		
Copper nickel ingots	42		
Hot rolled copper nickel rods (base)	52		
Manganese nickel hot rolled (base) rods "D" — low manganese	64		
Manganese nickel hot rolled (base) rods "D" — high manganese	67		

Domestic Welding Material (Swedish Analysis)—Welding wire in 100-lb lots sells as follows, f. o. b. New York: 5/32, 8½c. per lb.; ¼, 8c.; 5/16 to ½, 7½c Domestic iron sells at 12c. per lb.

MISCELLANEOUS STEEL—The following quotations in cents per pound are from warehouse at the places named:

	New York Current	Cleveland Current	Chicago Current
Openhearth spring steel (heavy)	7.00	8.00	9.00
Spring steel (light)	10.00	7.00	12.00
Coppered bessemer rods	9.00	8.00	6.75
Hoop steel	4.70	4.04	5.32
Cold-rolled strip steel	12.50	8.25	10.75
Floor plates	6.25	4.00	6.63

WROUGHT PIPE—The following discounts are to jobbers for carload lots on the Pittsburgh basing card:

	BUTT WELD				
Inches	Steel Black	Steel Galvanized	Inches	Iron Black	Iron Galvanized
⅛ to 3	54–57½%	41½–44%	⅛	15½–25½%	+1½–11½%
			¼	19½–29½%	1½–11½%
			⅜ to 1¼	24½–34½%	8 –18½%
	LAP WELD				
2	47 –50½%	34½–38%	1½	.....	.....
2½ to 6	50 –53½%	37½–41%	1½	.....	.....
7 to 12	47 –50½%	33½–37%	2	20½–28½%	6½–14½%
13 to 14	37½–41 %	.....	4½ to 6	22½–30½%	9½–17½%
15	35 –38½%	.....	2½ to 4	22½–30½%	9½–17½%
			7 to 12	19½–27½%	6½–14½%
	BUTT WELD, EXTRA STRONG PLAIN ENDS				
⅛ to 1½	52 –55½%	39½–43%	⅛ to 1½	24½–34½%	9½–19½%
2 to 3	53 –56½%	40½–44%			
	LAP WELD, EXTRA STRONG PLAIN ENDS				
2	45 –48½%	33½–37%	1½	.....	.....
2½ to 4	48 –51½%	36½–40%	1½	.....	.....
4½ to 6	47 –50½%	35½–39%	2	21½–29½%	8½–16½%
7 to 8	43 –46½%	29½–33%	2½ to 4	23½–31½%	11½–19½%
9 to 12	38 –41½%	24½–28%	4½ to 6	22½–30½%	10½–18½%
			7 to 8	14½–22½%	2½–10½%
			9 to 12	9½–17½%	5½ +2½%

	New York Black	New York Galv.	Cleveland Black	Cleveland Galv.	Chicago Black	Chicago Galv.
⅛ to 3 in. steel butt welded	38%	22%	39%	30%	54%40%	40%@30 %
2½ to 6 in. steel lap welded	33%	18%	41%	26%	50@40%	37½@27½%

Malleable fittings. Classes B and C, banded, from New York stock sell at plus 45%. Cast iron, standard sizes, plus 5%.

METALS

MISCELLANEOUS METALS—Present and past New York jobbers' quotations in cents per pound, in quantities up to car lots:

	Current	Month Ago	Year Ago
Copper, electrolytic	15.00	15.50	22.50
Tin in 5-ton lots	36 25	38.75	56.50
Lead	5.75	6.75	6.25
Zinc	7.00	7.00	7.60
ST. LOUIS			
Lead	6.25	7 25	6.00
Zinc	6.75	6.25	7.15

At the places named, the following prices in cents per pound prevail, for 1 ton or more:

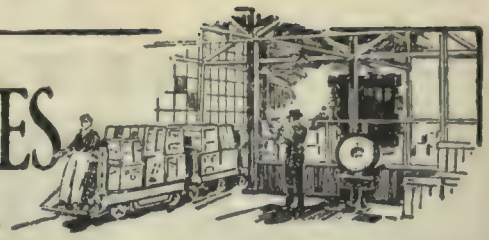
	New York Current	New York Month Ago	New York Year Ago	Cleveland Current	Cleveland Year Ago	Chicago Current	Chicago Year Ago
Copper sheets, base	22.50	23.50	33.50	24.50	35.50	28.50	36.50
Copper wire (carload lots)	20.00	20.00	30.75	22 00	30.50	25 00	26.00
Brass sheets	22.25	28.50	32.00	25 00	33.00	25 25	28.00
Brass pipe	25.00	28.00	36.00	27.00	39.00	30.00	37.00
Solder (half and half) (case lots)	27.75	29.00	45.00	29.00	41.00	22.50	38.50

Copper sheets quoted above hot rolled 24 oz., cold rolled 14 oz. and heavier, add 2c.; polished takes 5c. per sq.ft. extra for 20-in. widths and under; over 20 in., 7½c.

BRASS RODS—The following quotations are for large lots, mill. 500 lb. and over, warehouse; net extra:

	Current	One Year Ago
Mill	18.25	24.00
New York	19.50	28.00@29.75
Cleveland	23.00	29.00
Chicago	23.25	27.00

SHOP MATERIALS AND SUPPLIES



ZINC SHEETS—The following prices in cents per pound are f.o.b. mill + less 8% for carload lots..... 11.50

	Warehouse			
	In Casks		Broken Lots	
	Current	One Year Ago	Current	One Year Ago
Cleveland	15.30	12.50	14.70	13.00
New York	14.00	11.50	14.50	12.50
Chicago	14.50	16.50	14.95	16.00

ANTIMONY—Chinese and Japanese brands in cents per pound, in ton lots for spot delivery, duty paid:

	Current	One Year Ago
New York	6.50	9.50
Chicago	7.00	9.75
Cleveland	7.50	9.75

OLD METALS—The following are the dealers' purchasing prices in cents per pound:

	*New York			
	Current	One Year Ago	Cleveland	Chicago
Copper, heavy, and crucible	12.00	17.00	10.00	11.50
Copper, heavy, and wire	11.50	16.00	9.50	11.00
Copper, light, and bottoms	10.00	14.00	9.00	9.50
Lead, heavy	4.00	4.75	4.00	4.50
Lead, tea	3.00	3.75	3.00	3.50
Brass, heavy	7.00	10.50	7.00	10.50
Brass, light	5.50	7.50	5.00	5.50
No. 1 yellow brass turnings	6.50	10.00	5.50	5.50
Zinc	4.50	5.00	3.00	4.50

*These prices nominal because of dull market

ALUMINUM—The following prices are from warehouse at places named:

	New York	Cleveland	Chicago
No. 1 aluminum, 98 to 99% pure, in ingots for remelting (1-15 ton lots), per lb	$33.00	$26.00	$33.50

COPPER BARS—From warehouse sell as follows in cents per pound, for ton lots and over:

	Current	One Year Ago
New York (round)	28.00	32.00
Chicago	21.00	31.00
Cleveland	25.00	35.00

BABBITT METAL—Warehouse price per pound:

	New York		Cleveland		Chicago	
	Current	One Year Ago	Current	One Year Ago	Current	One Year Ago
Best grade	70.00	90.00	46.00	70.00	43.00	60.00
Commercial	30.00	50.00	16.50	16.50	11.00	13.00

NOTE—Price of babbitt metal is governed largely by formula, no two manufacturers quoting the same prices. For example, in New York we quote the best two grades, although lower grades may be obtained at from $16 to $20.

SHOP SUPPLIES

NUTS—From warehouse at the places named, on fair-sized orders, the following amount is deducted from list:

	New York		Cleveland		Chicago	
	Current	One Year Ago	Current	One Year Ago	Current	One Year Ago
Hot pressed square	+$1.25	$1.50	List net	$2.25	+1.15	1.85
Hot pressed hexagon	+ 1.25	1.50	List net	2.25	+1.15	1.85
Cold punched hexagon	+ 1.25	1.50	List net	2.25	+1.15	1.30
Cold punched square	+ 1.25	1.50	List net	2.25	+1.15	1.30

Semi-finished nuts, ⅞ and smaller, sell at the following discounts from list price:

	Current	One Year Ago
New York	30%	50–10%
Chicago	40%	50%
Cleveland	50%	55%

MACHINE BOLTS—Warehouse discounts in the following cities:

	New York	Cleveland	Chicago
½ by 4 in. and smaller	+10%	30%	20%
Larger and longer up to 1½ in. by 30 in.	Net list	30%	10%

WASHERS—From warehouses at the places named the following amount is deducted from list price:

For wrought-iron washers:
New York..... list Cleveland..... $2.50 Chicago..... $1.90
For cast-iron washers, ⅜ and larger, the base price per 100 lb. is as follows:
New York..... $7.00 Cleveland..... $4.50 Chicago..... $5.50

CARRIAGE BOLTS—From warehouses at the places named the following discounts from list are in effect:

	New York	Cleveland	Chicago
½ by 6 in. and smaller	+20%	30%	20%
Larger and longer up to 1 in. by 30 in.	+20%	25%	15%

COPPER RIVETS AND BURS sell at the following rate from warehouse:

	Rivets		Burs	
	Current	One Year Ago	Current	One Year Ago
Cleveland	25%	20%	10%	10%
Chicago	net	20%	net	20%
New York	30%	40%	net	20%

RIVETS—The following quotations are allowed for fair-sized orders from warehouse:

	New York	Cleveland	Chicago
Steel ⅞ and smaller	20%	40–5%	30%
Tinned	20%	40–5%	30%

Boiler, ½, ¾, 1 in. diameter by 2 to 5 in. sell as follows per 100 lb.:
New York..... $6.00 Chicago..... $5.73 Pittsburgh..... $4.50
Structural, same sizes:
New York..... $5.73 Chicago..... $5.83 Pittsburgh..... $4.60

MISCELLANEOUS

SEAMLESS DRAWN TUBING—The base price in cents per pound from warehouse in 100-lb. lots is as follows:

	New York	Cleveland	Chicago
Copper	$26.00	30.00	31.00
Brass	25.00	27.00	30.00

The prices, of course, vary with the quantity purchased. For lots of less than 100 lb., but not less than 75 lb., the advance is 1 c.; for lots of less than 75 lb., but not less than 50 lb., 2½c. over base (100-lb. lots); less than 50 lb., but not less than 25 lb., 5c. should be added to base price; quantities from 10-25 lb., extra is 10c.; less than 10 lb., add .15–20c.

Double above extras will be charged for angles, channels and sheet metal mouldings if ordered in above quantities. Above extras also apply to brass rod other than standard stock sizes—stock sizes being considered as ½-2 in. inclusive in rounds, and ½-1½ in., inclusive, in square and hexagon—all varying by thirty seconds up to 1 in. by sixteenths over 1 in. On shipments aggregating less than 100 lb., there is usually a boxing charge of $1.50.

LONG TERNE PLATE—In Chicago No. 28 primes from stock sell, nominally, for $8.85 per 100 lbs.

In Cleveland—$10 per 100 lbs.

COTTON WASTE—The following prices are in cents per pound:

	New York		Cleveland	Chicago
	Current	One Year Ago		
White	15.00@17.00	13.00	15.00	15.00@17.00
Colored mixed	9.00@14.00	9.00–12.00	11.00	11.00@13.00

WIPING CLOTHS—Jobbers' price per 1000 is as follows:

	13½x13½	13½x20½
Cleveland	55.00	65.00
Chicago	41.00	43.50

SAL SODA sells as follows per 100 lb.:

	Current	One Month Ago	One Year Ago
New York	$2.00	$2.00	$1.75
Philadelphia	2.75	2.75	1.75
Cleveland	3.00	3.00	2.50
Chicago	2.00	2.75	2.00

ROLL SULPHUR in 360-lb. bbl. sells as follows per 100 lb.:

	Current	One Month Ago	One Year Ago
New York	$3.50	$3.90	$3.65
Philadelphia	3.65	3.65	3.87
Chicago	3.85	5.00	4.12½

COKE—The following are prices per net ton at ovens, Connellsville:

	December 13	December 6	November 29
Prompt furnace	$ 8.00@$10.00	$8.00@$10.50	$11.50@$12.00
Prompt foundry	10.00@12.00	10.00@12.00	12.50@13.00

FIRE CLAY—The following prices prevail:

		Current
Ottawa, bulk in carloads	Per Ton	$8.00
Cleveland	100-lb. bag	1.00

LINSEED OIL—These prices are per gallon:

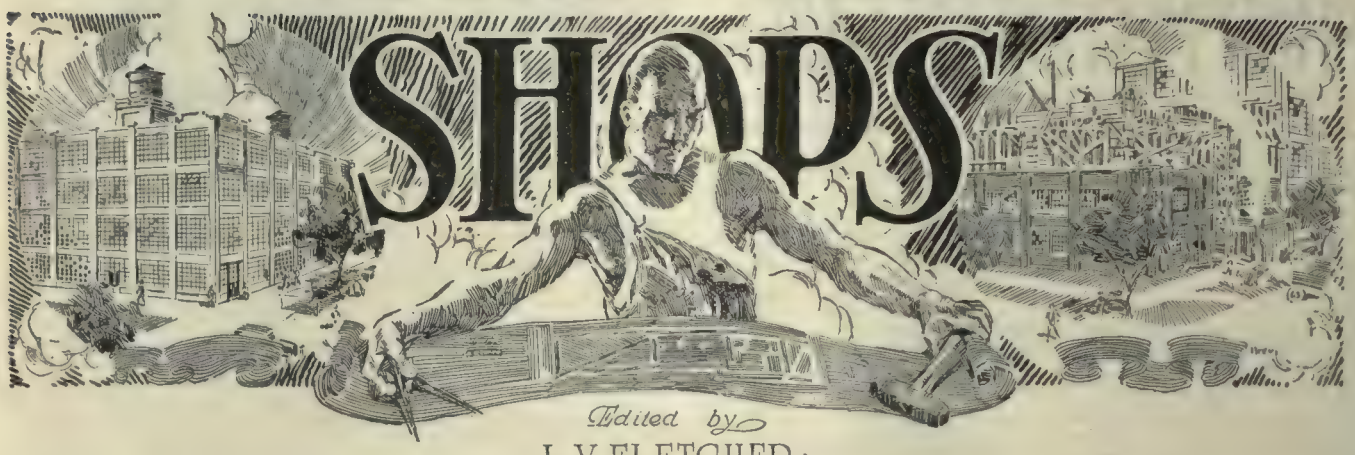
	New York		Cleveland		Chicago	
	Current	One Year Ago	Current	One Year Ago	Current	One Year Ago
Raw in barrels, (5 bbl. lots)	$0.90	$2.15	$1.05	$2.50	$0.97	$2.37
5-gal cans	1.05	2.30	1.30	2.75	1.22	2.57
1-gal cans (6 to case)	1.15	....	....	....	....	....

WHITE AND RED LEAD—Base price per pound:

	Red				White	
	Current		One Year Ago		Current	One Year Ago
	Dry	In Oil	Dry	In Oil	Dry and In Oil	Dry and In Oil
100 lb. keg	14.25	15.75	13.00	14.50	14.25	13.00
25 and 50-lb. kegs	14.50	16.00	13.25	14.75	14.50	13.25
12½-lb. keg	14.75	16.25	13.50	15.00	14.75	13.50
5-lb. cans	17.25	18.75	15.00	16.50	17.25	15.00
1-lb. cans	19.25	20.75	16.00	17.50	19.25	16.00

500 lb. lots less 1% discount. 2000 lb. lots less 10–20½% discount.

NEW *and* ENLARGED



Edited by
L·V·FLETCHER

Machine Tools Wanted

If in need of machine tools send us a list for publication in this column

Conn., Hartford — The Hartford Machine Screw Co., 476 Capitol Ave.—miscellaneous machine tools.

Mass., South Boston—The T. L. Harkins Machine Co., 50 Farnsworth St.—machine tool equipment.

Tenn., Nashville—R. R. Sanders, 508 Gay St., manufacturer of jewelry and novelties —No. 91 Bliss double crank press, (used).

Va., Richmond—The Virginia Machinery and Well Co., 1319 East Main St., C. F. Cole, Pres. and Treas.—one 4½ in. to 6 in. or 4½ in. to 8 in. portable pipe threading machine.

W. Va., Logan — The Guyan Machine Shops, B. Shell, Purch. Agt.—general machine shop equipment including shaper, punch, shear and drill.

Ill., Chicago — The Natl. Plumbing & Heating Co., 6044 South State St.—pipe manufacturing equipment.

Ill., Chicago—H. G. Paro Co., 1412 South Michigan Ave.—one 14 or 16 in. lathe with chucks and a 1 in. bolt threader.

Ill., Chicago—The Rock Island R.R., La Salle St., F. D. Reed, Purch. Agt.—1 improved style 5 A pipe bending machine.

Ill., Chicago—The Union Ry. Equipment Co., McCormick Bldg.—one 4 spindle heavy duty drill, (used).

Mich., Birmingham — H. W. Booth—machines and tools for sheet metal-working shop.

Mich., Detroit—D. Cotwell, Hamilton Ave. and Methune St.—mechanical equipment for garage.

O., Columbus—The L. & S. Mfg. Co., 2625 North High St., manufacturers of metal specialties and auto accessories, L. C. Lewis, Genl. Mgr.—complete metal working machinery to include lathe, drill press, grinder, etc.

Wis., Milwaukee — The Universal Appliance Co., 625 Cedar St., A. A. Kern, Purch. Agt.—machine tools for the manufacture of automobile appliances.

Wis., Milwaukee—The Wetzel Art Furniture Co., 1367 Green Bay Ave. — drum sander, jig saw, trim saw, etc., for Cedarburg plant.

Wis., Oshkosh—The Giant Grip Mfg. Co., 29 Osceola St., manufacturers of horseshoes—one trimming press.

Wis., Waupaca—Waupaca County, C. J. Knudson, Court House, Purch. Agt.—machinery for repairing of highway machinery.

Wis., West Allis—The Warner Machine Co., 7521 Scott St.—heavy duty grinder for car wheel work.

Minn., Mankato—The Little Giant Co.—3 lathes similar to Oliver Machinery Co.'s No. 56—motor drive, (new or used).

Mo., St. Louis—T. J. Moss Tie Co., Security Bldg.—pipe threading machines for its branch at Granville, Wis.

Que., Montreal—The Can Welding Co., Amherst St. near Ontario St.—equipment for its proposed plant on St. Timothee St.

Que., Rimouski—J. A. Theberge—equipment for garage repair work.

Machinery Wanted

N. J., Asbury Park—The New Jersey Cleaning & Dyeing Co., 505 Main St.—machinery.

N. Y., New York—(Borough of Bronx) Niewenhous Bros., 165th St. and Park Ave. —1 gasoline driven portable saw.

Pa., Williamsport—The Vallamont Building & Planing Mill Co.—machinery.

Mich., Marquette—The Paveglio Granite & Marble Co., P. Paveglio, Purch. Agt.—traveling crane.

O., Columbus—J. W. Goddard, 776 East Starr Ave.—barrel stave machinery.

O., Toledo—The U. S. Mop Co.—one No. 3 punch press.

Wis., Green Bay—Brown County, J. J. Cormier, Courthouse, Purch. Agt. — one loading crane.

Wis., Kaukauna—The Molock Co., manufacturers of stokers—4 electric traveling cranes.

Wis., Milwaukee—The Atlas Bread Co., 927 Central Ave.—bakery equipment.

Wis., Milwaukee—The Badger Concrete Mixer Co., 221 Grand Ave.—crane for its plant at Watertown.

Wis., Shawano—C. Foesch, cabinet maker —wood-working machinery.

Tex., Dallas—The Bd. Educ., Municipal Bldg.—shop equipment for manual training department.

Ont., Kingsville—The Conklin Planing Mills—equipment.

Ont., Wallaceburg — The Wallaceburg Glass Co., Ltd.—equipment.

Metal Working

NEW ENGLAND

Conn., Hartford—T. R. Forestiere, c/o B. L. Sellew, Archt., 223 Aylum St., is having preliminary plans prepared for the construction of a 2 story, 12 x 50 ft. addition to his garage and bottling plant, on Charter Oak Pl.

Conn., New Haven—A. C. Gilbert Co., Blatchley Ave., has awarded the contract for the construction of a 1 story, 26 x 240 ft. addition to its toy plant. Estimated cost, $7,500.

Mass., Allston (Boston P. O.)—The T. L. Harkins Machine Co., 50 Farnsworth St., South Boston, has had plans prepared for the construction of a 2 story, 50 x 100 ft. plant on Union Sq., for the manufacture of vulcanizing machinery.

Mass., Cambridge—G. Lawrence, Inc., 24 Cambria St., will soon award the contract for the construction of a 1 story addition to its plant, for the manufacture of automobile springs. Estimated cost, $40,000. W. T. Littlefield, 9 Hamilton Pl., Boston, Archt. Noted Aug. 5.

Mass., South Boston (Boston P. O.)—The State Bd. of Pub. Wks., State House, Boston, has awarded the contract for the construction of a 1 story, 60 x 325 ft. portable steel garage, here. Estimated cost, $20,000.

N. H., Manchester—The United States Bobbin & Shuttle Co., Main St., has awarded the contract for the construction of a 2 story addition to its manufacturing plant. Estimated cost, $25,000.

MIDDLE ATLANTIC STATES

D. C., Georgetown—The Rosslyn Steel & Cement Co., Woodward Bldg., will soon award the contract for altering and constructing a 100 x 200 ft. addition to its shop.

Md., Baltimore—Gibson & Kirk Co., 211 Key Highway, has had plans prepared for the construction of a 1 story, 30 x 91 ft. foundry, for the manufacture of brass marine hardware.

Md., Baltimore — Ralinek & Brambart, Pennington Ave. and Beech St., have had plans prepared for the construction of a 16 x 39 ft. foundry.

Md., Baltimore—G. R. Vincenti, 312 Light St., is having plans prepared for the construction of a 3 story, 127 x 140 ft. garage at 3-7 North Paca St. Estimated cost, $60,000. E. G. Blanke, 532 North Calvert St., Archt.

Md., Curtis Bay (Baltimore P. O.)—The Baltimore Car & Fdry Co., Curtis Ave. and Locust St., has had plans prepared for the construction of two 1 story additions to its plant. Estimated cost, $18,000.

N. J., Camden—J. B. Van Sciver Co., Market St. Ferry, manufacturers of furniture, carpets, etc., has awarded the contract for the construction of a 1 story, 30 x 70 ft. kiln building.

N. J., Newark—The Jay Realty Co., 790 Broad St., has awarded the contract for the construction of a 1 story, 50 x 100 ft. garage on Jay and Dickerson Sts. Estimated cost, $14,800.

N. J., Newark — The Southern Lumber Co., 870 Broad St., has awarded the contract for the construction of a 1 story, 45 x 80 ft. garage at 427 Halsey St. D. Jacobson, Genl. Mgr.

N. J., Trenton — The Remington Phonograph Co., 1662 Bway., New York City, has purchased a 14.83 acre site, here, and plans to construct a large phonograph and record factory.

N. J., Trenton—The Star Motor Sales Corp. has awarded the contract for the construction of a 2 story, 65 x 70 ft. repair shop and storage plant on Prince St. Estimated cost, $10,000.

N. Y., Binghamton—The Auto Storing Co., Chamber of Commerce Bldg., is having plans prepared for the construction of a 2 story garage on Henry St. Estimated cost, $175,000. A. T. Lacey, Kilmer Bldg., Archt.

N. Y., Buffalo—The Hewitt Rubber Co., 240 Kensington Ave., has awarded the contract for the construction of a 1 story, 30 x 180 ft. addition to its factory. Estimated cost, $30,000.

N. Y., Jamaica—G. Cooke, Kissam Pl., will soon award the contract for the construction of a 1 story, 35 x 60 ft. machine shop on the corner of Kissam Pl. and Archer Pl. Estimated cost, $9,500. H. T. Jeffrey, Jr., 309 Fulton St, Archt.

N. Y., Jamaica—A. Hoerning, c/o F. J. Schfeick, Archt., 4168 Park Ave., New York City, will build a 1 story, 100 x 155 ft. garage on Hillside Ave. Estimated cost, $30,000.

N. Y., New York (Borough of Bronx)—A. C. Chesley & Co., 277 Rider Ave., manufacturers of fireproof doors, is having plans prepared for the construction of a 2 story, 50 x 200 ft. factory, on 132d st. and Cypress Ave. Estimated cost, $100,000. P. J. Murray, 141 East 40th St., New York City, Archt. and Engr.

N. Y., New York (Borough of Bronx)—The Ferncliffer Garage, Inc., c/o DeRose & Cavalieri, Archts. and Engrs., 370 East 149th St., will build a 1 story, 120 x 125 ft. garage on 3d Ave. near Franklin Ave. Estimated cost, $75,000.

N. Y., New York (Borough of Bronx)—T. Phelan, c/o Moore & Landseidel, Archts. and Engrs., 148th St. and 3d Ave., will build a 1 story garage on Burnside Ave. Estimated cost, $50,000.

N. Y., New York (Borough of Brooklyn)—D. Eisenberg, c/o F. Millman & Son, Archts., 26 Court St., will build a 1 story, 80 x 100 ft. garage on De Kalb Ave. near Skillman St. Estimated cost, $25,000.

N. Y., New York (Borough of Brooklyn)—The Garage Property Corp., 44 Court St., will build a 1 story, 90 x 100 ft. garage on Lawrence Ave. Estimated cost, $30,000. T. H. Gluck, Pres.

N. Y., New York (Borough of Brooklyn)—S. Morrison, 99 Clarkson St., has awarded the contract for the construction of a 1 story, 20 x 52 ft. garage and repair shop. Estimated cost, $10,000.

N. Y., New York (Borough of Brooklyn)—The Victory Operating Co., c/o S. Millman, Archt., 26 Court St., will build a 1 story, 115 x 140 ft. garage on Parkside Ave. between Rogers and Nostrand Aves. Estimated cost, $45,000. S. Halperin, Pres.

N. Y., New York (Borough of Manhattan)—The Dorsma Garage Corp., c/o F. J. Schefeick, Archt., 4168 Park Ave., will alter 1 story garage and build a 1 story, 55 x 115 ft. addition to same at 1016 St. Nicholas Ave. Estimated cost, $45,000.

N. Y., New York (Borough of Manhattan)—F. Hogan, 45 East 135th St., has awarded the contract for the construction of a 1 story, 25 x 99 ft. garage at 52 West 140th St. Estimated cost, $10,000.

N. Y., New York (Borough of Manhattan)—The Hup Realty Co., 229 East 38th St., has awarded the contract for the construction of a 1 story, 75 x 100 ft. garage at 317 East 38th St. Estimated cost, $30,000.

Pa., Bethayres—Klauder-Weldon of Jenkintown are having plans prepared for the construction of a 1 story, 150 x 250 ft. factory for the manufacture of dyeing machinery. C. B. Keen Bailey Bldg., Philadelphia, Archt.

Pa., Philadelphia—Stokes & Smith, Summerdale Station, manufacturers of box machinery, have awarded the contract for altering their 2 story factory at Summerdale Station along the tracks of the Philadelphia & Reading R. R. Estimated cost, $19,000.

Pa., Philadelphia—M. Wenger, 1229 Walnut St., has awarded the contract for altering and constructing an addition to his garage. Estimated cost, $15,000.

Pa., Sheridan—The Acme Die & Stamping Co., McKees Rocks, will soon award the contract for the construction of a 2 story, 40 x 96 ft. factory, here. Estimated cost, $50,000. J. H. Phillips, Fulton Bldg., Pittsburgh, Archt.

MIDDLE WEST STATES

Ill., Chicago—The Railway Steel Spring Co., 30 Church St., New York City, has awarded the contract for the construction of an addition to its factory on Chicago Heights, here. Estimated cost, $60,000.

Mich., Detroit—D. Cotwell, Hamilton Ave. and Bethune St., plans to build a 2 story, 90 x 140 ft. addition to his garage. Estimated cost, $50,000. William Bros., 1111 Kresge Bldg., Archts.

Mich., Detroit—The Detroit Evening News Co., Lafayette Blvd., has awarded the contract for the construction of a 1 story, 90 x 140 ft. garage. Estimated cost, $75,000. Noted Oct. 21.

O., Cleveland—The Cataract Motor Sales Co., 8812 Bway., has awarded the contract for the construction of a 3 story, 77 x 250 ft. garage at 8807 Bway. Estimated cost, $150,000.

O., Cleveland—The Prame Realty Co., c/o J. H. Dickman, 214 Williamson Bldg., is having plans prepared for the construction of a 1 story garage at 742 Hamilton Ave. Estimated cost, $50,000. W. S. Lougee, Marshall Bldg., Archt.

O., Cleveland—M. Purer, 2724 East 53rd St., will soon award the contract for the construction of a 1 story, 80 x 120 ft. garage at 796 East 105th St. Estimated cost, $40,000. M. Orlin, 2909 East 112th St., Archt.

O., Cleveland—The Realty Syndicate Co., c/o F. Riley, 309 Williamson Bldg., will soon award the contract for the construction of a 4 story, 116 x 240 ft. commercial building and garage on East 79th St. and Hough Ave. Estimated cost, $300,000. J. M. Dyer, Ulmer Bldg., Archt.

O., Cleveland—The Republic Tool & Mfg Co., 1399 West 9th St., is having plans prepared for the construction of a 2 story factory and warehouse on Harvard Ave. and East 49th St. Estimated cost, $200,000. G. S. Rider & Co., 1900 Euclid Ave., Archts.

O., Cleveland—J Spang Baking Co., 2701 Barber Ave., has awarded the contract for the construction of a 1 story, 25 x 62 ft. garage at 2603 West 30th St. Estimated cost, $10,000. Noted Oct. 28.

O., Cleveland—W. S. Tyler Co., East 36th St. and Superior Ave., has awarded the contract for the construction of a 4 story, 60 x 260 ft. factory for the manufacture of ornamental iron. Estimated cost, $200,000. Noted Dec. 2.

O., Cleveland—G. Zauba, 1848 West 24th St., will build a 1 story, 27 x 80 ft. garage. Estimated cost, $10,000.

O., Columbus—The Brown Steel Co., 480 Neilston St., is having plans prepared for the construction of a 1 story, 55 x 390 ft. shop on Marion Rd. Estimated cost, $75,000.

O., Columbus—The Ohio Highway Comn., Stoneman Bldg., has had plans prepared for the construction of a 1 story, 100 x 150 ft. garage and number of sheds. Estimated cost, $175,000. V. Redding, 30 Bird Bldg., Mansfield, Archt.

O., Yorkville—The Wheeling Steel & Iron Co. plans to build an addition to its tin mill here. Estimated cost, $150,000.

Wis., Milwaukee—The city is having plans prepared for the construction of a 1 story, 18 x 30 ft. blacksmith shop at 6th St. Viaduct Estimated cost, $5,000. C. E. Malig, City Hall, Archt.

Wis., Sheboygan Falls—P. Kwekkelboon, 10th Ave., is having plans prepared for the construction of a 2 and 3 story, 65 x 120 ft. garage, sales room and office building. M. Howard, Sheboygan Falls, Archt.

Wis., Valders—W. E. Christel is having preliminary plans prepared for the construction of a 2 story, 50 x 85 ft. garage and office building on Main St. Estimated cost, $75,000. Juul-Smith, Imig Bldg., Sheboygan, Archts

WEST OF THE MISSISSIPPI

Ia., Cedar Rapids—The Chicago, Rock Island & Pacific R.R. Co., 179 West Jackson Blvd., Chicago, plans to build a 1 story, 40 x 60 ft. wheel repair shop and improve its shops here. Estimated cost, $16,000.

Ia., Vinton—The Vinton Truck & Mfg. Co. plans to build a plant. W. F. Mether and J. McElroy of Vinton are interested.

Minn., St. Paul—E. Swanson, 129 La Fond St., is having plans prepared for the construction of a 1 story, 112 x 140 ft. garage on Selby Ave. and Dunlap St. Estimated cost, $45,000. W. D. MacLeith, 432 Endicott Bldg., Archt.

WESTERN STATES

Wash., Tacoma—The City Council has passed an ordinance authorizing the construction of a storehouse and shops for the water and light department. Estimated cost, $80,000. I. S. Davidson, Comr. of Light and Water.

CANADA

B. C., Vancouver—The Coast Range Steel Co., 419 Metropolitan Bldg., recently incorporated with $15,000,000 capital stock, plans to build a large iron and steel works, near here.

Ont., Ottawa—The Dept of Pub. Wks. has awarded the contract for the construction of an ore dressing plant. Estimated cost, $6,233.

Ont., Owen Sound—The Corbet Fdry & Machine Co., 1064 1st Ave., W., plans to build a 2 story, 60 x 90 ft. addition to its foundry and machine shop. Estimated cost, $25,000. Forrester & Clark, 1076 1st Ave., W., Archts.

Que., Rimouski—J. A. Theberge plans to build a garage to accommodate 20 cars.

General Manufacturing

NEW ENGLAND STATES

Conn., New Haven—The Connecticut Sash & Door Co., 451 Grand Ave., plans to construct 3 buildings on Grand Ave., to replace those which were recently destroyed by fire. Loss, $70,000. Private plans.

Mass., South Egremont—The Bershire Stone Products Corp. of Boston has awarded the contract for the construction of 3 lime kilns, stone crushing plant, saw sheds, 60 x 400 ft. crane and runway and various other frame buildings, etc. at its plant, here. Estimated cost, $100,000.

N. H., Seabrook—Seabrook associates has awarded the contract for the construction of a 1 story, 45 x 250 ft. factory, for the manufacture of shoes. Estimated cost, $20,000.

MIDDLE ATLANTIC STATES

N. J., Asbury Park—The New Jersey Cleaning & Dyeing Co., 505 Main St., plans to build a 2 story, 50 x 92 ft. dyeing plant Estimated cost, $30,000.

N. J., New Brunswick—The State Building Comn., Trenton, is having plans prepared for the construction of a 2 story, 50 x 80 ft. ceramic building. Estimated cost, $100,000. F. H. Bent, 142 West State St., Trenton, Archt

Pa., Philadelphia—Kolbs Bakery, 10th and Reed Sts., has awarded the contract for altering and constructing an addition to its bakery on Broad and Butler Sts. Estimated cost, $100,000.

Pa., Williamsport—The Vallamont Building & Planing Mill Co. plans to construct a 6 story, 100 x 200 ft. planing mill and warehouse, on Pine and Court Sts. The first floor will be used as mill and the upper floors as warehouse and supply house. Estimated cost, $100,000.

SOUTHERN STATES

Fla., Palatka—Stringfellow, Padgett & Co. has had plans prepared for the construction of a cold storage plant. A. Haile, Mgr. Private plans.

La., Kaplan—The town will issue $40,000 bonds to construct an ice plant. E. Miers, Genl. Mgr.

La., New Orleans—The Apex Paper Co., Paris Ave. and the New Orleans Terminal R.R., manufacturers of toilet paper, will build a 1 story, 40 x 90 ft. warehouse and factory Estimated cost, $50,000. H. W. Schlosser, Secy.

La., New Orleans—The International Harvester Co., 606 South Michigan Ave., Chicago, has had preliminary plans prepared for the construction of a twine manufacturing plant, and a storage warehouse for farm implements manufactured in the Central Mississippi Valley. The industry will occupy a front of 700 ft. on the river on the Jefferson side, between Napoleon Ave. and Louisiana Ave. ferries, here. Estimated cost, $6,000,000. Private plans.

N. C., Gastonia—Arkray Mills has awarded the contract for the construction of a 20,000 spindle cotton mill. Estimated cost, $750,000.

N. C., Greensboro—The Allright Mfg. Co. plans to construct a 2 story, 110 x 130 ft. building to cover 46,000, sq.ft. of floor space, also a dry kiln, shed, etc., for the manufacture of toilet seats. T. W. Alderman, Secy.

S. C., Dillon—The McLellan Cotton Gin Co. plans to rebuild its ginery which was recently destroyed by fire. Estimated loss, $65,000.

Tenn., Chattanooga — The Chattanooga Stamping and Enameling Co. has awarded the contract for the construction of an addition to its plant. Estimated cost, including equipment, $20,000.

Va., Norfolk — The Cementile Roofing Corp., 19th St. and Monticello Ave., has awarded the contract for the construction of a mill building for the manufacture of roofing tile. A. LeB. Ribble, Mgr.

W. Va., Huntington—The Wilson Creamery Co. is having plans prepared for the construction of a 2½ story, 75 x 140 ft. ice cream plant. Estimated cost, $125,000. McCormick Co., Century Bldg., Pittsburgh, Pa., Archts. and Engrs.

MIDDLE WEST

Ill., Centralia—The Amer Rubber Co., 1526 Wabash St., Chicago, will soon award the contract for the construction of a 2 story, 60 x 400 ft. rubber factory. Estimated cost, $100,000. The Consulting Co., 2801 Union Central Bldg., Cincinnati, O., Archts.

Ill., Elgin—The Sweet Spot Confectionery Co. has awarded the contract for the construction of a 2 story, 70 x 80 ft. ice cream manufacturing plant. Estimated cost, $40,000.

Ind., Kendallville—The Noble Tire & Rubber Co. will receive bids after Jan. 1, for the construction of a 2 story, 50 x 200 ft. rubber factory. Estimated cost, $75,000. A. M. Strauss, 207 Bank Bldg., Ft. Wayne, Archt.

Mich., Flint—The Perkins Structural Steel Co., 1603 Garland St., is building a 60 x 200 ft. steel fabricating plant. Estimated cost, $40,000. W. L. Perkins, Treas. and Mgr.

Mich., Port Huron—C. Kern & Co. plans to build a 2 story ice plant on River St. Estimated cost, $100,000. Private plans.

O., Cleveland—The Cleveland Refrigerator Co., 2996 East 72nd St., will soon award the contract for the construction of a 1 story, 70 x 240 ft. factory on Sideway Ave. and East 65th St. Estimated cost, $50,000. P. Matzinger, Caxton Bldg., Archt.

O., Cleveland—The Premier Refining Co., 1187 West 11th St., plans to alter its 2 story factory on Harvard Ave. Estimated cost, $35,000. Service Constr. Co., 6110 Euclid Ave., Archt.

O., Painesville—The Middle States Rubber Co., c/o E. Ewing, 708 Williamson Bldg. Cleveland, is having plans prepared for the construction of a 2 story, 60 x 200 ft. factory and warehouse. Estimated cost, $200,000. Osborn Eng. Co., 2848 Prospect Ave., Cleveland, Archt. and Engr.

Wis., Delavan—The State Bd. of control, Madison, will receive bids until Dec. 28, for the construction of a 1 story, 32 x 65 ft. laundry, at the State School for the Blind, here. Estimated cost, $20,000. A. Peabody, Madison, State Archt.

Wis., Manitowoc—The Manitowoc Products Co., 10th and Washington Sts., is having preliminary plans prepared for the construction of a 2 story, 55 x 142 ft. bottle factory on Washington St. W. J. Raeuber, 826 South 8th St., Archt.

Wis., Milwaukee—The Atlas Bread Co., 927 Central Ave., is having plans prepared for the construction of a 2 story, 60 x 160 ft. addition to its wholesale bakery. Estimated cost, $75,000. A. Koch, Wells Bldg., Archt.

Wis., Plymouth—The Plymouth Phonograph Co., c/o W. A. Thomas, Pres., plans to build a 2 or 3 story, 60 x 185 ft. addition to its phonograph factory on Main St. Estimated cost, $75,000. Probably private plans.

Wis., Watertown—The Badger Concrete Mixer Co., 221 Grand Ave., Milwaukee, plans to build a 1 story, 80 x 300 ft. factory, here.

WEST OF THE MISSISSIPPI

Col., Lafayette—The Great Valley Sugar Co., 800 Central Savings Bank Bldg., Denver, has awarded the contract for the construction of a sugar factory. Estimated cost, $1,000,000.

Col., Pleasant Valley—(Noel P. O.) The Great Valley Sugar Co., Central Savings Bank Bldg., Denver, has awarded the contract for the construction of a sugar factory, here.

Minn., Minneapolis—The State Bd. of Control, Capitol, St. Paul, plans to build a 2 or 3 story, mines experiment station, at the State University, here. Estimated cost, $250,000. D. F. Mullen, Secy. C. H. Johnston, 715 Capitol Bank Bldg., St. Paul, Archt.

Tex., Corsicana—The Frick Ice Cream Co. will receive bids until Jan. 1, for the construction of a 1 story, 35 x 40 ft. ice cream plant. Estimated cost, $20,000. B. H. Frick, Secy.-Treas.

Tex., Dallas—The Bd. Educ., Municipal Bldg., has awarded the contract for the construction of a 3 story high school, to include a manual training department, on Haskell and McKinny Sts. Estimated cost, $765,000.

WESTERN STATES

Cal., Los Angeles—The Coast Envelope Co., Higgins Bldg., plans to build a [illegible] story factory on a 140 x 160 ft. site on Santa Fe Ave. and Jesse St., to replace the one which was recently destroyed by fire.

CANADA

Ont., Kingsville—The Conklin Planing Mills plans to rebuild its plant which was destroyed by fire. Loss, $50,000.

Ont., Pembroke—McGuire, Patterson & Palmer, Ltd., 343 Dorchester St., Montreal, have awarded the contract for the construction of a match factory, here. Estimated cost, $5,000,000.

Ont., St. Catherines—The Kenleth Paper Co., Welland Canal, has awarded the contract for the construction of a 2 story addition to its paper factory. Estimated cost, $25,000.

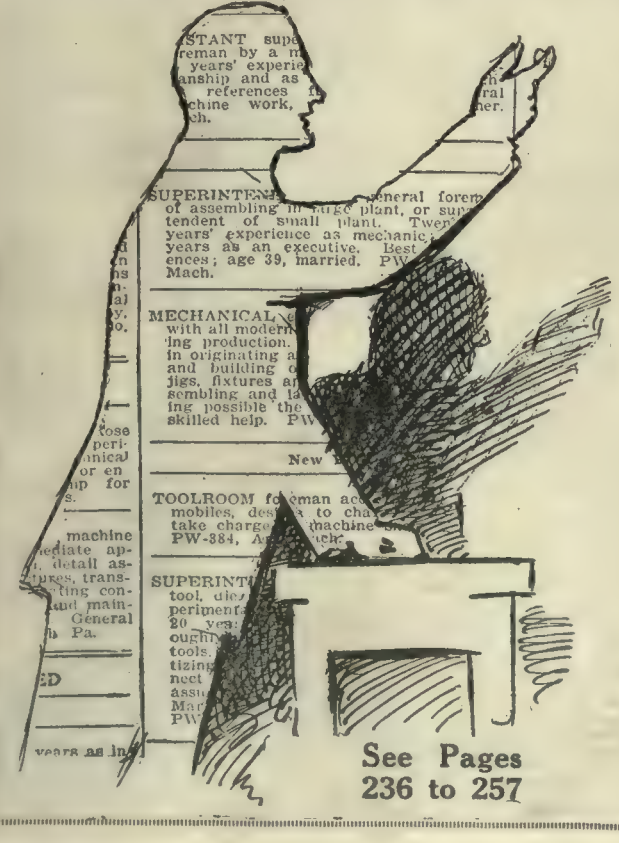
Ont., Wallaceburg — The Wallaceburg Glass Co., Ltd. plans to expend $50,000 on plant.

Ont., Welland—The Cross Fertilizer Co. Ltd., plans to build a 2 story fertilizer factory. Estimated cost, $250,000.

Que., Montreal East—The Dominion Carriage Co., Marien Ave., plans to build a 4 story addition to its plant. Estimated cost, $50,000. F. Arthur, Mgr.

Que., Montreal—I. Malo, 167 Dufresne St., will soon award the contract for the construction of a refrigeration plant. Estimated cost, $25,000.

Que., Three Rivers—The Three Rivers Pulp & Paper Co. has awarded the contract for the construction of a pulp and paper plant. Estimated cost, $500,000.



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Sheet Metal Work for Automobiles

By Fred H. Colvin
EDITOR AMERICAN MACHINIST



OF THE many developments which can be traced to the growth of the automobile industry, none is more striking than the stamping and forming of sheet metal work for frames, fenders, bodies and other parts of the modern motor car. The illustrations herewith show the way in which such work is handled in a thoroughly modern shop, the various examples being taken from the regular product for a number of well known builders.

The sheet-metal work which goes to make up the bodies and fenders of automobiles offers many problems. Some of them are recounted and their solutions explained.

The rapidity with which sheet-metal stampings are turned out in the modern shop makes the tonnage handled run up into large figures and necessitates enormous supplies of raw material being constantly on hand in order to keep the different machines in operation. The headpiece shows the receiving bay of the Michigan Stamping Co., which, as can be seen, is piled high with sheet metal in various forms and sizes. This material is handled by a travelling crane which happens to be at the other end of the runway, and it will also be noted that a runway for handling material in the other direction is to be seen at the left of the headpiece. This allows the crane from the other bay, at right angles to the storage bay, to run over into the storage section and carry material to the large machines shown in Fig. 1. This view shows the crane in the center and the stock which has been delivered. It also gives a general idea of the heavy machinery used in this work.

The machines shown in the headpiece are for cutting up the material into strips of various lengths and also preparing material for the presses, which are located in the bay, shown in Fig. 1. In the same way the shears shown in the lower left-hand corner of Fig. 1 prepare material for the presses in that line,



FIG. 1. ONE BAY OF THE SHOP

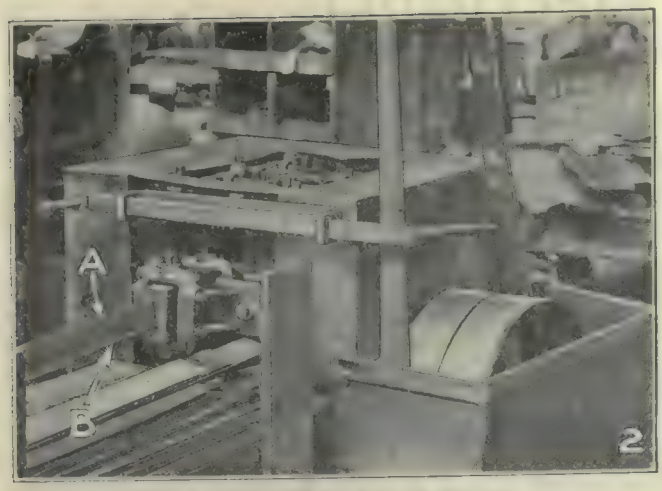


FIG. 2. WIRING THE SIDE STRIPS

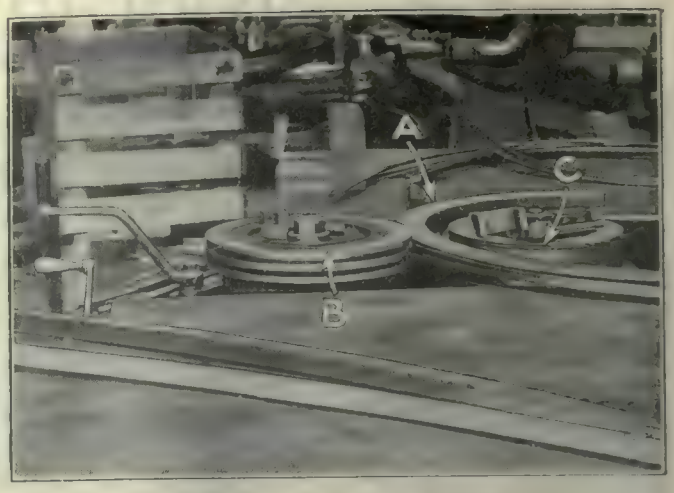


FIG. 3. BENDING TO FORM

so as to keep the stock moving progressively down the line. Some of the work done is shown in the following illustrations.

There are a number of distinctly different designs for automobile fenders, most of them being built up of two parts, as shown in the assembling and fitting operation in Fig. 13. This is quite different from the older type of fender in which the projecting edge was a narrow strip or ribbon of metal, fastened on in different ways. These ribbons were made up separately, as shown in Figs. 2 and 3, Fig. 2 showing the way in which they are wired for stiffening the edges and Fig. 3 the device used for curving to suit different conditions. In Fig. 2 the flat strip of metal *A* and the wire *B* are fed together into the curling rolls which are driven by the pulleys shown. A guide insures their entering the rolls in the correct position and as those who are at all familiar with this work know, such a machine as this will turn out wired ribbons very rapidly.



FIG. 4. A FENDER DIE

Fig. 3 shows some double wired ribbons or those wired on each edge. The ribbons are curved edgewise by running between the form *A* and the grooved roller *B*. The form is backed up by the roller *C* which allows it to move at the same peripheral speed as the roller *B*. Different forms can be substituted for *A* so as to give a machine of this kind a rather wide application. The fenders built up in this way are going out of fashion and those in which the crown is drawn down on the edge, as shown in Fig. 13, are becoming more popular, both on account of ease of manufacture and of keeping them in presentable shape.

Dies for fenders of the latter kind are shown in Fig. 4, the central portion being independent of the sides so as to allow the metal to be drawn down over its edges and down into the die. This punch is shown

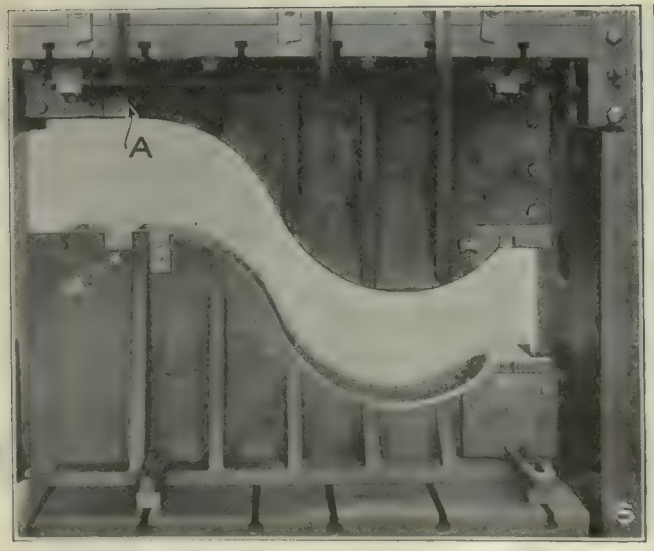


FIG. 5. DIE OPEN SHOWING DRAW PLATES

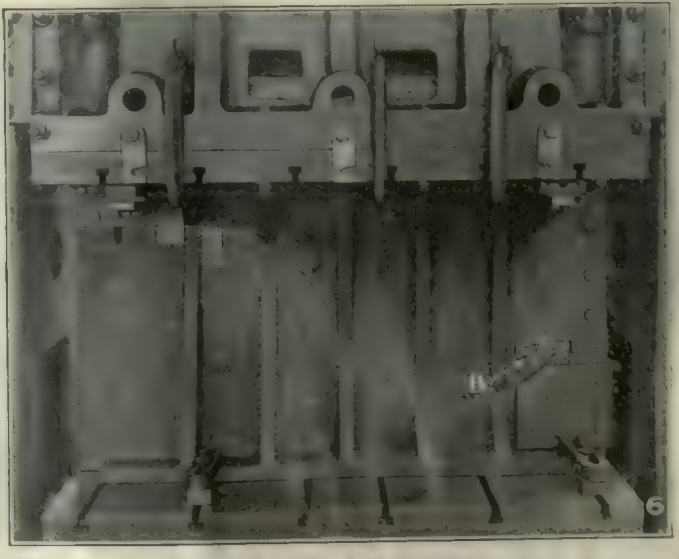


FIG. 6. THE DIE CLOSED



FIG. 7. BLANK FOR QUARTER PANEL

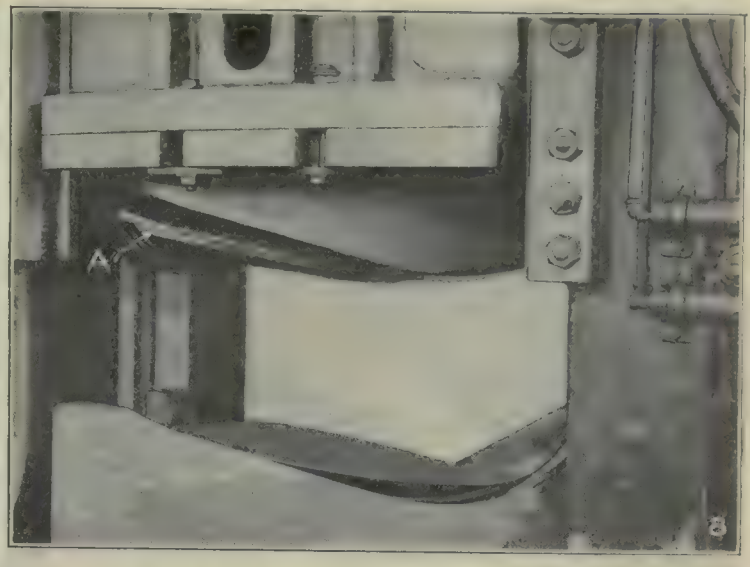


FIG. 8. PRESS FOR QUARTER PANEL

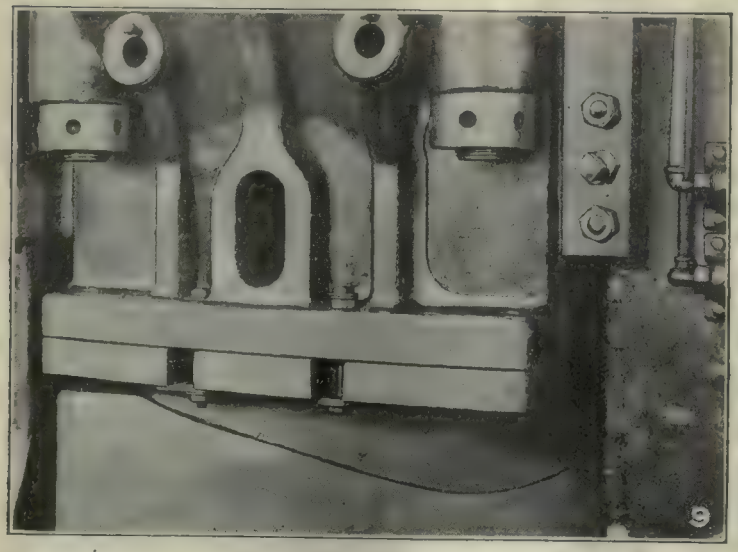


FIG. 9. THE DIES CLOSED

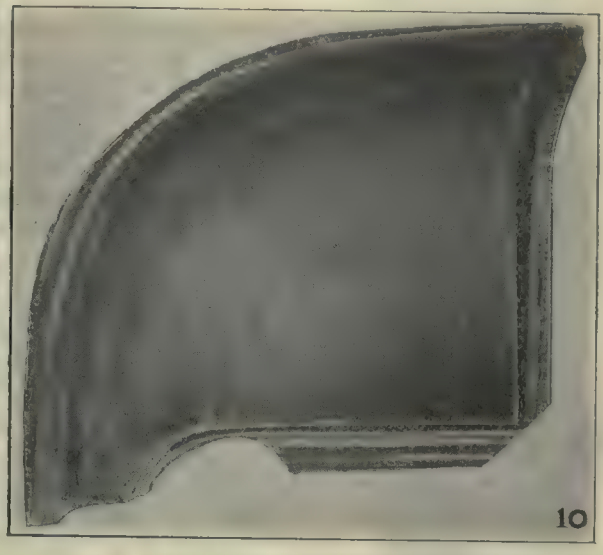


FIG. 10. THE PANEL BEFORE TRIMMING

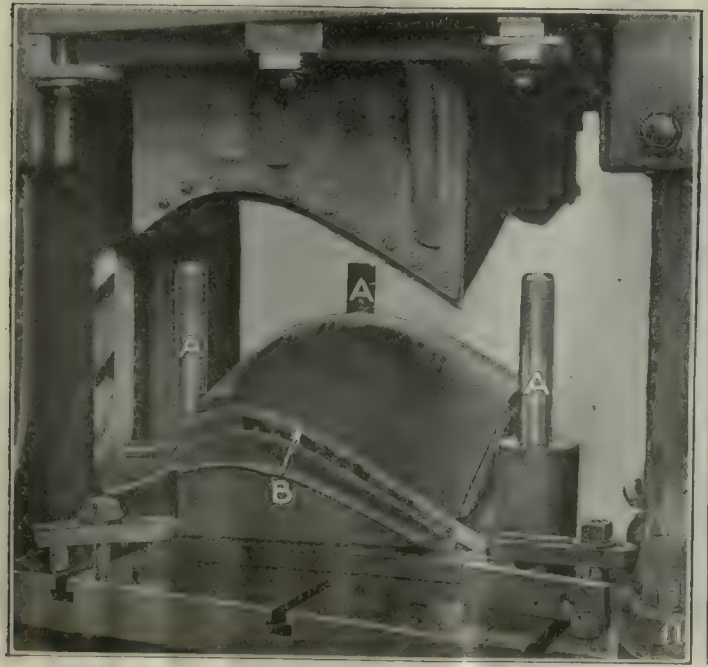


FIG. 11. THE FORMING AND TRIMMING DIE



FIG. 12. THE TRIMMED PANEL



FIG. 13. INSPECTING AND STRAIGHTENING



FIG. 14. THE BUMPING HAMMER

in position in Fig. 5 together with the die into which it mates. This view also shows the inserted plates at *A*, these taking the friction of the metal as it draws down into the die.

Fig. 6 shows the die closed and the meeting of the friction pieces at the end. It also shows the use of *C*-clamps in place of the hooks for holding the die up against the ram. The end piece at *A* is fastened by the dovetail block *B*. The blank is shown in Fig. 7.

Figs. 8 and 9 show the die for a curved wing of a fender in both the open and closed positions. The position of the sheet and the drawing ribs shown on the punch at *A*, Fig. 8, gives a good idea of the way in which these dies are made and shows the punch with the ribs which help to keep the wrinkles out of the flat portions.

Figs. 10 and 11 show a quarter panel trimming die and the piece itself before trimming. Three guides are used, as at *A*, this operation doing the final forming and also trimming the edge as shown at *B*. By allowing extra metal, a clean edge is secured, as all tendency to wrinkle can be confined to the portion which is trimmed off, as can be seen. The trimmed panel is shown in Fig. 12.

The shaping of the fenders is shown in Fig. 14, this being a hand operation and requiring considerable skill. The machine used is called a bumping hammer. It gives an elastic or cushioned blow owing to the suspension of the head by a leaf spring and leather straps. As in the working of all sheet metal, much depends upon knowing exactly where to strike a blow in order to take out wrinkles and bulges. The form shown chalked on the bench in Fig. 14 is the side line of the fender. This is for inspecting and re-shaping a trifle should it prove necessary.

The joining of the upper or crown part of the fender to the apron or quarter panel is an oxy-acetylene welding job as shown in Fig. 15. The panels are first tacked in position with the use of a form and then welded on the simple welding bench shown, the main object being to have it at a convenient height for the operator.

Fig. 16 shows how the fenders are fitted to a sample frame and incidentally shows the type of fender brace used by some makers.



FIG. 15. WELDING THE SEAMS



FIG. 16. TESTING FENDERS ON A FRAME

A New Method of Case-Hardening Steel*

By WM. J. MERTEN
Metallurgical Engineer, Westinghouse Electric and Manufacturing Co.

Here is a recent development in the carburizing of steel, in the form of a method that promises much for the future. Greater speed, uniformity and depth than now obtainable are claimed for the process described. The factors governing case-hardening and the methods in use at present for performing it are reviewed in the first part of the article.

IRON and low carbon steels absorb carbon from so-called carburizers very readily when in contact with these carbonaceous materials at temperatures above the upper critical point (Ac_2). The quantity of carbon absorbed depends upon:

1. The temperature or degree of heat above the Ac_2 point of the steel; or, in other words, the higher the temperature the faster and deeper the penetration of the carbon. This temperature is high enough to change the iron to gamma iron, which is capable of forming a solid solution with carbon or cementite. Beta and alpha iron do not absorb carbon to an appreciable extent.

2. The character of the carburizer is a very important factor in the successful conductance of case-hardening. Elementary carbon as such is only of secondary importance. Oxygen and nitrogen compounds, which are added or are naturally present in the so-called energizers that form carbonaceous compounds with solid carbon, are necessary to generate nascent gaseous carburizing mixtures of carbon monoxide and cyanogen gas (CO and CN). Flourishing industries are built up on the production of these carburizing materials and energizers.

3. The percentage of carbon present in the steel to be case-hardened has also a marked influence upon the affinity of the material for more carbon up to saturation. More specificially, a low carbon steel absorbs faster than high carbon steel.

4. The presence of chromium, tungsten, or manganese accelerates the absorption of carbon, since these elements form double carbides with iron. Nickel and silicon, however, retard the absorption. The fact that they form solid solutions with iron may be the cause for this retardation.

From the statement under paragraph (2), which states the necessity of nascent carbonaceous gas formation for penetration and absorption of carbon, it is readily conceivable that, if a properly heated piece of steel be brought into contact with pure nascent gas continuously generated in a separate unit or chamber and preferably under pressure, the conditions for case penetration would approach the ideal. A process of this type is the one presented in this paper; but before giving the description a survey of the processes now in vogue with their disadvantages and deficiencies seems to be appropriate.

Present-Day Methods of Case-Hardening

First Method. The most general and commonly used method of case-hardening is conducted by packing steel parts in a metal box filled with carburizing materials, and then firing the tightly closed box and contents at a sufficiently high temperature for a length of time adequate to give the desired depth of case. This process is quite simple and assures fair success if properly conducted in accordance with a prescribed procedure, experimentally determined to give certain definite results under definite and specific conditions. The disadvantages of the process are:

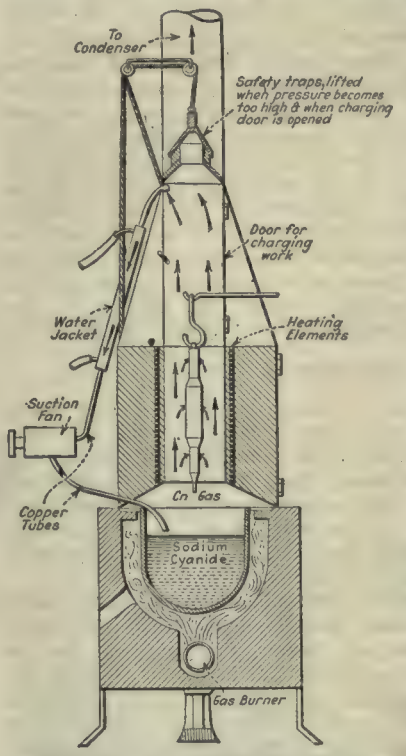
1. Uncertainty of obtaining the proper reaction within the closed box.

2. Difficulty in duplication of results as pre-determined, because of non-uniformity of carburizers.

3. Long time exposure of the steel to a heat not well controllable produces a questionable structural condition.

4. High cost of operation because of the inefficiency of the heating method, the cost of the boxes and the rapid deterioration of them by oxidation or scaling.

Second Method. Another method of case-hardening is performed by immersing the steel article in a cyanide bath heated to about 860 deg. C. (1,580 deg. F.). This process is convenient and effective on small articles only and where the depth of the case required is not more than 0.005 in. to 0.015 in., or where mere surface hardening is wanted. This is a fast case-forming method, and from 10 to 15 minutes gives the desired depth. The outstanding disadvantage of this process is that no uniform case can be produced. The parts deep in the melted bath do not get the same depth of penetration as the parts near the surface. The evolution of the cyanide gases at or near the surface favors the penetration, and it is hardly feasible to have pots with a large enough surface area to take care of the case-hardening work of an entire plant.



SKETCH OF REGENERATIVE CYANOGEN-GAS CARBURIZING FURNACE

Third Method. The third method consists of dipping of a cherry red piece of steel or tool into a container of a powdered cyanide salt, such as potassium cyanide, sodium cyanide or ferro- and ferri-cyanides; or sprinkling the powdered salt of these cyanides on the red hot steel surface and putting the steel back into the fire again. The case-hardening produced in this way is but a very superficial one, and resistance to excessive wear cannot be expected.

Fourth Method. In the fourth method the carburizing gases are passed over a piece of steel heated in a retort. This process is applicable to parts that are intricate in design.

All these processes serve the needs of the different industries more or less satisfactorily. Box case-hardening is at best dirty, wasteful and unsatisfactory in a number of instances. Case cyaniding by firing in fused cyanide salt is inefficient, unreliable, dangerous and costly. Retort case-hardening with carbonaceous gases is a step in the right direction, but it leaves something to be desired on account of the selection of the carbonaceous gases and the method of application.

Cyanogen Gas as a Carburizer

The process to be discussed next, although still in the experimental stage, owing to radical changes in the principle employed, appears to present opportunities for efficiency, preservation of the product, simplicity of operation, assurance of uniformity and duplication of results,

*Presented before the Pittsburgh Chapter, Heat-Treaters Research Society, Sept. 9, 1920.

speed of operation, reasonable cost, and wide range of utility. We may call this process a regenerated cyanogen gas case-hardening.

It has long been recognized that the most effective carburizing gas is cyanogen (CN), that by it a case can be produced more rapidly, with greater uniformity, and with deeper penetration than one produced by carbon monoxide (CO); but the highly poisonous character of the substance has been a serious objection to its use, and the tendency is to wastefully lead the gas to the stack and out of harm's way, instead of controlling it to get maximum efficiency.

To case-harden steel and iron alloy articles in a stream of cyanogen gas evolved from a container filled with an alkali cyanide salt, heated by electrical energy or other means to accomplish vaporization or boiling of the salt, is the principle upon which the new process is based. The articles or materials to be processed are independently heated out of contact with the fused cyanide salt. The advantage of this will readily be appreciated on recalling the statements made regarding the fact that case-hardening is produced by contact with gaseous and not with solid carbon, and more especially with cyanogen gas. The depth of penetration is then only a function of the uniformity of the temperature of the article treated and the duration of treatment. Nascent cyanogen gas has a speed of penetration of four or five times that of carbon monoxide.

The furnace shown in the sketch embodies the regenerative principle, since the excess gases not absorbed by the steel are forced under pressure into the fused cyanide bath, are reheated, causing a vigorous stirring of the bath and a lively evolution of cyanogen gas. The gas is thus produced with more energy and in larger quantities, and it more vigorously attacks the surface of the steel, thus causing an accelerated and deeper penetration.

Regenerative Type of Furnace

This regenerative type of furnace is a means of using the rather expensive salt economically, as the nitrogen gas on returning to the bath will combine with the sodium, and a carbon supply in some cheap form such as charcoal can be added to the liquid as required, thereby retaining the original amount of cyanide salt intact. It is, therefore, obvious that this process may compete with the present box or packing carburizing processes.

To prevent the poisonous gases, which are under pressure, it should be recalled, from escaping into the room, the suction fan is shut down before the charging door is opened, a bell ventilating device for inducing draft is arranged so as to open the bell when the fan stops and prior to opening the door. The speed of the pump or blower is to be regulated so as to cause the desired degree of circulation. Parts of the pump or suction fan wherever possible should be of non-ferrous metals, such as copper basic alloys or hard copper. Water cooling jackets or other protective methods are to be employed for the return flues containing hot gases, and the nozzle end of the flue must be of hard copper, monel metal or other non-ferrous alloy with a high melting point.

Sodium cyanide melts at 600 deg. C. (1,112 deg. F.) and boils at 800 deg. C. (1,472 deg. F.). The temperature of the pot must therefore be not less than 800 deg. C., and to effectively absorb the gas the steel is at a temperature above AC_3, or about 900 deg. C. (1,650 deg. F.).

The furnace illustrated in the sketch is designed especially for the processing of shafts, but a slight modification of the upper or steel heating chamber will adapt it to a variety of work. Grates of nichrome metal with knife-edge grate bars for supporting the work can be employed.

The advantages of this process are the following:

1. Temperature control is more perfect, since a pyrometer is inserted directly in the heating chamber;

2. It gives a finer, more uniform, and deeper case than any other process and requires less time, and is therefore cheaper;

3. It eliminates the use and storage of carburizers and carburizing boxes.

The efficiency of cyanogen gas for case hardening has never been fully appreciated, nor has it been fully obtained, since during previous tests the temperature was at or below the boiling point of sodium cyanogen (1,465 deg. F.), which is considerably below the AC_3 point of the steel. But, even in this unfavorable condition an exceptionally high speed of penetration has been noted by different writers on the subject.

It should be noted that, while some of the less important features of this process are still speculative in character because of the experimental stage of the development, the method is based upon well known principles and the conclusions have been drawn from a careful study of general case-hardening practice.

The Turn of the Tide

By Entropy

For fifty years preceding 1914 the man who wanted a job met competition while the employer could pick, choose and bargain. There were always men whose necessities caused them to accept less than the going wage. For the five years succeeding 1914 the reverse was true. Employers competed with each other and workmen received more in dollars and cents. This apparent reversal of position was not altogether a profit for employees, for the very fact that they had the upper hand compelled their employers to pass along the burden to the general public, or as it has been so well put, "the ultimate consumer." Inasmuch as the ultimate consumer is made up very largely of wage earners, to that extent they paid their own increases in income. The only people badly hit were salaried men and those few who were unable to shift quickly into lines of business in which there was a war profit.

During the fifty years referred to there was a great deal of complaint from employees that advantage of them was being taken, and that their necessities made them victims to their employers. During the five years there has been at least as much wailing and gnashing of teeth as through the whole fifty years, and yet it is not likely that there has been as much monetary loss to employers as there was previously to employees. The trouble seems to be complicated with non-financial features; that is, in addition to the problem of the proper distribution of the earnings of industry between labor and the directors of capital, there is the problem of control.

Out of any body of men there will always be a few who want to "run things." They are not necessarily born executives, but they think they are. If they are not, and yet get in control, they are a serious drawback in any business no matter whether they are in the ranks of wage earners or in the office of the company. Not very many years ago the larger part of the business houses had single names at their heads. Then there were partnerships of two people only. In the directory of my home town for the year 1842 I find that there were 139 people doing business under single names, 38 partnerships of two people, almost always brothers, and only two partnerships of three people. The only corporations at that time were railroads, banks and fire insurance companies. These were all in businesses which are today more often incorporated than not. Since that time there has been a growing tendency for men to operate businesses who do not own the money which they manage. At that time if a man needed more money in his business than he himself possessed he went out and borrowed it, of a bank if he could not get it from his friends, but he was very shy about letting anyone know the secrets of his business, either financial or relating to his designs or

methods of manufacture. Today men are just as shy about putting all their money into one business. The far-famed advice of David Harum, if it was his, to put all your eggs in one basket and then watch that basket, is not so often followed as quoted. Men invest in other than the business they are in and trust their money to the management of a hired man exactly as they trust the running of a lathe to a hired man. He sometimes is on a piecework basis, sometimes on a bonus plan and sometimes on a straight salary, but as a usual thing he sits with the board of directors, is one of them in fact, and oftentime is thought by the public to *be* the company. He is really a hired man who has gone a step further than the men whom he in turn hires.

By this process of evolution the old problem of labor and capital has become a problem of the work of management versus the labor of production and the question of proper division of the product of both is not altogether impossible of solution. There still remains the problem as to whether these two kinds of labor shall co-operate or antagonize. There is an old saying that it takes two to make a fight, which is true enough, but it takes only one to start a massacre. If the man into whose hands capital is entrusted wants to do so, he can at times take a very great advantage of all the people with whom he deals, but not all at the same time. He can use his capital to buy at bankrupt sales and he can use it to make such sales possible; he can use it to extort high prices from customers, but not usually at the same time that he is getting favorable purchases; he can, usually about the same time he is making advantageous purchases get his labor for less than the market rates if he is so disposed. He can do all these things at different times but he has to realize that the worm nearly always turns and he is realizing more and more that it is not only good ethics, but good business, to live and let live. He realizes that if he crowds the people from whom he purchases supplies too much, they may go to the wall and he may have to buy his goods in the open market after all. He realizes that if the people from whom he buys when they are in need survive, they will take reprisals when their turn to come on top occurs. He is beginning to realize that labor is likely to do the same thing, because that is what it has done in the last five years.

A Serious Difficulty

There is though, a serious difficulty about living and letting live as applied to employees, in that the average employee is not educated up to the standard that permits him to see this policy in its true light. The important thing to a laborer, or to a semi-skilled operative, is money in this week's pay envelope. He does not seem to think in terms of the next ten or twenty years. For that reason it is difficult to lay out long programs based on stabilized labor conditions. Education in the affairs of the world is necessary, and best of all, has begun. There is many times as great interest taken today by the plain people of the country in events outside their own sphere as there was before the war. Any street car is likely to be the scene of a sharp debate on National issues, where five years ago nothing outside the town except baseball scores was mentioned. This is a hopeful sign. When men begin to question whether their home hardware dealer is to blame for the scarcity of paint brushes, or whether it is due to business conditions in Russia, there is hope that they will take an equally intelligent interest in the ability of the shop in which they work to pay large wages, or work short hours or provide the comfortable working conditions which prevail in some other shop more favored by circumstances.

The great danger, just at this time when men are uneasy and are doubting their own as well as others' judgment, is that their employers may take advantage of the turn of the tide to wreak vengeance. Anyone who has that feeling might well stop to consider whether the workmen themselves had any part in the increases in their wages or whether they were simply carried along by conditions for which they can claim no credit, and for the results of which they were not to blame. The law of supply and demand has never been out of operation for very long at a time. When workers were scarce employers were bidding against each other. When the unions made demands for higher wages or shorter work day units they were rather extensively granted because the work which the men could do was so profitable to their employers that they could afford to put their pride in their pockets. In some instances they made bargains with their men which they wish they had not. Some of them even went so far as to make their shops closed shops for immediate profit. Now they feel that they threw away a part of their rightful management by so doing. It is especially easy for such managers to feel that their chance to rescind such agreements is soon coming. So long as these agreements are re-made in accordance with the terms of the original agreement, there can be no adverse criticism.

Tendency to Admit Employees to Councils

There will undoubtedly be an increased tendency to admit employees to the councils of the firm, and if it is done with the aid of simple, frank and complete information as to the business standing of the company there should be an increased stability of employment, which in itself may readily make a profit larger than the usual dividends. In the course of bringing such an arrangement into good running order there is great danger of misunderstanding. The formation of a shop committee in itself tends to make less important the work of the walking delegate who wants his job just as badly as anyone else. If he can make the employees suspicious that the statements concerning the firm's affairs are not correct he is likely to do so. The only answer is to make them so clear and so easily verified that he can be answered at once and convincingly. Fighting is going to do employers little good. Education of the employee can accomplish infinitely more. We should look on men who decline to take good jobs as men who are mistaken, just as we look on the firm that will not buy our product as someone to be sold and not antagonized. There is very little difference. The prospective customer is studied and we send one salesman after another to see him to discover his method of reasoning before we give him up.

If we have a superintendent or a foreman who cannot get along with the men, or if we have an employment manager who cannot get men who will stick to the job, or if the men all become antagonistic to the firm we should use the same sales methods and find out how we can get a suitable body of steady workers. It is possible that we do not understand them any better than they understand us.

Programs of Apprenticeship and Special Training In Representative Corporations

By J. V. L. Morris



THE Carnegie Steel Co. in its three principal plants and central office in Pittsburgh offers some interesting developments of the training idea in industry. An apprentice school has been in operation for seven years and a salesmen's school is also well established. Out of the technical training for the latter has grown the idea of the third and perhaps most interesting type—the works school.

VII. The Carnegie Steel Co., Pittsburgh, Pa.

This is the first article of the series that takes up the subject of employee training in the steel-production industry. The tendency in the plant under consideration seems to be to instruct in the problems peculiar to the industry all those who work with their brains, and others who seem capable of advancement.

(Part VI appeared in the Dec. 9 issue.)

SALESMEN'S SCHOOL.—As regards the salesmen's school, it should be remarked at the outset that it is not the policy of the company to take on inexperienced young men who think that they want to become salesmen, give them a course of training and send them into the field as their sales representatives. Those accepted for the training course are already successful salesmen. The plan of the course is to give two months to the concentrated study of the technical elements of steel, coupled with inspections and observations throughout the mills. It is thus expected that the salesman under training will arrive at a point where he knows steel sufficiently well to be of service to the company's customers and, through understanding their needs, to present the merits of his product.

For this purpose classes of approximately eight salesmen are formed four times a year, thus providing for training thirty to thirty-five men each year. Three men, the director of this work and two assistants, all first-class salesmen as well as technical experts in regard to the product sold, constitute the faculty, which by lectures and plant inspections provides the instruction.

WORKS SCHOOL.—The fact that the material developed for the lectures in the salesmen's school would be equally valuable for training all the personnel of the company whose intelligence is in any way enlisted in maintaining or improving the quality of the product, has gradually grown in the minds of the management. Consequently, this material has been compiled in a 600-page book written in layman's rather than in technical phras-



FIG. 35. DRAFTING CLASS IN APPRENTICE SCHOOL



FIG. 36. APPRENTICES IN SHOP-PROBLEMS CLASS

ing. It has been put into an attractive and durable format and is to be sold to all employees who desire it at a nominal sum—less than half that which the management finds it necessary to charge the general public.

An able educator has been engaged to open classes in each of the three major plants of the company, in which this book will be used as a text. Attendance at these classes will be voluntary, although they will be held on the company's time and composed usually of men selected by the foremen as of a superior sort in intelligence. It is possible that ultimately the classes will include all, from the superintendents down to the brighter apprentices, who are ambitious and capable of advancement.

To start the experiment, these classes will meet but one hour a week during a period of twenty-four months, which is expected to be the time required to cover the course as now projected. A considerable amount of outside reading will be expected, for which ample facilities are available—as might be expected in Carnegie plants—in the generously provisioned metallurgical libraries provided for each of the plants.

The course as projected follows:

CARNEGIE STEEL COMPANY
DUQUESNE WORKS APPRENTICE SCHOOL
SHOP PROBLEMS WORK RECORD

Term No. _____
Intelligence _____
Attitude _____
Workmanship _____
Speed _____
Total rating _____

NAME _____ START _____
FINISH _____
CHECK NO. _____ DEPT. _____ TOTAL ____ Mo. _____

JOB	PROBLEM NO. 1	2	3	4	5	6	7	8	9	10	TIME RECORD	Total hours	Workmanship	Attitude (Weekly)	REMARKS

FIG. 34

CARNEGIE STEEL COMPANY
DUQUESNE WORKS APPRENTICE SCHOOL
MECHANICAL DRAWING WORK RECORD

Term No. _____
Intelligence _____
Attitude _____
Workmanship _____
Speed _____
Total rating _____

NAME _____ INST. NO. _____ START _____
FINISH _____
CHECK NO. _____ DEPT. _____ BOARD NO. _____ TOTAL ____ Mo. _____

DRAWING JOB NO.	Time Record	Total hours	Workmanship	Attitude (Weekly)	Remarks
BLUEPRINT READING Drg. No.					

FIG. 37

FIG. 34. FORM FOR RECORDING SHOP WORK DONE BY APPRENTICE
FIG. 37. FORM FOR RECORDING WORK IN DRAWING

FIRST PERIOD—STUDY OF RAW MATERIALS—4 MONTHS

1. Preparatory study, physics and chemistry, 1 month.
2. Refractories, 1 week.
3. Ores of iron, 1 week.
4. Fuels and the manufacture of coke, 2 months.
5. Fluxes and slags, 2 weeks.

SECOND PERIOD—STUDY OF THE BLAST FURNACE—5 MONTHS

1. Composition and constitution of pig iron.
2. Principles of the process and equipment for the manufacture of pig iron.
3. Construction of the blast furnace.
4. Blast furnace accessories.
5. Equipment for handling raw materials.
6. Operating the furnace.
7. Chemical reactions.

THIRD PERIOD—THE MAKING OF STEEL—7 MONTHS

1. Consideration of the ferrous products.
2. The bessemer process, 6 weeks.
3. The basic open-hearth process, 3 months.
4. The electric process, 1 month.
5. The duplex and triplex processes, 1 week.
6. The chemical testing of steel, 3 weeks.
7. The physical testing of steel, 2 weeks.

FOURTH PERIOD—THE SHAPING OF STEEL—6 MONTHS

1. Methods of shaping steel.
2. Essentials of rolling mill construction and operation.
3. Ingots and their defects.
4. The soaking pit.
5. The rolling of blooms and slabs.
6. The rolling of billets.
7. Rolling sheet bars and skelp.
8. Defects in the semi-finished product.
9. Rolling of sheared plates.
10. Rolling of universal mill plates.
11. Rolling of large sections.
12. The hot rolling of strip.
13. Merchant mills.
14. The rolling of circular shapes.
15. Forging of circular shapes.
16. Forging of axles, shafts, and similar shapes.

FIFTH PERIOD—THE CONSTITUTION, HEAT-TREATMENT AND COMPOSITION OF STEEL—2 MONTHS

1. The structure of plain steel.
2. Thermal critical points for plain steel.
3. The crystalline structure of steel.
4. Heat treatment of plain steel.
5. The composition of steel.

TOTAL—24 MONTHS.

APPRENTICESHIP SCHOOL.—To study the apprenticeship provided by this company the Duquesne Works were visted. Here apprenticeship has been in operation since the establishment of the works, although supplementary instruction in a corporation school has only been provided during the past seven years. There are now seventy apprentices, to whose instruction a supervisor gives his whole attention with the aid of six part-time assistants from the technical staff.

A larger variety of trades are recruited in this plant by apprenticeship than is the custom in many plants, as will be seen by the following summary of enrollment:

Armature winders	4	Masons	12
Blacksmiths	1	Painters	1
Machinists	38	Patternmakers (at present)	0
Boilermakers	7	Pipefitters	5
Carpenters	1	Roll turners	1
		Total	70

Twenty-two have been graduated during the past three years, thus at an average of a little over seven per year, while fifty-one have resigned, a mortality which may be accounted for to a considerable degree by the unsettlement of employment conditions attendant upon the late war.

CARNEGIE STEEL COMPANY
DUQUESNE WORKS APPRENTICE SCHOOL

APPRENTICE RECORD

Name _____ Check No. _____ Dept. _____

Date of birth _____ Height ____ ft. ____ in. Wt. ____ lbs. Nationality _____

Date left Public School _____ Last grade passed _____ Rating _____

Date of enrollment in Apprentice Course _____ Date of finish of Apprentice Course _____

Previous Practical Experience

Kind of Work	With Whom	Where	How long

Father's name and address _____

Father's business _____

Term No. Rate	Class	CLASS RECORD: Late	Absent	Attendance %	Intelligence	Attitude	Workmanship	Speed	Total	Average	SHOP RECORD: Attendance %	Intelligence	Attitude	Workmanship	Speed	Gen. Value	Total	Combined Rating	Remarks
1	Drawing																		
	Shop Prob.																		
2	Drawing																		
	Shop Prob.																		
3	Drawing																		
	Shop Prob.																		
4	Drawing																		
	Shop Prob.																		
5	Drawing																		
	Shop Prob.																		
6	Drawing																		
	Shop Prob.																		
7	Physics																		
	Shop Prob.																		
8	Iron & Steel																		
	Shop Prob.																		
	Averages																		

FIG. 38. FORM FOR KEEPING RECORD OF WHOLE PERIOD OF APPRENTICESHIP

The work which provides the experience for the apprentices, particularly for the machinists, but in general for all trades except those in the nature of a specialty, is largely provided through the repair and maintenance jobs always to be found in a large plant, these being of a varied nature, but fruitful in providing a broad general experience. To insure that these jobs will embrace all the oeprations to be expected of a trained worker in the trade being pursued, and to rate the quality of workmanship, intelligence, and general attitude displayed in performance, the supervisor records and keeps on file the form Fig. 34 for each six months of each boy's apprenticeship. It will be seen that this provides for a job number for the jobs or operations which have been performed, with the problems which have been selected as suitable to accompany the same. This form is mimeographed on letter-size paper and provides for weekly entries.

The supplementary instruction is for four hours a week on the company's time and is divided into two-hour periods, seven to nine in the morning for those on day shifts and five-thirty to seven-thirty in the evening for those who are on night duty. The classes run through the usual school year of ten months and continue throughout the four years of apprenticeship. The instruction provided is in drawing, a class being shown in Fig. 35, mathematics, and the science related to the industry and trade concerned, in which subjects the excellent books now published are utilized as texts. In Fig. 36 is shown a class studying shop problems.

The accompanying record blank for drawing jobs and blueprint reading, Fig. 37, shows the method of rating the progress in drafting and blueprint reading. It should be noted that as far as possible classes are differentiated according to trades. This permits the assignment of problems and drafting of a kind which will have definite utility in the trade which the apprentice is pursuing. Naturally, where the number in a trade is too small to warrant forming a class, the individuals concerned are placed in the class where the instruction will be most closely allied to the work of their respective trades.

The complete record of the apprentice throughout the four years of service is entered on the blank shown in Fig. 5. It will be seen that both class and shop records call for exact reports of attendance and estimates of intelligence, attitude, workmanship and speed, while in the shop record an additional rating on general value is called for. All these ratings are then averaged and provide the combined rating for each term.

NIGHT SCHOOL.—During the past winter the company has for the first time maintained a night school, in which there was an enrollment of 150. The school finished with 45 per cent of the enrollment, which compares favorably with most evening trade extension schools. This represents a fourth type of educational endeavor existing in the corporation, the importance of which type may be expected to increase with the expanding of facilities for instruction.



Helix Angle of Twist Drills

By BRUCE W. BENEDICT
Manager of Shop Laboratories, University of Illinois

The author concludes from his experiments that, with the present design of flute, the most efficient high-speed milled twist drill has a helix angle of 35 deg. and that a drill with this helix angle consumes less power and generally has greater endurance than drills of other helix angles.

THE commercial twist drill is a metal working tool of great merit. It is accurately and ruggedly made; it is uniform in quality; it has great endurance; and it is cheap. Among the many high-grade standard tools there are none which outrank the twist drill in those qualities that make for service. Drill manufacturers follow common practices in methods of production, in design, and in use of special steels, which results in a remarkably uniform product. It would be difficult to identify the manufacturers of most drills if their names were removed, and production would not suffer if drills were purchased indiscriminately from leading manufacturers. There are few better examples of standardization in industry. Since 1862, when the Morse Twist Drill Co. commenced the manufacture of twist drills as a regular product, there have been no radical changes in twist drill design. Methods of production during this period have undergone great change, and the development of steel used in drills can be characterized quite properly by the term "revolutionary." The drill of today is vastly superior as a metal removing tool to the one of 50 years ago, largely on account of the methods of producing it and the character of the steel employed in its construction. Details of design have not undergone an equivalent transformation for the reason that original shapes proved to be structurally sound, and the manufacturer, confronted with the demand for greater endurance, naturally subordinated questions of design to those of technical production. Drill manufacturers and independent investigators have conducted large numbers of tests, most of which were concerned with point angles, clearance angles, or with power and endurance factors. The element of design has not been overlooked, but it is apparent from a study of published data that investigators have reported less about design (especially that relating to helix angle) than about the other factors mentioned above.

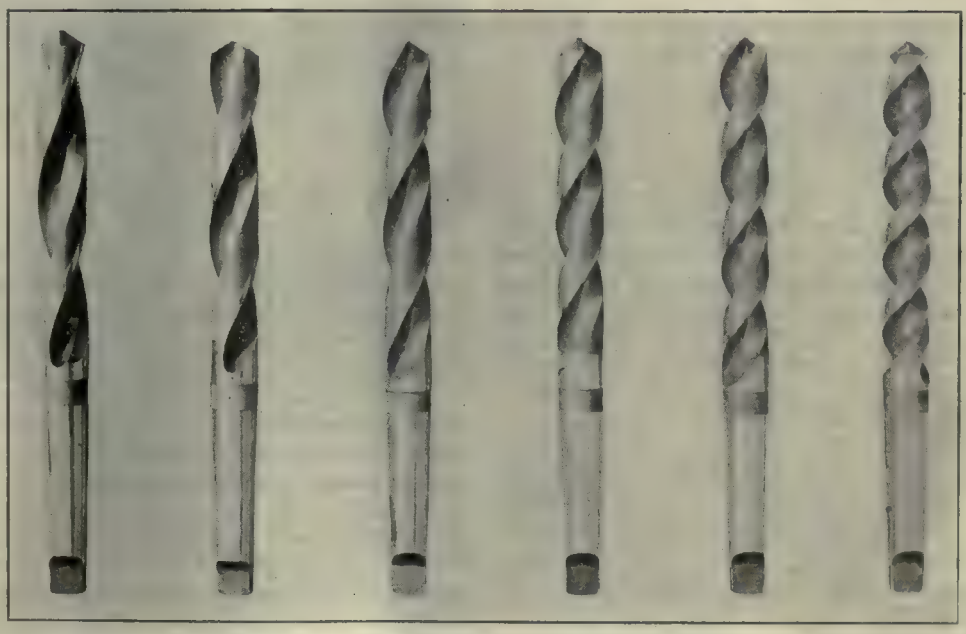


FIG. 1. GROUP OF TYPICAL TWIST DRILLS USED IN THE TEST

The twist drill is a cutting tool with the same function to perform as other metal-working tools, i.e., removing metal. In structure and method of application, it is unlike any other tool, and yet its action in the removal of metal is similar to that of other tools, notably lathe tools, which differ materially from twist drills in form and in methods of use. Although the mechanical processes of drilling and turning are quite dissimilar, the phenomenon involved in the actual separation of the chip from the metal undoubtedly is very much the same in both tools. If we keep this fact clearly before us, and at the same time make correct distinctions for various tool types, we have all the recorded experience with cutting tools to aid us in solving the problems surrounding the twist drill. In a machine tool, metal is removed by a combination of shearing, tension, and compressive stresses. The metal chip literally is torn from the main portion. This process comes within the broad meaning of the term "cutting," since a chip is severed from the original part. In reality it more nearly resembles the action of "tearing." If the tool was driven into the work as a wedge and a portion of the mass removed, the tool would perform an action in conformity with the true meaning of "cutting." While the cutting edge of the tool is wedge-shaped, one face of it only comes in contact with the metal, and the resulting action is not "cutting" in the strict meaning of the term. If metal could be severed with a sharp, thin tool in the same manner as cheese is cut, not only would we have a clear case of "cutting" but also the most economical method of performing this work. The blunt edged tool of 50 years ago, is almost the exact opposite of the tool just mentioned, both in shape and method of application. Its action in removing the chip is a violent tearing off of small particles, the

process resembling to some extent that of a long stroke punch press making half-holes in the edge of a very thick sheet. The efficiency of metal removal by this form of tool stands at the opposite extreme from that of the first mentioned tool. It is obvious that since a metal-working tool cannot be made like a cheese knife, and also that the ancient blunt form of cutting tool is hopelessly inefficient, there is some form of cutting tool between these extremes that will remove metal with the least power and at the least expense per unit of work done.

Unquestionably the most effective tool performs its work through an action resembling "cutting" more than "tearing," continuing the rather broad interpretation of these terms just employed. This condition is secured by increasing the keenness (acuteness) of the cutting edge to a degree that does not result in a sacrifice of endurance of the cutting edge. In general, all tool development is focussed on the cutting edge, the ultimate aim being to increase keenness without lowering durability. F. W. Taylor's classic experiments with lathe tools led to his adoption of standard shapes having "in each case the keenest cutting angle which is free from danger of spalling." He recommends the smallest degree of clearance in order to keep the top slope at a maximum, to mass the largest amount of steel near the point, for the transmission of heat. His findings, and the performance of the tools themselves are the most effective proof that keenness of cutting edge is an essential characteristic of the modern high-duty tool.

Use of Carbon and High-Speed Steel for Twist Drills

It is doubtful if twist drill manufacturers (as a whole) have attempted to utilize fully the principle of keenness in the cutting edge, to the extent permitted by the use of high-speed steel. With one exception known to the writer, manufacturers are producing high-speed twist drills of exactly, or of approximately, the same

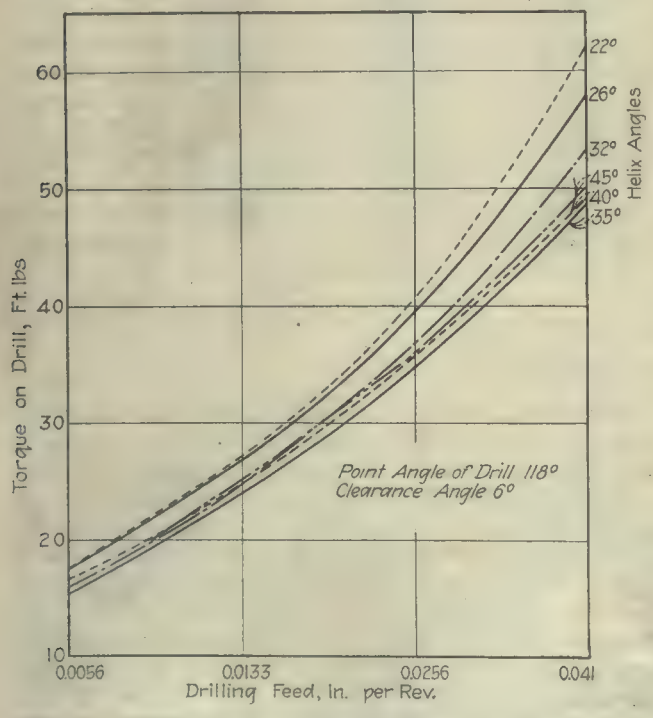


FIG. 2. POWER REQUIRED TO DRIVE 1-IN. DRILL OF VARIOUS HELIX ANGLES, AT VARIOUS FEEDS, IN CAST IRON

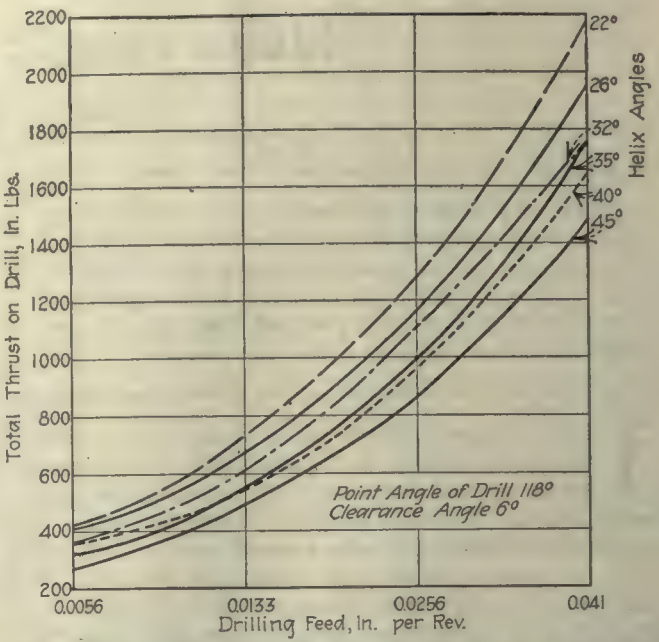


FIG. 3. TOTAL END THRUST ON 1-IN. DRILLS OF VARIOUS HELIX ANGLES, AT VARIOUS FEEDS, IN CAST IRON

cutting angle as established by them in the days of the carbon-steel drill. The superior hardness, strength, and edge retaining qualities of high-speed steel permit the use of a more acute cutting angle in drills than was possible with carbon steel. Taking full advantage of these factors the designer will produce a drill with maximum keenness and of great endurance. Such a drill will remove metal freely with a "cutting" rather than a "tearing" action and parallel the performance of other types of tools constructed on the same basic principles.

The basis for making the previous statement that manufacturers of twist drills generally have not utilized the possibilities offered by high-speed steel to increase the keenness of the drill cutting edge, is found in the fact that with the one exception noted by the writer, milled drills of both carbon and high-speed steel of prominent makers have identical helix angles. The helix angle as here used, is the angle between the cutting face at the periphery of the drill, and the axis of the drill. It is a measure by which keenness of cutting edge, or the degree of the cutting angle is determined. If twist drill development had followed that of lathe tools for instance, high-speed drills would have greater helix angles (and less cutting angles) than carbon-steel drills. Since this particular development in drill design is not necessarily a logical one for reasons that apply to lathe tools, it is obvious that this question can be determined only through special investigations. The subject has been investigated in some detail* at the University of Illinois, and the conclusion was definitely reached that milled high-speed steel drills with helix angles of 35 deg. remove a given amount of metal with less power and with less thrust on the points than drills of any other form. Equal or superior endurance also was shown by the drill named. Results of the investigations proved that a close agreement existed between theoretical considerations and shop performance.

Helix angles of milled drills made by the leading manufacturers vary between 20 and 26 deg. at the point, although one company markets a special drill having an angle of 32 deg. at the point. With the latter exception,

*Reported in Bulletin No. 103, Engineering Experiment Station.



FIG. 4. DRILL OF 35-DEG. HELIX ANGLE CUTTING SOFT CAST IRON

the majority of milled drills, of both high-speed and carbon steels, have helix angles of either 22 or 26 deg. In many of these, the helix angle is decreased gradually toward the shank a total of 2 or 3 deg., so that cutting angles become increasingly blunt as the drills wear. Comparing these drills with the ideal form developed by the test, we observe that the cutting angles of the drills having 22- and 26-deg. helix angles are in excess of the former by 13 deg. and 9 deg. respectively. The meaning of this in terms of performance is shown hereafter.

The investigation included tests with milled drills having the following helix angles (in degrees): 10, 15, 22, 26, 32, 33, 34, 35, 36, 37, 38, 40, and 45. The regular drills used were stock drills purchased in the open market. The special drills used were made by a prominent manufacturer according to usual specifications except design. One-inch drills were used throughout. A group of typical drills is shown in Fig. 1. Most of the tests were made in cast iron, and the data presented here is from these records, since they are more complete than the observations made in steel to check the companion observations in cast iron.

The effect of changes in the helix angle on the power required to rotate the drill against the work and remove the chip is shown in Fig. 2. Limits of this article prevent an extended analysis of the results recorded on this diagram, but it is sufficient to note that the power consumption (represented by torque on the chart) of the 35-deg. helix angle drill, is less than that of drills of other helix angles. Power saving is greatest at heavy drilling rates; at a feed of 0.041 in. per revolution the power consumed by the 35-deg. helix angle drill is over 20 per cent less than the power consumed by the 22-deg. angle drill. The results of this test confirm the findings of investigators seeking to establish the relationship of cutting angle to power consumption in other types of tools. The 35-deg. helix angle drill removes metal more economically than drills of lesser helix angles because it has a more acute cutting angle and a cutting edge of greater keenness.

End thrust on the point of the drill is equivalent to the resistance of the metal to penetration of the cutting edges of the drill. Thrust decreases progressively as the helix angle increases; the unit changes being most marked at high drilling rates. See the diagram, Fig. 3. While thrust is less in drills of 45-deg. helix angle than in all others, a number of mechanical factors make it inadvisable to consider the use of helix angles above 35 degrees. At a drilling rate of 0.041 in. per revolution, the end thrust on the 35-deg. helix angle drill is approximately 20 per cent less than that on the drill of 22-deg. helix angle. It is clear that increasing the helix angle reduces the pressure on the cutting edges per unit of feed, resulting in less friction and heat.

Tests for endurance demonstrated the fact that the drill with 35-deg. helix angle would retain its cutting edge equally well or better than drills with helix angles of 22 and 26 deg., under usual drilling conditions. In fact the endurance record of the 35-deg. angle drill was generally superior to that of drills with lesser helix angles.

In drilling deep holes the 35-deg. angle drill proved to be more efficient in ejecting chips than the 22- and 26-deg. angle drills. No drill will eject all chips from a vertical hole, but the one with the smallest helical pitch of the flutes acts as the best conveyor. The shape and condition of the chip as it is removed retards or assists the process of ejection, and it is here that the 35-deg. angle drill proves superior to drills of lesser helix angles. A free curling chip to a large extent ejects itself. It is possible to obtain these even in cast iron with a correctly designed and properly ground drill. Note the work of the 35-deg. angle drill in cast iron as shown in Fig. 4.

The Best Clearance Angle

A clearance angle of 12 deg. is generally recommended by manufacturers. This is more than is necessary from the standpoint of clearance in drilling. With machine grinding a clearance of 6 deg. is sufficient. The inaccuracy of hand grinding requires more clearance than this, but hand grinding is a drill atrocity that should not be permitted. Metal removed from the heel of the drill reduces the volume of it available for the transmission of heat. Taylor recommends, as previously mentioned, the smallest clearance in order to keep the top rake of the tool at a maximum. One or the other elements must be sacrificed if sufficient metal for conducting heat is retained in the tool. A drill with a helix angle of 35 deg. and a clearance angle of 6 deg. has approximately the same quantity of metal in the cutting end,

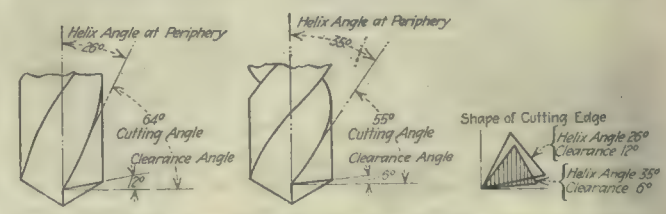


FIG. 5. COMPARISON OF CUTTING ANGLES OF USUAL AND PROPOSED DESIGNS OF DRILLS

as the 26-deg. angle drill with a clearance angle of 12 deg., as may be seen from the sketches in Fig. 5. Since less heat is produced by the 35-deg. angle drill in cutting, than by drills of the usual design, it is obvious that with virtually the same amount of metal at the point for the transmission of heat, this drill will possess superior qualities of endurance, depite its greater keenness of cutting edge.

Evidence produced by the investigation warrants the assumption that with present design of flute, the most efficient milled twist drill has a helix angle of 35 degrees. It is possible that development in the shape of the flute will lead to the employment of helix angles above 35 deg., and the attainment of still greater efficiencies. Such a development is logical, as high-speed steel presents great possibilities to the designer seeking to improve the cutting qualities of the twist drill.

Target Shooting as an Aid in Industry

By C. B. Lister

Promotion Section, E. I. Du Pont de Nemours & Co., Inc., Wilmington, Del.

It has come to be an accepted fact that the employer's interest in his employees does not end when the whistle blows, but extends on down the street into their homes or, more directly, into their community life. Contented employees with that "group spirit" which places "our company," "our department," or "our division" in a class above the ordinary factory where men toil only to earn their daily bread, is the best insurance against the "57" varieties of labor troubles that are rearing their heads here, there and everywhere. Athletics with their intense group appeal have assumed a prominent place in the work of manufacturers directed toward the fostering of community interest, and athletic fields are now a common sight near many plants, large and small. These fields, which need not be elaborate, and the equipment required for the various teams, are cheap at any price provided they accomplish the desired result of cultivating an efficiency-increasing, all-together spirit. It is true that in the very small plants the personality of the manager and the limited number of employees make it possible to develop a kind of family atmosphere that is wholesome to the final degree but even there some form of competition with neighboring plants would inject spice into the work that would relieve it of its monotony.

There is also a general desire for some form of sport which will be open to all employees. Baseball, football and similar games excite great enthusiasm but only the favored few, men in the prime of life and with particular ability or "beef," can actually participate and get the benefit of team training, and of the steadiness of hand, keenness of eye, and quickness of mind that come from taking part in the sport.

The Urbana Tool and Die Co., of Urbana, Ohio, and several plants in New England and the East have successfully adopted a sport which seems to fill all of the requirements. It can be enjoyed on as elaborate a scale as the size of the factory warrants; it promotes the keenest kind of team spirit; no matter how small the division or plant, it may boast of its prowess; women and girls quite frequently give the male members of the force a "run for their money," veterans of the shop, men too old to take part in baseball or football games, find a means for taking their part in upholding "our shop's" honor; while the young men, both those who usually occupy the bleachers and those who play on the field, find in it a sport calling for their utmost skill. The Urbana plant officials have this to say for the game:

> While the primary object is recreation, it has been pleasing to notice that steadiness of nerve, keenness of vision, fairness, honesty, confidence, good fellowship and pride in achievement are invariably the reward for consistent effort on the range. We have the highest appreciation of target practice as one of the manly sports.

Target shooting with the small bore, .22 calibre rifle, has assumed an important place in the list of American sports following the experience of our men in the war. Formerly considered as more or less a boy's weapon the .22 has been elevated to a position where the biggest figures in the rifle shooting game are boosting for it. At the Urbana Plant the employees have had a range for five years. A room in the plant is furnished the shooters free of charge and is lighted and heated at company expense. Expenses for targets, etc., are met by dues of 25 cents per month from each of the riflemen. Official shoots are held once a week and practice shoots on certain other evenings. Individual and team prizes are awarded for high scores, handicaps are given on a basis of the scores made in official shoots, and the men are divided into classes according to their ability, stress being laid on the development of new marksmen as well as on the reward of the veteran shots, the idea being to interest as many men as possible and so spread the team spirit throughout the plant. Matches are held from time to time with teams from other plants and from surrounding clubs. Luncheons following these matches are the means of forming "friendly relations of beneficial and lasting endurance," to quote R. C. McDonald of the Urbana Co.

Rifle shooting as a sport has the added advantage that it is nationally recognized. The plant baseball star may be well known in the home town but he has little chance of ever receiving notice outside of his immediate locality. The small bore rifle shooter, however, has the opportunity of securing national prominence without ever leaving his club range. The National Rifle Association which is, as its name implies, the national association of riflemen in this country, arranges matches for all its affiliated clubs and gives trophies and qualification medals for certain scores made in practice, publishes a bi-weekly magazine containing news of national interest to devotees of rifle shooting, and in other ways encourages the sport. Should ground be available for a military range, the N. R. A. will issue regular U. S. Army Springfield rifles and ammunition to clubs free of charge, or if there happens to be a Government range near the plant, the club members are privileged to use the range and will be furnished rifles and ammunition by the officer commanding. Small bore rifles may be purchased for a rifle team for less than the cost of a baseball outfit and they will not wear out after a season's use, nor after several seasons' use for that matter. The ammunition costs only a fraction of a cent a round and an evening of the keenest competition can be held for the price of a new baseball. The range can be installed at very little cost and is practically indestructible. The possibilities of this sport as a means of successfully promoting the much talked about and much sought after "community of interest" among employees and employers are unlimited, as it appeals to men in all grades and walks of life.

Shooting with the small bore rifle seems about to assume an important place in America's industrial life.

Early Traces of the Toothed Wheel—II

By H. H. MANCHESTER

This article takes up the development of gearing from the sixteenth century up to the time of Watt. Some of the illustrations shown seem to be more fanciful than real, but the simpler arrangements pictured were no doubt in practice.

(Part I was published last week.)

BEGINNING in the latter part of the sixteenth century, a number of books on machinery were produced which not only prove the growing importance of machines, but indicate the kinds of gearing in use at that time.

One of these books was by Jacques Besson, of Paris, the first edition of which was published in 1565. Among Besson's illustrations the most interesting cut, Fig. 6, shows two wheels in the same plane, the teeth of which are drawn to fit with fair exactness. This use of wheels in the same plane was very rare at the time, probably because it required too much pains to make the teeth fit. In this case the teeth and indentations are roughly semicircular, and the spurs on the wheels geared with the lantern are decidedly curved, an arrangement which seems to have been comparatively unusual.

From the viewpoint of gearing the most important engineering book of the sixteenth century was that by Ramelli, which was published in 1588. This book contains a number of engravings which show combinations of pinwheels and lanterns with worms, as well as a very few examples of fitted spur wheels.

In one case we see a combination of drum, rope drive, worm, pinwheel and lantern, employed to raise stone, Fig. 7. Here the teeth of the pinwheel are semicircular disks, while the screw of the worm is evidently formed by winding the thread around the shaft.

In another cut, Fig. 8, similar combinations of screws, spur wheels and lanterns are used to pump water, the power being furnished from a waterwheel.

Early Example of Gearing Set Obliquely

One of the earliest illustrations of gearing set obliquely, is in a design showing a waterwheel employed to raise water through the medium of three Archimedian screws, Fig. 9. The screws are necessarily inclined, and the lanterns at the tops meet obliquely the pinwheels which are on the same shaft as the waterwheel. In this case the rounds of the lanterns are very short, and

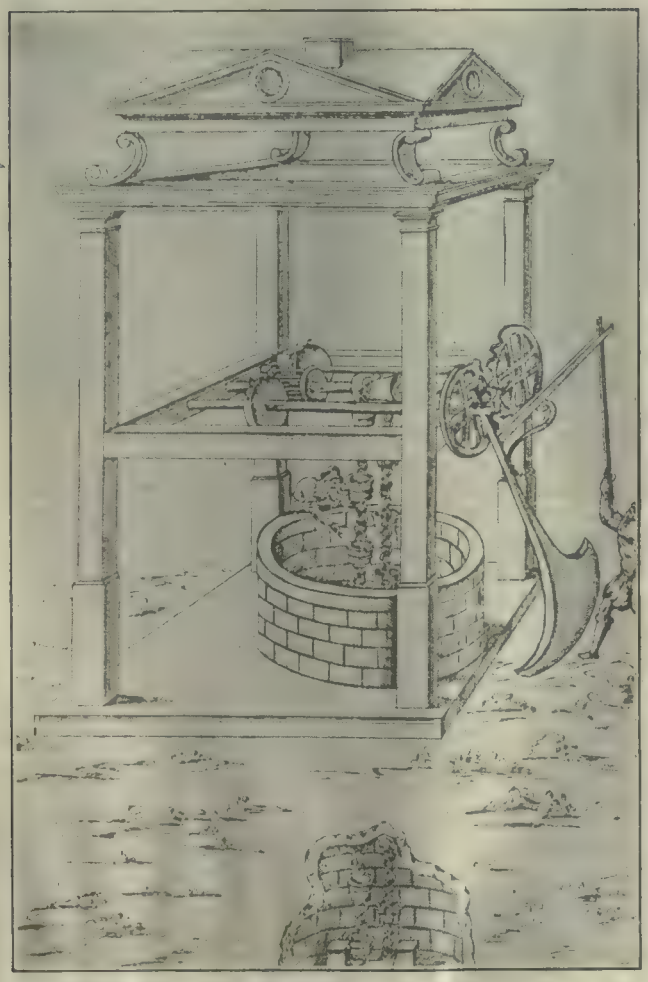


FIG. 6. BUCKET CONVEYOR SHOWING EARLY USE OF TWO WHEELS IN SAME PLANE

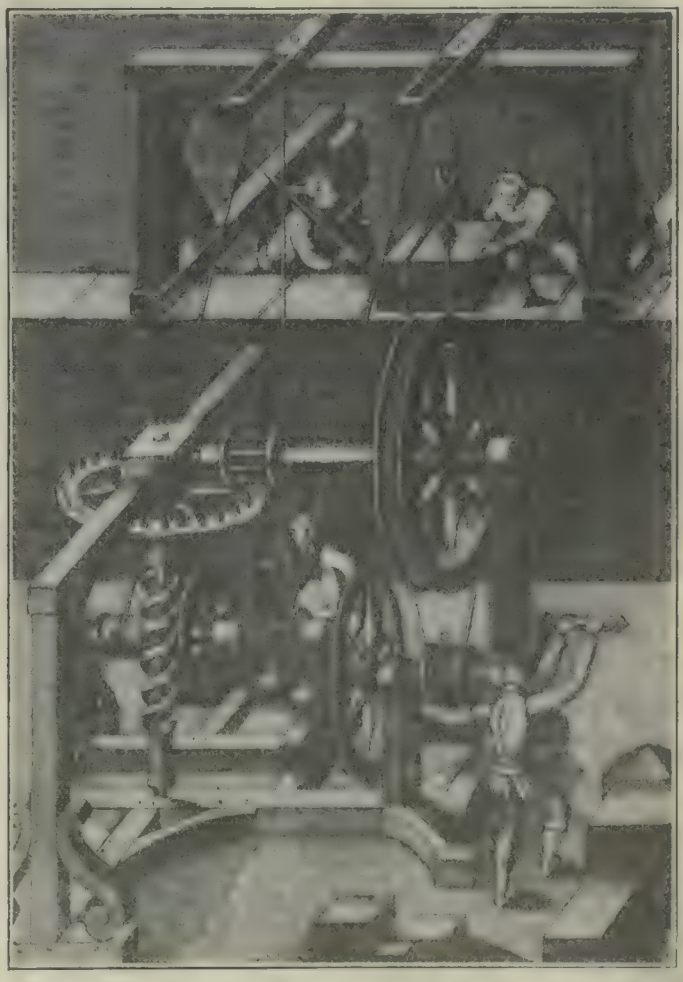
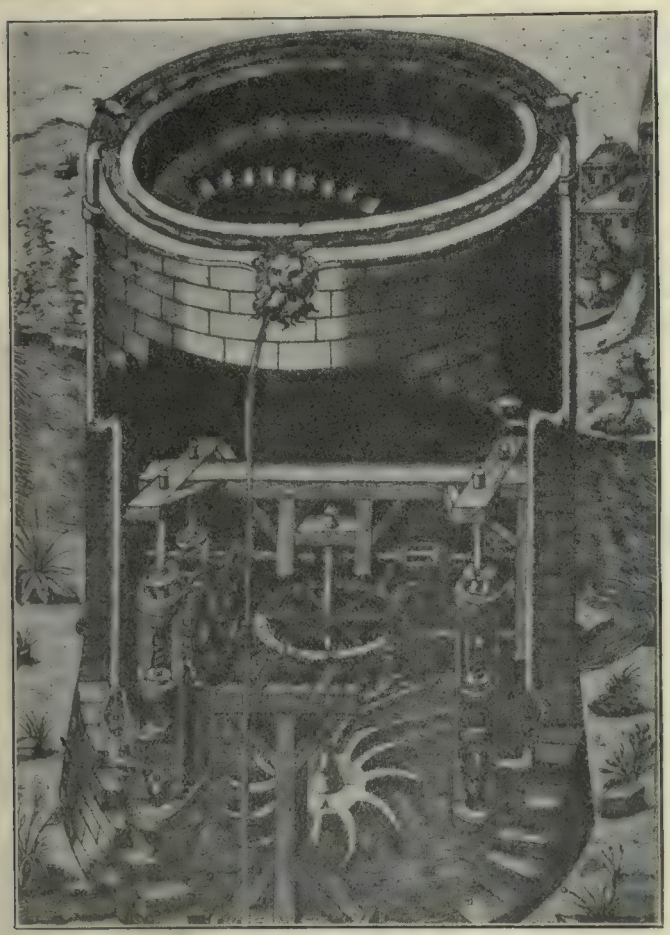


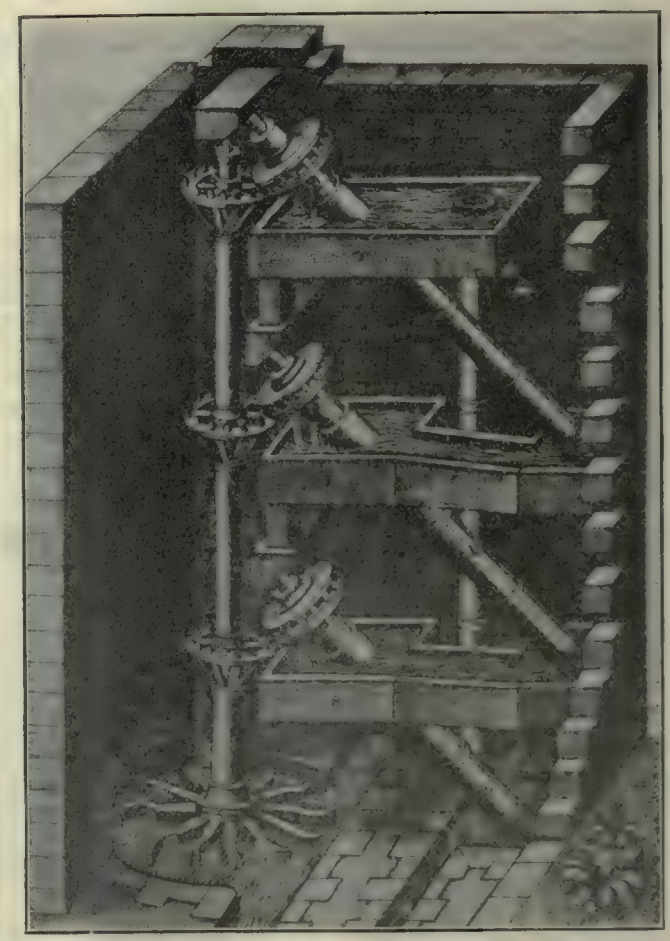
FIG. 7. COMBINATION OF DRUM, ROPE DRIVE, WORM AND LANTERN TO RAISE STONE

evidently required more exact construction than most rundles used at the time.

The pictures of wheels in the same plane with teeth made to fit number only two or three, which shows the rarity of such usage at the time. In the illustration, Fig. 10, the teeth are roughly semi-circular. The bucket shown could probably be raised by hand alone; therefore, this is probably one of Ramelli's designs of gearing which was never put into practice.

A design hitherto unnoted, shown in Fig. 11, is one where the cogs of the spur wheel fitted into a lantern where the rounds are arranged like spokes in the disk of the wheel. In order to strengthen the rounds, they were shortened by covering most of the face of the wheel. This design was made for a big bomb and stone throwing machine which was expected to rival the inefficient artillery of the period.





FIGS. 8 AND 9. TWO WATER-PUMPING SCHEMES

Beginning of Seventeenth Century

The practice in gearing at the beginning of the seventeenth century is illustrated in a work by Zonca published in 1607. This includes various examples of mills using toothed wheels and rundles, and a few with cams. More important are several designs showing the use of cog wheels in the same plane.

Zeising, in his various books which were published in the first quarter of the seventeenth century, includes a large number of designs for machines, but none of them show any gearing beyond what we have already mentioned. The same might also be said of Branca, whose book was published in 1629. He illustrates various lanterns combined with face and spur wheels, but the only improvement seems to be that the teeth on the face wheels were formed to some extent to fit the rounds in the lanterns.

In the many engravings included by Boeckler in his book printed in 1662, probably the only novel type of gearing seems to be the use of an oblique screw and cog wheel.

Second Half of the Seventeenth Century

In the second half of the seventeenth century the form of the cogs and teeth began to be considered principally by the mathematicians. This was probably due to the improvement in the clock, brought about by the application of the pendulum. Christian Huygens, to whom this important advance is ascribed, realized the necessity of the wheels in the clock running as smoothly as possible. He even took up, in an incomplete way, the evolution of the cycloid and traced the curve of evolutions; that is, the evolute. He favored this curve, at least theoretically, for the construction of the teeth on clock wheels, but it is not known that it was put to any general practical use for this purpose. Epicycloids were also discussed in a theoretical way by Desargues in 1674.

An important point to note is that the scientific and mathematical discussion of the shape of the teeth was in connection with exact instruments, such as the clock, rather than ordinary machinery.

The best insight into the ordinary usage in gearing at the end of the seventeenth century is afforded by the work of Mandey and Moxon, published in 1696. This includes a brief chapter on epicycloids, and one entitled

"Of the Length and Disposition of the Teeth of Wheels." The most interesting chapter, however, is that headed "To Make Divers Kinds of Wheels Commonly Used in Engines." This includes a number of definitions, or descriptions of the different types of teeth, which show what were in use at the period. Some of these run in part:

DEFINITIONS OF GEARING

A toothed wheel is that whose periphery sticks out with little handles endued with the semicylindric form.

A fingered wheel is that whose periphery is garnisht with plain cylindrick small stakes.

A sharp-pointed wheel is that whose periphery is cut with little handles like the figure of the point of a sword.

A studded wheel is that in whose periphery little sphaeres or convex hemi-sphaeres are disposed.

A starred wheel is that whose circumference is furnisht with three-sided prismes.

A hilical or screw wheel is that in whose circumference chanellings or grooves are made, according to the quantity of the angle of the axis of the inclined wheel, whatsoever figure the same hath, which nevertheless are reduced to four kinds, semicylindrick, trigonal, trapezias, or unequal.

A hooked or crooked wheel is that which hath hooks disposed in its circumference.

Also wheels are named with respect to their figure—let the teeth be what they will: orbiculates, convex cylindric, concave cylindric, conic.

Note that all the kinds of teeth may be made not only in the periphery but also in one or both of the lateral superfices.

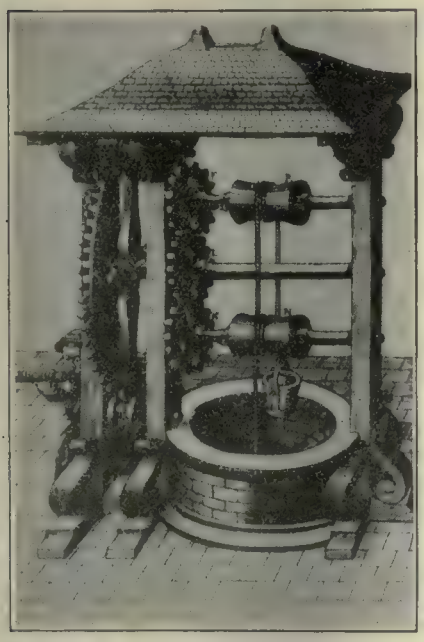


FIG. 10. A SIXTEENTH CENTURY USE OF GEARING

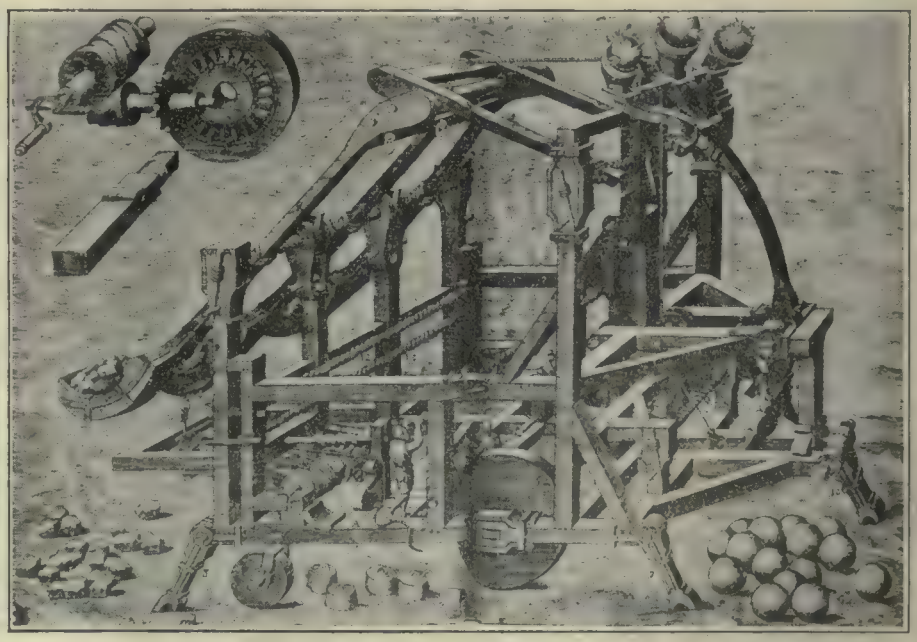


FIG. 11. A BIG BOMB AND STONE THROWING MACHINE OF THE EARLY SEVENTEENTH CENTURY

LITTLE IMPROVEMENT IN GEAR TEETH

Good evidence that but little improvement had been made in the teeth of wheels may be found in the several engineering books of Leupold, and especially in his general work on machines which was published in 1724. While he states here that the cogs of wheels must be made to fit as neatly as possible, he gives no definite principles for doing so, and implies that the whole subject was still left to the rule-of-thumb skill of the workman.

The bevel wheel is sometimes said to have been invented by Camus in 1572, though a simple form of it was suggested by Besson 180 years previously.

The first gear-cutting machine seems to have been invented by James Brindley. The construction of the machinery for Pattison and Clayton's new silk mill in Cheshire, England, had been given to a millwright by the name of Johnson. He got himself all tangled up on the job, which was in a fair way of being a complete failure. Brindley was an assistant in charge of part of the work, but, as he was not a full-fledged millwright, Johnson would not deign to ask his aid.

Finally, however, the proprietors took alarm and called in Brindley to help them out of the desperate situation. One of his first steps was to design a machine for gear cutting. In the words of Samuel Smiles, "In order that the tooth and pinion wheels should fit with perfect precision, he expressly invented machinery for their manufacture—a thing that had not before been invented—all such wheels having until then been cut by hand at great labor and cost. By means of this new machinery, as much work, and of a far better description, could be cut in a day as had before occupied at least a fortnight."

This device, though called a machine by Smiles, was probably one worked by hand rather than by water power; in fact, most such labor-saving inventions employed manual power long before they did steam or water.

In 1771 Kaestner showed a method of describing and applying the involute to the teeth of wheels. Soon afterward Professor Robinson attempted to use this curve in constructing the cogs of wheels for a mill near Edinburgh, but the result was, for one reason or another, very unsatisfactory.

One of the first practical applications of beveled gears seems to have been made in the cotton mills of Arkwright, and to have been introduced chiefly through his suggestion.

An even newer type of gearing was the sun and planet motion which was invented by William Murdock in 1782, to be used in Watt's rotary engine for changing the reciprocating to a circular motion. Watt himself said, "It has the singular property of going twice around for each stroke of the engine, and may be made

to go oftener around if required, without additional machinery."

The introduction of the steam engine, and especially of the rotary engine, created a demand for gearing able to stand a more rapid movement. This led to the practical use of iron instead of wood.

Perhaps the best appreciation of this is contained in Smiles' account of the steps toward this end taken by John Rennie (1784-1788): "The completion of the Albion Mills indeed marked an important stage in the history of mechanical improvements; and they may be said to have effected an entire revolution in millwork generally. Until then machinery had been constructed almost entirely of wood, and it was in consequence exceedingly clumsy, involving great friction and much waste of power. Mr. Smeaton had introduced an iron wheel at Carron in 1754 and afterward in a mill at Belper in Derbyshire—mere rough castings, imperfectly executed, and neither clipped nor filed in any particular form; and Mr. Murdock (James Watt's ingenious assistant) had also employed cast-iron work to a limited extent in a mill erected by him in Ayrshire; but these were very inferior specimens of iron work, and exercised no general influence on mechanical improvement at that time.

"Mr. Rennie's system of wrought and cast-iron wheels, after a system, was of much greater importance, anw was soon adopted generally on all large machinery. The whole of the wheels and shafts of the Albion Mills were of these materials, with the exception of the cogs in some cases, which were of hard wood, working into others of cast iron; and where the pinions were very small, they were of wrought iron. The teeth, both wooden and iron, were accurately formed by chipping and filing to the form of epicycloids. The shafts and axles were of iron and the bearings of brass, so that the power employed worked to the greatest advantage and at the least possible loss by friction."

The Three-Shift System in the Steel Industry

AT THE joint meeting of the Management and Metropolitan sections of the American Society of Mechanical Engineers, the New York section of the American Institute of Electrical Engineers and the Taylor Society, Dec. 3, Horace B. Drury delivered an address on "The Three-Shift System in the Steel Industry." Mr. Drury was formerly of the Economics Department, Ohio State University and recently with the Industrial Relations Division, U. S. Shipping Board. He has, during the past few months, visited practically all of the steel plants in the United States working under the three-shift system, to collect technical data covering the details of their operation. The excellent paper he presented at the joint meeting was a general review of his findings.

The meeting was held in the Engineering Societies Building, New York City, Fred J. Miller, president of the American Society of Mechanical Engineers, presiding. Discussion of Mr. Drury's paper was led by Robert B. Wolf, consulting engineer, New York City, and participated in by William H. Baldwin, formerly secretary Ohio Steel Co. and S. P. Rectanus, director of employment, the American Rolling Mill Co.

The following is an abstract from Mr. Drury's address:

The actual percentage of steel industry employees who under the two-shift system have been employed twelve hours a day has been variously estimated at from 26½ to 52 per cent. The truth of the matter would seem to be that, so far as concerns those continuous operation processes which make up the heart of the steel industry, such as the blast furnace, the openhearth furnace, and most types of rolling mills, together with the various auxiliary departments necessary to support these processes and make a complete plant, the bulk of the employees work twelve hours. The proportion of twelve-hour jobs in these places is not a full 100 per cent, for the reason that in many of the departments there is a certain amount of work, usually of a common labor or mechanical type, which can be concentrated in the daylight hours and is commonly organized on a ten-hour basis. But all the shift men, all the men whose presence is essential to the carrying on of the processes, from the chemist and bosses down to the lowest helper—the technical graduate, the American-born roller, and the unskilled foreigner—all these, with very few exceptions work twelve hours. Most likely the percentage of twelve-hour workers for the whole plant—which we are assuming is entirely, or almost entirely, devoted to the more fundamental steel processes—will be considerably over 50 per cent, possibly two-thirds.

But while fully one-half of the men in these plants or departments of plants which constitute the seat of the steel industry work twelve hours, the percentage of twelve-hour men taking the American steel industry as a whole, would be considerably less than 50 per cent.

Health of the Worker Is Involved

I wish to remove the impression which may have been created that the matter of health is not involved at all. While the general opinion of well-informed steel men, even those who are very much in favor of three shifts, is that the twelve-hour day is not hard on the men physically, such a statement is probably only approximately correct. It is hard to believe that twelve hours in a shop is as good for a man physically as eight hours in the shop and the balance outside. It seems possible that if we had health records as accurate as those which we will later examine for the quality of openhearth steel, we would find that eight hours would keep a man in better health and increase his longevity in comparison with what it would be under twelve hours.

So it would probably be assuming a good deal to say that the twelve-hour day is in no respects a strain on the health of steel workers. Yet the principal argument against the two-shift system is not the physical argument.

What sort of a home life, one hears it asked on all sides, can a man have who, including the time lost in coming and going, is on the job practically thirteen hours every day? Add to this an hour for meals and eight hours for sleep, and barely two hours a day are left for the duties and pleasures of family and community life. For a few years the ambitious, newly-arrived immigrant may seek such a life; and throughout life, the dull man, or the one-interest-in-life man, may run on contentedly on this schedule. But any definite continuation of such a system for a block of several hundred thousand persons would simply mean the accentuation and continuance in American life of those lines of class and culture which immigration has already made too dangerous and deep. Who wants to have in America a class of men who do not know what to do with themselves unless they are under some one else's orders? Is this the way to raise the general level of literacy and personal capacity, and build up in America a civilization in which we may take pride? The argument against the twelve-hour day based on the proportion of a man's time which it consumes

is in short simply unanswerable both from the standpoint of individual freedom and development, and from the standpoint of national power and culture.

Both Managers and Men Prefer the Three-Shift Day

Perhaps the one thing that stands out the most obviously as a result of my visits to and talks with the managers of the three-shift plants is the fact that practically all of them are glad that they made the change. Not that they had no problems to meet, but they were in practically all cases looking ahead, not back.

Equally important with the attitude of the managers is the attitude of the workers. It has often been pointed out that one of the difficulties involved in changing the steel industry from the two- to the three-shift system is the fact that the men do not want to work the shorter hours. I have made it a special point to talk this phase of the situation over with the managers, and to argue about it with other persons whom I thought could speak for the men, and I am firmly convinced that in times past this has been a very serious obstacle to the introduction of the shorter day. There have been large numbers of foreigners who would just as leave work twelve hours as eight, and who would much rather earn twelve hours' pay. And there have been many others who from pressure of circumstances or because of habit were willing to work twelve hours a day while work was to be had. But with the coming of the war the foreigner found his egress to Europe cut off, and he began to think of America as a place where he could stay a while.

The shortening of a man's day from twelve to eight hours means that the possible energy and attention which he can put into his work in each working hour is greatly increased. But to harness this new energy, as to develop a new country, will take time.

The Matter of Costs

While costs are likely to go up some at the start, I think there is substantial reason for believing, in view of what has already been done in some of the plants, that before long the adjustment will work out along lines that will mean very little if any higher cost.

If hourly wage rates are compromised half way, the force of men increased not a full 50 per cent, but on the average 35 per cent, and if output could on the average be increased 10 per cent, then the labor cost under three shifts would be practically the same as under two shifts. If the first figure were 20 per cent, or the second 30 per cent, or the third 12½ per cent, the others being as they are here, there would be no increase at all.

The experience of all the plants which I have visited shows that the wage adjustment specified is a practical one. Where it is expected that the men will turn out a greatly increased output, or where there is a very material decrease in the number of men, it would be only justice to give the men perhaps as much for eight hours as they had previously earned in twelve. In that case there would of course be no difficulty about labor costs. But assuming that we are not so fortunate as to be able to realize any very large increase in efficiency, it has been shown that the men see the reasonableness of paying for their greater leisure by some reduction in total earnings. This figure of 25 per cent is the maximum that would be required even under conditions of labor shortage.

The figure for a 35 per cent increase in men, instead of 50 per cent is also a conservative one. In many plants exactly 50 per cent more men are employed on three shifts than on two, and most of them are close to the 50 per cent figure. But the 35 per cent standard has been attained by such large plants as those of the International Harvester Co. and Inland Steel Co., and a much better showing was made by the American Rolling Mill Co. It might be noted that the limitation to 35 per cent increase can be obtained if, where ten men are now employed on a shift, it is possible to get along with nine. That is, twenty-seven men employed on three shifts is just 35 per cent more than 20 men employed on two shifts. It seems only reasonable to assume that with so large a reduction in the number of hours, it would be possible to cut out one man out of ten.

This figure for increased output of 10 per cent seems not very far away as an average. It is, of course, too high for a blast furnace. I know of no reason to expect greater output at all from a blast furnace on three shifts. Fortunately in the case of a blast furnace the labor cost is small. In the case of the open hearth furnace a 10 per cent increase in output would be an ambitious program. Most steel men would say that any increase in output at all would be impossible. Others think that wide awake labor can hasten the charging and guarantee that the melting takes place at maximum speed. Fortunately about an open hearth furnace there are ample opportunities for improving the quality of the steel, prolonging the life of the furnace, and saving in materials, which may more than make up for the difficulty of increasing output. As regards rolling mills, the human equation enters in to a considerable extent, so that increase in output may be looked for. The amount depends on the type of mill and the opportunities for doing more rapid work. It would also depend some on the efficiency of the arrangements for supplying the metal to be rolled, and for shearing and taking away the finished product. On many mills, however, actual figures show that the increase in output may run up well toward 25 per cent.

However, the striking thing about the cost of the three-shift system is the smallness of the amount at stake, whichever way one looks at it. Suppose that there were no increase in efficiency at all, that the plant increased its force of shift men precisely 50 per cent, that the output is no greater in any department than under two shifts, and that the hourly wage rates are raised 25 per cent.

Cost Figures

In a good blast furnace plant the labor cost at present wage levels and efficiency should not be far from $1 per ton; to be safe we will say $1.25 a ton. Assuming that the change from twelve hours to eight would affect two-thirds of the men, the pay of these men under the two-shift system would amount to two-thirds of $1.25 or 83 cents per ton. An advance of 25 per cent in the hourly wages of these men would increase the labor cost per ton of pig iron by 21c. Considering the fact that pig iron sells for around $40 a ton, that the ore that goes into a ton when delivered at Pittsburgh costs about $8, the trifling risk involved in increasing the labor cost a maximum of about 21c. is apparent. Likewise in open hearth work the labor cost might be $1.30 a ton; to be safe we will say $1.50 a ton. The maximum increase in labor cost here, assuming no increase in efficiency, would be 25c. Thus the total increase in labor cost for the steel ingot would be not more than 46c., still a small figure for something that sells for about as many dollars. In the rolling mills the labor cost will run higher, especially where material is rolled several times, and into light shapes, as rods, sheets, etc. But in proportion as the product is put through many processes the opportunities for getting higher labor efficiency increase, until at the sheet mill end of the process no one questions but that the shorter day means no added cost at all. In various of the rolling mills visited there has been no increase in labor cost.

The magnitude of the problem of finding the extra labor is not nearly so great as is commonly supposed. As for the higher positions, these may be filled by promotion of helpers. This promotion in itself has a favorable effect on the men, as the better workers make up in promotion for what they would otherwise lose because of decreased earnings. The lower positions may be filled by new labor.

However, under present conditions, the time may soon be at hand when the three-shift system could be introduced without bringing any new labor into the industry. If indeed we are face to face with a time of considerable unemployment in the steel industry, then this would be the time of all times to cut out one man's working twelve hours a day, and another's working not at all, and distribute the work so that all would have employment for a reasonable work-day. Under these conditions the change can be made with the greatest benefit all around, and perhaps no cost anywhere.

Cylindrical Grinding in 1920*

By W. H. CHAPMAN

(Continued from last week's issue.)

THE most important development in recent grinding machines is the recognition and utilization of the fact that overall operating efficiency for traversed cylindrical work *increases as traverse speeds are increased.* (This assumes that for a given traverse speed width of wheel and revolution of work are so related as to cause the cutting face to just cover the lead of the work.)

This fact is based upon certain scientific laws. It will now be shown why this is true and an expression will be derived for determining the effect of traverse speeds. Professor Alden did not go into this question, and Mr. Guest apparently did not recognize the true conditions as he considers traverse speed of negligible effect.[2]

It is evident what grain depth of cut is, and how it affects wheel wear. The wheel width of cut also affects wheel wear. If we consider, for instance, the resistance offered to forward motion of a snow plow we know that if the plow is set at an angle it is easier to push, although we will have to push it further to clean off the same area of surface than when it is set exactly against the direction of the path.

Consider the grinding wheel as stationary, nonrotating, and the work to revolve. If the work is traversed the path will be a helical ribbon. The width of this ribbon measured parallel to the axis of rotation of the work is the same as the cylindrical path cut by the wheel when the work is not traversed. For the same *angular* movement of the work both paths are of equal area. The work done is the same. In the case of the traversed work, however, the resultant motion between wheel and work is at an angle to the axis of rotation. The tangent of this angle is the length of the projected arc, or circumferential distance traveled by the work, divided by the distance traversed in the same time. The actual length of the path measured in the direction of this relative motion is greater than the length of the projected arc, while the width of path perpendicular to this length is less than the width of the straight-in cut. The length of cut becomes equal to the length of equivalent straight-in cut divided by the sine of the traverse angle or lead angle of the work. The width of path is diminished in the same proportion, being the width of the straight-in cut times the sine of the traverse angle whose tangent was given above. With the wheel still at rest, we see that we have reduced the wheel width of cut by the proportion of the sine of the traverse angle. Referring to Fig. 2, let

W = width of wheel face;
L = length of projected arc of rotation of work;
M = actual length of path of traversed cut;
B = actual width of path of traversed cut;
β = traverse angle.

Then $B = W \sin \beta$; $M = L/\sin \beta$; areas $W \times L$ and $B \times M$ are equal. Wheel width of cut is proportional to W for straight-in cut, but reduced to B for traversed cut.

It is to be noted that relative work speed has been increased over actual work speed in the inverse proportion of the sine of the traverse angle. This relative increase does not appear in the projected (end view) relations. As these alone affect individual grain depth of cut we have gained in relative work speed to get over the longer path M, so as to cover the same area in the same time on a narrower width B, *without* increasing grain depth of cut.

Now, if the wheel rotates each grain cuts across the work at an angle θ, resulting from speed relations shown by Fig. 2 (vector diagram for rotating wheel). Then the individual grain paths are at a much steeper angle

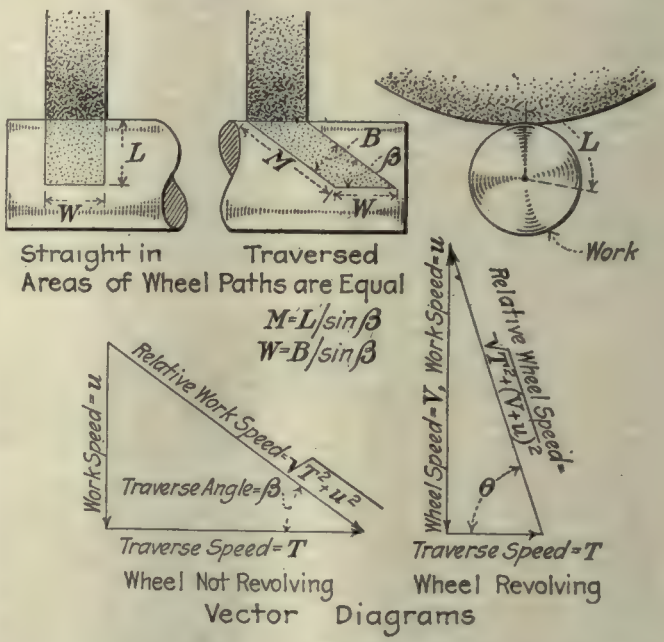


FIG. 2. SPEED RELATIONS BETWEEN WORK AND WHEEL

than the wheel path to the axis of work rotation, but we have gained in relative wheel speed *without* increasing individual grain depth of cut. Our wheel width of cut is also reduced by a slight amount proportional to sin θ, which is, of course, much less than the reduction before the wheel was rotated. The net result is a reduction in wheel stress proportional to sin θ and an increase in work speed proportional to sin β, *without* increase in grain depth of cut.

The "head resistance" against the wheel as a whole is reduced by the sin β factor, while wheel width of cut is reduced by sin θ. These both directly affect wheel wear. For traversed-feed conditions our grain depth of cut remains the same as in straight-in feeds, but wheel wear is reduced in the proportion of sin β $\times$ sin θ.

If T = traverse speed, V = wheel speed, u = work speed, then

$$WW_1 = \left(\frac{u}{\sqrt{T^2 + u^2}}\right)\left(\frac{V+u}{\sqrt{T^2 + (V+u)^2}}\right)\left(\frac{\mu u}{rV^2}\right)\sqrt{2rf} \quad (8)$$

In practical cases the second term will be so nearly 1 that it may be neglected. It is evident that T affects the quantity appreciably only when u is kept relatively

*Presented at the annual meeting, New York, December, 1920, of the American Society of Mechanical Engineers, 29 West 39th Street, New York.

[2]See "Guest's Grinding Machinery," Arnold, 1915 edition, p. 80.

low. This indicates that a wide wheel should be used to get the effect of reduced wear for a given production, traversing as rapidly as possible. The above formula assumes no overlapping of the cut.

Now by making assumptions and neglecting values whose effect is so small as to make no appreciable difference for purposes of comparison we reduce the expressions for WW_I exactly as we did in the case of straight-in feeds and obtain:

$$\text{Index of wheel wear } WW_I = \frac{\mu u}{V^2}\left(\frac{u}{\sqrt{T^2+u^2}}\right)\sqrt{\frac{2f}{r}} \quad (9)$$

Laws of Grinding for Traversed Cuts

From this it is evident that for traversed work:

a Wheel wear increases directly with the work speed;

b Wheel wear decreases directly as the decrease in the quantity which we term "traverse factor," which is work speed divided by the square root of the sum of the squares of traverse and work speeds;

c Wheel wear decreases directly as square of wheel speed increases;

d Wheel wear decreases directly as the square root of the work radius increases;

e Wheel wear increases directly as the square root of the feed increases.

The value $\frac{u}{\sqrt{T^2+u^2}}$ in our expression for index of wheel wear is our traverse factor. Where T is large with respect to u this factor will be appreciably less than unity, but as u increases the reduction in wheel-wearing action is less pronounced.

Table II gives values of the traverse factor for a certain machine having the work speeds previously given for draw-in cuts, and the following table (traverse) speeds: 10.02, 14.00, 17.00, 19.70, 26.90 and 32.60 ft. per min. The table shows combinations of speeds giving leads from 2.3 in. upward. As the machine was designed for a wheel 2½ in. wide combinations of speeds giving lesser leads of work are not given.

If we now multiply each of the traverse factors in Table II by the wheel-wear value for the corresponding work speed and work diameter as shown in Table I (draw-in cuts), we will have a table of wheel-wear values for traversed cuts. These products are given in Table III.

By assigning certain wheels to specified ranges of wheel-wearing action we may select the proper wheel through the use of Table III in the same way that we did from Table I. Actually, in the case of Table III, the wheels used would be somewhat softer for the same index figure because the actual depth of cut does not follow the indicated depth (as shown by the feeding mechanism) as closely for traversed work as for draw-in work, and therefore the actual cut is not so deep. This means, of course, that the "spring away" action of the work is more pronounced for traversed than for draw-in work. Careful use of steady rests is therefore very essential.

TABLE II. TRAVERSE FACTORS

Traverse, Ft. per Min.	Work, R.p.m.	Lead, In.	Work Diameters 1 In.	2 In.	3 In.	4 In.
10.02	53	2.3	0.810	0.950	0.975	0.985
14.00	53	3.1	0.705	0.883	0.946	0.968
14.00	72.5	2.3	0.805	0.938	0.968	0.976
17.00	53	3.8	0.632	0.850	0.926	0.955
17.00	72.5	2.8	0.730	0.910	0.955	0.974
17.00	87	2.3	0.802	0.935	0.972	0.985
19.70	53	4.4	0.576	0.817	0.905	0.943
19.70	72.5	3.2	0.691	0.884	0.943	0.967
19.70	87	2.7	0.756	0.916	0.961	0.980
19.70	101	2.3	0.802	0.935	0.971	0.986
26.90	53	5.9	0.460	0.720	0.839	0.900
26.90	72.5	4.4	0.574	0.815	0.902	0.942
26.90	87	3.6	0.646	0.860	0.931	0.958
26.90	101	3.1	0.703	0.890	0.950	0.974
26.90	138	2.3	0.801	0.936	0.960	0.982
32.60	53	7.35	0.397	0.655	0.790	0.865
32.60	72.5	5.3	0.505	0.760	0.867	0.919
32.60	87	4.4	0.580	0.815	0.908	0.945
32.60	101	3.8	0.635	0.854	0.927	0.960
32.60	138	2.8	0.748	0.914	0.945	0.977
32.60	167	2.3	0.807	0.936	0.967	0.982

TABLE III. WHEEL-WEAR VALUES FOR TRAVERSED CUTS

Traverse, Ft. per Min.	Work, R.p.m.	Lead, In.	Work Diameters 1 In.	2 In.	3 In.	4 In.
10.02	53	2.3	0.01340	0.02240	0.02820	0.03280
14.00	53	3.1	0.01170	0.02080	0.02740	0.03230
14.00	72.5	2.3	0.01820	0.02450	0.03775	0.04390
17.00	53	3.8	0.01050	0.02005	0.02685	0.03185
17.00	72.5	2.8	0.01650	0.02900	0.03720	0.04370
17.00	87	2.3	0.02190	0.03620	0.04620	0.05390
19.7	53	4.4	0.00955	0.01930	0.02620	0.03142
19.7	72.5	3.2	0.01560	0.02820	0.03675	0.04350
19.7	87	2.7	0.02060	0.03540	0.04570	0.05355
19.7	101	2.3	0.02540	0.04185	0.05245	0.06260
26.9	53	5.9	0.00763	0.01695	0.02430	0.03000
26.9	72.5	4.4	0.01290	0.02600	0.03520	0.04240
26.9	87	3.6	0.01760	0.03320	0.04420	0.05235
26.9	101	3.1	0.02220	0.03980	0.05125	0.06185
26.9	138	2.3	0.03470	0.05130	0.06195	0.08500
32.6	53	7.35	0.00660	0.01545	0.02290	0.02885
32.6	72.5	5.3	0.01140	0.02420	0.03380	0.04130
32.6	87	4.4	0.01580	0.03150	0.04315	0.05160
32.6	101	3.8	0.02000	0.03820	0.05000	0.06100
32.6	138	2.8	0.03230	0.05580	0.06095	0.08450
32.6	167	2.3	0.04210	0.06940	0.08800	0.10230

The following wheels are found to be satisfactory for our machine for traversed cuts on mild steel under the assumed conditions:

Wheel Designation		Wheel-Wear Values Table III
36 or 46 I	for values up to	0.02500
36 or 46 J	for values from	0.02500 to 0.04000
36 or 46 K	for values from	0.04000 to 0.05000
36 or 46 L	for values from	0.05000 to 0.06000
36 or 46 M	for values from	0.06000

Use No. 60 grain for hard material and a grade softer; but use no wheel softer than I.

Important Note. These statements of wheel assignment are based upon assumptions of the best machine conditions and most careful operation to prevent any abuse of the wheel. Field practice will usually show harder wheels in use due to conditions which abuse the wheel. Efficiency is sacrificed where such is the case.

Production Costs

Grinding efficiency is usually considered as (production) ÷ (wheel wear). It is expressed as cubic inches of material removed per cubic inch of wheel wear. If wheel wear were the most important element of production cost grinding efficiency might be considered on this basis without leading to the fallacy which exists today. As a matter of fact the wheel cost is almost negligible compared to the other costs, and wheel selection should be based upon the production capacity of the wheel under the given set of grinding conditions, allowing the wheel wear to be as high as is necessary to get a free action without excessive wear (which would cause difficulty in sizing work and the need for frequent dressing). The all-important factor is the rate at which the wheel may be made to cut and still not get out of truth. This affects the grinding time, any reduction of which is of vastly more

importance than an increase of wheel wear which may result from such a reduction.

In good practice the volume of wheel wear is approximately a tenth of the material removed (mild steel) during roughing operations. A conservative estimate of the cost of operating a modern cylindrical grinding machine (exclusive of wheel cost) is, say, 5c. per min., including labor at day-rate wages.[3] The useful content of the wheel may be assumed to be such that the wheel is actually worth 7c. per cu.in. If production could be increased to 2 cu.in. per min. where previously we obtained 1½ cu.in. and wheel wear jumped from 0.15 cu.in., say, to 0.25 cu.in. per min., our first cost would be: $(0.05 + 0.15 \times 0.07) \div 1.5 =$ \$0.0404 or 4.04c. per cu.in. removed. In the second case, $(0.05 + 0.25 \times 0.07) \div 2 =$ \$0.0338, or 3.38c. per cu.in. removed.

Now the over-all production efficiency of the machine based upon all costs involved is indicated by production-cost factors proportional to the earning rate of the machine. In the first case this factor would be (production) $\div$ (cost) $= \frac{1.5}{0.05 + 0.15 \times 0.07} = 24.8$. In the second case, $\frac{2.0}{0.05 + 0.25 \times 0.07} = 29.6$.

It evidently will pay to wear the wheel more in order to obtain the higher rate as the over-all gain in the foregoing is about 19 per cent. The above-assumed values are reasonable and the figures given might be considered as typical. Table IV gives these production-cost factors, or relative earning rates based upon these costs and the grinding conditions previously assumed in Tables I, II and III, the variations being due to traverse and work-speed relations only, but with proper choice of wheels in each case. Then, for the machine which we have used as an illustration it is evident that for work of a certain size and a wheel of a certain width there is one speed combination which will utilize the machine to the greatest profit. If we are able to use wheels of the width needed to cover the lead under the best speed-relation conditions we will obtain the best earning rate of which the machine is capable. If wide wheels are not available we still have speed-relation conditions which will give very nearly as high a rate for the narrower wheels.

In Table IV the production-cost factors are given for 1-in. and 4-in. diameters of work only. The factors may also be expressed as earnings per unit of time, or the relative amounts the machine would earn in equal lengths of time under the various conditions as given.

Note that, due to high traverse, a 2.3-in. wheel which earns \$3.68 in a certain length of time when grinding 1-in. work at low traverse and work speeds will earn \$10.62 in the same length of time when using the high speeds. If the widest wheel (7.35-in. face) be used the machine will earn \$11.70 in the same length of time. The grade of wheel is suitable in each case according to the speed changes. This clearly shows that high traverse speeds cause a corresponding increase in earnings in spite of the necessary increase in work speed.

Considering the cost of wheels 7.35 in. wide as compared to wheels 2.3 in. wide, and the relative power

[3]The figure of 5 cents a minute as time cost of operation is based upon labor at 75 cents an hour and an hourly burden of \$2.25 an hour (power, investment, rent, heat, light, etc.).

TABLE IV. PRODUCTION-COST FACTORS

Table Speed, Ft. per Min.	Work, R.p.m.	Lead, In.	— Diameter of Work — 1 In.	4 In.
10.02	53	2.3	3.68	13.45
14.00	53	3.1	5.16	18.80
14.00	72.5	2.3	4.95	17.85
17.00	53	3.8	6.00	21.00
17.00	72.5	2.8	6.00	21.80
17.00	87	2.3	5.85	22.00
19.70	53	4.4	6.40	23.70
19.70	72.5	3.2	6.80	23.50
19.70	87	2.7	6.84	23.45
19.70	101	2.3	6.75	23.30
26.90	53	5.9	9.05	29.80
26.90	72.5	4.4	9.34	29.85
26.90	87	3.6	9.00	29.00
26.90	101	3.1	9.03	29.10
26.90	138	2.3	9.00	29.15
32.60	53	7.35	11.70	35.70
32.60	72.5	5.3	11.30	34.60
32.60	87	4.4	11.00	33.60
32.60	101	3.8	10.90	33.40
32.60	138	2.8	10.80	33.30
32.60	167	2.3	10.62	32.90

required to drive the two wheels, it is very evident that the use of a harder wheel 2.3 in. wide would offset the difference in wearing action without greatly reducing production and that the production of the 7.35-in. wheel is matched by the production of the 2.3-in. wheel using highest traverse and highest work speed.

The most striking conclusion from the above is the fact that in order to use a narrow wheel and get great production the high work speed does not cause excessive wheel wear *due to the relief* on the wheel brought about by the *high traverse speed.* This traverse speed is also necessary to allow the rapid exposure of fresh work surface to the cutting face, making for a highly economical combination.

The foregoing should demonstrate clearly what this new development in the science of grinding may mean to the art as practiced throughout our production shops.

Actual grinding tests upon a machine having the high-traverse feature, and making use of the speeds shown in the table, have conclusively proven the deductions indicated by the mathematical calculations. On mild machine steel (0.15 per cent carbon) over diameters ranging from ¾ in. to 4 in. production rates as high as 2 cu.in. per min. have been easily attained, grinding to limits of 0.0010 in., removing 0.060 in. from the diameter over lengths of from 36 to 72 in.

When machine conditions, truth and balance of wheel, and proper use of steady rests and grinding compound are intelligently and skillfully handled wheels of 36 and 46 grain size, and grades I to L (Norton system of grading) have been used in these roughing operations. Especially where the feeding is carefully regulated so as *never* to *crowd* the *radial depth* of cut to more than the possible depth of grain penetration (say not to exceed 0.0015 in. on the diameter) per traverse it has been found that the wheel face remained sufficiently true to leave a commercial finish of fair degree absolutely free from chatter marks, feed lines or any other imperfections of real or imaginary consequence.

Owing to the fact that in the above the highest work and traverse speeds were used in every case the grade (hardness) of wheel was increased as the diameter of the work increased. This is in accordance with our formula for index of wheel wear. Instead of considering the work speed and work radius independently, they were in this case tied together by the fact that a constant work r.p.m. was used. The expression for this is as follows:

$$\text{Work speed } u = \frac{2\pi rN}{12} \qquad (9)$$

where r = work radius (inches) and N = r.p.m.,

Formula (8) for traversed cuts, with second and third terms omitted as unimportant, becomes

$$WW_1 = \frac{\mu u}{V^2}\left(\frac{u}{\sqrt{T^2 + u^2}}\right)\sqrt{\frac{2f}{r}} \qquad (10)$$

Substituting (9) in (10),

$$WW_1 = \frac{0.275\mu}{V^2}\left(\frac{N^2}{\sqrt{T^2 + 0.275r^2N^2}}\right)\sqrt{2fr^3} \qquad (11)$$

Now if V, N, T and f are made constant WW_1 must vary as the value r appears in the formula, the greatest effect being the $\sqrt{r^3}$ factor, and we would expect, therefore, to use harder wheels as r increases.

Conclusions

The conclusions to be drawn from the foregoing are definite and indicate positively how to arrive at the solution of precision grinding problems, provided one has an intelligent knowledge of abrasive wheels and the usual materials ground.

Theoretical Conclusions (Cylindrical Grinding). Great grinding efficiency is obtained by the use of the *softest wheels* suited to the nature of the material ground. This efficiency is dependent upon the control of the dimension and speed relations between the wheel and the work so that the individual chip may have the minimum depth for a given volume determined by the maximum allowable radial depth of cut. This means long arc of contact, low work speeds and maximum feeds.

With the above conditions established, *increase of traverse speed increases production without increase* of *wheel-wearing action.*

Practical Conclusions. Machine conditions must be such as to maintain as accurately as it is reasonably possible the speed and dimensional relations of the wheel and the work. This includes a great number of individual factors, any one of which may serve to entirely or partially impair the successful operation of the machine in following the theoretical fundamental laws as previously stated. It is entirely worth while to emphasize here some of the most important of these.

a The power drive must not allow speed variations unless under the willful control of the operator;

b The wheel must be in good running balance and in absolute truth, and must be held in its position relative to the work within the closest possible limits;

c The work must be accurately held with respect to the wheel and must be *uniformly* rotated. Relative traverse between work and wheel must be uniform;

d The work must be rigidly supported over its entire length and no vibration allowed to occur between centers;

e Feed control must be sensitive and accurate and feeding must be at a rate such that the feed increment *never exceeds the maximum grain penetration.* This is the most frequently violated of the factors involved;

f Work must be kept at a uniform temperature and local heating prevented at all times. A copious supply of grinding compound should be directed to the *arc of contact* at all times. Eccentric work due to bowing from heat effects is the usual result of failure to supply sufficient compound at the arc of contact. In truing the wheel with a diamond the use of the cooling medium is vital to accuracy. Save the diamond by using a dresser to roughly true a wheel, using the diamond only when necessary to put the wheel in exact truth for precision work. Never feed a diamond over 0.001 in. per traverse;

g Select wheels intelligently, and do not try to use a single wheel for a variety of work sizes or materials unless the job is too short to warrant efficient grinding as compared with the time of changing wheels. It is seldom that this is true. Hard work (hardened steel, manganese steel, stellite, etc.) requires soft, rather fine wheels. The fine grain reduces the chip size but removes more chips, and wheel wear is not so likely to cause a pounding of the wheel, nor will the small grain cause the glazing which is bound to occur with coarse, hard wheels;

h An accurate finish requires the use of a soft, free-cutting wheel so controlled that the chips are very small (light feed and slow work speed with traverse to make the wheel face just cover the lead);

j A burnished finish may be obtained by a peening action of a coarse, hard wheel trued dead smooth. Heating and inaccuracies of surface are likely to occur;

k Cases are rare where a wheel harder than grade M may be properly used in cylindrical grinding. Low wheel speeds, too small a wheel, too high a work speed and abusive feeding—these are usually the causes for the use of hard wheels. Mention should also be made of failure to take draw-in cuts to establish traverse limits, thus requiring too hard a wheel in order to make the "corner stand up." Along this line may properly be mentioned design and drafting-room practice in calling for sharp shoulders where a generous fillet might be allowed. This makes needles, difficulty in grinding and weakens the piece ground;

l The contact of the wheel face with dry work at any time immediately ruins its value for finishing. The common practice of just touching the dry work when bringing up the wheel to contact is wrong, due to the charging of the wheel face with the uncooled chips (loading).

When the machine is properly designed and operated the grinding action will closely follow the theoretical laws. These laws are always at work, and when there is apparent conflict between the theoretical and the actual there exists some fault in the machine or with its operator. There is an enormous field for the industrial engineer in obtaining better production at less cost in grinding operations. There is a definite science involved, there is no mystery about it. The proper appreciation of the laws of grinding by machine designers and operators is rapidly increasing and we may expect a constant improvement in the art as a consequence.

The Cost of Labor and the Labor-Cost

By ELMER W. LEACH

The suggestion that the cost of labor, or wages, be kept up by reducing the labor cost, or increasing production per man, is no new idea but Mr. Leach's method of presentation is original and convincing.

ASK a man the difference between a quarter of a cubic inch and a cubic quarter of an inch and you've got him guessing—the chances are he'll have to get a pencil and paper to convince himself that you are not joking. And the title to these few remarks is just like that interesting mathematical problem in that there really is a difference between the two terms, and that difference is by no means a joke.

Only yesterday I had occasion to purchase some soft collars (the first ones for a long time, I'll admit), and plain white linen collars of a kind that one wears to the office each day were selling at fifty and seventy-five cents each. Prices did do some queer things while some of us were drawing our clothes from Uncle Sam's Q. M. depots and it's a bit hard to accustom ourselves to the changes that took place while we were away, but frankly, I had expected soft collars were selling at about fifteen cents each, possibly two for a quarter.

"Can you imagine it?" a stout gentleman remarked rather indignantly, "seventy-five cents for a soft collar. And look at that next counter, twenty and twenty-four dollars for a silk shirt. How long is it going to last anyway?"

The clerk had the right idea for he replied pleasantly as the stout gentleman walked away without purchasing, "I'm sorry, sir, but really we can't sell them for any less until we can buy them for less."

In the morning one of our crack salesmen had just returned from a most discouraging trip through probably fifteen states. "You simply can not sell them," he told the sales manager. "Everyone seems to be waiting for a drop in the market. No one cares to stock up on anything because he feels something is going to happen."

Now the real fact is that we are still getting steel and pig iron under some contracts made several months ago; and if our present prices were based on today's raw material market instead of the costs we obtained under those old contracts we should have to be charging at least 10 per cent more than we are charging for our goods.

But the dealers are looking for a 20 per cent drop and not a 10 per cent raise. And so the sales manager is writing some very pertinent letters:

"There can be no appreciable reduction in the prices of our goods until we are able to reduce the cost of production. This will only be possible when we can purchase our raw materials for less money, and when we can lessen the labor cost of our products; and we see no immediate prospects of being able to do either of those two things."

Whether we like to admit it or not, that paragraph smashes the nail pretty squarely on the head. It isn't exactly how we would arrange the problem if we were writing a story, but it is the problem nevertheless; and it will be solved and eliminated only when each one of us has studied out just what his individual part in its solution is.

In one of his plays Shakespeare has a character say something to this effect, "The fault is not in our stars but in ourselves that we are underlings."

I cannot help but wonder if that same thought is not applicable in the present situation. Before this article can appear in print the events of the political campaign will have passed into history; but at the time of writing, and particularly in the writer's Middle-Western state, so-called "people's candidates" are shouting "Death to the profiteers," and are telling of all the legislation they will enact to reduce the cost of living.

Perhaps I am overstepping the bounds of propriety and caution in this next remark, but it is my own personal opinion that the fault is "not in our Senators but in ourselves" that the cost of living and the cost of production are not sliding down hill as fast as we should like. And by that I mean that all the legislation in the world cannot reduce the cost of living any more than it can control the rate of foreign exchange.

It's a job for individual effort, which means that you can help and I can help—all of us helping together is what will bring about the desired result.

"But," you ask, "what has all of this to do with the labor-cost or the cost of labor? What have Senators and soft collars to do with what we thought you were going to talk about?"

In my title I use the expression "cost of labor" to represent the price or the wages that we are paying today to the men of industry. And by the "labor-cost" I mean that portion of the manufacturing cost of an article which is incurred through a workman putting part of his time into the making of that article. Putting it into dollars and cents, the cost of labor for a certain man might be $35 a week, whereas the labor-cost of the part he was working on might be one cent or a hundred dollars, depending on how many of those parts he turned out in a certain period of time.

If your position is such that you are sitting in the directors' meetings of some large manufacturing concern, if you are a member of your Shop Conference Committee, or even if you are one of those who take part in the "dinner-pail dialogues" that hold forth in almost any corner of the shop during the noon hour, you must know this thing to be a fact—that not a single manufacturer in the country really wants to lower the wages of his employees. Instead, it is the "labor-cost" of their product that they want to bring down, and they are trying to accomplish this by finding simpler ways of doing things and better methods for turning out more work in a given time.

If you can help them to do that by buckling down a bit more seriously and more conscientiously to the job and increasing your own individual production not a boss in the land will be so ungrateful as to deny you a share of the saving you will have effected for him—it is far more unthinkable that he would give you less money for having helped him to make more money.

There is a class of agitators among us today who

claim that Capital and Labor have nothing in common. They would make these two opposing factions rather than two co-operating groups. If we are to have anything but industrial chaos and disorder in this good land of ours during the years that lie ahead we must realize that Capital and Labor have got to stand on common ground and pull together in meeting the gigantic problems that face them both.

It would be as foolish to attempt to preserve the sanctity of the marriage state by arraying the fathers and mothers of the country in direct opposition to each other and telling them that they had no common interest in the future of the great American home, as it would be for the employer and the men who work with him to dare hope that the Stars and Stripes might continue to float over a land of successful business and industrial accomplishment if either of them believed, for one moment, that he could get along without the help and the co-operation and the good will of the other.

Increased production will lower the cost of things just as effectively and much more satisfactorily than decreased wages. That is what the directors of companies are saying today in their meetings, and it is what they are trying to bring home to their employees in every possible way. But increased production must go hand in hand with industrial teamwork if it is to be truly beneficial.

If you will pardon the illustration, the best of near-beer is a poor substitute to those who indulged in the genuine article because there is a "kick" that is lacking. It was the kick that made the real stuff the real stuff.

The workingman of today must put the same kind of a kick into his efforts, a push or an incentive that will give him the spirit of wanting to produce more. If he will read a recent issue of any of the trade papers he will see its pages devoted largely to articles on Better Relations, Bonus Systems, Premium Plans, Profit-sharing Arrangements, Foremen's Committees, Industrial Self-Government, and similar subjects. He must realize that the employer who is building his business on solid ground is spending a great deal of time devising means for making partners of his employees to participate with him in sharing and enjoying the results of their common labors.

He must realize that when business leaders of today talk about "reverting to the old order of things" they do not mean stepping backward to $50-a-month wages and 10-cents-a-dozen eggs; but rather do they mean going back to the old order by going ahead through a new conception of each man's individual duty to a fairer proportionate relation of price and profit to production.

The day is gone when Labor was considered a commodity to be bargained for the same as pig iron and coke. Gone also is the day when the mechanic was merely a part of his lathe. In these days of domestic reconstruction, just as surely as in the day when a foreign danger threatened us, we must work together if we are to carry out the necessary readjustment in an orderly manner.

Individual and Collective Effort Necessary

If we have faith in ourselves and in the future of our country we can easily believe that there are better days ahead for all of us; days of greater prosperity through a lower cost of living; days in which we can expect our work to contain a little less of the drudgery that is next to slavery and a little more of the pleasantness and sunshine that makes life worth living.

Kipling has very aptly said in one of his poems:

"It ain't the individual, nor the army as a whole;
But the everlasting teamwork of every blooming soul."

We all agree with the hesitant purchaser of today that something has got to happen. We cannot help but believe in the salesman's remark that one must buy for less before one can sell for less. Both ends of that problem tie up very definitely with each one of us, but we must tackle the first phase of it first, that of making it possible to buy for less, and the second will naturally follow.

If we all make it our own personal problem to increase our own productivity, no matter what our work may be, we shall be doing our bit toward lowering the labor-cost of commodities; and when we can do that it will not be necessary to worry about a reduction in the cost of labor.

Correcting Hand Reamer Chatter

By J. C. Nicholson

Trying to ream a straight hole by hand is a troublesome job, but it is so often necessary in certain kinds of work that a suggestion on the matter may be welcome. The most annoying feature in the operation is chatter and, contrary to what is usually expected, this is only made worse by using a double-end wrench unless by rare good luck and great care the reamer is well entered before chatter begins, whereas it is just at this point that chatter is most likely. Of course the whole trouble is due to having no fixed guide for steadying the shank end; but recourse may be had to another aid.

As in all cases of chatter one of the simplest remedies is something that will cause the cutting edge to spring or move away from the work when the pressure of cut increases. Of course a reamer cuts with each land, making this alternative seem needless, but owing to the use of a wrench for turning it, there are four points at which chatter is likely to occur; namely, at two points on a line parallel to the wrench handle and at points at right angles to these. In the first case pressure on the wrench toward or away from the work on either side sets up an unbalanced condition. In the second the same unbalanced state results from unequal pressure on opposite ends of the wrench in turning it.

Now this unbalanced condition is not always a bad thing so far as chatter is concerned. On the contrary it may even be used to prevent chatter. But in using a double-end wrench it is practically impossible for one to tell by the feel of the wrench whether it is going to act in the right direction. By using a single-end wrench, however, this is possible. As the wrench is pulled around one way the right hand use the left hand on the extreme end of the reamer pressing a little harder in the *opposite direction.* A little thought will show that this gives the state of unbalance which prevents rather than causes chatter, and it works beautifully. Of course such a procedure tends to make a taper hole, but so does chatter, which has additional objections.

The suggestion has particular force when for any reason it becomes necessary to ream one hole over to one side into alignment with another and also when using an expansion reamer in babbitt.

Side-Cutting of Thread-Milling Hobs*

BY EARLE BUCKINGHAM

It has long been known that, due to the helix of a thread, the side-cutting action of a hob distorts the form of the thread on the work. In other words, the form of the tooth on the hob is not reproduced on the threaded part. The present paper is the result of a mathematical investigation of this subject and points out the corrections in the form of thread-milling hobs which can be readily made and also produce threads sufficiently correct as to form for all practical purposes.

THE profile of the thread cut with a hob is a combination of two distinct curves. First, a small fillet is formed at the root of the thread which is the path of the outside corner of the hob. No correction in the form of the hob is possible to correct this point. Second, the larger part of the flank of the thread consists of a slightly curved profile which is formed by the overlapping paths of the infinite number of cutting points which form the cutting edge of the hob. Mathematically, a curved correction can be applied to the form of the hob which will correct this profile entirely. Practically, a straight-line correction can be applied which is almost exact, as the amount of the actual curvature on the flanks of the thread is seldom greater than one-tenth of a thousandth part of one inch. The greater the angle of helix of the thread, the greater the amount of correction necessary.

One very interesting fact is that the diameter of the hob has no effect on the form of the main part of the profile. The actual amount of side-cutting is more and the height of the fillet at the root of the thread is greater, as the diameter of the hob is increased, but the rest of the profile is unchanged.

This paper deals with both externally and internally threaded parts. The general conditions of side-cutting are identical in both cases. On a screw, however, the flanks of the hobbed thread will be convex, while in a nut they will be concave. Furthermore, the height of the fillet at the root of the thread and the actual amount of side-cutting are relatively greater in a nut than on a screw.

When a thread is chased in a lathe and the cutting tool has proper clearance and is set so that the plane of the cutting edges contains the axis of the thread, the exact form of the tool will be duplicated on the work. Assuming that the thread is completed, if the tool in its cutting position is brought into contact with the flanks of the thread, it will have a line bearing only. If sufficient clearance can be provided on the tool, this holds true regardless of the pitch of the thread, the angle of the flanks, or its diameter.

When a thread is hobbed, however, the axis of the hob being parallel to the axis of the thread, the path of any one cutting point is a circle, and this circle will interfere with the helix of the thread to an amount depending upon the pitch of the thread, the angle of the flanks, and the diameters of both hob and thread.

*Presented at the annual meeting of the American Society of Mechanical Engineers, New York, Dec. 7 to 10, 1920.

It is assumed in this discussion that the cutting teeth of the hob are backed off sufficiently to prevent any dragging of the relieved portion of the tool on the work. The interference between the cutting edge of the hob and the helix of the thread therefore results in the removal of additional metal, thus distorting the form of the thread. The amount of this distortion varies as the values of any of the following factors change: The pitch of the thread, the form of the thread, the diameter of the work, and the diameter of the hob.

It will be shown that correction for some of this distortion inevitable with this method of manufacture is impossible. The amount of this distortion, however, can be reduced in many cases by the proper relation between the diameters of work and hob. It will also be shown that most of the distortion can be corrected by a suitable alternation in the form of the cutting tool.

THE HOBBING OF SCREWS

In Fig. 1, which shows a diagram of a hob and screws, let

R = radius of any cutting point on the hob;
r = radius of deepest point on work touched by R;
N = number of threads per inch;
A = angle of rotation of hob;
B = angle of point of contact of R at angle A;
C = $\frac{1}{2}$ included angle of thread;
r' = radius of point of contact of R on work.

Formulas will first be derived to show the interference between the path of any cutting point on the hob and the flanks of the thread and for purposes of plotting the value of y will be taken as the radial

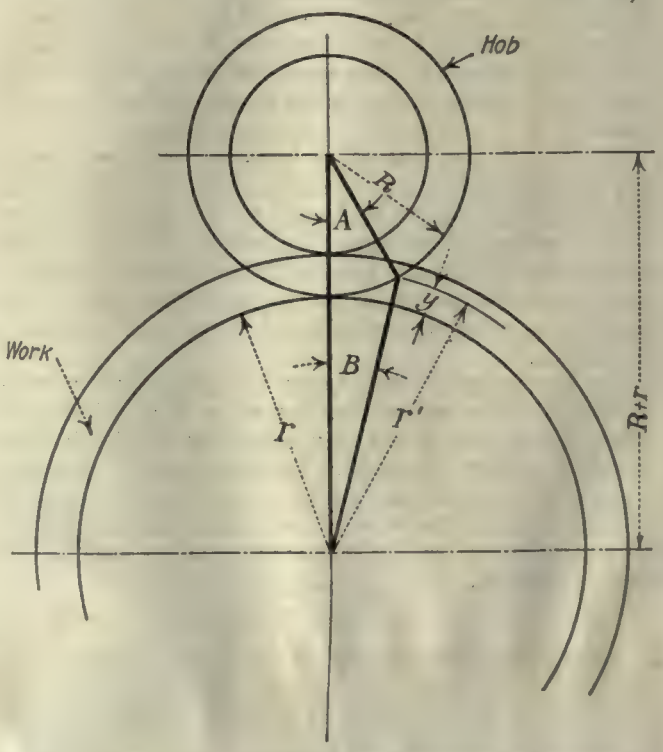


FIG. 1. DIAGRAM OF HOB AND EXTERNAL SCREW

distance of the cutting point R from the deepest point on the work touched by R. In other words,

$$y = r' - r \qquad (1)$$

The value of x will be taken as the longitudinal (or axial) distance of the cutting point R from the flank of the theoretical thread. A plus value of x will indicate a clearance, while a minus value of x will indicate an interference or side-cutting.

In order to determine the value of y the triangle shown in heavy lines in Fig. 1 must be solved. The known factors will be taken as r, R and B. We first have

$$\frac{(R + r) \sin B}{R} = \sin 180° - (A + B)$$

$$\sin 180° - (A + B) = \sin (A + B)$$

$$\frac{(R + r) \sin B}{R} = \sin (A + B) \qquad (2)$$

From this equation we determine the value of A. Solving the triangle for r', we have

$$r' = \frac{R \sin A}{\sin B} \qquad (3)$$

and when the value of r' is determined, the value of y is established from equation (1).

As the hob revolves away from the common center line of the hob and work, the cutting points on one side of the tooth of the hob, due to the helix of the thread, will have a clearance with the flank of the thread, while the cutting points on the other side of the tooth of the hob will develop an interference. The particular side involved depends upon the direction of the helix of the thread, whether left-handed or right-handed. But the side of the hob which clears the helix as the cutting point revolves away from the common center line will interfere as the cutting points approach to the common center line, and the nature and extent of this interference will be symmetrical and equal on both flanks of the thread as long as the form of the thread is symmetrical, such as in V-threads, U. S. form threads, Whitworth threads, Acme threads, etc. For buttress-formed threads the interference or side-cutting on each flank must be determined separately. As this last form of thread is seldom used only symmetrical threads will be considered.

The amount of interference depends upon the value of B and the pitch of the thread, or number of threads per inch, N. Thus

$$\text{Interference due to helix} = \frac{B}{360N} \qquad (4)$$

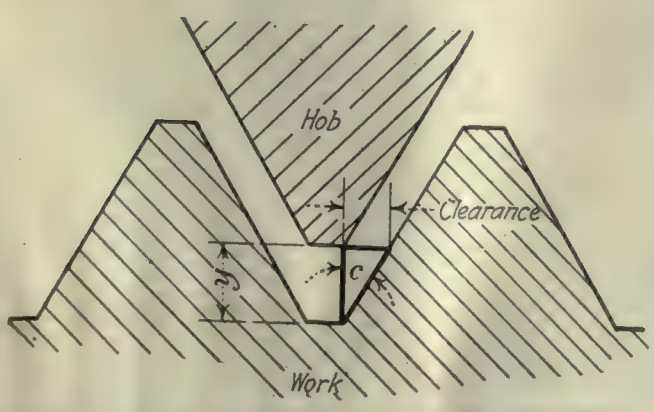


FIG. 2. DIAGRAM SHOWING CLEARANCE BETWEEN HOB AND WORK

If the included angle of the flanks of the thread is greater than zero—which is the case for all but square threads—as the cutting point of the side of the cutting tooth departs from the common center line of the hob and work a clearance develops between the cutting point on the hob and the flanks of the thread. The amount of this clearance depends upon the value of y and the included angle of the thread, and referring to Fig. 2,

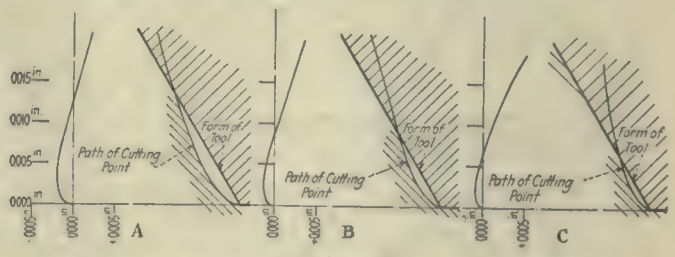


FIG. 3. CURVES SHOWING PATHS OF CUTTING POINT

it will be seen that its value, ignoring for the present the helix of the thread, may be expressed as:

$$\text{Clearance} = y \tan C \qquad (5)$$

The value of x is therefore found by subtracting the amount of interference given by equation (4) from the amount of clearance given to equation (5), or

$$x = y \tan C - \frac{B}{360N} \qquad (6)$$

As an example of the use of the above formulas we will assume that we wish to hob a thread which has a radius r of 0.5625 in. at the minor diameter with a hob whose radius R is 2.250 in. at its outside diameter with 4 threads per inch. A thread with a relatively large helix angle is taken as the first example in order to show the nature of the resulting side-cutting of a hob. The thread has an included angle of 60 deg., making $C = 30$ deg., and $N = 4$. The value of B is taken consecutively from 0 deg. which gives the following values for x and y:

For B =	0°	2°	3°	4°	5°	6°
x =	0	−0.00114	−0.00152	−0.00176	−0.00193	−0.00194
y =	0	0.00043	0.00097	0.00176	0.00267	0.00386

For B =	0°	7°	8°	10°	12°
x =	0	−0.00183	−0.00157	−0.00064	−0.00084
y =	0	0.00524	0.00691	0.01092	0.01589

The above values are plotted in Fig. 3-A at the left, and the actual path of the cutting point is shown at the right. These curves show the general form of the side-cutting of any point on the cutting face of a thread hob. This cutting face of the hob is made up of an infinite number of points. As the positions of these points vary the ratio between R and r varies, as also does the helix angle of the thread, and therefore each cutting point travels in a different form of path. Thus, in order to determine the resulting form of a thread cut with a hob it will be necessary to plot the paths of a few other points. A point 0.20 in. higher on the flank of the thread will therefore next be taken. This gives $R = 2.050$, and $r = 0.7625$, as before, $C = 30$ deg. and $N = 4$, and the values for x and y with these factors are as follows:

For B =	0°	1°	2°	3°	4°	5°
x =	0	−0.00061	−0.00102	−0.00126	−0.00129	−0.00117
y =	0	0.00015	0.00063	0.00143	0.00258	0.00398

For B =	0°	6°	7°	8°	9°
x =	0	−0.00084	−0.00032	−0.00041	−0.00136
y =	0	0.00577	0.00786	0.01034	0.01318

These values are plotted at the left in Fig. 3-B. The actual path of the cutting point is shown at the right.

A third point 0.40 in. above the bottom of the thread will next be taken. This point is beyond the top of the thread, but it is taken to accentuate the distortion developed by hobbing. In this case $R = 1.85$, $r =$ 0.9625, $C = 30$ deg., and $N = 4$. The values for x and y with these factors are as follows:

For $B =$	0°	1°	2°	3°	4°	5°	6°	7°
$x =$	0	−0.00057	−0.00088	−0.00093	−0.00073	−0.00026	−0.00049	−0.00151
$y =$	0	0.00022	0.00087	0.00199	0.00354	0.00566	0.00807	0.01104

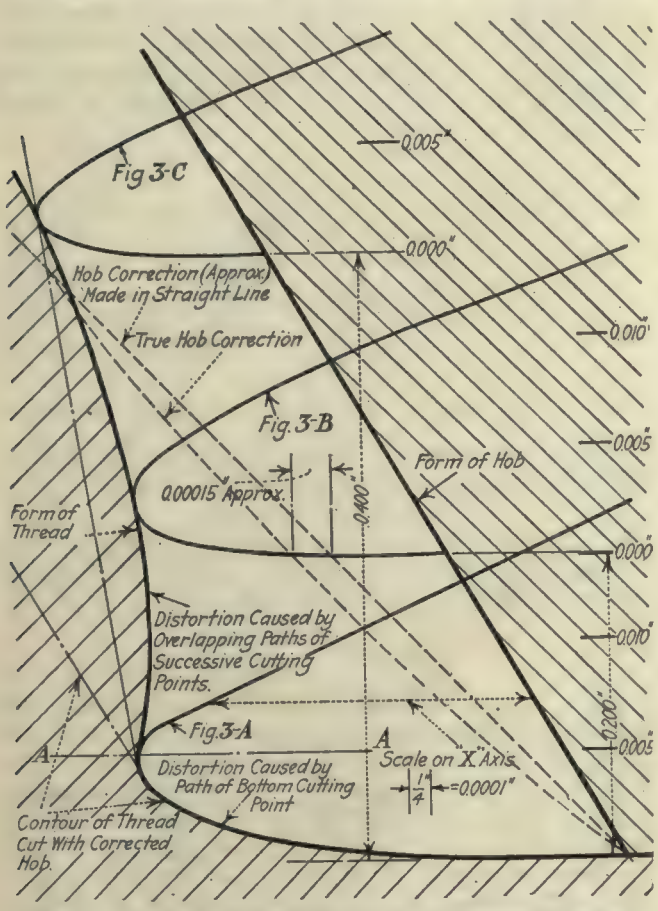


FIG. 4. CURVES SHOWING SHAPE OF CUTTING PATH

The above values are plotted at the left in Fig. 3-C. The actual path of the cutting point is shown at the right.

In order to show more clearly the nature of the side-cutting of hobs the curve in Fig. 4 is plotted in an exaggerated form with the intervals along the y-axis equal to 0.001 in., and those along the x-axis equal to 0.0001 in. The curves shown in Figs. 3-A, 3-B and 3-C are plotted to this scale and brought together proportionately; that is, the origins of these curves are spaced equally from the bottom, but these spaces are not to scale. This distorts still further the exact shape of the curve, but its general properties are correct.

This curve shows the general nature of the distortion in the form of a thread which is caused by the side-cutting of the hob. It will be noted that it is a double curve, the lower part (below the line A–A) being developed by the bottom corner of the hole tooth, while the upper part (above the line A–A) is developed by the overlapping paths of successive cutting points on the cutting face of the hob. It is evident that the distortion shown at the bottom of the curve is inevitable and no correction in the form of the hob is possible that will eliminate it. It can be reduced in many cases, however, by making the hob smaller in diameter, as will be discussed later. On the other hand, the distortion shown in the upper part of the curve can be eliminated by changing the form of the cutting edge on the hob.

Fig. 5 shows graphically the successive positions of the cutting edge of the hob in relation to the thread, illustrating just how the distorted form develops. The line 1–1 shows the flank of the hob tooth when the cutting edge is on the common center line of the hob and the work; 2–2 shows this edge as it is about to leave the upper part of the flank of the thread; 3–3 and 4–4 are finishing intermediate points of the flank; 5–5 shows the cutting edge at the point where the side-cutting is greatest; and 6–6, 7–7 and 8–8 show it in successive positions after it has finished cutting.

Referring again to Fig. 4, two dotted lines will be seen, one marked "Hob Correction (approx.) Made in a Straight Line," while the other is marked "True Hob Correction." These represent the contour of the correction. In order to maintain the proper width of thread space the thickness of the hob teeth must be reduced.

The correction of the hob is determined in the following manner: The greatest amount of side-cutting is done by the bottom corner of the hob. In the foregoing example the tabulation shows 0.00194 in. when $B = 6$ deg. This is not necessarily the exact maximum. If a closer value is required the tabulations must be made with increments of B of smaller amounts. Tabulations as shown, however, will be correct to the fourth decimal place, which is sufficiently accurate for most purposes.

If the tooth of the hob be narrowed at each point of the cutting edge by the amount which it side-cuts the thread form the contour of the thread above the line A–A in Fig. 4 will be correct. To do this exactly would require a curved form on the hob. For example, the maximum side-cutting at the top of the thread form shown in Fig. 4 amounts to 0.00093 in. when $B =$ 3 deg., while at the middle point it amounts to 0.00129 in. when $B = 4$ deg. If the bottom of the hob tooth is reduced 0.00194 in. on a side and the upper point is reduced 0.00093 in. on a side and the two points

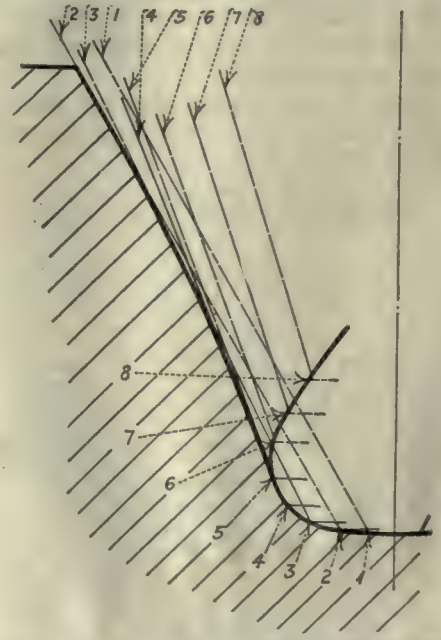


FIG. 5. DIAGRAM SHOWING POSITIONS OF CUTTING EDGE OF HOB IN RELATION TO THREAD

are connected by a straight line the middle point will be reduced but 0.00129 in. In this case a correction in a straight line will introduce an error of about 0.00015 in. In most cases it will be found that the correction in a straight line will be sufficiently accurate as the resulting error will be negligible.

Fig. 6-A represents the form of a thread cut with a hob having the form of the cutting edges identical with the true form of the thread. In this figure,

C = half included angle of thread;
F = width of flat of thread at the root or minor diameter;
r_1 = largest value of r employed (radius of major diameter);
r_2 = smallest value of r employed (radius of minor diameter);
x_1 = maximum minus value of x for r_1;
x_2 = maximum minus value of x for r_2;
$(r_1 - r_2)$ = depth of thread;
$2(r_1 - r_2) \tan C + F$ = width of space at major diameter (outside).

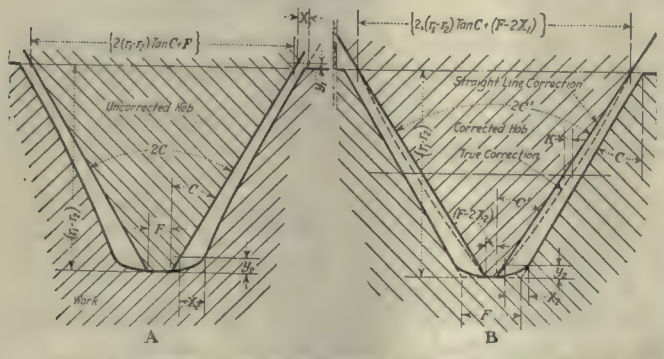


FIG. 6. FORM OF EXTERNAL THREAD CUT WITH UNCORRECTED AND CORRECTED HOB

Fig. 6-B illustrates a corrected hob and the form of thread cut with it. In this figure

$F - 2x_2$ = width of flat at bottom of hob form;
$2(r_1 - r_2) \tan C + (F - 2x_1)$ = thickness of hob form at top;
C' = half the included angle of corrected hob.

If the cutting edge of the hob is kept as a straight line the tangent of half the included angle of the hob form will be equal to half the difference between the widths of hob form at the top and bottom divided by the height of the form. Using the values shown in Fig. 6-B we have the following:

$$\tan C' = \frac{2(r_1 - r_2)\tan C + (F - 2x_1) - (F - 2x_2)}{2(r_1 - r_2)}$$

$$\tan C' = \tan C + \frac{F - 2x_1 - F + 2x_2}{2(r_1 - r_2)}$$

$$\tan C' = \tan C + \frac{x_2 - x_1}{r_1 - r_2} \qquad (7)$$

It will be seen from equation (7) and also from the figures that a corrected hob will have a greater included angle than the thread itself; or, in other words, the included angle of a hobbed thread on a screw or male-threaded part will be less than the included angle of the hob.

The dotted line in Fig. 6-B represents the true correction of the hob. Also in this figure,

r_3 = value of r at middle of thread flank (or at pitch diameter);
x_3 = maximum minus value of x for r_3;
K = difference at r_3 between straight-line correction on hob and true correction;

$$\frac{x_2 - x_1}{2} + x_1 = \frac{x_2 - x_1 + 2x_1}{2} = \frac{x_2 + x_1}{2}$$

= correction at r_3 when hob form remains a straight line;

$$K = \frac{x_1 + x_2 - x_3}{2} \qquad (8)$$

If the rounding or fillet at the bottom of the thread as shown in Fig. 6-B is objectionable the point of the hob may be extended by an amount about equal to y_2, provided that such an undercut is permissible. By so doing an almost theoretically perfect thread form will be secured. This condition is illustrated in Fig. 7. Theoretically, the point should extend slightly more than y_2, as at this point r becomes smaller and R becomes larger than the values of r_1 and R_1. Referring to equation (3), this increase in the value of R will increase the value of r'. Referring to equation (1), this increase in the value of r' and the decrease in the value of r will increase the value of y. But for all practical purposes an extension on the point of the hob of the nearest even dimension to y_2 will usually be sufficiently accurate. On standard threads cut with hobs the resulting error will be in fifth or sixth decimal place.

For the purpose of simplifying calculations Tables I and II have been developed. These tables are based on work whose radius is 1.000. The value of $B/360$ is given opposite varying values of B and values of y/r are given for different values of r/R. In order to use the tables the value of r/R must first be determined, then the value of y/r is multiplied by the radius

TABLE I. VALUES OF RATIO y/r FOR r/R = 0.05 TO 0.45 (EXTERNAL THREADS)

		Ratio r/R of Radius of Deepest Point on Work to Radius of Cutting Point on Hob														
B	$B/360°$	0.05	0.06	0.07	0.08	0.09	0.10	0.12	0.14	0.16	0.18	0.20	0.25	0.30	0.35	0.40	0.45
0° 30′	0.001389	0.00004	0.00004	0.00004	0.00004	0.00004	0.00004	0.00004	0.00004	0.00004	0.00004	0.00004	0.00005	0.00005	0.00005	0.00005	0.00005
1°	0.002778	0.00015	0.00015	0.00015	0.00015	0.00016	0.00016	0.00016	0.00017	0.00017	0.00018	0.00018	0.00019	0.00019	0.00020	0.00021	0.00022
1° 30′	0.004167	0.00034	0.00034	0.00035	0.00035	0.00036	0.00037	0.00038	0.00039	0.00040	0.00041	0.00042	0.00042	0.00043	0.00043	0.00044	0.00044
2°	0.005556	0.00064	0.00065	0.00066	0.00067	0.00068	0.00069	0.00070	0.00071	0.00073	0.00074	0.00075	0.00077	0.00079	0.00082	0.00085	0.00088
2° 30′	0.006944	0.00100	0.00101	0.00102	0.00103	0.00104	0.00105	0.00107	0.00109	0.00111	0.00113	0.00115	0.00118	0.00121	0.00124	0.00128	0.00132
3°	0.008333	0.00148	0.00149	0.00150	0.00151	0.00152	0.00153	0.00156	0.00159	0.00161	0.00164	0.00167	0.00173	0.00179	0.00185	0.00191	0.00197
3° 30′	0.009722	0.00204	0.00205	0.00206	0.00207	0.00208	0.00209	0.00215	0.00220	0.00226	0.00231	0.00237	0.00242	0.00248	0.00254	0.00260	0.00266
4°	0.011111	0.00269	0.00270	0.00271	0.00272	0.00273	0.00274	0.00279	0.00285	0.00291	0.00298	0.00304	0.00313	0.00323	0.00333	0.00343	0.00353
4° 30′	0.012500	0.00328	0.00329	0.00330	0.00331	0.00332	0.00333	0.00340	0.00347	0.00355	0.00362	0.00369	0.00383	0.00397	0.00411	0.00425	0.00440
5°	0.013889	0.00406	0.00407	0.00408	0.00409	0.00410	0.00411	0.00420	0.00429	0.00438	0.00447	0.00456	0.00475	0.00494	0.00513	0.00532	0.00551
6°	0.016667	0.00598	0.00599	0.00601	0.00602	0.00604	0.00605	0.00616	0.00626	0.00637	0.00647	0.00658	0.00686	0.00714	0.00742	0.00770	0.00798
7°	0.019444	0.00822	0.00824	0.00826	0.00827	0.00829	0.00831	0.00843	0.00856	0.00868	0.00881	0.00893	0.00932	0.00971	0.01011	0.01051	0.01091
8°	0.022222	0.01068	0.01072	0.01077	0.01081	0.01086	0.01090	0.01107	0.01125	0.01142	0.01160	0.01177	0.01228	0.01279	0.01330	0.01382	0.01434
9°	0.025000	0.01342	0.01350	0.01358	0.01367	0.01375	0.01383	0.01406	0.01429	0.01453	0.01476	0.01499	0.01564	0.01629	0.01695	0.01761	0.01827
10°	0.027778	0.01646	0.01659	0.01672	0.01685	0.01698	0.01711	0.01741	0.01771	0.01800	0.01830	0.01860	0.01942	0.02024	0.02106	0.02188	0.02270
11°	0.030556	0.01984	0.02002	0.02020	0.02039	0.02057	0.02075	0.02112	0.02149	0.02187	0.02224	0.02261	0.02361	0.02461	0.02562	0.02663	0.02764
12°	0.033333	0.02357	0.02380	0.02405	0.02428	0.02452	0.02476	0.02521	0.02567	0.02612	0.02658	0.02703	0.02824	0.02945	0.03067	0.03189	0.03311
13°	0.036111	0.02766	0.02796	0.02826	0.02855	0.02885	0.02915	0.02969	0.03024	0.03078	0.03133	0.03187	0.03331	0.03476	0.03621	0.03766	0.03911
14°	0.038889	0.03212	0.03248	0.03284	0.03321	0.03357	0.03393	0.03457	0.03521	0.03586	0.03650	0.03714	0.03884	0.04054	0.04224	0.04394	0.04565
15°	0.041667	0.03696	0.03739	0.03782	0.03825	0.03868	0.03911	0.03986	0.04061	0.04135	0.04210	0.04285	0.04483	0.04681	0.04879	0.05077	0.05275

TABLE II. VALUES OF y/r FOR $r/R = 0.50$ TO 2.00 (EXTERNAL THREADS)

B	$B/360°$	Ratio r/R 0.50	0.60	0.70	0.80	0.90	1.00	1.50	2.00
0° 30′	0.001389	0.00006	0.00006	0.00006	0.00007	0.00007	0.00008	0.00010	0.00012
40′	0.001852	0.00010	0.00011	0.00011	0.00012	0.00013	0.00014	0.00017	0.00021
50′	0.002315	0.00016	0.00017	0.00018	0.00019	0.00020	0.00022	0.00027	0.00032
1°	0.002778	0.00023	0.00024	0.00025	0.00026	0.00028	0.00030	0.00038	0.00046
1° 10′	0.003241	0.00027	0.00030	0.00033	0.00036	0.00039	0.00042	0.00053	0.00064
1° 20′	0.003704	0.00034	0.00038	0.00042	0.00046	0.00050	0.00055	0.00069	0.00083
1° 30′	0.004167	0.00045	0.00049	0.00054	0.00059	0.00064	0.00069	0.00086	0.00103
1° 40′	0.004630	0.00057	0.00062	0.00068	0.00074	0.00080	0.00086	0.00106	0.00126
1° 50′	0.005093	0.00073	0.00079	0.00085	0.00091	0.00097	0.00103	0.00127	0.00151
2°	0.005556	0.00091	0.00096	0.00102	0.00108	0.00114	0.00120	0.00151	0.00183
2° 30′	0.006944	0.00136	0.00146	0.00156	0.00167	0.00178	0.00189	0.00238	0.00287
3°	0.008333	0.00204	0.00217	0.00230	0.00244	0.00258	0.00272	0.00344	0.00416
3° 30′	0.009722	0.00272	0.00292	0.00312	0.00332	0.00352	0.00373	0.00469	0.00566
4°	0.011111	0.00363	0.00388	0.00413	0.00438	0.00463	0.00488	0.00614	0.00740
4° 30′	0.012500	0.00455	0.00488	0.00521	0.00554	0.00587	0.00620	0.00781	0.00943
5°	0.013889	0.00570	0.00609	0.00649	0.00689	0.00729	0.00769	0.00969	0.01169
6°	0.016667	0.00826	0.00884	0.00942	0.01000	0.01059	0.01118	0.01408	0.01701
7°	0.019444	0.01131	0.01212	0.01293	0.01374	0.01455	0.01537	0.01938	0.02343
8°	0.022222	0.01486	0.01594	0.01702	0.01810	0.01919	0.02028	0.02563	0.03107
9°	0.025000	0.01893	0.02033	0.02173	0.02313	0.02453	0.02593	0.03293	0.04002
10°	0.027778	0.02353	0.02529	0.02705	0.02881	0.03057	0.03233	0.04132	0.05041
11°	0.030556	0.02865	0.03082	0.03299	0.03516	0.03733	0.03951	0.05084	0.06247
12°	0.033333	0.03433	0.03696	0.03959	0.04222	0.04485	0.04748	0.06153	0.07650
13°	0.036111	0.04056	0.04370	0.04684	0.04998	0.05312	0.05627	0.07343	0.09258
14°	0.038889	0.04736	0.05106	0.05476	0.05847	0.06218	0.06589	0.08658	0.11147
15°	0.041667	0.05473	0.05905	0.06337	0.06770	0.07203	0.07636	0.10102	0.13380

of the work to obtain the value of y. The values of y/r may be obtained by interpolation when the value of r/R does not agree with any of those given. The values given under $B/360$ are divided by N and substituted in the equation $x = y \tan C - (B/360N)$ to obtain the value of x.

In order to illustrate the use of these tables and to determine the effect of varying the diameter of the hob the following three examples will be taken: An Acme thread, 5 threads per inch, one inch in outside diameter will be cut with hobs (1), one inch in diameter, (2) two inches in diameter, and (3) four inches in diameter. An Acme thread is selected because the smaller included angle of thread results in more side-cutting, thus making more pronounced the effect of varying the diameter of the hob. The depth of an Acme thread of this pitch is 0.110 in. The included angle is 29 deg.

The width of the flat at the root of the thread is 0.0689 in.

In the first example we have the following:

$C = 14$ deg. 30 min. $\quad N = 5$

$r_1 = 0.500$ in. $\quad R_1 = 0.390$ in.

$r_3 = 0.445$ in. $\quad R_3 = 0.445$ in.

$r_2 = 0.390$ in. $\quad R_2 = 0.500$ in.

This gives the following values for $\frac{r}{R}$:

$$\frac{r_1}{R_1} = \frac{0.500}{0.390} = 1.28 \qquad (a)$$

$$\frac{r_3}{R_3} = \frac{0.445}{0.445} = 1.00 \qquad (b)$$

$$\frac{r_2}{R_2} = \frac{0.390}{0.500} = 0.78 \qquad (c)$$

The values of x and y for the ratio (a) will first be computed. Referring to Table II, and interpolating between $r/R = 1.00$ and $r/R = 150$ for $r/R = 1.28$ gives the values for y/r. Dividing the values of $B/360$ in this same table by the value of $N(= 5)$ gives the values of $B/360N$. These values are as follows:

For B =	5°	6°	7°	8°
$\frac{y}{r}$ =	0.00881	0.01280	0.01762	0.02328
$\frac{B}{360N}$ =	0.002778	0.003333	0.003889	0.004444

Multiplying the values of y/r by $r(=0.500)$ gives the values of y. Substituting these values of y and the values of $B/360N$ in the equation $x = y \tan C - B/360N$, gives the values of x. These values thus obtained are as follows:

For B =	5°	6°	7°
x =	—0.001637	—0.001678	—0.001611
y =	0.004405	0.006400	0.008810

As soon as the maximum minus value of x is determined, it is unnecessary to proceed further.

In like manner the values of x and y for the ratio (b) are determined. These are as follows:

For B =	6°	7°	8°
y =	—0.002046	—0.002123	—0.002110
y =	0.004975	0.006830	0.009025

The values of x and y for ratio (c) are as follows:

For B =	7°	8°	9°	10°
x =	0.002519	—0.002641	—0.002694	—0.002671
y =	0.005296	0.006973	0.008912	0.011099

Using equation (7) the correction in the angle of the hob form is computed. The tabulations above give the following factors:

$r_1 = 0.500 \qquad x_2 = 0.002695$

$r_2 = 0.390 \qquad x_1 = 0.001678$

$r_1 - r_2 = 0.110 \qquad x_2 - x_1 = 0.001017$

$\tan C = \tan (14° 30,) = 0.25862$

Substituting these values in equation (7) we have

$$\tan C' = 0.25862 + \frac{0.001017}{0.110} = 0.26786$$

$$C' = 14° 59' 43''$$

$$2C' = 29° 59' 26''$$

In this case the difference between the angle of the hob and the angle of the work is 59 min. 26 sec.

The above correction is made in a straight line. Equation (8) will show the difference between this correction and the true correction at the middle of the flank; thus:

$$x_1 + x_2 = 0.004373$$

$$x_3 = 0.002123$$

$$K = \frac{x_1 + x_2}{2} - x_3 = \frac{0.004373}{2} - 0.002123 = 0.000064 \text{ in.}$$

This is negligible and can safely be ignored. In fact, it is much less than the probable error in the hob.

Referring to Fig. 6-B, the dimensions of the corrected hob and the thread produced will be as follows:

Work	Hob
$F = 0.0689$ in.	$F - 2x_2 = 0.0635$ in.
$2C = 29$	$2C' = 29° 59'$
$y_2 = 0.0089$	

This means that the corrected hob will cut an almost theoretically perfect thread form above the fillet which extends 0.0089 in. above the root of the thread. In an Acme thread a clearance of 0.010 in. is provided at this point, so that no further correction need be made. If desired, however, the point of the hob could be extended about 0.010 in., as shown in Fig. 7. In like manner the following values are determined in the second example:

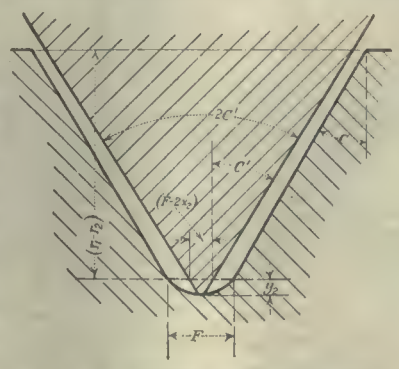


FIG. 7. FORM OF EXTERNAL THREAD CUT WITH POINT OF HOB EXTENDED

$2C' = 30° 0' 16''$	$F - 2x_2 = 0.0619$ in.
$K = 0.000054$ in.	$y_2 = 0.012344$ in.

The values in the third example are as follows:

$2C' = 30° 0' 54''$	$F - 2x_2 = 0.0608$ in.
$K = 0.000026$ in.	$y_2 = 0.014422$ in.

The following tabulation is made to show the various effects of varying the diameter of the hob. (Fig. 6-B.)

Hob. diam. =	1.000 in.	2.0000 in.	4.000 in.
x_2 =	0.002695	0.003475	0.004048
y_2 =	0.008912	0.012344	0.014422
$2C'$ =	29° 59' 26''	36° 0' 16''	30° 0' 54''
$F -$ $2x_2$ =	0.0635	0.0619	0.0608
K =	0.000064	0.000054	0.000026

From the above tabulation it will be seen that the amount of side-cutting at the bottom of the thread (x_2) increases as the diameter of the hob is increased. The height of the fillet at the bottom of the thread (y_2) also increases as the diameter of the hob increases, in fact, it increases about three times as much in this case as x_2. The included angle of the corrected hob ($2C'$) increases very slightly as the diameter of the hob increases. The width of the point of the corrected hob ($F - 2x_2$) varies less than 0.003 in. as the diameter of the hob is increased from 1 to 4 in. The dimension K in Fig. 6-B is reduced as the diameter of the hob increases.

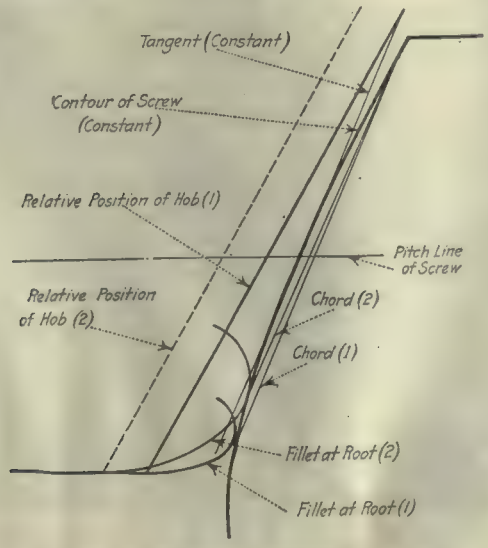


FIG. 8. DIAGRAM SHOWING CORRECTION FOR ANGLE

The correction for angle used in these solutions is a chordal correction. This shows a slight change in angle as the diameter of the hob varies. A geometrical solution of this side-cutting will show that except for the fillet at the root of the thread the profile is unchanged regardless of the diameter of the hob. Therefore, if the correction is taken as the tangent of the profile at the pitch line of the thread the angle C' will remain unchanged. This is shown in Fig. 8. The formulas for determining this angle are as follows:

Let $C = \frac{1}{2}$ included angle of thread;
$C' = \frac{1}{2}$ included angle of corrected hob;
$H =$ helix angle of thread at pitch line.

Then

$$\tan H = \frac{1}{\pi N \times \text{pitch diameter of thread}}$$

and $\tan^2 C' = \tan^2 C + \tan^2 H$.

It is evident from the above that if the form of the cutting edge of a hob of a certain diameter be corrected to cut a thread of a certain diameter and pitch a variation in the diameter of the hob of, say, 25 per cent will have but little effect on the form of the thread produced on the work.

In order to determine the effect of varying the diameter of the work the following tablation was made for a hob 2.0000 in. in diam. with Acme threads per inch.

Work diam. =	1.000 in.	2.000 in.	4.000 in.
x_2 =	0.003475	0.001161	0.000350
y_2 =	0.012344	0.004103	0.001512
$2C'$ =	30° 0' 16''	29° 14' 8''	29° 3' 6''
$F -$ $2x_2$ =	0.0619	0.0666	0.0682
K =	0.000054	0.000012	0.000003

The above tabulation shows that the amount of side-cutting at the bottom of the thread (x_2) decreases as the diameter of the work increases. The height of the fillet at the bottom of the thread (y^2) decreases as the diameter of the work increases. In this case it decreases about four times as much as x_2. The included angle of the corrected hob decreases quite rapidly as the diameter of the work increases. The width of the point of the corrected hob increases about 0.006 in. as the diameter of the work is increased from 1 in. to 4 in. The dimension K in Fig. 6-B decreases as the diameter of the work increases. In this case the amount of error introduced by a straight-line correction in the hob is in the fifth and sixth decimal place and is negligible.

It is evident, therefore, that a hob which is corrected for a certain diameter of work cannot be used on work which varies very much in diameter if accurate results are desired. The smaller the diameter of the work the more this condition is accentuated. This is due, in large measure, to the rapid increase of the helix angle on smaller diameters. On work of large diameters, where the helix angle is very small, little or no correction is required on the hob.

(To be continued in next week's issue.)

Making a Narrow Belt from a Wider One

By John A. Grill

There is an error in the sketch accompanying the article under the above title on p. 823 of *American Machinist*. The wooden block between the vise jaws should be just large enough to let the belt slide through.

Made in the manner indicated by the sketch the belt would crowd over to the other jaw because there is nothing to prevent such action, especially if the knife blade is not parallel to the jaws. With the space between the jaws just wide enough to let the belt slip through it cannot get out of position.



Unnecessary Finish On Tools

By John A. Honegger

On page 365, Vol. 52, of the *American Machinist*, George H. Henrietta gives certain "Instructions to Toolmakers" regarding the finish on tools.

This "putting on of finishing touches" as one might say not only crops up in the jobbing shop but wherever there is a toolmaker who takes pride in the work he turns out. The writer also has had trouble in this respect and to eliminate it had a rubber stamp made as following:

NO FINISH EXCEPT ON WORKING SURFACES OR WHERE INDICATED

The letters were about $\frac{5}{64}$ in. high by $\frac{3}{32}$ in. wide and the whole stamp covered a space of about $1\frac{1}{2}$ x 6 in.

This notation was stamped on all detail and assembly drawings in two places: at the top of the sheet and to the left of the title. With this notation on the drawing it was strictly up to the workman or the jobbing shop. If at inspection the tool was found to have extra finish on it the producer had to explain.

Know What You Are Doing and Why You Are Doing It

By John A. Grill

Under this title on p. 612 of *American Machinist* A. W. Forbes writes of setting a lathe tool below the center line of the work in order to make it cut better. I keep mine *above* the center. When I lower it the results are not so good.

Mr. Forbes says: "A way that leads to knowledge . . . is to break every rule and see what happens." Here is the way I broke one.

A casting mounted upon a mandrel in the lathe had a small boss projecting from its face at a distance of 8 in. from the center of the mandrel. I was facing off this boss, the tool cutting only when the projection came around, and was "cutting wind" for the remainder of each revolution. The tool was set about level with the lathe centers.

I had ground the tool in every way I could think of and had tried several different settings; had also tried running the lathe at various speeds, but the job persisted in chattering very disagreeably.

Along came a friend, who said: "Turn over your tool and run the lathe backward." I did this and it worked fine. I could run the lathe at a pretty good clip, there was no chatter, and I secured an excellent finish. What caused the work to act that way is beyond me unless it gets a better support by pulling up.

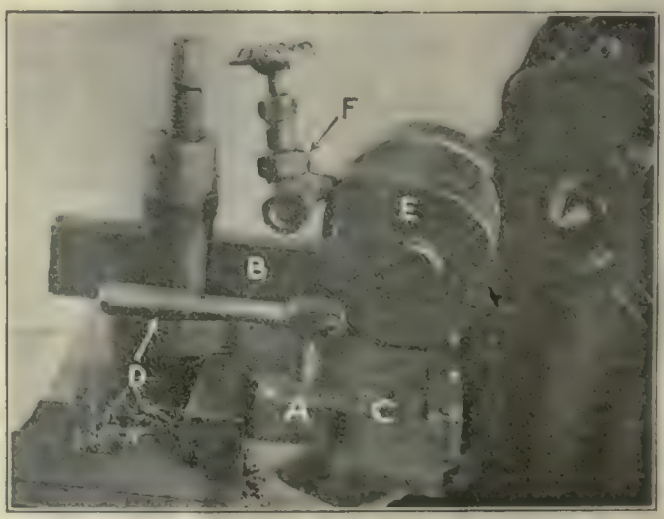
Grinding Device Run by an Air Turbine

By J. V. Hunter

The grinding device operated by an air turbine and shown in the illustration was built in the Decatur car shops of the Wabash Railroad Co. for grinding lathe centers and for handling little jobs of grinding that are sometimes done on a lathe. The lower frame *A* is attached to a shank *B*, that enables the whole device to be supported in the toolpost of a lathe.

The housing for the turbine and the wheel-arbor are mounted on the slide *C*, which enables them to be fed longitudinally by means of a rack and pinion drive operated by the lever *D*. The turbine consists of a cast brass housing *E* in which a common fan-type propeller is rotated by the air blast coming from a small nozzle and controlled by the valve *F*. The air hose is not shown connected. Exhaust from the turbine is through a number of small holes drilled in the left-hand side of the periphery of the housing. It will be noted that a small cast wheel-guard covers the upper side of the grinding wheel.

It may be noted in passing that air turbines of this character are usually heavy consumers of compressed air, and that therefore they cannot be looked upon as providing an efficient method of propulsion.



AIR-TURBINE DRIVEN DEVICE FOR GRINDING LATHE CENTERS

Rockford Heavy-Duty Horizontal Boring Machine

SPECIAL CORRESPONDENCE

A boring and drilling machine intended chiefly for the work encountered in the automotive field, particularly the machining of crankcase bearings, is the subject of this paper. The tool has been developed from past designs of machines intended for the same purpose.

THE Rockford Drilling Machine Co., Rockford, Ill., builds a heavy-duty horizontal drilling and boring machine for automotive work. As early as 1916 it became apparent to the staff of the concern that there was a real demand for a single-purpose, heavy-duty, horizontal drilling and boring machine which could be highly standardized for automotive work and still would be flexible enough to meet almost any requirement. As a nucleus for the horizontal machine, the head of the Rockford vertical, heavy-duty drilling machine, complete with driving gears, spindle and feed mechanism, was used. This head can be shortened to give as little as 12-in. spindle travel or increased to give 40 in. In combination with different spindle designs and multi-spindle heads, it provides the means of rotating the bars and tools.

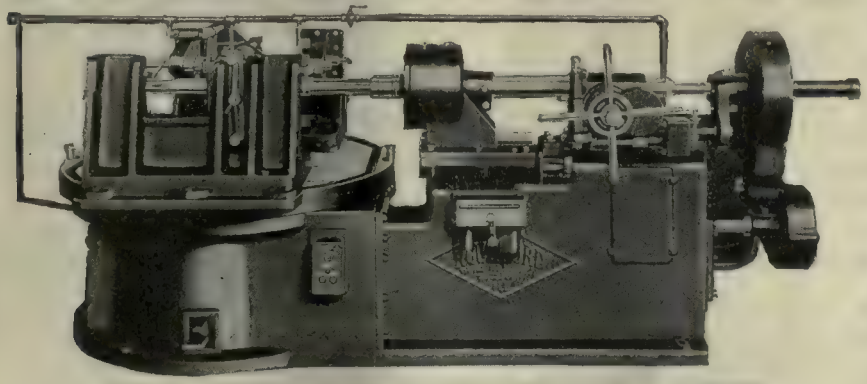


FIG. 1. ROCKFORD HEAVY-DUTY HORIZONTAL BORING MACHINE FOR AUTOMOTIVE WORK

The machine here described, see Fig. 1, is one of three built for the Olds Motor Works, Lansing, Mich., for boring crankshaft and camshaft bearings on an 8-cylinder motor. This machine is provided with two duplicate work-holding fixtures mounted on an indexing table. The loading station is at the rear of the machine and the operating station at the front.

While one fixture is being unloaded and loaded, and the bars and cutters changed at the loading station, the other fixture is at the operating station and the piece it holds is being bored. When the operation is complete, the operator disconnects the bars from the driving head and steps on the treadle projecting through the front side of the base. The treadle mechanism pulls the index pin and lifts the table on a large ball slightly off its bearing on the base. The table is then rotated 180 deg., bringing the new piece of work in line with the spindle and the finished one around to the loading station. This method of handling makes the operation almost continuous.

Care has been taken in designing the fixtures so as to provide adequate clamping devices of such form that the work will be held firmly, but not sprung out of shape. In this particular case, the lower surface of the crankcase is clamped against hardened-steel plates mounted on a vertical surface. This arrangement keeps the locating surfaces clean. Location of the crankcase is obtained by means of hardened dowels entering reamed holes in its lower surface. These dowels are relieved of all cutting strain by means of spring plungers, which are locked in position after the case is in position. The main drive may be either by motor or countershaft. When the countershaft drive is used, a three-step cone is provided, also a tight- and loose-pulley countershaft equipped with Hyatt roller bearings. The motor shown mounted on the back of the machine in Fig. 2, is directly connected through gears without the use of flexible couplings or chains. Interchangeable gears are provided for speed changes with both types of drive.

Feed changes are four in number, the mechanism being incorporated in a feed box employing a movable driving-key. The feeds are placed in geometric ratio, with a factor of 1.5. A forward and reverse feed mechanism can also be provided. All bearings on both the drive and feed mechanisms are bronze-bushed. The base is of heavy box section, well ribbed, and is bolted together in such a manner as to facilitate changes in design without many pattern changes. The feed and drive mechanisms are completely mounted on one base section and the fixtures holding the work are mounted on the other section.

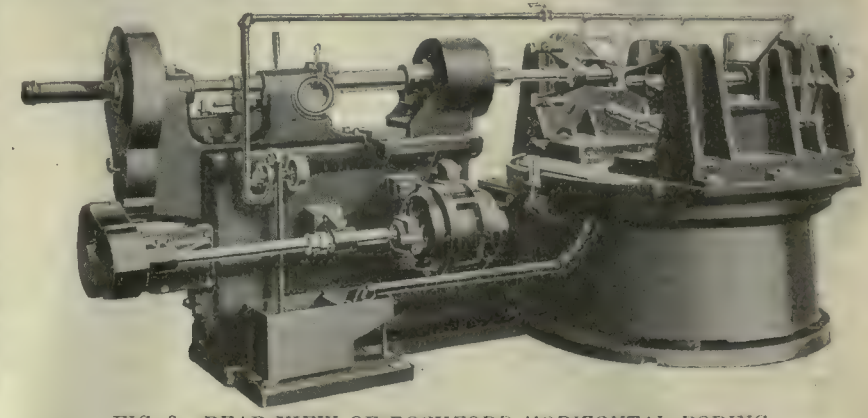


FIG. 2. REAR VIEW OF ROCKFORD HORIZONTAL BORING MACHINE, SHOWING MOTOR AND FIXTURES

The machine bores simultaneously two crankshaft bearings 2 $\frac{15}{16}$ in. diameter by 2 $\frac{3}{4}$ and 2 $\frac{15}{16}$ in. long, respec-

tively, and three camshaft bearings in aluminum at a cutting speed of 200 ft. per minute and 0.010 in. feed per revolution of the spindle. The operations are divided into rough boring, facing and finish boring, a machine being provided for each operation. All these operations with the addition of counterboring, drilling, etc., may be combined on one machine, if the rate of production does not warrant more equipment.

The Equipment

The equipment for the work includes a complete set of Kelly Reamer Co.'s bars and cutters. A floating drive is used between the bars and spindles, so that the accuracy of the work depends upon the fixture alone. Liner bushings are provided in all cases, so that it should be easy to re-align the boring-bar guides in case of wear.

It is said that the machines are adaptable to a wide range of work and can be easily arranged to take care of holes from 1 in. in diameter in steel to 12 in. in cast iron and aluminum. They are rated at a capacity of 2½ in. in diameter when drilling from the solid in steel.

The machines have been adapted to different sorts of work, such as crankcase and transmission-case boring for tractors, trucks and passengers cars, including facing and counterboring, cylinder boring for tractors, drilling and reaming, rear-axle drilling and boring, gun-carriage work, centering of large forgings, milling pads on crankcases, and double-end drilling.

Making Thrift Seem More Worth While

By FRANK H. WILLIAMS

It is not very generally realized by plant executives that thrift among employees is very closely allied with contentment on the part of employees, and with increased production. But such is the case as any executive can very readily determine for himself by investigating conditions among employees who are saving on a systematic basis, and among employees who are always "only a month ahead of the poor house."

IF A PLANT executive will undertake an investigation in an impartial frame of mind and if his investigation is thorough and unbiased, he will find—in the great majority of cases—that the restless employees are those who spend everything they make and that the substantial employees, upon whom he has to depend in the long run for the great bulk of production, are those who are laying up something for a rainy day.

And the exectuive will also find that among the more substantial employees there is a very clear appreciation of just what thrift is and an almost enthusiastic commendation of any worth while steps taken by the plants where they are employed to help them in their savings.

An employee who saves is taking the first step toward the owning of property—his own home, first of all. And employees who own their own homes or any sort of property are always the ones who are anxious for stabilized working conditions and who are generally leaders in all fights against bolshevism and kindred evils.

Consequently, it is very evident that the cultivation of thrift among employees of any plant is a mighty good thing for that plant in the way of stabilizing conditions and in the way of increasing production.

And, just as it is a good thing for any plant to have employees who are thrifty, so is it an infinitely better thing for the plant to create a feeling of co-operation between employer and employees by doing something definite and specific to help the employees with their savings. And if the employer in helping the employees does more in the way of help than would be done by any outsiders—such as banks, trust companies, home building companies, etc.,—then the confidence of the employees in the employer will be increased by just that much, and the spirit of co-operation between the two will be fostered by just that much extra help given employees beyond what an outsider would do for them.

Ways of Helping Employees to Save

Now there are a number of ways in which a plant can help employees in making savings, and in considering these plans it is best to first consider the usual ways in which employees save money.

One of the newest and most popular methods of saving is by means of "Christmas Clubs" in which a specified amount is paid every week for a period of fifty weeks at the end of which the bank or trust company conducting the club sends a check to the saver for the total amount of his savings plus a small amount of interest. While such clubs are ostensibly for the purpose of providing the savers with money for Christmas expenses, the fact is that the great majority of club members use the clubs simply as easy methods of saving money. Only a small percentage of the total volume of Christmas club checks is ever used for Christmas presents.

Life insurance is an established form of saving money among men employees.

A regular savings account is another method of saving money.

Purchase of stock in the employing company by means of deductions from the regular weekly wages, constitutes another method.

Purchase of Liberty bonds or other securities on the partial payment plan is another method, and the purchase of necessities on the partial payment plan, while not primarily a method of saving money, still is a method of increasing the employees' "working capital."

Employers who seek to help employees save money generally adopt some method in line with the foregoing, but because of familiarity with all these plans and because of the fact that most of the plans are almost hoary with age, the employees quite frequently do not respond to the conveniences offered them with as much enthusiasm as the company would like. And yet, if the employers tried out some new method of inducing thrift among the employees it is quite likely that the employees would almost entirely ignore it through fear that the new plan was designed primarily for "putting something over" on them.

The problems confronting employers who wish to

increase production and stability through increasing the thrift tendencies of employees are—How can thrift be made to seem more worth while? How can more employees be induced to save money? And how can those employees who are saving a little be induced to save more?

Most successful business enterprises when confronted with a business problem attack it from these angles:—1. What is the difficulty to be overcome? 2. What are the methods of overcoming the difficulty? 3. What results will be achieved by each of the plans suggested for solving the problem?

It would seem as though the same questions should be applied to this thrift proposition. Under this questioning we find that the answer to the first question brings out this interesting point—the difficulty to be overcome is an individual, personal difficulty with most of the employees. It is not a problem for mass settlement, but a problem for individual treatment. Under the second question we find that all of the methods suggested for saving money are good plans. Under the third question we find that the results to be achieved with one employee under the Christmas savings plan would be splendidly satisfactory, while with another employee the problem of life insurance is most important, so that aid in the purchase of life insurance would make the greatest hit with the latter employee. And so on with all the employees.

A Personal, Individual Problem

In the final analysis, the matter of thrift among employees is a personal, individual matter which demands personal, individual treatment. Just as general health rules are a good thing for the employees of any plant, so general thrift suggestions are a good thing for them. But to make some employee well who is suffering with fever, it is necessary to give that employee careful, thoughtful, personal and individual attention. And just in the same way it is necessary to give some impractical employee who sneers at thrift suggestions some careful, thoughtful, personal, individual attention if that employee is to be made to see the advantages of saving money; is to be helped in saving money in the manner which most appeals to him and is, through the building up of a personal thrift habit, to be made into a conscientious, contented and dependable employee.

A man's personal money affairs are just about as intimate and individual as anything can possibly be. The normal man resents the usual sort of probing and prying into his money affairs and he hates to be lumped in the class of "unthrifty" according to some general scheme of statistics. But he will open his heart and listen to reason when a friend in whom he trusts goes out of his way to show why thrift is well worth while.

So if you want to get the best results in building up thrift among the employees of your plant, get away from the idea that it is a mass problem. It isn't! It's an individual, personal problem. And the more individual and personal your treatment of it is, the more satisfactory will be the results.

Help-Wanted Advertisements

By H. M. Fitz

I was interested in the article in the *American Machinist*, page 892, by A. W. Forbes, entitled "Getting the Right Man Through the Help-Wanted Columns." Not being an authority on advertising, I can speak only from experience which indicates that what is said in the ad makes all the difference in quantity and quality of applicants.

Looking over the help-wanted column you see many ads that you know it is a case of taking a chance to answer. For instance, this is an actual ad word for word: "An all-round mechanic wanted, state age, married or single and salary expected—Address Box —." Can anyone tell to what vocation the above ad refers? It may be that of an all around boilermaker, carpenter, plumber, machinist, or any one of fifty other vocations. The age makes a difference and if a road job, a single man is preferable. Salary means a great deal because some people would rather work at half price at certain localities than at others. It is also a blind ad. Who? Where? As Mr. Forbes says, everybody out of a job will answer it. On that particular ad thirty-six men did take the chance but not one was employed because the ad failed to tell what was wanted, and as mechanics are not versed in mind reading, they all lost out; so did the author of the ad.

The position was vacant until this ad appeared: "A mechanic who is an all-around boilermaker, 35 to 50 years of age; some road work; single man preferred; 90c. per hour; address, H. H. & H. Co., Cleveland, Ohio." This ad cost twice as much as the other one and only four answers were received. One was employed and to tell the truth it was hard to pick that one, as no doubt any one of the four could have filled the job. It seems to me that the more definite the ad the better the results. It may not bring as many answers but those who do answer, will, no doubt, be nearer what is wanted.

"Blind" Ads

The writer some years ago answered the following ad: "An efficiency man wanted; good salary and prospects; give age, experience and reference in first letter. Box —." The reply I received was to this effect: "As you have had no coal mining experience we cannot use you." If the ad had mentioned "coal mining experience" I am sure it would have saved both of us time and trouble.

Another: "A production manager wanted by a first-class firm for special work on Sundays. Not oil, or land, or insurance, but good money assured." No, I did not answer this one for the reason that they take up too much space telling what it is not rather than tell in less words what it is. Also, it was "blind" and the deep secret will remain such so far as I am concerned.

A friend not long ago asked me to loan him $1,000 and showed me an ad in large type as follows: "Wanted: A production man to invest $1,000 with services; $20 a day and 10 per cent interest on your investment. Box —." I told him to answer it and find out who it was and all about it. He did so and got an answer from The ——— Transportation Co. advising him to call for personal interview as soon as possible on a matter of great importance to him. He therefore took a day off and went to the nearby town where the firm was located to cinch this wonderful opportunity. The next day I said "Jim, how did you come out? You want that money today?" "No," replied Jim, "he doesn't want a production manager; he wants a truck driver and tried to sell me a half interest in his two-truck route."

My experience has been that we can't expect to get the right man with the wrong ad any more than we can expect to catch brook trout with alligator bait—they may bite but you will never land them. A blind, indefinite ad may bring answers, but not results.

WHAT to READ —for the man in a hurry



Suggested by the Managing Editor

THERE is more of the automotive information this week in the leading article. Fred Colvin continues his series by writing on "Sheet-Metal Work for Automobiles." He enumerates several of the problems encountered in the sheet-metal branch of the industry and explains their solutions.

The highly poisonous cyanogen gas, which for the most part has hitherto been led as quickly as possible to the stack and allowed to dissipate, is now being controlled and caused to perform the work for which it is very effective—that of carburizing. "A New Method of Case-Hardening Steel" is the title of the paper by Wm. J. Merten, page 1169, in which the cyanogen gas method of carburizing is compared with present methods and a design of a regenerative cyanogen-gas carburizing furnace is shown.

What to read was not a difficult matter to decide two hundred years ago when books were few and magazines unheard of. It is far different now when so much reading matter is offered to pass the time pleasantly or profitably as the reader chooses. We are doing our utmost to make the "American Machinist" not only profitable but indispensable as a clearing house of ideas and news of the machinery world. This page is the editors' advertisement of their section of the paper. It gives the high spots

Entropy writes on "The Turn of the Tide," page 1170. He refers to the tide of ever-changing wages, that, as he sees it, is now an ebb-tide. "The law of supply and demand has never been out of operation for very long at a time," and "It takes two to make a fight, but only one to start a massacre," are two of Entropy's interesting statements.

We have recently had a report on the three-shift day in the steel industry which leads us to believe that we shall eventually get entirely away from the twelve-hour day in this, the last big industry, to give it up. At the same time some of the members of the steel industry have been leaders in another movement of importance—namely, education. Morris' seventh installment of his series on apprenticeship deals with schools at the Carnegie Steel Co.'s Pittsburgh plant. Page 1172.

An account of the meeting at which the report on the three-shift system in the steel industry was read, begins on page 1182. It was a joint meeting of the Management and Metropolitan Sections of the American Society of Mechanical Engineers, the New York section of the American Institute of Electrical Engineers and the Taylor Society. An abstract from the paper by Horace B. Drury is given.

Bruce W. Benedict, manager of shop laboratories, University of Illinois, has a very interesting article on "Helix Angle of Twist Drills," page 1175. He concludes, from experiments, that with the present design of flute, the most efficient high-speed milled twist drill has a helix angle of 35 deg. and that a drill with this helix angle consumes less power and generally has greater endurance than drills of other helix angles.

Many suggestions have been made as to how to increase production, satisfy workers, maintain morale and in general to make of the plant a big, happy family. Now comes C. B. Lister with advice that target shooting is an aid in industry. Page 1178.

The second part of "Early Traces of the Toothed Wheel" begins on page 1179. Manchester is the author. He takes up the development of gearing from the sixteenth century up to the time of Watt.

W. H. Chapman's paper, "Cylindrical Grinding in 1920," is concluded in this issue, page 1184. The first part appeared last week.

An interesting article is that on "The Cost of Labor and the Labor-Cost" by Elmer W. Leach, page 1188. Labor does not want its wages reduced, yet if selling price is lowered labor-cost must come down. Read the suggestions Mr. Leach has to offer to bring about adjustments to satisfy all concerned.

A paper which received much praise from engineers was "Side Cutting of Thread-Milling Hobs," by Earle Buckingham, of the Pratt & Whitney Co., read before the Machine Shop Section of the A. S. M. E. at the annual meeting last week. We understand that the preparation of this paper extended over a period of two years. Beginning on page 1192, we are publishing the part dealing with the hobbing of screws. The article will be concluded next week with the publication of the second part, dealing with the hobbing of internally threaded parts.

Our shop equipment news section is not large this week, but it should be borne in mind that the general article on the Rockford heavy-duty horizontal boring machine should be read in connection with that section.

CHRISTMAS—*the turning point*

THE CHRISTMAS SEASON is not one when the Spirit of Gloom is welcome. He and his chief-of-staff, General Discouragement, have had things very much their own way for too many weeks, but with the advent of the Spirit of Christmas their fortunes are doomed to a sudden reverse which may well be made the beginning of a complete rout of all their forces.

Just as the bright and confident spirit of the little force of Americans at Chateau Thiery stopped the on-rush of the German hordes and revived the flagging courage of the jaded French and British veterans, so will the perennially youthful Christmas spirit defeat the forces of gloom and point the way for all of us to follow. Christmas alone cannot carry the day—we have all got to dig in and help. For Christmas is soon over and we may easily suffer a relapse from the confidence that means good business, to the doubt that spells depression.

It is not a baseless, Pollyanna-like optimism that we urge for there is plenty of reason to look forward to a prosperous year in American industry.

DON'T FORGET that we are blessed with better than average crops and that in the last analysis the buying power of the farmer determines the volume of the country's business. It is quite true that the reduction in prices of farm products means a considerable lowering of the farmer's income as compared to that of last year. But on the other hand the prices of the goods the farmer buys are bound to follow the drop in prices of the goods he produces and thus make his dollar of income buy more than it did last spring. It is too much to hope that an equalization of prices will be reached immediately. There is back-lash in the gears of trade which must be taken up. But the slow speed lever of deflation has been thrown in and it will not be many weeks before the driving impulse reaches the last gear in the train and the whole mechanism of business settles down to a steady pull that is more significant of solid success than the feverish racing along on high that has just ended.

Transportation difficulties are much less serious than they have been in years. While there is still much to be done to bring the railroads back to real efficiency there is good reason to believe that their affairs will be in such shape before summer that they can place orders for the tools they have long needed so badly.

THE MOST ENCOURAGING NEWS of the month is the formation of the Foreign Trade Financing Corporation at Chicago for the purpose of supplying the capital necessary to finance foreign trading under the provisions of the Edge law. The new corporation is a practical step in the right direction and while its limited capital will not go very far in financing the foreign trade of the United States, it will help and will serve to turn men's thoughts to the problems of equalizing exchange. The present exchange rate on American dollars all over the world represents a barrier that is more difficult to surmount than any protective tariff wall ever devised. Further steps will undoubtedly be taken during the coming year to remedy this evil.

So far as domestic finance is concerned we are in a better position than ever before. The Federal Reserve System has withstood inflation and deflation strains that would have wrecked the banking system of the last decade. Perhaps it has not always managed to care for everyone, but is that to be wondered at in the reconstruction period following the greatest war in history?

MANY OTHER FAVORABLE CONDITIONS and tendencies could be added but they have been discussed so many times that it seems useless to reiterate them. Most of our adversities have passed, or are passing, and it is therefore our present duty to recognize the fact and relegate it to the dead past.

The events of the last half of the year 1920 have disclosed a startling lack of morale among American business men. Is this a sudden development or the result of the softening effect of four years of easily-secured orders and unusual profits? Have we forgotten how to fight so soon? Granting that the intangible cohorts of gloom are harder to fight than many Germans, we have certainly not acquitted ourselves of late as we should. The picture of the richest nation in the world facing a promising future with dark foreboding must be one to excite the people of war-torn Europe to scornful derision.

LET'S BRACE UP! Worrying over the future never helped any one. On the contrary it is usually a contagious disease that spreads like a forest fire and consumes the courage of all who encounter the worrier. If you must worry, don't do it in public but present a bold front to the men you meet and open your intelligence to the basic economic facts that insure a golden future for all of us here in America.

Let the Christmas spirit into your soul to banish the shadows of past reverses and make sure of success in the new year by keeping it there.

We wish you all a very merry Christmas and a *busy* New Year.

SHOP EQUIPMENT NEWS

-Edited by-
S. A. HAND

SHOP EQUIPMENT • NEWS •
A weekly review of modern designs and • equipment •

Descriptions of shop equipment in this section constitute editorial service for which there is no charge. To be eligible for presentation, the article must not have been on the market more than six months and must not have been advertised in this or any previous issue. Owing to the news character of these descriptions it will be impossible to submit them to the manufacturer for approval.

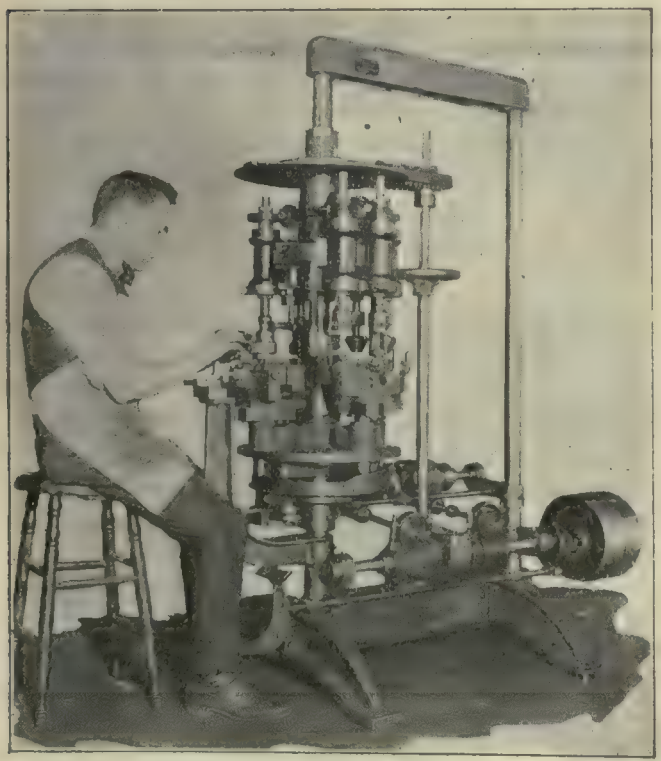
• CONDENSED • CLIPPING INDEX
A continuous record of modern designs • and equipment •

Jackson Vertical Automatic Chucking Machine

The Jackson vertical automatic chucking machine is manufactured by the Long-Henkel Manufacturing Co., Reading, Pa. It is intended for drilling, threading, turning, facing, etc., in the quantity production of small parts, such as nuts, pulleys, pipe fittings, battery terminals and electrical fixtures.

The machine is built in three types, the illustration showing one of the reciprocating kind and listed as "Type B." It has four duplex automatic chucking vises and three pairs of working spindles, being adapted chiefly to the class of work requiring drilling or boring, drilling to size, and then threading or tapping.

The chucking vises automatically eject the finished articles, and after the operator puts the unmachined parts in place the vises close automatically, thus relieving the operator of everything but the handling of the blank pieces and the observation of the work, which is constantly in his view. The machine has a positive drive throughout and is fully equipped with ball bearings.

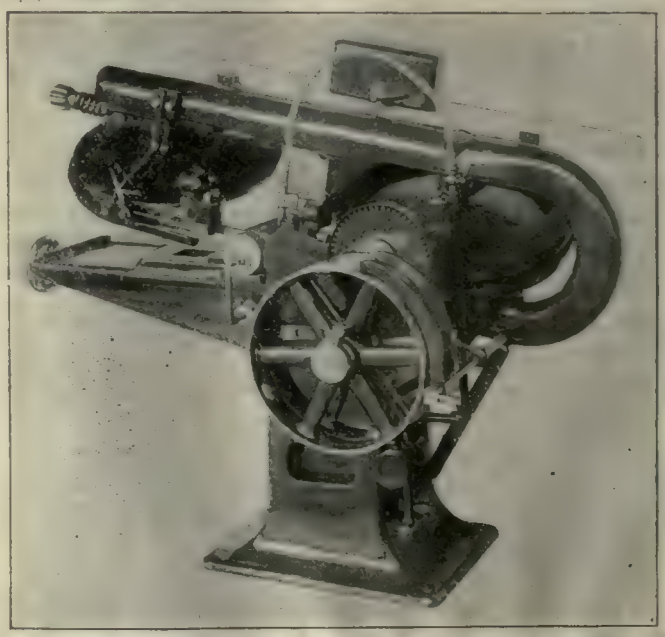


JACKSON "TYPE B" VERTICAL AUTOMATIC CHUCKING MACHINE

Quick-acting tool adjustments are provided, so as to facilitate setting up. The machine can be used to perform a number of operations at one time, the possibilities being limited chiefly by the number of spindles that may be used. As a threading or tapping machine for standard work, a magazine feeding appliance may be used. It is said that no particular skill is required of the operator. The floor space required is 3 x 5 ft., and the approximate weight is 1,450 lb. When boxed for export the weight is 1,750 lb. and the volume of the box is 1,050 cu.ft.

"Horizontal Junior" Metal Cutting Machine

The illustration shows the "Horizontal Junior" metal-cutting machine recently placed on the market by the Metal Saw and Machine Co., Inc., Springfield, Mass. The cutting is done by means of a bandsaw mounted almost horizontally on a frame that can be swung in a vertical plane in order to raise the saw. A capacity for work up to 4 x 4 in. is provided, the machine being a general-purpose, quantity-production tool. The cutting portion of the saw is held in position by means of roller guides, it being claimed that the cut made



"HORIZONTAL JUNIOR" METAL-CUTTING MACHINE

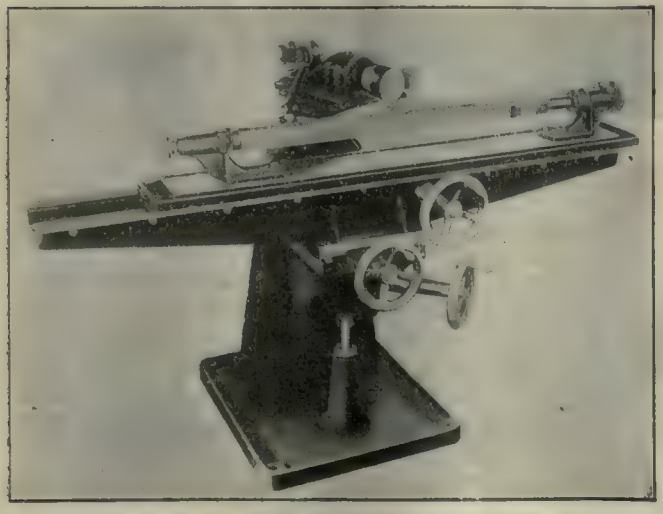
Specifications: Capacity, 4 x 4 in. Saw: length, 8 ft. 4 in.; width, ⅝ in.; thickness, 0.032 in.; kerf, 0.047 in. Cutting speed, 120 ft. per minute. Speed of drive pulley, 250 r.p.m. Height, floor to table, 26¼ in. Floor space, 2 ft. 8 in. x 4 ft. 6 in. Weight: net, 425 lb.; crated, 500 lb.; boxed for export, 625 lb. Export box, 54 x 32 x 40 in.

is very straight and square. A hand adjustment for securing the proper tension of the saw is provided on the head.

The feed of the saw is by gravity, the pressure of the cut being adjustable. It is claimed that the machine cuts a kerf only 0.047 in. wide, thus saving stock. The saws are said to give an average of 20 hours of service, although some give as high as 60 hours, the fact that all teeth of the saw do the same amount of cutting being pointed out. Saws can be furnished to suit special needs. The machine is equipped with a gear-driven pump to circulate the coolant when wet cutting is done.

Grinding Machine for Broaches

The illustration shows a grinding machine, designed for the single purpose of sharpening broaches, which has recently been placed on the market by the J. N. Lapointe Co., of New London, Conn., manufacturers of broaching machines and tools. This machine was designed and built a number of years ago for use in the Lapointe factory and because of a demand from many users of broaching tools for such a machine it is now being offered to the trade.



LAPOINTE BROACH GRINDING MACHINE

The machine consists of a column supporting a vertically adjustable knee, carrying a table for which both cross and longitudinal hand feeds are provided. Head- and foot-stocks, clamped to this table by the usual T-head bolt, take care of all broaches that can be held upon centers; while square broaches and keyway cutterbars may be clamped directly to the surface of the table. The head-stock is provided with an indexing mechanism for use when grinding spline broaches and also a live-center, belt driven from a three-speed auxiliary countershaft.

The capacity of the machine is ample to grind broaches 64 in. long and 8 in. in diameter.

The grinding wheel is carried on a spindle supported by a swiveling-head, which makes it possible to grind both the rake angle on the back of the broach teeth and to undercut the faces. The head swings on the column of the machine to any angle in the horizontal plane and so permits the grinding of teeth at any angle to the axis of the broach.

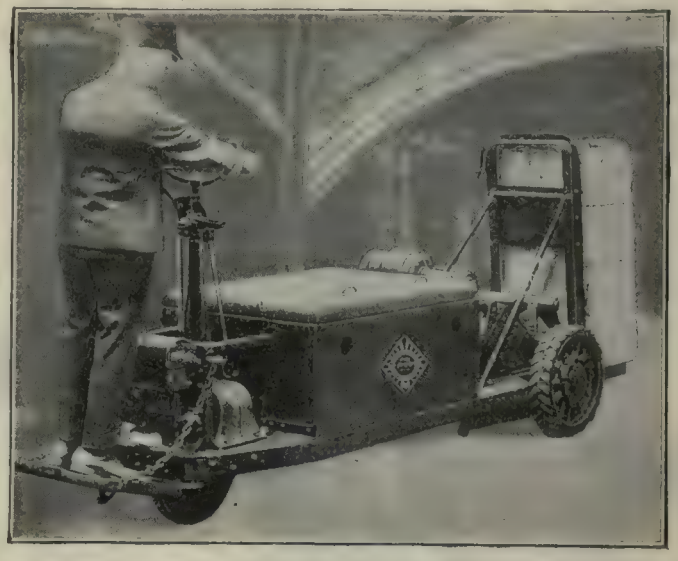
The grinding wheel spindle is belt driven from the main countershaft. A pair of idler pulleys change the direction of this belt to accommodate any angle to which the spindle may be set. The head is moved forward and back by a hand lever to bring the grinding wheel in contact with the broach teeth.

The machine occupies a floor space of 39 x 164 in.

Elwell-Parker Electric Malleable Pot Truck

The illustration shows an electric truck, intended for the handling of the pots used in the heating process necessary when making malleable castings, and recently placed on the market by the Elwell-Parker Electric Co., Cleveland, Ohio. The truck is intended for conveying the pots from the foundry and to the rattlers after the heating, as well as for charging the ovens or furnaces. The capacity of the truck is 4,000 lb., the pots being mounted on stools, so that the forks at the front end of the machine can fit underneath them.

Electricity is furnished by storage batteries inclosed in a steel case. It is claimed that from 150 to 200 complete trips and handling operations of the pots can be performed on one charging of the battery. A heavy frame of hot-riveted steel is used, and most of the parts of the truck are made of steel or of malleable iron. The machine has three wheels, the two at the carrying end doing the driving and the one at the operating end the steering, the truck being capable of turning in a radius equal to its wheel-base. The steered wheel is mounted in a spring cradle, in order to cushion shocks. Rubber tires are used when the ovens are charged at low temperature. For the charging of heated ovens a smooth steel wheel is used for steering and steel wheels having herringbone treads as the driving wheels.



ELECTRIC TRUCK FOR HANDLING MALLEABLE-POTS

The driving motor is totally enclosed and connected with the wheels by means of worm gearing and a differential. The axle is of the full-floating type, the housing carrying the weight of the truck. Double-row ball bearings 7½ in. in diameter are used in the wheels, and a contracting brake is provided between the motor and the differential.

The operator stands on two pedals and steers by means of an automobile-type wheel, the shaft of which is mounted in ball bearings. Depressing the left pedal releases the brake, while depressing the right one closes the circuit breaker, so that the truck may be run by

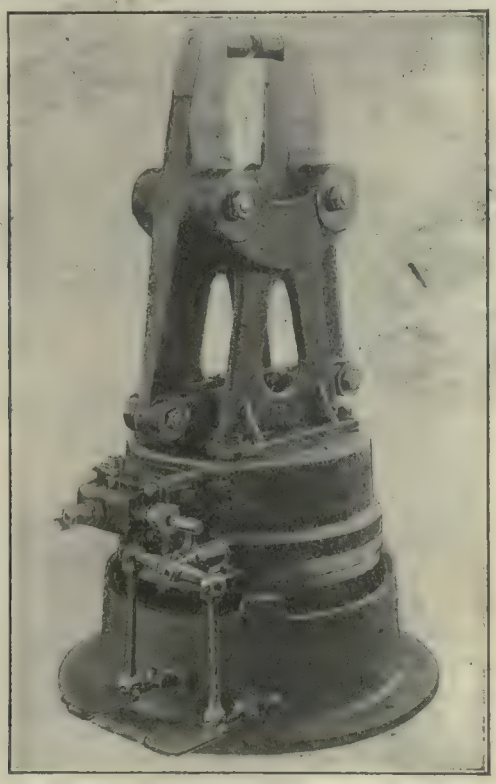
operating the controller. If the operator steps off the truck while it is moving, it automatically stops.

The toggle lifting mechanism is driven by a series motor through worm gearing and a special clutch. The pot can be lifted 6 in. from the floor, the mechanism automatically stopping at the end of the travel. By means of the switch, the forks and the pot may be stopped at any point in the up or down travel. The lifting mechanism is completely inclosed and runs in oil. The overall-length of the truck is 12 ft., and the weight with the battery is 3,600 lb.

Baird Truck-Frame Riveter

The illustration shows an adaptation of the "pinch bug" pneumatic riveter manufactured by the Baird Pneumatic Tool Co., Kansas City, Mo., especially for riveting industrial cars and truck frames. The device is adaptable to any steel fabrication within its range where the work is suspended from above and worked to completion from that position. The riveter itself is rigidly mounted on a stand.

The sliding valve is controlled by two pedals, thus leaving the hands of the operator free to guide the



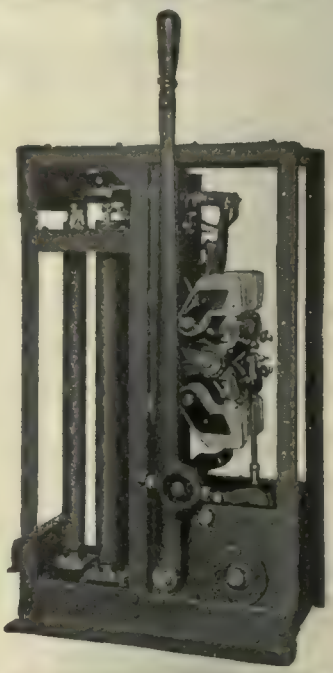
BAIRD TRUCK-FRAME RIVETER

work to its proper place. The riveter drives and heads ¾-in. rivets, hot. It occupies little space, being but 38 in. high and weighing approximately 600 lb.

Allen-Bradley Clapper-Type Controller

The Allen-Bradley Co., Milwaukee, Wis., has placed on the market a line of mill, crane and hoist controllers of the type shown in the illustration, to supplant its Types Q, R and S controllers. The new controller, made in sizes ranging from 1 to 150 hp., is known as the "clapper-type controller," primarily because all switching and contact-making are done with a clapper-switch contactor.

The controller is equipped with a graphite compression resistor, avoiding the use of grids or wire-wound resistors and the need of step contacts. All speed control is obtained by variation of the pressure upon the resistor column by means of the control lever. The controller is made for either direct or alternating current. Clapper contactors of the copper-to-copper, rolling type are used exclusively. The clapper switches, mounted inside the controller, are mechanically operated, and perform all switching in controllers up to 100 hp. in capacity. Larger controllers use external magnetic clapper switches actuated from a pilot switch within the controller. Switch cams positively open and close the switch clappers. A single lever gives full control in either direction without steps or jumps, and also actuates the clapper contactors.

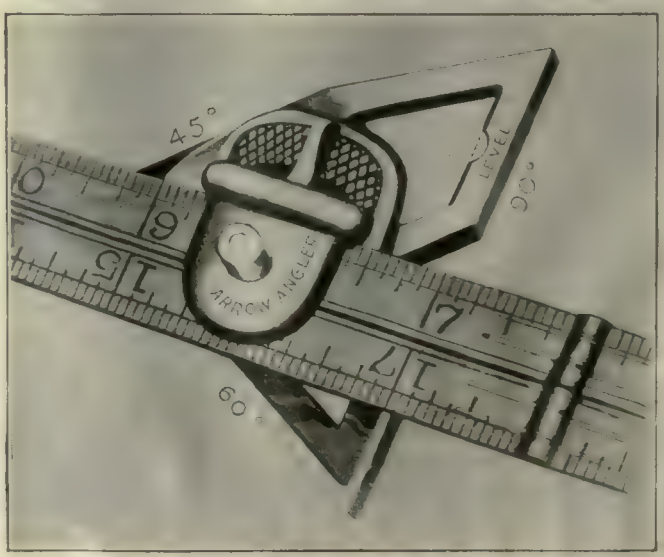


ALLEN-BRADLEY CLAPPER-TYPE CONTROLLER

The frame is constructed of steel, with pressed-steel inclosing covers. The controller is said to have advantages by virtue of the simple wiring and switch gear and the use of the compression resistor. Under-lever control gear, limit switch, brake connections and inclosing covers for the resistor compartment can be furnished.

"Arrow Angler"

Barnes & Irving, Inc., Syracuse, N. Y., has placed on the market the "Arrow Angler," shown in the accompanying illustration. The device is intended primarily for attachment to a straight-edge or a folding rule, being small enough to fit in the pocket conveniently. It it stated that it does not deface the rule and can be quickly attached and adjusted.



"ARROW ANGLER" ATTACHED TO FOLDING RULE

The device can be used for such purposes as a T-square, try-square, depth gage or scratch gage. It is said to form a quick means of laying out or finding angles, of bisecting angles, or of finding centers, diameters or tangents of circles. It is made of light-weight, non-corrosive metal.

"Rex" Expansion Hand Reamer

The illustration shows an expansion hand reamer which the Schellenback Hunt Co., Cincinnati, Ohio, is bringing out under the trade name of "Rex."

The reamers are split clear through the lengths of the teeth and are thus expanded at the starting ends

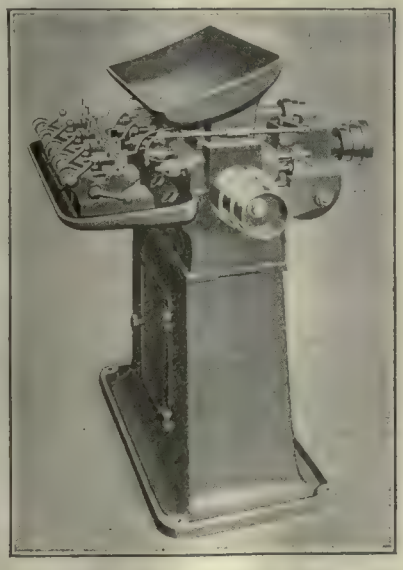


THE "REX" EXPANSION HAND REAMER

of the cutters and not in the center only. The expanding screw is taper threaded and engages tapped threads near the starting end of the reamer. The ends of the teeth are ground at an angle and are locked after adjustment by means of a beveled locknut as shown. The construction permits of a wide range of expansion of the cutters—0.025 in. or more is easily obtainable in a ½-in. reamer, with corresponding increase in the larger sizes. The adjusting screw and locknuts are hardened.

Changes in Detroit Semi-Automatic Five-Spindle Drilling Machine

The Detroit Machine Tool Co., 1487 St. Antoine St., Detroit, Mich., has made some changes in the design of its semi-automatic, multiple-spindle drilling machine. The machine is intended for the drilling of small holes in light work. The accompanying illustration shows how the large pan on the top of the machine for holding the work is tilted, so that the parts will slide to the lowest side and always be in convenient reach of the operator.



DETROIT SEMI-AUTOMATIC FIVE-SPINDLE DRILLING MACHINE

The chief new feature of the machine lies in the clutch in the feed mechanism contained in a housing on the right of the machine. The long, horizontal rod to be seen below the work tray is used to actuate a jaw clutch, so as to engage or disengage the worm drive in the feed. It is said that this feature is of advantage when the machine is being set up, as the spindles can be brought to their extreme forward positions in turn, and left there without stopping their rotation. The fixtures holding the work can then be moved to the position giving the proper depth of hole and clamped there. The feed can be instantly stopped if necessary, as when a drill sticks in a hard spot. By changing the belt on the cone pulleys on the right, feeds of 0.002, 0.004 and 0.006 in. per revolution can be obtained.

The type of work-holding fixture shown has a V-shaped jaw and a standard machine handle, although it is essentially the standard fixture No. 6100. It is intended for holding either hexagon or round stock from ¼ to 1⅛ in. in diameter, as when drilling cotter-pin holes in screws and bolts.

Restrictive Measures on the Shutdown of Industrial Plants in Germany

A law, fostered by the federal ministries of economics and labor, and bearing upon the closing down or breaking up of plants in Germany, has been passed by the preliminary national industrial parliament.

This law makes it compulsory for all firms contemplating a partial or entire break-up of their plants, as well as a temporary or permanent stoppage of operations, to bring such intention to the notice of the authorities whenever such measures would tend to result in the discharge of men to any undue extent. It covers all industrial plants—except those being the property of the Reich or of one of the federal states—including transportation service plants employing at least twenty workmen. From the date of filing the application, a period of suspension of four weeks in the case of a temporary shutdown and six weeks when contemplating breaking up will be compulsory, during which time no materials or legal changes likely to affect the proper management of the company will be permitted. In special cases an extension of three months will be granted when applying for a permit to break up.

To Prevent Unemployment

The period of suspension is principally intended to enable the demobilization authorities in charge of the execution of the regulations to take such steps as are deemed necessary in order to prevent a shutdown or breakup of plants; all such measures are to be taken in conjunction with the works management and the works council and, should circumstances require it, in collaboration with local and export organizations. A detailed statement giving instructions as to methods of procedure has been drafted for the commissioners, explaining the steps to be taken in dealing with the difficulties responsible for the proposed shutdown or breakup, as for instance, productive unemployment benefit, communal orders and contracts, etc. The commissioners entrusted with the proper execution of the regulations are advised not to regard each closing down of an establishment as a national or economic disaster, inasmuch as the coal famine may easily lead to temporary restrictions on production in the interest of an economical utilization of available stocks of raw material.

With a view of facilitating an efficient exploitation and utilization of available stocks and raw materials, the demobilization officials will be empowered to confiscate and expropriate all such stocks as soon as an application for a closing-down or breakup has been filed; and prompt measures will be taken to turn over the seized stocks—particularly coal—to works of national and economic importance.

The Machine-Tool Industry Abroad

Business Conditions in England

By OUR LONDON CORRESPONDENT

LONDON, Dec. 3, 1920.

THE general falling-away in trade here is quite apparent and newspapers (even those associated directly with the government) have been admitting the facts and discussing the remedy. "Heading for Bankruptcy" and similar phrases are being used.

The present rates of exchange prevent export trade and it is generally recognized that until the exchanges become more nearly level nothing like normal conditions can obtain in industry and commerce. A dwindling number of people are still against trading with Germany; those that are interested in a given branch of industry claim that Germany, in that particular direction, must be put out of competition or even permanently out of action. It may still be war, but it is not magnificent. And as an opinion it does not display much wisdom.

EXPORT TRADE NECESSARY TO PAY BRITAIN'S DEBT

In the selfish interests of Great Britain, trading between the nations must be fostered and encouraged. Contrary to pre-war conditions, Great Britain has a large external debt; only by exporting can this be repaid. It is therefore with some concern that people in England have noted the suggestion of increased—largely increased—import duties on the U. S. side.

COMPETITION WITH GERMANY

In engineering in particular, Great Britain may expect the strongest competition from Germany if that country only holds together. Great Britain has managed to cope with this competition up to the present time—unlike other countries—without erecting a tariff wall which, whether high or moderate, was designed to exclude. The government is, however, understood to have the tariff matter in hand. It is clear that at present Great Britain cannot compete on the European continent with Germany in many branches of engineering. Quite recently a British firm, and doubtless other firms, bidded to sell a supply of turbo-generating machinery to be sent to the continent of Europe. A German firm was successful—at a price one-third that of the English tender.

THE MACHINE-TOOL POSITION

The machine-tool position can hardly be said to grow more hopeful. Money is tight and no one is buying except for immediate requirements. In the Manchester district many firms have work in hand that will occupy them for several months. Cancellations are fairly frequent and although a number of inquiries have been received for tools of heavier types apparently nothing can be settled. Conditions are too shifting. The demand for small machine tools continues small, and several important shops in various parts of the kingdom are working short time, including half-time; discharges also can be recorded. One firm, relatively small and supplying machine tools that must be sold at about £300, has discharged practically the whole of its force; the cost of production per machine was found to be in the neighborhood of £1,200. One of three schemes of payment by results had been accepted by the workmen, but permission to work was refused by the local branch of the engineering trade union. The Armstrong-Whitworth concern shut down its locomotive works in the Newcastle district for a similar reason, though here it is understood that on seeing the firm's books the trade union officials have agreed to a piecework system of payment.

The small tool trade is in a very dull condition. Twist drills are without demand; few milling cutters are called for; one firm reports considerable activity on taps, dies, etc., but gages seem to be forgotten. It is stated that large stocks have been released by the government and that with present conditions it is useless to reduce prices. Price-maintenance associations have been formed and, despite the declining demand, have increased prices with increase in the cost of steels. The remark above regarding twist drills applies to the high-speed steel variety. The case is different with carbon-teel drills; for these Great Britain has, in the past, depended on overseas supplies, largely German. The opportunity has not yet been taken completely to fill the place of the exported article. The position therefore of one well-known factory is that in high-speed steels a stock valued at £30,000 or more has steadily been accumulated, while orders for carbon steel drills are two months behind.

KEY INDUSTRIES LOBBYING FOR PROTECTION

The key-industry argument has been much worked of late and, unless all reports are false, much lobbying has been practiced in or near parliament to insure the support of that august body of "men who look as if they had done well out of the war." The magneto industry is, apparently with reason, fearing German competition and is crying aloud for protection. Here the fact has emerged that a price-maintenance association was formed; but, it is explained, this policy was given up fairly soon after the end of the war. The price maintenance scheme applied only while there was but one customer; namely, the nation. Other cries relate to pianos, steel billets, needles, tungsten and toys. The dye industry, too, is in the throes of the same kind of agitation. It has been admitted that so far Great Britain has not been able to produce certain dyes of quality equal to that of dyes from Germany. These dyes are essential for an important section of the export trade in textiles. Now although Great Britain may refuse to accept the German dyes it is by no means certain that India and other textile competitors will follow this example; consequently these countries may easily wrest the trade from Lancashire, bringing about the downfall of the Lancashire textile industry and with it, the Lancashire man will add, the downfall of Great Britain. Textile machinery makers, by the way, continue busy and night shifts have been noted.

AUTOMOTIVE EXHIBITS

The series of commercial vehicle, pleasure vehicle and cycle and motor-cycle exhibitions held at Olympia, London, W., comes to an end this week. To judge by appearances the motor-cycle show may possibly be in proportion most effective as a business-producer; though with strange unanimity the press asserted that the automobile industry was evidently on its feet again, and, as the result of the recent show, has been in receipt of large firm orders. Indeed it has been stated that orders accepted at Olympia amounted to £50,000,000. Having appeared in print, this statement must be true. Nevertheless rumors of troubles and liquidation are again to be heard—a petition in connection with a subsidiary firm has been postponed for a fortnight and one well-known small car, doubtless an exception, could at the time of the show be bought at two-thirds of its nominal price. It is pretty generally felt that the coming winter will see the elimination of a few smaller firms, but the industry as a whole will get through the troublous times with some success.

The French motor-car industry is in a worse position. To raise the wind, one well-known firm has been hawking certain of their machine tools about London; again, a vessel was chartered and loaded with motor cars, to call at Far Eastern ports until the cargo had been sold. The motor boat show, provisionally arranged for next spring, is to be abandoned.

Labor Conditions

Despite threats of a complete closedown of electric generating stations, for the time being peace reigns in industrial circles; or rather did until a day or two ago, when shipyard joiners struck against reduction in wages to be enforced by the employers. Some time ago in order to put these workers on an equality with similar men engaged in house building they were given a bonus of 12s. a week. This is now to be deducted, the state of the shipbuilding industry being the reason offered. Belfast workers have agreed to the reduction. Then one of the leaders of the railwaymen has been stating that "there will be a big struggle yet ahead—a big fight in the next few months in this country." It will not be a question of hours and wages but of improvement in the status of the railwayman, who is not merely to be regarded as a hewer of wood and drawer of water, but as a contributor to efficient railway management. In short, a share in management is to be claimed, and this leads to the suggestion, not by any means novel, that a definite indication of the desires of the workers of Great Britain would be an advantage. Probably no one can make such a statement. Aims are diverse and the end, or approximate end, is not visualised.

Arthur Gleason has been studying us, and concludes that what is demanded includes a higher standard of living, more leisure, regulation of private profits, the distribution of wealth by state action (that is taxation), prevention of unemployment, further education, better housing, the nationalization of public services, etc. But it is fair to add that there is a fuller general ideal, or approach to an ideal, at the back of the minds of many now leading the working classes of Great Britain.

Labor's Desires

They desire complete co-operation between capital, labor and management, but decline to admit that capital as such is entitled to take all the fruits of industry after subsistance has been granted to producers, direct and indirect. The idea is that capital shall be entitled to interest at market rate, whatever this may be; apart from that, capital as such will have no rights. The wages and salaries of the managing, producing and distributing human elements will be the first charge and then, after payment of interest on capital, the surplus profits will be divided on some agreed plan between those who are actually engaged in the industry. As one outcome, the industry would itself be responsible for the maintenance of its unemployed members.

How in this particular detail the scheme would work can easily be seen in current experience in certain trades, for example, the building and printing trades, where entry into the trade is barred because the demand may cease in the course of a few years and unemployment ensue. If payment for unemployment came directly and solely from the pockets of the members of the industry they would, if sufficiently organized, be quite sure to see that the labor market in that particular direction was not overstocked. The scheme, in fact, in many respects is like that of the Whitley councils, and suffers from the root fallacy of much argument for protective tariffs. It is that each industry is self-contained and only self-regarding, whereas experience teaches that we are all brethren one of another. The war has tested many "isms"; in one direction or another all have been found wanting.

Mining Workers' Problems

According to preliminary statements, proceedings in connection with the settlement of mining workers' problems are proceeding fairly satisfactorily. A record tonnage was bought-up last week. Also preliminary questions regarding overtime and night work pay, etc., discussed between employers and employed in the engineering industry have been settled on lines that are almost generally acceptable, for the time being at least. But a decision regarding the claim for an increase of 6d. an hour has yet to be made; it is due in about a week. Many employers have of course long been definitely for fighting. On the other hand, many think that if by concessions troubles can be tided over a few months at a time it is all to the national gain. Some, indeed, suggest that the claim of the skilled engineers should be met, or that, on the other hand, the wages of certain unskilled workers, such as builders' laborers, should be reduced, there being no equity in the present position. For instance in Leeds the carrier of bricks and mortar may get 2s. 1d. an hour and the skilled engineering workman 1s. 10d. In the Clyde district the unskilled building laborer may get 2s. 4d. against 1s. 11d. an hour for the skilled joiner. Looking at the cost of building employers in the trades may, in fact, attempt reduction in the pay of their skilled workers, with unskilled labor at 25 per cent less than skilled.

Price Declines in Copper, Tin, Lead and Silver

A marked and fairly steady decline has of late been shown in the prices of copper, tin, lead and silver. Gold, too, has fallen within the last three weeks or so but appears again to be rising. Tin is stated to be something like 20 per cent below cost of production. Rubber also, which enters into some branches of engineering, is at a low ebb and proposals have been made for a complete stoppage of tapping; anything less than this is regarded as so much tinkering. At the London Iron and Steel Exchange recently little business was done, although it is thought that the present output of steel hardly covers current requirements. The marine side of engineering remains a good customer. Belgian billets are apparently obtainable at £8 a ton below home products, and at a meeting of the South Durham Steel and Iron Co., Viscount Furness, the chairman, mentioned as an illustration that steel joists can be imported from the continent at a cost of £17 a ton at English ports against £24 the price of home-produced joists. The South Durham Company, by the way, pays 25 per cent for the year.

Cooperite, understood to be the invention of H. S. Cooper of the Cooper Research Co., Cleveland, Ohio, has been demonstrated in the works of the Sheffield Mercantile Steel Co., Ltd., Sheffield, the rights in the material having been acquired by Zirconium Alloys Syndicate, Westminster, S. W. It is of course a non-ferrous material used for the casting of cutting tool; durability greater than that of high-speed steels has been claimed.

Situation of the Austrian Machine Industry

Special Correspondence

Reports from the various industrial centers would tend to show that the period of stagnation which has been obtaining for some time is gradually passing, and that there cannot be the slightest doubt that the commercial treaty recently concluded between Austria and Roumania bids fair to stimulate Austrian machinery export trade to a considerable extent. Under the terms of this agreement Austria will receive orders for the delivery of large quantities of machinery and apparatus. The automobile industry will come in for orders of 2,000 new cars, 1,000 trucks and 5,000 bicycles, and the shipbuilding industry for the construction of a number of Danube craft valued at 500 million kronen. Other orders which will be placed with Austrian industries are: pumps, valued at 300 million kronen; 100 million kronen worth of agricultural machines and implements; 4,000 sewing machines; 6,000 typewriters; 900 railroad trucks; 1,000 tank cars; 10 locomotives; and orders for railroad equipment, machinery, etc. will amount to 200 million kronen.

One of the most interesting features of the Austrian machine situation is the marked tendency for an "east-

ern orientation" which is easily explained by the foreign-exchange anomaly. Export of machinery and apparatus to Jugo-Slavia and Poland has shown a distinct increase of late, while the decision of the reparation committee to grant Austria credits for the purchase of raw materials is also partly responsible for the renewed export activity.

The locomotive industry reports very satisfactory business, many orders having been placed by Poland and Italy while negotiations for deliveries to France and Russia are still pending. Interested quarters are fairly confident that negotiations with France will be carried to a successful end before long, but deliveries for Russia will not be for some time owing to technical difficulties quite apart from the question of payments. The orders placed by the government for the state railroad are nearly completed but repeat orders both from the state railroads and private companies will probably be placed soon. A number of freight locomotives have been ordered by Roumania.

The government ordnance works at Vienna, Woellersdorf and Fischamend which were turning out munition, guns, flying machines, machine equipment and other kinds of war material, have now almost completed their reconstruction for the production of peace products. By far the greatest part of the new products are agricultural machines and implements, such as plows, harrows, cultivators, threshers, etc. The daily output of the various works amounts to 200 plows, 100 cultivators, 50 threshing machines and 50 straw choppers. A large part of the output has been contracted for by both inland and foreign concerns and such has been the demand of late that some of the works are working overtime and nightshifts. This will hardly come as a surprise to anyone making a closer study of the situation. Most of the materials used at the ordnance works in the manufacture of new machines and implements are so-called "demobilization materials," that is, parts or materials gained in the compulsory destruction of munitions or other kinds of war material. This costs the state practically nothing while enabling the works to produce at a lower cost than private companies, and it goes without saying that the latter feel rather sore on that point, though the fact should not be forgotten that the lower cost prices of the government works are but a temporary feature and an adjustment of prices will have to come about the moment the demobilization materials are exhausted. Moreover, latest information shows that the sale of ordnance works to private industry is contemplated, it being stated that the annual deficit amounts to 20 to 25 million kronen, owing to works serving as objects for socialization experiments.

German Machine Trade Conditions

BY OUR BERLIN CORRESPONDENT

BERLIN, Nov. 15, 1920.

BUSINESS is still suffering under the general depression which set in last spring. The reports of manufacturers' associations and of stock companies are full of complaints as regards business. Employment has decreased almost everywhere; only about 50 per cent of the machine-building works are running a 48-hr. week. The others have reduced working hours anywhere down to sixteen hours per week. Few factories, however, have shut down completely, as a business improvement was expected this fall. Although a slight revival has set in during the last two months, evidently caused by the further sinking of the German currency, it is not marked enough to give a more optimistic outlook. In general the hopes for a return of fair business have been doomed to disappointment. It has been feared that under such conditions the retrenching of the industry will make quick progress and cause a large number of works to close, thus increasing the already swelled number of unemployed. In anticipation of such intentions the government has issued regulations which are making it difficult for factory owners to shut down their factories without showing good reasons. By these regulations workshops employing more than ten men have to send in a notification at least four weeks in advance together with a statement explaining their reasons for wishing to shut down. The government has the right to investigate the soundness of reasons given and will undertake eventually to procure employment for the works thus affected. These regulations are meant to put a stop to the wanton shutting down of factories, which it is expected would otherwise prevail.

This measure is strongly resented by the factory owners, who can say for themselves that no owner would shut down so long as there is the possibility of keeping the works going. In fact there is a great reticence in this respect which is due to the common fear that no one going out of business temporarily knows nowadays when and whether at all he can resume activities.

The pessimistic view prevailing is not only caused by the persistent dullness of the inland market, but more so by the reports coming in from other countries, which show that the business depression is general and that little can be expected from the foreign market. The failure of the fairs held in Leipzig in August and in Frankfurt in October of this year strengthened this view. There was little German business, and foreign buyers, although a fair number of them attended, were doing nothing more than sampling, only few actual buyers coming forward. The German industry which had made great efforts to advertise these fairs and to spread the news that it could now offer firm prices and prompt delivery, giving at the same time indications of willingness to make prices more attractive, was shocked at the almost total absence of results. The belief is now general that a return to even normal market conditions will not set in until Europe is allowed to come to more settled conditions.

LACK OF EMPLOYMENT AND THE COAL SHORTAGE

The lack of employment is lately more and more ascribed to the coal shortage. Complaints in this direction are coming forward in ever-increasing numbers and have been substantiated by apparently incontrovertible facts.

All stages of manufacture, from steel works to manufacturers of finished articles, are said to be strongly affected by the lack of coal, specially steel mills and machine-building shops. Although such complaints come from all parts of the country, curiously enough most of them originate from the coal districts themselves. As a demonstration of the coal shortage the imports of American coal have been given large publicity, although the quantity imported is quite insignificant. It is a fact that the coal left at the disposal of the German industry, after deducting free exports and exports under the Spa treaty, is about 60 per cent of the pre-war supply and no doubt the German industry will find itself in a precarious position if business is in full swing once more, although a considerable part of the shortage is made up by strictest economy. In the present circumstances, however, statements ascribing the reduction of employment to the coal shortage are largely misleading. In this connection it will be remembered that the Spa treaty will soon run out and negotiations for a further settlement of deliveries are close at hand.

The steel works have lately decreased prices of raw material and semi-finished articles. Pig iron went from 2,140

to 1,770 Marks; bars from 2,840 to 2,440 Marks; plates over 2 in. from 3,595 to 3,090 Marks per ton; castings for machine parts, which have been up as far as 9 Marks per kilogram, can now be obtained for 5.50 to 6 Marks.

The above prices for bars and sheets are maximum prices. Actual sales have been concluded considerably lower—that is, 10 to 20 per cent—with the sole exception of ship-plate, which has still an exceedingly strong market. This reduction of prices is solely due to the necessity to meet market conditions and does not indicate a reduced production caused by the coal shortage.

It has been hoped that the reduction of the steel prices would set the prices moving on the downgrade along the whole line. The price question is considered the key to the whole business situation. The conviction has become general that prices have reached their utmost limit and have even surpassed it, thus causing the reaction which is now being felt so severely. So far as coal is concerned there is however no hope of such reduction. The coal miners have lately received an increase of wages and the mine owners have tried to raise prices accordingly. This has been stopped by the government on the strength of the enormous profits which are being made by the owners according to their own reports. While it can be expected that coal prices will remain stationary, their reduction is out of the question. Although the lower cost of raw material relieves the situation of the machine-building industry to a certain extent, the main relief is expected to come from the possibility to cut down the wages and other expenses. Such a possibility, however, seems very remote, as the living expenses show no decline and the workmen have lately given signs of a reviving unrest. It is more likely that wages and expenses will go up a step or two in the near future. A reduction of prices can therefore only be made by lowering the sale price independent of cost, which can be done to a considerable extent—at least in the case of the large works, judging from their excellent returns—and still leave a profit.

Some Large Profits

The Wotan-Werke in Leipzig for instance, a firm specializing in shapers, made in its business year, July, 1919, to June, 1920, a clear profit of 1,700,000 Marks, with a capital stock of 1,600,000 Marks; and Reineker in Chemnitz, with a capital of 6 million Marks, has just reported a rise of its gross profits from 3,700,000 Marks to 10,300,000 Marks, and a clear profit of over 3 millions, this being more than 50 per cent of its capital.

So far only the export prices have been reduced, but the inland prices have remained firm; whereby the difference between export and inland prices, which has been very large at the beginning of the year, has almost entirely disappeared.

Lately the whole front shows signs of weakening, beginning from the medium-sized and small works which are the hardest hit by the financial conditions and the tightness of money.

The Machine Tool Industry

It is reported from the machine-tool industry, which forms the largest section of the German machine-building industry and which, as the recognized forerunner of the fluctuations of the market, is closely watched from all sides, that the business stagnation continues, only the leading works having noticed slight improvements. The inland market is still in a sorry state, even the biggest users having restricted buying to immediate necessities. Inquiries are coming in more freely and it is seen from such inquiries that the large manufacturers are figuring on some new equipment, without however being able to come to the buying point. Only the state railways have lately been on the market for re-equipment of their workshops, which are still in the majority of cases stocked with machinery of obsolete type. The export market is dull. An improvement is hoped for from the decline of the German currency, which is now almost where it was last February, although it is not expected that anything like the rush of that time will come from foreign markets owing to the depressions prevailing there; especially as many dealers in the surrounding neutral countries are said to be still full up with machinery bought at that time.

Unemployment

There is hardly a shop in the country fully employed. The employment is, in the majority of cases, from 30 to 50 per cent, and only part of that is on full time, leaving an ever-increasing surplus. The big works have still been able to stand the financial strain, while the small works are making price concessions. Chemnitz lathes, which have been up to 20 Marks per kilogram, can now be bought for from 10 to 12 Marks. First-class lathes, which have been quoted at from 20 to 25 Marks per kilogram, are now freely offered at from 14 to 16 Marks per kilogram. Milling machines show stronger prices, on the average from 16 to 20 Marks per kilogram, grinding machines are quoted at 25 Marks per kilogram in the average; special machinery is considerably higher. Of foreign countries the best buyers of last spring like Holland, Sweden and Denmark have almost withdrawn from the market. Most orders are now coming from Spain, Italy and South America; even Australia is showing attention to the German market, which however has not materialized to actual business. Finland and other independent Eastern states are buying frequently. Soviet Russia, although very busy getting quotations, is not buying to a noticeable extent on account of the difficulties of payment.

Dealers keeping large stocks have lately been compelled to relieve their situation by selling below cost. This does not, however, apply to the dealers of high standing who have taken care not be burdened with extensive stock.

The Second-Hand Trade

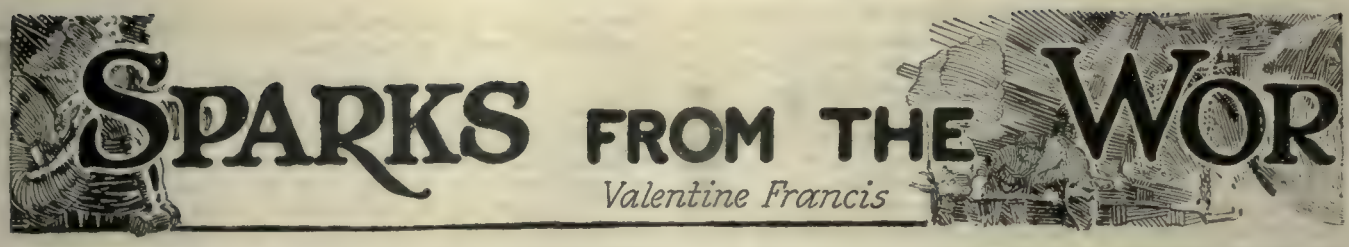
Up to now the depression has most been felt on the second-hand market. Numerous shops have gone out of business and sold their equipment, which is now a great load on the market. One large firm of second-hand dealers has no less than 4,000 tools on stock. It can safely be estimated that over 20,000 still serviceable machine tools accumulated by sales of government and private equipment are at present in the hands of the second-hand trade. Prices quoted for second-hand machinery have lately gone down considerably to from 5 to 8 Marks per kilogram, according to condition. Second-hand lathes have lately even been offered at an average price of 3 Marks per kilogram.

The market for heavy machine tools is greatly depressed. It is noteworthy to remember that the Maschinenfabrik Oberschoeneweide, formerly German Niles Works which has been closely connected with Ludwig Loewe A. G., has been shut down and the equipment sold with the exception of the pneumatic tool department; the latter department will be continued in other premises. The stock has changed hands, and the firm has resumed the old style of "Deutsche Niles Werke" or German Niles Works. This is the first instance of a return of styles which have been abandoned during the war owing to apparently foreign associations, and indicates that such styles are no more considered a handicap to business. Close observers may even think that the pendulum will strongly swing in the other direction, as quite a number of purely German firms are now assuming foreign styles in the expectation, apparently, to make a better show on the foreign market.

Imports of Machine Tools

There is little heard of imports of foreign machine tools, specially American, into Germany, although a number of sales have been concluded, among them being several Gleason gear-shaping machines. As regards import-licenses the principle has been established to grant licenses only for tools of a type or quality not made in Germany.

On the strength of this principle the National Cash Register Co., which is equipping large shops near Berlin for the manufacture of its cash registers, has been able to import a large amount of machine tools and small tools from the U. S. The license has aroused strong objections, not from the machine-tool and toolmakers, but from the German rivals of the National Cash Register Co., which now include Krupp's, who have taken up the manufacturing of cash registers, and will soon market that product.



Bankers and Manufacturers Form Foreign-Trade Financing Corporation

A financial undertaking, to which all manufacturers and machine-tool builders will look forward with hopeful interest, was brought about in Chicago early in December. It will possibly afford some relief for the present stagnation of business if the plan is successfully consummated for the formation of a gigantic export financing combine, to be capitalized at $100,000,000, with the possibility of its ultimate extension to a total capitalization of one billion dollars.

At the series of conferences at the Congress Hotel on December 10 and 11 more than 500 of the leading bankers, business men and manufacturers from all over the country were in attendance. The convention was originally planned by the American Bankers Association, as the result of suggestions presented at their annual convention, and its arrangement was handled by a committee under the chairmanship of John McHugh, vice-president of the Mechanics and Metals National Bank of New York.

The new export financing corporation is planned to act under the authorization of the so-called Edge Act recently passed by Congress to take care of such a condition in foreign trade channels as now exists.

At the organization of the meeting Willis H. Booth, vice-president of the Guaranty Trust Co., New York, was elected as permanent chairman, with G. A. Ranney, secretary of the International Harvester Co. to serve as vice-chairman, and William F. Collins of New York, secretary.

Need for the Organization

The scope of the proposed organization was outlined in the opening address by John S. Drum, president of the American Bankers Association. He called attention to the necessity for the creation of some financial machinery to take care of the demands from foreign countries for raw and finished materials, in order that we may get these moving toward their shores as the logical point of consumption. In moving these products we are simply disposing of our excess production. However, in order to promote future world prosperity consideration must be shown alike to both producer and consumer.

Demands have recently been made upon the government to undertake the financing of foreign trade in order to bolster up the condition of falling commodity markets, and these demands were answered in the address by Senator Walter E. Edge, of New Jersey, author of the Edge Act. He stated that when the government attempts to make money it usually loses, as witnessed by the governmental administration of the railroads. He asserted his unalterable opposition to the government administering business in any form, and for this reason thought it better for business to attempt to help itself rather than that the government should intervene and make a mess of it. The problem is so important that it is just as necessary to raise money for this purpose as it was to sell Liberty Bonds during the war. Money must be raised by subscriptions of the business men and the public, as the government could only do so by further burdening the taxpayers.

World Trade Relations

In reporting for the organization committee John McHugh dealt rather fully with the conditions of world trade relations that have brought about the impasse in which our present foreign trade rests. He stated in part: "Prior to the outbreak of the war, in 1914, we were a debtor to the rest of the world to the extent of approximately four billions of dollars. Out of the earnings of our railroads, mills and factories we sent abroad each year upward of two hundred millions of dollars in settlement of interest and in payment of dividends. We practicaly depended upon London to finance such foreign trade as we then had. . . .

"Europe was the center of the world-finance when the war broke out in 1914. Then the state of affairs changed dramatically. . . . When we entered the war in April, 1917, we had already practically wiped out our debt abroad. . . . It is estimated that the floating debt of foreign countries to ourselves has now reached almost $4,000,000,000. The creation of this great debt has enabled our foreign trade to go on. It has brought our total loans to foreigners to $15,000,000,000 and enabled us to pass Great Britain as the leading creditor nation of the world.

"But in extending short-term credits to finance exports during 1919 and 1920 we, as a people, did not stop to consider the total effect on our business and financial structure. These credits were called "short-term" but really were not. They could be shifted about within the country, but so long as our exports exceeded our imports, and so long as people abroad could not meet their obligations with goods, gold or investment loans they could not be paid off. Thus it is seen that $4,000,000,000 of floating credit, extended to facilitate our export trade, has been one of the leading factors in bringing about the credit stringency in the United States, and that stringency, in turn, has been one large factor contributing to the recent violent decline in commodity prices.

"No one will maintain that it has ever been a proper function of commercial banks to finance a relatively permanent one-sided balance of trade, and unless a remedy is found, our export trade must be severely curtailed.

"Conditions are now changed. Our extraordinary prosperity has stopped. Factories and mills have shortened their hours of work; many even have closed down. As for prices, these have fallen sharply; in the last half year wholesale prices on the average have dropped 25 per cent. . . . Goods prepared for export have backed up at all our seaports, owing to ineffectual means to finance their shipments, and our markets are glutted in consequence.

"The success of the plan that is proposed is based upon these two essentials; upon thrift, in order that a part of the savings of our people may be used to finance our foreign trade and thus sustain our prosperity; and production, in order that we may spare the means of supplying foreign markets without subjecting ourselves to increased prices for our own needs.

"We should emphasize that the affairs of the corporation must be so managed that it will be, not only an emergency measure but a permanent instrumentality for the purposes for which it is brought into being.

"We should here adopt articles of incorporation and by-laws, and we should name, if possible, at least some of the men into whose hands we are willing to entrust the destinies of the corporation.

A Mutual Directorship

"We should here name a tentative Board of Directors, and in selecting its members we should be guided by the wishes and opinion of the different groups of bankers, business men and producers representing different parts of the country in this meeting.

"Every stockholder, so far as practicable, should become an agency for distributing the debentures of the corporation. These debentures should be absorbed by the public—not by means of excessive borrowing but by saving.

"There are many instances where American business men have actually ceased to carry on business with foreign customers because of disturbed exchanges; they cannot convert their accumulated foreign funds into American dollars without suffering a loss.

LD'S INDUSTRIAL FORGE
News Editor

"We are presented with the opportunity to finance our trade with the outside world on a stable and permanent basis, through the instrumentality of this great corporation which we have in view. By means of this corporation we could provide for the most careful and thorough credit investigation and the strongest commercial safeguards in the interest of American capital. By means of the corporation we could supply the materials to keep factories and mills running, in the interest of foreign customers. Our loans would be protected, and we would lend in each individual instance only as we felt assured of the security of each particular loan.

"Only as we face the situation that is before us boldly will we seize our present opportunity to maintain our foreign trade, preserve our prosperity, and mitigate our present depression. Only so can we take our full part in meeting our present responsibilities to the world."

Committees were appointed on "Resolutions" and on "Plan and Scope," which reported at the resumption of the conference the following morning. The first committee reported approving the formation of a corporation for the formerly estimated capitalization of $100,000,000; the corporation to be strictly limited to trading with countries which possess a stable form of government; and all transactions to be confined to those which will benefit future trade relations. Co-operation for the formation of the corporation was asked from agriculture, labor, finance and manufacturing industries.

PERSONNEL OF COMMITTEE

The committee on Plan and Scope reported the plan was too big to be handled by a temporary committee and the convention adopted its report favoring the appointment of a permanent committee of thirty. A few well-known men among the personnel of the permanent committee are Chairman John McHugh, of New York; John S. Drunn, San Francisco; James B. Forgan, Chicago; Paul Waller, New York; Philip Stockton, Boston; Paul M. Warburg, New York; and Herbert Hoover.

The committee will be invested with full authority to add to its numbers and "to take all steps decreed by it necessary or appropriate to organize and bring into operation a corporation under the provisions of the Edge Act, with a capital of $100,000,000 for financing future American foreign trade."

The latter principle relative to future foreign trade emanated from the agriculture interests whose purpose it was to prevent the unloading of some of the present floating debt of Europe to America upon the new company. In other words new foreign business, instead of liquidation of old credits piled up in sea board banks, is what the new corporation is established for.

For underwriting the organization expenses of the new corporation it was estimated that the sum of $110,000 will be required and that amount was raised by subscription within a few minutes before the close of the convention.

World's Industrial Exhibition at London in 1922

Announcement is made of a world's industrial exhibition to be held at the Chrystal Palace, London, during the months of May-October, 1922, of the industries, products, arts, sciences, and inventions of the leading manufacturing countries of the world. It will be on a co-operative basis, the capital being provided by the exhibitors and those otherwise connected with the exhibition (such as the guarantors of each nation who guarantee sufficient for the preliminary work connected with the exhibition of their nation), and the profits accruing from the various sources of revenue, such as contracts for advertising, catering, amusements, season tickets, gate receipts, etc., will be apportioned pro rata among the exhibitors in order to bring the cost of exhibiting to the lowest possible figure. Each country will elect its own exhibition committee, which in turn will be represented on the general exhibition committee.

The management will be under the control of a committee representing the exhibitors and guarantors generally.

Tractor Production in the United States

In an investigation made by the Bureau of Public Roads, United States Department of Agriculture, of the production of tractors in the United States during 1919, reports from eighty manufacturers show that they manufactured a total of 164,590 tractors during the year. The number actually manufactured during the year was only a little over one-half of the total production estimated in reports made to the Office of Farm Equipment Control, United States Department of Agriculture, in January and February, 1919. Labor troubles and shortage of material, together with the fact that some of the companies discontinued the building of tractors, accounts in part at least for the decrease in production below the estimated output.

Long Range Machine Gun Developed by Ordnance Department

A new long-range machine gun whose caliber is about one-half inch has recently been successfully tested at the Aberdeen Proving Ground. The development of a gun of this type has been under way in the Ordnance Department for some time, and quite remarkable progress has been made during recent months.

In connection with the development of this weapon the Ordnance Department naturally solicited the aid of John M. Browning, the inventor of the caliber 0.30 Browning machine gun and the Browning automatic rifle of the same caliber, which weapons have been received with remarkable favor by the service; also the aid of the Colt's Patent Fire Arms Manufacturing Co. which was responsible in a large degree for the successful development of the manufacture during the war of the Browning weapons.

The unusual possibilities of the Browning type of mechanism have been clearly demonstrated in the results recently obtained with the new large caliber machine gun. Each round of ammunition fired by this new weapon weighs approximately one-fourth of a pound, and the bullet weighs nearly five and one-fourth times as much as the bullet fired by the Springfield rifle.

The first gun developed and manufactured in accordance with the recent ideas of Mr. Browning and the specifications from the Small Arms Division, Ordnance Office, was tested on Nov. 24, 1920, and those witnessing the test were enthusiastic over the showing which was made. It was demonstrated that the effective range is at least twice as great as the effective range of the caliber 0.30 machine gun. The weight of the gun is about twice as great as that of the caliber 0.30 Browning machine gun. Its water jacket has a capacity of two gallons, and the water used for cooling purposes reaches the boiling point after three hundred rounds of continuous firing.

The rate of firing this weapon can be regulated between 400 and 700 shots per minute by a very ingenious buffer mechanism. Preliminary tests so far conducted indicate that the gun is extremely accurate at long ranges and the grouping of shots unusually good. Accurate fire is easily directed by virtue of the fact that the fixed sight which has been placed upon the top plate of the gun has been placed as near as practicable to the gunner's eye, and on account of the size of the weapon it has been possible to make the sight radius unusually long.

The tripod, as at present tentatively designed for this weapon, weighs about ten pounds more than the gun with the water jacket filled with water. It is believed that the design of this tripod is unusually good, and the firing conducted so far shows it to be very stable.

Several new and desirable features have been added to this unusual weapon which are not found in the caliber 0.30 Browning machine gun, and an attempt has been made in the new weapon to overcome such defects as have developed in the 0.30 caliber type. The gun has a double grip somewhat similar to, but much simpler than, the double grip found on the Maxim and Vickers machine guns, and the excessive racking effect that would inevitably follow from the use of so powerful a weapon as this has been minimized by the use of an ingenious buffer mechanism, which has been added to absorb the recoil. This feature has made possible a considerable reduction in the weight of the weapon.

American Takes Over Canadian Machine Co.

Word comes from Toronto that an agreement has been signed whereby the American Ironing Machine Co., of Chicago, acquires the plant of the Woodstock Worsted Knitting Co., taking a year's lease and option to buy at the end of twelve months. The American Ironing Machine Co. was established in 1905 at Algonquin, about fifty miles from Chicago. The desirability of securing Canadian and other British Empire business led to the decision to establish in the Dominion.

It is planned to commence installing machinery in March next and to start production soon afterward.

Advance Convention Announcement

A triple convention of the National Supply and Machinery Dealers' Association, the Southern Supply and Machinery Dealers' Association and the American Supply and Machinery Manufacturers Association will be held in Atlantic City, New Jersey, May 16, 17, 18, 1921, with headquarters for all three Associations at the Marlborough-Blenheim. F. D. Mitchell, 4106 Woolworth Building, New York, is secretary of the last named association.

At a conference held last week in Atlanta, Georgia, with the executive committee of the Southern Supply and Machinery Dealers' Association, although a preference had been expressed by them that the convention be held in a Southern city, yet because of the many weighty problems which will be presented to the 1921 Convention, they agreed to accept the invitation of the National Supply and Machinery Dealers' Association to meet the Manufacturers in convention at Atlantic City.

Each member is earnestly requested to do his part, not only by sending one or more executives to the convention, but in bringing into the association before the convention one new member.

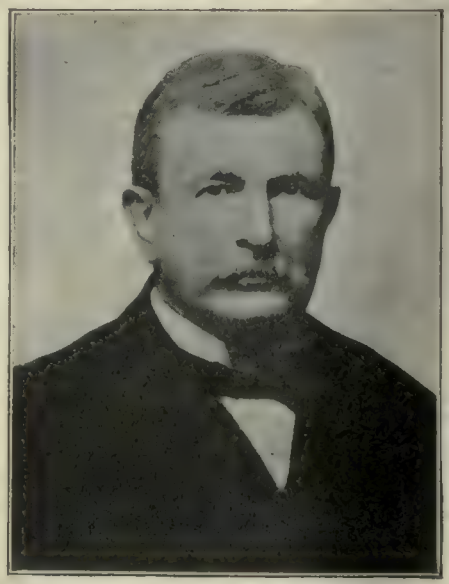
Exports of Manufactures Continue to Increase

Manufactures continue to increase the proportion which they form in our export trade. They actually formed over 51 per cent of our total domestic exports in the ten months ending with October, 1920, against 45 per cent in the calendar year 1919, 47 per cent in the fiscal year preceding the war, 45 per cent in 1910, and 35 per cent in 1900. In fact, says a statement by The National City Bank of New York, manufactures exported in the ten months ending with October, 1920, were 18 per cent greater in value than in the same months of 1919, while the remainder of the domestic merchandise exported shows an actual decrease in the same period. In the ten months ending with October manufactures exported showed an increase of $530,000,000 over the same period of last year, while all other domestic merchandise exported showed an actual decline of $175,000,000.

Obituary

Benjamin Holt

Benjamin Holt, president of the Holt Manufacturing Co. and inventor of the caterpillar tractor, whose inventive mind developed the tanks that took



BENJAMIN HOLT

such a great part in the World War, died in St. Joseph's Hospital, Stockton, Cal., on Dec. 5.

He had been confined to his bed about ten days, and his death came so suddenly there was not sufficient time to summon his family.

Benjamin Holt, by his inventive genius and wonderful ability, gave Stockton its greatest industry, made employment for thousands of men, put agriculture on a higher plane and gave the world a machine that has been characterized as the greatest contribution to the success of the Allies in the great war.

He was born in Merrimac County, New Hampshire on Jan. 1, 1849. His primary education was gleaned in the public schools around his boyhood home, and in an academy at Tilton, N. H. Later he attended a Baptist institution at New London, Conn.

Unlike many inventors and organizers, Holt lived to see the fruition of his dreams and ambitions in the building of two immense factories for the manufacture of his product, to see thousands of those machines sent out to every part of the civilized world, and finally, to realize the greatest triumph of all—the success of the Allied armies, due more than anything else, to the tank and tractors that were the development of his brain.

GEORGE M. WHITIN, treasurer of the Whitin Machine Works, at Whitinsville, Mass., and for thirty-four years the business head of the concern, died at his home in Whitinsville on Dec. 8, after a year's illness. Mr. Whitin was sixty-four years old and was interested in various other industries throughout Massachusetts.

FREDERIC IVER JOHNSON, oldest son of Iver Johnson, inventor and the founder of the arms and cycle works which bears his name, at Fitchburg, Mass., died at his home in Fitchburg, Dec. 9. Mr. Johnson was for a number of years president of the Iver Johnson Arms and Cycle Works, at Fitchburg, but resigned some years ago.

DESMOND H. WHEELER, director and official of the Acme Shear Co., Bridgeport, Conn., for a number of years, died at his home in Bridgeport on Nov. 29 at the age of seventy-one years. Mr. Wheeler was well known in industrial circles in this section.

JOHN B. ADT, president of the John B. Adt Co., Baltimore, Md., manufacturer of machinery, died on Dec. 14 at the home of his son, Edwin B. Adt, in Baltimore. He was 85 years old.

Business Items

The North & Judd Manufacturing Co. of New Britain, Conn., manufacturer of hardware, has increased its capital stock from $2,000,000 to $3,000,000, by adding forty thousand shares at $25 par.

Foster, Merriam & Co. of Meriden, Conn., manufacturer of hardware, has increased its capital stock from $570,000 to $1,000,000.

The Wicaco Screw and Machine Works, Inc., Philadelphia, Pa., announces the removal of its manufacturing plant and general offices to Stenton Ave. and Louden St. The new quarters afford considerably more floor space and more modern equipment.

The Locke Steel Belt Co. of Bridgeport, Conn., manufacturer of steel belts and chain, announces the placing of in-

Condensed-Clipping Index of Equipment

Patented Aug. 20, 1918

Rust Remover, "Meno"

Peter A. Frasse & Co., Inc., 417 Canal St., New York, N. Y.

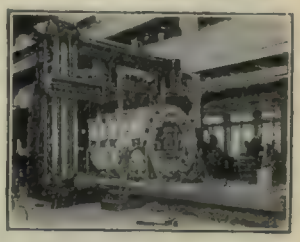
"American Machinist," Nov. 4, 1920

Rusty articles can either be painted with this compound or suspended in a tank containing the compound diluted with water. It is claimed that it will loosen and dissolve rust, grease, oil, dirt, carbon, paint or any other foreign substance irrespective of its age or hardness and that the metal surface will not only not be injured in any way but will be protected from corrosion for a long time after the application. It is also claimed that the compound is safe to use as it will neither burn nor explode.

Planer, 16 Ft.

William Sellers & Co., Inc., 1600 Hamilton St., Philadelphia, Pa.

"American Machinist," Nov. 25, 1920



The bed is made in three sections, a central one to which the uprights are bolted and which carries the driving shaft and pinion, and two end sections. The table is driven by the Sellers type drive, through a spiral pinion engaging a rack on the under side of the table. The spiral pinion is mounted on a shaft which is set at an angle of 33 deg. from the center line of the bed, and is about 24 in. long. Specifications: Will plane 16 ft. in width, 13 ft. in height and 36 ft. in length. Width of table, 13 ft. Uprights: width of face, 24 in.; depth, front to back, 10 ft. Cross-rail: face, 27½ in.; height, including reinforcing beam, 51 in. Table rack: pitch, 3¼ in.; face, 12 in. Weight, 412,300 pounds.

Profiling and Milling Machine, Automatic, Multiple-Spindle, "Coulter"

Automatic Machine Co., Bridgeport, Conn.

"American Machinist," Nov. 25, 1920



This machine is a modification of that described in the *American Machinist*, page 1332, Vol. 52. It has been equipped with a transfer table designed to permit the use of double or reciprocating fixtures so that a milling operation may be carried on with practical continuity by having one portion of the fixture in position for unloading and reloading while the cutters are at work upon pieces held in the other portion. This machine is adaptable to a wide range of work by reason of the adjustability of the spindle positions and the varied arrangements of the cams possible.

Gages, Snap, Solid and Adjustable

Sheffield Machine and Tool Co., Dayton, Ohio.

"American Machinist," Nov. 25, 1920

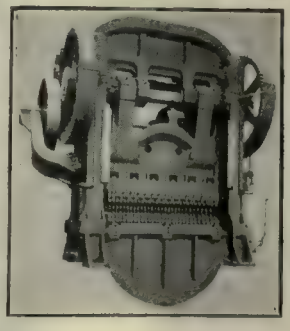


The solid, two-sided go and not-go length snap gage is shown. The end-blocks, including anvils and anvil holders, are made up as units and are then assembled to strip-steel beams thus making it possible to secure any desired length. A cylindrical snap gage made by this company is assembled from unit end-blocks and castings in a series of sizes from ¼ in. upward. Anvils are either adjustable or renewable, and both external and internal gages can be furnished.

Press, Punch, Multiple, Double-Crank, Twin-Gear Drive

Toledo Machine and Tool Co., Toledo, Ohio.

"American Machinist," Nov. 25, 1920



As shown, this press is fitted with sixty independently adjustable punches and dies for punching holes with varying distances between the centers. The punch holders are fitted with gags, so that by pulling out or pushing in the gags, holes may be punched or omitted as desired. The press is capable of punching fifteen 1-in. holes through $\frac{1}{16}$-in. steel, and is driven by a 30-hp. motor. Weight, about 165,000 lb. Width between uprights, 103 in. Area of bed, 36 x 102 in. Opening in bed, 4 x 98 in. Area of slide, 22 x 94 in. Diameter of crankpin, 13½ in. Distance from bed to slide, raised, 33 in.

Welding Machine, Electric-Arc, Portable for Small Work

Electric Arc Cutting and Welding Co., 152-58 Jelliff Ave., Newark, N. J.

"American Machinist," Nov. 25, 1920

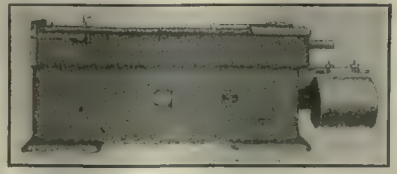


This device weighs 100 lb. and is intended for light work, such as in a garage machine shop. It can use electrodes from $\frac{1}{16}$ to $\frac{3}{16}$ in. in diameter. When using the smaller sizes of electrodes it can be operated continuously, but with the larger sizes the operation must be intermittent. It is possible to operate the machine fom a lamp socket on light loads, but it is intended that the supply wires of the device be attached to the panel board feeding the lights, provided that a current of 5 kva. is available. The machine will operate on any voltage between 90 and 130 and between 180 and 260.

Broaching Machine, Rack-Type, Nos. 1½ and 3

American Broach and Machine Co., Ann Arbor, Mich.

"American Machinist," Nov. 25, 1920

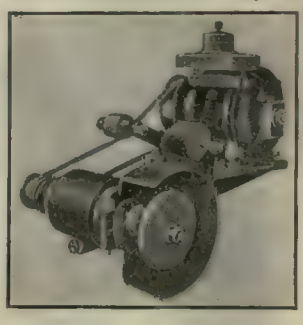


The No. 3 machine is illustrated; it handles broaches 53 in. long, and the No. 1½, up to 40 in. The drive is by belt, the speed reduction being made by means of an inclosed steel worm and phosphor-bronze worm-gear on the rear of the machine. A hardened pinion on the shaft of the worm-gear drives the rack, to which the broaches are attached by means of the sliding head. The section of the rack is D-shaped, the flat side with the teeth being on the bottom. The reversal of motion of the rack is accomplished by shifting the belt at the ends of the stroke. Specifications: Maximum capacity: length of broach, 58 in.; will square or spline hole, 3½ in.; will cut keyways, 1¾ in. Height to center of bore, 32⅜ in. Face, 15 x 14⅜ in. Bore, 5-in. diameter. Weight, crated with countershaft, 4,300 pounds.

Attachment, Grinding, for Lathe

François Chappuis, Room 2632, 120 Broadway, New York, N. Y.

"American Machinist," Nov. 25, 1920



This machine is intended for internal and external cylindrical grinding. Either motor drive, as shown, or countershaft drive can be used; the former is preferable, owing to its ability to operate in any positon desired. The spindle runs in three sets of ball bearings, mounted in an eccentric case, so that the height of the spindle can be regulated. Since the speed of the machine is from 12,000 to 18,000 revolutions per minute, a belt-tightening device is used. A small pulley and a splinter guard are furnished with the machine.

surance on all its employees, numbering about 125. The form is group life insurance, placed with the Travelers Insurance Company of Hartford, Conn.

The Geometric Tool Co. of New Haven, Conn., manufacturer of screw cutting tools, etc., has increased its capital stock from $100,000 to $1,000,000.

The Hubbard Machine Co., ball-bearing manufacturer, 54-70 Commercial St., Worcester, Mass., will remove its plant from there to Hartford, Conn., on Jan. 1, and occupy the new factory recently constructed at the plant of the S. K. F. Ball Bearing Co. on New Park Ave., of which concern the Hubbard Co. is a subsidiary. The new building is a one-story brick and steel structure, 75 x 225 ft.

The American Machinery and Equipment Co. of Newington, a suburb of Hartford, Conn., has recently been incorporated to deal in and manufacture machinery, tractors, etc. The capital stock of the company is $500,000.

The Brien Heater Co. of Westfield, Mass., has been taken over by the Phillips & Clark Co. of Geneva, N. Y., and will be removed to that city the first of the year.

The Black & Decker Manufacturing Co., Towson Heights, Baltimore, Md., has established a new branch office at 303 Penn Ave., Pittsburgh, Pa. This office will be the headquarters for the sales force in western New York, western Pennsylvania and northwestern part of West Virginia. It will be in charge of W. D. Royer, formerly sales engineer of the Robbins Electric Co. of Pittsburgh. A service station has also been established at the same address.

Personals

The friends of ALBERT A. BOWMAN, formerly of 2 Charter Oak Ave., Hartford, Conn., are anxious to get in immediate touch with him.

BERTRAM D. TAITT has been selected as superintendent of the National Works of the Wickwire-Spencer Steel Corporation at Worcester, Mass., to succeed James E. McKenny, recently resigned. Mr. Taitt has been assistant superintendent of the same plant for the past two years previous to which he was general manager of the Stenman Wire Specialty Co. of Worcester.

JOHN H. GOSS, general superintendent of the Scovill Manufacturing Co. of Waterbury, Conn., was elected first vice president of the Connecticut Chamber of Commerce, at the annual meeting held in Hartford recently.

STANLEY H. BULLARD, vice president of the Bullard Machine Tool Co. of Bridgeport, Conn., manufacturer of machinery, was elected president of the Connecticut Chamber of Commerce at the annual meeting of the chamber held in Hartford on Dec. 8. Mr. Bullard succeeds Charles E. Chase.

FRANK O. HOWARD, who has been connected with the North Works of the American Steel and Wire Co. at Worcester, Mass., for the past eleven years has been appointed manager of the new office the company has opened in Atlanta, Ga. Mr. Howard has already started in with his new duties.

C. F. LEWIS, metallurgist of the Greenfield Tap and Die Corporation of Greenfield, Mass., resigned his position on Dec. 1 to take charge of the metallurgical department of the American Tube and Stamping Co.'s plants at Bridgeport, Conn.

LAWRENCE M. KEELER, agent and also a director of the Whitin Machine Works at Whitinsville, Mass., is planning a trip to Japan and China in February in connection with business interests of the company.

HENRY REEVES, for years with the Stocker-Rumely Co. and since the reorganization with the Stocker-Rumely-Wacks Co., will be auditor and credit manager of the Dale-Brewster Co., starting on Jan. 1.

ROBERT F. KIMBER, formerly of the Le Moyne Steel Co., will have charge of sales in the milling cutter and special tool department of the Cooney-Dunn Co., New York and Mt. Vernon, N. Y.

BERKELEY WILLIAMS, until recently chief engineer of the F. H. Lawson Co., Cincinnati, Ohio, is now general manager of the Chatham Manufacturing Co., Middletown, Conn.

W. L. CHURCHILL and ALBERT MCDONALD announce the formation of the McDonald-Churchill Corporation, industrial engineering service, New York City. Mr. Churchill, president, was formerly engaged in consulting industrial engineering, and Mr. McDonald, vice-president and general manager, was formerly vice-president of the C. E. Knoeppel & Co., Inc., New York.

F. J. MORSCHES and ALBERT DUDLEY have been appointed assistant superintendents at the Black Diamond File Works of the G. & H. Barnett Co., Philadelphia, Pa. Mr. Morsches was for a number of years connected with the Nicholson plant at Anderson, Indiana; Mr. Dudley was formerly chief machinist at the Philadelphia plant of the same company.

Trade Catalogs

Duff Lifting Jacks. The Duff Manufacturing Co., Pittsburgh, Pa. Catalog No. 104, pp. 148. This company has issued a catalog describing and illustrating its complete line of Duff lifting jacks. It also includes jacks for all purposes—railway, automotive and industrial, in sizes ranging from 1 to 75 tons lifting capacity.

Dodge Standardized Elevators and Conveyors. Dodge Sales and Engineering Co., Mishawaka, Ind. This catalog contains 160 6 x 9-in. pages and 150 illustrations, and covers the elevator and conveyor field in a thorough and comprehensive manner. Gear design, drives, pitches, teeth, shaft sizes and speed regulation are some of the subjects presented.

Do You Know How to Make a Chisel. Joseph T. Ryerson & Son., Chicago Ill. This company has issued a small three-page leaflet containing a description on how to make a chisel.

Uses and Treatments of high-speed and tool steel. Halcomb Steel Co., Syracuse, N. Y. A 7 x 11-in. chart giving specifications for heat-treating eight brands of steel. Hardening temperatures, and directions for various degrees of hardness are included. The uses of these eight brands of Halcomb steel are also given.

Electric Overhead Cranes and Hoists. Victor R. Browning, 17701 Lake Shore Blvd., Cleveland, Ohio. Catalog, pp. 23, 8½ x 11 in. The views illustrated in this catalog show practical installations of the different types of electric overhead cranes and hoists.

Electric Air Heaters. C-H Convector Type Electric Air Heaters are illustrated and described in a new 4-page 8½ x 11-in. leaflet, being distributed by the Cutler-Hammer Manufacturing Co., of Milwaukee, and New York, and known as Publication 862. The leaflet also tells briefly the advantages of electric heat over other forms of heating and gives thumb rules which enable the customer to closely estimate the number or size of heaters required for any particular installation. The C-H Convector Type Air Heater is described as being a compact and sturdy appliance. It consists of several of the widely-known C-H Space Heaters mounted horizontally between cast-iron end plates and completely enclosed in a protecting screen of perforated sheet metal, so that nothing inflammable can touch the heaters or any live parts. The heaters are made in eight different capacities ranging from 1 to 5 kw. for standard commercial voltages, and all except the smallest and largest sizes are designed for three different heats.

Wave Power Tools. W. H. Dorman & Co., Ltd., Stafford, England. Booklet, pp. 68, 8½ x 11 in. This booklet presents a series of practical working appliances which economically transmit and apply energy by waves through water. It is profusely illustrated.

Chucks and Collets. The Charles L. Jarvis Co., Gildersleeve, Conn. A small folder briefly describing its quick-change chucks and collets.

Regulators. American Galco., Inc., New York City. Catalog, 9 x 11 in. An illustrated and descriptive catalog of its different types of regulators.

Wayne Oil and Gasoline Storage Systems—Oil Filtration Systems—Oil Burning Systems—Furnaces for Metal Melting, Forging and Heating.—Wayne Oil Tank and Pump Co., Fort Wayne, Ind. This 9 x 11-in. catalog is a beautiful example of the printer's art. The cover is printed with raised letters, is imitation leather and incloses a large number of bulletins issued by the company and advertising its products. The cover is made so that new bulletins can be added.

Handbook for Drillers. The Cleveland Twist Drill Co., Cleveland, Ohio. Booklet, pp. 37, 4¾ x 8 in. This volume is designed for students of drilling; it is not a complete treatise on the subject, but gives an introduction to the theory underlying the use of the twist drill. The company charges a nominal sum for this booklet.

The Primary Function of a Vise. Reed Manufacturing Co., Erie, Pa. This small pamphlet describes the functions of a vise.

Forthcoming Meetings

The Society of Automotive Engineers will hold its annual meeting on Jan. 11 to 13 inclusive at New York.

The Engineering Institute of Canada will hold its thirty-fifth annual meeting in Toronto, King Edward Hotel, on Feb. 1, 2 and 3.

A triple convention of the National Supply and Machinery Dealers' Association, the Southern Supply and Machinery Dealers' Association and the American Supply and Machinery Manufacturers' Association will be held in Atlantic City, N. J., May 16, 17 and 18, 1921, with headquarters for all three associations at the Marlborough-Blenheim. F. D. Mitchell, 4106 Woolworth Building, New York, is secretary of the last-named association.

The Spring Convention of the National Machine-Tool Builders' Association will be held on Thursday and Friday, May 19 and 20, at Hotel Traymore, Atlantic City, N. J. Chas. E Hildreth, care of the Association, Worcester, Mass., is general manager.

Condensed-Clipping Index of Equipment

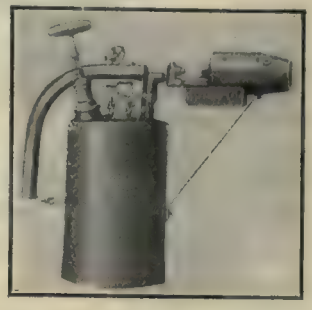
Patented Aug. 20, 1918

Truck, Tier-Lift, No. 703-A
Lakewood Engineering Co., Cleveland, Ohio
"American Machinist," Nov. 25, 1920.



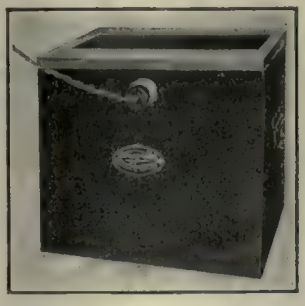
The general characteristics of the machine are similar to those of the Model 703 truck described in the *American Machinist* on page 52, vol. 52. Both models are built in four sizes with lifts of 42, 60, 76 and 96 in., respectively. The difference is that the Model 703-A machine has an elevating speed nearly twice as great as the other machine, its maximum load being 2,000 lb., while that of the 703 truck is 4,000. The new model is intended especially for the handling of rather light, bulky packages.

Torch, Kerosene, Style "T"
Mahr Manufacturing Co, Minneapolis, Minn.
"American Machinist," Nov. 25, 1920.



This torch is intended for use in foundries, tin shops, machine shops, or wherever a small heating appliance is required. It is stated that the torch operates under a wide range of pressure, so that a few strokes of the pump will provide sufficient pressure to last for an hour. Starting the torch requires about four minutes. It is made in three sizes, ½, 1 and 1½ gal., the oil consumptions being, respectively, 1, 2 and 3 quarts per hour. The net weights are 6½, 8½ and 10½ lb., the box weights, 12½, 15½ and 18½ lb., and the volumes when boxed are 1, 1.5 and 2 cu.ft.

Demagnetizer, "Demagnetool" No. 2
William Brewster Co., Inc, 30 Church St., New York.
"American Machinist," Nov. 25, 1920.



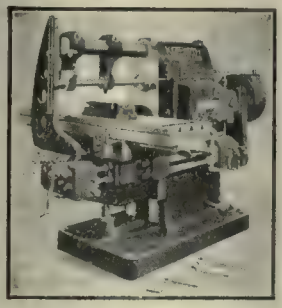
A type of demagnetizer suitable for production work, and with which it is not necessary either to rub or to place the work on the plate of the device is shown. It is only necessary to drop or pour the work through the opening in order to demagnetize it. It is claimed that, due to the design of the transformer, the magnetic flux crosses at right angles the opening through which the work is passed, so that the action extends equally to all points of the working space. The No. 2 has an opening 6 x 12 in., but other sizes can be furnished.

Lathe, Double-Carriage, Production
Hamilton Machine Co., Hamilton, Ohio
"American Machinist," Dec. 2, 1920.



The object of the two carriages is to enable the turning and facing operations to be performed at the same time; the front carriage holds the turning tools, while the rear one carries the facing tools. The machine is intended for production work on such parts as steering knuckles for automobiles and tractors, small shafts, axle parts and gears of different types. It is stated that when the lathe is properly tooled for a given job, it may be run by a comparatively unskilled operator and yet give speedy production and accurate work.

Milling Machine, Plain, "Maximiller No. 2"
Kempsmith Manufacturing Co., Milwaukee, Wis.
"American Machinist," Dec. 2, 1920.



Specifications: Working surface of table, 12 x 56 in. Table adjustment: Longitudinal, 28 in.; transverse, 10 in.; vertical, 19 in. Face of column to brace, 24¾ in. Arbor: diameter, 1¼ in.; length shoulder to nut, 22¼ in. Spindle: front bearing, 4⅜ in. diameter by 4 7/16 in. long; taper hole, No. 12 B. & S.; hole through spindle, 1¼ in. Driving pulley: 3½ x 15 in; speed, 400 r.p.m. Spindle speeds: number 18; range, 16 to 400 r.p.m. Feeds: number, 18; range, ⅝ to 25 in. per minute. Power quick traverse: longitudinal, 100 in. per minute; transverse and vertical, 36 in. per minute. Floor space, 85 x 105 in. Weight: net, 4,200 lb.; domestic shipping, 4,500 lb.; export, 4,900 lb.

Drilling Machine, Sensitive, Automatic
Kingsbury Manufacturing Co., Keene, N. H.
"American Machinist," Dec. 2, 1920.



The machine is intended for production drilling on small parts. Specifications: Capacity, 7/16-in. drills. Spindles; diameter, 7/8 in.; standard stroke, ¾ in.; vertical adjustment, ⅝ in. Vertical adjustment of tables, 5 in. Distance between spindles, 8 in. Spindle to column, 6 in. Bottom of chucks to tables, maxmium, 8 in. No. of speeds, 3; 1,500, 2,400 and 3,750 r.p.m. with drive-shaft speed of 750 r.p.m. Drive pulley, 5 in. Height, 28 in. Base; belt-drive, 16 x 20 in.; motor drive, 16 x 24 in. Weight; belt drive, 250 lb.; motor drive, 270 lb.

Brake, Plate-Bending
Dries & Krump Manufacturing Co., Chicago, Ill.
"American Machinist," Dec 2, 1920.



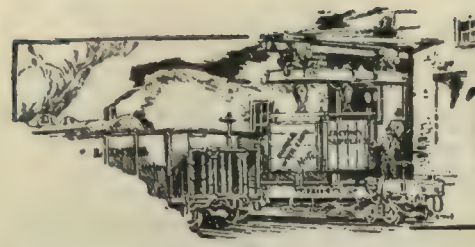
This machine is said to be the largest plate-bending brake in the world. The brake weighs 30 tons, and can bend cold plates 12 ft. long up to ⅝ in. thick. It is built of steel throughout. The housings are steel castings, the links which connect the upper and lower jaws being forgings. The nose of the upper jaw carries a tool-steel edge. The motor is mounted within the machine, driving a shaft carrying direct and reverse friction clutches. The reverse motion for lowering the bending leaf is obtained through an idler gear. Floor space required, 16 x 12 ft.

Milling Machine, Continuous, "Model 0-3"
Newton Machine Tool Works, Inc., 23rd and Vine Sts., Philadelphia, Pa.
"American Machinist," Dec. 2, 1920.



This machine is intended for face-milling the ends of such work as shafts, rods and crankshafts. A production of 250 pieces per hour can be obtained, the shafting being 1⅜ in. in diameter. The machine consists of a heavy bed carrying two heads, one of them being movable along the bed in order to accommodate work of different lengths. An individual motor drive is employed. End or face mills are used, a depth adjustment being provided. The work is secured at each end in a fixture fastened to the head. The feed motion is obtained by rotation of the fixtures.

Clip, paste on 3 x 5-in. cards and file as desired



THE WEEKLY PRICE GUIDE

IRON AND STEEL

PIG IRON—Quotations compiled by The Matthew Addy Co.:

	Current	One Year Ago
CINCINNATI		
No. 2 Southern	$44.50	$30.35
Northern Basic	40.00	27.55
Southern Ohio No. 2	42.00	28.55
NEW YORK—TIDEWATER DELIVERY		
2X Virginia (Silicon 2.25 to 2.75)	51.26	32.40
Southern No. 2 (Silicon 2.25 to 2.75)	48.26	35.20
BIRMINGHAM		
No. 2 Foundry	40.50	29.25
PHILADELPHIA		
Eastern Pa., No. 2x, 2.25 2.75 sil.	42 50	29.00–30.00
Virginia No. 2	46 25	33.10
Basic	38 25	26.75
Grey Forge	40 25	26.75
CHICAGO		
No. 2 Foundry local	40 00	26.75
No. 2 Foundry, Southern	46 66	28.00
PITTSBURGH, INCLUDING FREIGHT CHARGE FROM VALLEY		
No. 2 Foundry	41.96	28.15
Basic	38 00	27.15
Bessemer	38.00	29.35

* F.o.b. furnace. † Delivered.

STEEL SHAPES—The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses at the cities named:

	New York Current	New York One Month Ago	New York One Year Ago	Cleveland Current	Cleveland One Year Ago	Chicago Current	Chicago One Year Ago
Structural shapes	$3 80	$4 15	$3.47	$3.58	$3.37	$3.58	$3.47
Soft steel bars	3 70	4 15	3.37	3.34	3.27	3.48	3.37
Soft steel bar shapes	3.70	4 15	3.37	3.48	3.27	3.48	3.37
Soft steel bands	4.65	5 50	4.07	6.25	.....	.....	.....
Plates, ¼ to 1 in. thick	4.00	4.15	3.67	3.78	3.57	3.78	3.67

BAR IRON—Prices per 100 lb. at the places named are as follows:

	Current	One Year Ago
Mill, Pittsburgh	$4.25	$2.77
Warehouse, New York	4.75	3.37
Warehouse, Cleveland	3.52	3.27
Warehouse, Chicago	4.12	3.37

SHEETS—Quotations are in cents per pound in various cities from warehouse; also the base quotations from mill:

Blue Annealed	Large Mill Lots Pittsburgh	New York Current	New York One Year Ago	Cleveland	Chicago
No. 10	3.55	5 20	4.57	5.00	6.13
No. 12	3.60	5 25	4.62	5 05	6.18
No. 14	3.65	5 30	4.67	5 10	6.23
No. 16	3.75	5 40	4.77	5 20	6.33
Black					
Nos. 18 and 20	4.20	6 30	5.30	5 60	6.90
Nos. 22 and 24	4.25	6.35	5.35	5 75	6.95
No. 26	4.30	6 40	5.40	5 80	7.00
No. 28	4.35	6.50	5.50	5.90	7.10
Galvanized					
No. 10	4.70	7 05	5.75	6 25	7.25
No. 12	4.80	7 15	5.85	6 35	7.30
No. 14	4.80	7 15	5.85	6.35	7.45
Nos. 18 and 20	5.10	7 40	6.15	6.65	7.75
Nos. 22 and 24	5.25	7.55	6.30	6.80	8.15
No. 26	5.40	7.70	6 45	6 95	8.30
No. 28	5.70	8.00	6.75	7.25	8.60

Acute scarcity in sheets, particularly black, galvanized and No. 16 blue enameled.

Automobile sheets are unavailable except in fugitive instances, when prices are 9.45c per lb. for No. 16; 9.50 for Nos. 18 and 20, and 9.55c for Nos. 22 and 24.

COLD FINISHED STEEL—Warehouse prices are as follows:

	New York	Chicago	Cleveland
Round shafting or screw stock, per 100 lb. base	$5.50	$5.80	$4 84
Flats, square and hexagons, per 100 lb. base	6.00	6.30	5.34

DRILL ROD—Discounts from list price are as follows at the places named:

	Per Cent.
New York	50
Cleveland	50
Chicago	50

NICKEL AND MONEL METAL — Base prices in cents per pound F. O. B. Bayonne, N. J.

Nickel	
Ingot and shot	43
Electrolytic	45

Monel Metal			
Shot and blocks	35	Hot rolled rods (base)	42
Ingots	38	Cold rolled rods (base)	56
Sheet bars	40	Hot rolled sheets (base)	55
Special Nickel and Alloys			
Malleable nickel ingots			45
Malleable nickel sheet bars			47
Hot rolled rods, Grades "A" and "C" (base)			60
Cold drawn rods, grades "A" and "C" (base)			72
Copper nickel ingots			42
Hot rolled copper nickel rods (base)			52
Manganese nickel hot rolled (base) rods "D" — low manganese			64
Manganese nickel hot rolled (base) rods "D"— high manganese			67

Domestic Welding Material (Swedish Analysis)—Welding wire in 100-lb lots sells as follows, f. o. b. New York: ⅛, 8½c. per lb.; ¼, 8c.; ⅜ to ½, 7½c Domestic iron sells at 12c. per lb.

MISCELLANEOUS STEEL—The following quotations in cents per pound are from warehouse at the places named:

	New York Current	Cleveland Current	Chicago Current
Openhearth spring steel (heavy)	7.00	8.00	9.00
Spring steel (light)	10.00	7.00	12.00
Coppered bessemer rods	9.00	8.00	6.75
Hoop steel	4 70	4 04	5.32
Cold-rolled strip steel	9.50	8.25	10.75
Floor plates	6.25	4.00	6.63

WROUGHT PIPE—The following discounts are to jobbers for carload lots on the Pittsburgh basing card:

Inches	Steel Black	Steel Galvanized	Inches	Iron Black	Iron Galvanized
	BUTT WELD				
¼ to 3	54–57½%	41½–44%	⅛	15½–25½%	+1½–11½%
			¼	19½–29½%	1½–11½%
			⅜ to 1½	24½–34½%	8 –18½%
	LAP WELD				
2	47 –50½%	34½–38%	1¼		
2½ to 6	50 –53½%	37½–41%	1½		
7 to 12	47 –50½%	33½–37%	2	20½–28½%	6½–14½%
13 to 14	37½–41 %		4½ to 6	22½–30½%	9½–17½%
15	35 –38½%		2½ to 4	22½–30½%	9½–17½%
			7 to 12	19½–27½%	6½–14½%
	BUTT WELD, EXTRA STRONG PLAIN ENDS				
¼ to 1½	52 –55½%	39½–43%	¼ to 1½	24½–34½%	9½–19½%
2 to 3	53 –56½%	40½–44%			
	LAP WELD, EXTRA STRONG PLAIN ENDS				
2	45 –48½%	33½–37%	1¼		
2½ to 4	48 –51½%	36½–40%	1½		
4½ to 6	47 –50½%	35½–39%	2	21½–29½%	8½–16½%
7 to 8	43 –46½%	29½–33%	2½ to 4	23½–31½%	11½–19½%
9 to 12	38 –41½%	24½–28%	4½ to 6	22½–30½%	10½–18½%
			7 to 8	14½–22½%	2½–10½%
			9 to 12	9½–17½%	5½–+2½%

	New York Black	New York Galv.	Cleveland Black	Cleveland Galv	Chicago Black	Chicago Galv.
⅛ to 3 in. steel butt welded	38%	22%	39%	30%	54%40%	40½@30 %
2½ to 6 in. steel lap welded	33%	18%	41%	26%	50@40%	37½@27½%

Malleable fittings. Classes B and C, banded, from New York stock sell at plus 45%. Cast iron, standard sizes, plus 5%.

METALS

MISCELLANEOUS METALS—Present and past New York jobbers' quotations in cents per pound, in quantities up to car lots:

	Current	Month Ago	Year Ago
Copper, electrolytic	15.00	15.50	22.50
Tin in 5-ton lots	35 25	38.75	56.50
Lead	5 75	6 75	6.25
Zinc	7.00	7 00	7.60
ST. LOUIS			
Lead	6.25	7.25	6.00
Zinc	6 75	6.25	7.15

At the places named, the following prices in cents per pound prevail, for 1 ton or more:

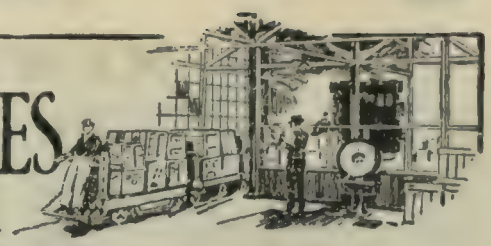
	New York Current	New York Month Ago	New York Year Ago	Cleveland Current	Cleveland Year Ago	Chicago Current	Chicago Year Ago
Copper sheets, base	22.50	23.50	33.50	24.50	35.50	28.50	36.50
Copper wire (carload lots)	17.00	20.00	30.75	22 00	30.50	25 00	26.00
Brass sheets	20.25	28.50	32.00	25 00	33.00	25 25	28.00
Brass pipe	25.00	28.00	36.00	27.00	39.00	30 00	37.00
Solder (half and half) (case lots)	27.75	29.00	45.00	29.00	41.00	22.50	38.50

Copper sheets quoted above hot rolled 24 oz., cold rolled 14 oz. and heavier, add 2c.; polished takes 5c. per sq.ft. extra for 20-in. widths and under; over 20 in., 7½c.

BRASS RODS—The following quotations are for large lots, mill. 1000 lb. and over, warehouse; net extra:

	Current	One Year Ago
Mill	18.25	24.00
New York	18 25	28.00@29.75
Cleveland	23 00	29.00
Chicago	23 25	27.00

SHOP MATERIALS AND SUPPLIES



ZINC SHEETS—The following prices in cents per pound are f.o.b. mill + less 8% for carload lots..... 11.50

	Warehouse			
	—In Casks—		— Broken Lots —	
	Current	One Year Ago	Current	One Year Ago
Cleveland	15.30	12.50	14.70	13.00
New York	14.00	11.50	14.50	12.50
Chicago	14.50	16.50	14.95	16.00

ANTIMONY—Chinese and Japanese brands in cents per pound, in ton lots for spot delivery, duty paid:

	Current	One Year Ago
New York	6.25	9.50
Chicago	7.00	9.75
Cleveland	7.50	9.75

OLD METALS—The following are the dealers' purchasing prices in cents per pound:

	*New York			
	Current	One Year Ago	Cleveland	Chicago
Copper, heavy, and crucible	12.00	17.00	10.00	11.50
Copper, heavy, and wire	11.50	16.00	9.50	11.00
Copper, light, and bottoms	10.00	14.00	9.00	9.50
Lead, heavy	4.00	4.75	4.00	4.50
Lead, tea	3.00	3.75	3.00	3.50
Brass, heavy	7.00	10.50	7.00	10.50
Brass, light	5.50	7.50	5.00	5.50
No. 1 yellow brass turnings	6.50	10.00	5.50	5.50
Zinc	4.50	5.00	3.00	4.50

*These prices nominal because of dull market

ALUMINUM—The following prices are from warehouse at places named:

	New York	Cleveland	Chicago
No. 1 aluminum, 98 to 99% pure, in ingots for remelting (1-15 ton lots), per lb	$33.00	$26.00	$33.50

COPPER BARS—From warehouse sell as follows in cents per pound, for ton lots and over:

	Current	One Year Ago
New York (round)	28.00	32.00
Chicago	21.00	31.00
Cleveland	25.00	35.00

BABBITT METAL—Warehouse price per pound:

	—New York—		—Cleveland—		— Chicago —	
	Current	One Year Ago	Current	One Year Ago	Current	One Year Ago
Best grade	70.00	90.00	46.00	70.00	43.00	60.00
Commercial	30.00	50.00	16.50	16.50	11.00	13.00

NOTE—Price of babbitt metal is governed largely by formula, no two manufacturers quoting the same prices. For example, in New York we quote the best two grades, although lower grades may be obtained at from $16 to $20.

SHOP SUPPLIES

NUTS—From warehouse at the places named, on fair-sized orders, the following amount is deducted from list:

	—New York—		— Cleveland —		— Chicago —	
	Current	One Year Ago	Current	One Year Ago	Current	One Year Ago
Hot pressed square	+$1.25	$1.50	List net	$2.25	+1.15	1.85
Hot pressed hexagon	+ 1.25	1.50	List net	2.25	+1.15	1.85
Cold punched hexagon	+ 1.25	1.50	List net	2.25	+1.15	1.30
Cold punched square	+ 1.25	1.50	List net	2.25	+1.15	1.30

Semi-finished nuts, ⅞ and smaller, sell at the following discounts from list price:

	Current	One Year Ago
New York	30%	50–10%
Chicago	40%	50%
Cleveland	50%	55%

MACHINE BOLTS—Warehouse discounts in the following cities:

	New York	Cleveland	Chicago
½ by 4 in. and smaller	+10%	5%	20%
Larger and longer up to 1½ in. by 30 in.	Net list	4%	10%

WASHERS—From warehouses at the places named the following amount is deducted from list price:

For wrought-iron washers:
New York..... list Cleveland..... $2.75 Chicago..... $1.90

For cast-iron washers, ⅜ and larger, the base price per 100 lb. is as follows:
New York..... $7.00 Cleveland..... $4.50 Chicago..... $5.50

CARRIAGE BOLTS—From warehouses at the places named the following discounts from list are in effect:

	New York	Cleveland	Chicago
½ by 6 in. and smaller	+20%	40%	20%
Larger and longer up to 1 in. by 30 in.	+20%	35%	15%

COPPER RIVETS AND BURS sell at the following rate from warehouse:

	Rivets		Burs	
	Current	One Year Ago	Current	One Year Ago
Cleveland	25%	20%	10%	10%
Chicago	net	20%	net	20%
New York	30%	40%	net	20%

RIVETS—The following quotations are allowed for fair-sized orders from warehouse:

	New York	Cleveland	Chicago
Steel ⅞ and smaller	20%	50%	30%
Tinned	20%	50%	30%

Boiler, ¾, ⅞, 1 in. diameter by 2 to 5 in. sell as follows per 100 lb.:
New York..... $6.00 Chicago..... $5.73 Pittsburgh..... $4.60

Structural, same sizes:
New York..... $5.73 Chicago..... $5.83 Pittsburgh..... $4.50

MISCELLANEOUS

SEAMLESS DRAWN TUBING—The base price in cents per pound from warehouse in 100-lb. lots is as follows:

	New York	Cleveland	Chicago
Copper	$26.00	30.00	31.00
Brass	25.00	27.00	30.00

The prices, of course, vary with the quantity purchased. For lots of less than 100 lb., but not less than 75 lb., the advance is 1 c.; for lots of less than 75 lb., but not less than 50 lb., 2½c. over base (100-lb. lots); less than 50 lb., but not less than 25 lb., 5c. should be added to base price; quantities from 10-25 lb., extra is 10c.; less than 10 lb., add .15–20c.

Double above extras will be charged for angles, channels and sheet metal mouldings if ordered in above quantities. Above extras also apply to brass rod other than standard stock sizes—stock sizes being considered as ½-2 in. inclusive in rounds, and ½-1½ in., inclusive, in square and hexagon—all varying by thirty seconds up to 1 in. by sixteenths over 1 in. On shipments aggregating less than 100 lb., there is usually a boxing charge of $1.50.

LONG TERNE PLATE—In Chicago No. 28 primes from stock sell, nominally, for $8.85 per 100 lbs.

In Cleveland—$10 per 100 lbs.

COTTON WASTE—The following prices are in cents per pound:

	New York			
	Current	One Year Ago	Cleveland	Chicago
White	13.00@15.00	13.00	15.00	15.00@17.00
Colored mixed	7.00@12.00	9.00–12.00	11.00	11.00@13.00

WIPING CLOTHS—Jobbers' price per 1000 is as follows:

	13½x13½	13½x20½
Cleveland	55.00	65.00
Chicago	41.00	43.50

SAL SODA sells as follows per 100 lb.:

	Current	One Month Ago	One Year Ago
New York	$2.00	$2.00	$1.75
Philadelphia	2.75	2.75	1.75
Cleveland	3.00	3.00	2.50
Chicago	2.00	2.75	2.00

ROLL SULPHUR in 360-lb. bbl. sells as follows per 100 lb.:

	Current	One Month Ago	One Year Ago
New York	$3.50	$3.90	$3.65
Philadelphia	3.65	3.65	3.87
Chicago	3.85	5.00	4.12½

COKE—The following are prices per net ton at ovens, Connellsville:

	December 20	December 13	December 6
Prompt furnace	$7.00@$7.50	$8.00@$10.50	$8.00@$10.50
Prompt foundry	8.50@ 9.00	10.00@ 12.00	10.00@ 12.00

FIRE CLAY—The following prices prevail:

		Current
Ottawa, bulk in carloads	Per Ton	$11.00
Cleveland	100-lb. bag	1.00

LINSEED OIL—These prices are per gallon:

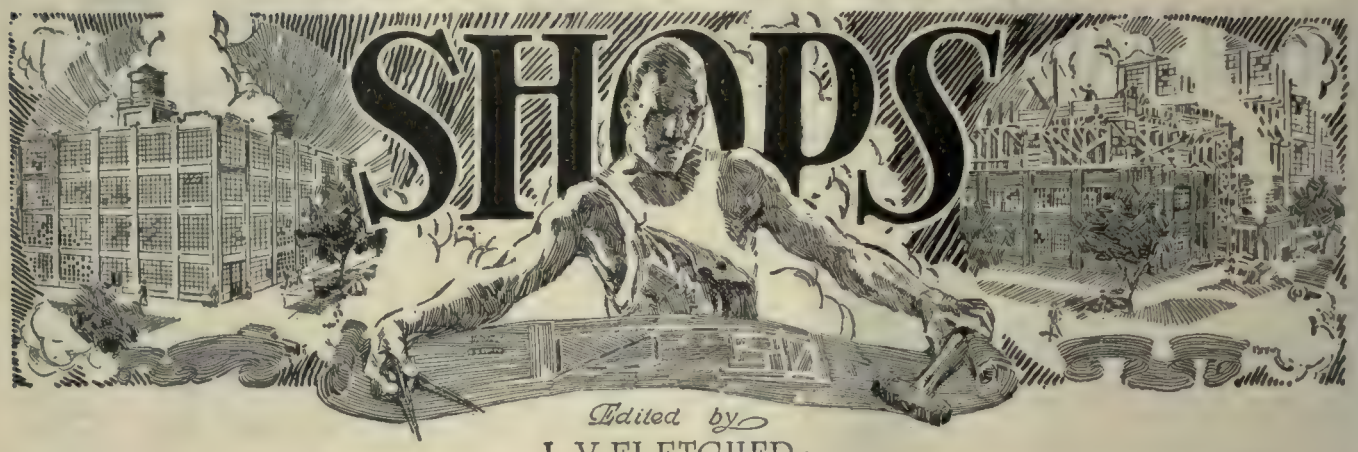
	—New York—		—Cleveland—		—Chicago—	
	Current	One Year Ago	Current	One Year Ago	Current	One Year Ago
Raw in barrels, (5 bbl. lots)	$0.90	$2.15	$1.05	$2.50	$1.01	$2.37
5-gal cans	1.05	2.30	1.30	2.75	1.26	2.57
1-gal cans (6 to case)	1.15	....	....	....	....	....

WHITE AND RED LEAD—Base price per pound:

	Red				White	
	Current		One Year Ago		Current	One Year Ago
	Dry	In Oil	Dry	In Oil	Dry and In Oil	Dry and In Oil
100 lb. keg	14.00	15.50	13.00	14.50	14.00	13.00
25 and 50-lb. kegs	14.25	15.75	13.25	14.75	14.25	13.25
12½-lb. keg	14.50	16.00	13.50	15.00	14.50	13.50
5-lb. cans	17.00	18.50	15.00	16.50	17.00	15.00
1-lb. cans	19.00	20.50	16.00	17.50	19.00	16.00

500 lb. lots less 10% discount 2,000 lb. lots less 10 4% discount. 10,000 lb. lots less 10-7½% discount.

NEW and ENLARGED



Edited by
L·V·FLETCHER

Machine Tools Wanted

If in need of machine tools send us a list for publication in this column

Mass., Worcester—J. Johnson, 26 Spofford Rd.—garage equipment.

Vt., Sprinfield — Gilmore & Co. — equipment for the manufacture of lathes.

N. J., Camden—The Dexter Metal Mfg. Co., Front and Arch Sts.—one 18-in. lathe.

N. Y., Patchogue — C. B. Loundes —one lathe with a 26 x 12 ft. bed.

N. Y., Schenectady—The General Electric Co., River Rd.—miscellaneous machine tool equipment.

La., New Orleans—H. M. Jannette, Room 712 Hennen Bldg.—one 12 in x 19 in. Le Blond lathe (new or used).
One 20 in. drill press (Champion or Hoefer).
One steam hammer.
One hazel power hammer (steam or electric).

Va., Richmond — The Auto Car Service Co., Richmond Meadows and Broad St.—large drill press.

Va., Richmond—A. I. Flemmig, 305 North Munford St.—medium size lathe and drill press for welding and repairing work.

Va., Richmond—C. H. Martin & Co., 221 West Broad St., C. H. Martin, Purch. Agt. —electric drill press and small lathe for its repair shop (new or used).

Va., Richmond—The Richmond Auto Repair Service, 509 West Marshall St., J. A. Scrapps, Purch. Agt.—drill press, small lathe and air compressor.

Va., Richmond — Shewbridge & Hare, Richmond Meadows above Broad St.—carbon removing out-fit and electric drill with valve grinding attachments, for auto repair shop.

Va., Richmond—The Southern Auto Repair Co., 210 North Madison St.—small lathe and battery testing and charging outfit.

Va., Richmond — The Younglove Auto Body Wks., 310-312 North Henry St., A. Younglove, Purch. Agt.—band saw, jointer and drill press.

Ill., Chicago—The Amer. Ironing Machine Co., 168 North Michigan Ave.—machinery for its factory at Woodstock, Ont.

Ill., Chicago—The Chicago, Indianapolis & Louisville Ry., (Monon Route), 608 South Dearborn St.—equipment for its car repair shop at Lafayette, Ind.

Mich., Birch Run—W. R. Hadsell—repair equipment for garage.

Mich., Detroit—The Royal Machine Co., 536 East Fort St.—miscellaneous machine shop equipment.

Mich., Detroit—Smiths Garage, 959 14th St., C. Smith, Purch. Agt.—one small lathe for repair work (used).

Mich., Detroit—The Walker Liberty Machine Co., 6913 East Jefferson Ave., Manufacturers of automobile part—one 20 in. disc grinder (used).

Mich., Kalamazoo—The Hill Curtis Co., North Pitcher St., manufacturers of saw mill machinery, N. Gumbinsky, Secy.—one 24 in. or 30 in. pulley lathe, (new or used).

Wis., Amery—The Amery Mfg. Co., P. C. Amundson, Purch. Agt.—machinery for the manufacture of gasoline engines, etc.

Wis., Caledonia — Goebel Bros., J. J. Goebel, Purch. Agt. — garage repair machinery.

Wis., Milwaukee — F. Luenzmann Co., 31st St. and Auer Ave., C. Luenzmann, Purch. Agt.—double head pony planer.

Wis., Milwaukee—The Milwaukee Specialty Mfg. Co., 884 23rd Ave., R. C. Frank, Purch. Agt.—lathe and drill press.

Wis., Milwaukee — The Standard Steel Corp., 1251 30th St., manufacturers of agricultural implements, etc., E. J. DeGuenther, Purch. Agt.—one 20-in. or 24-in. shaper and one 16-in. or 18-in. lathe.

Wis., Milwaukee — C. J. Trispel, 3915 Walnut St., (machinist)—small screw cutting lathe.

Kan., Leavenworth—The Great Western Mfg. Co., 2nd and Choctaw Sts., manufacturers of mill machinery—one brake to handle sheets 10 ft. long, No. 8 gage and lighter.

Ia., Sac City—H. L. Simonds—multiple spindle nut making machine, similar to National.

Ont., Toronto—The Canadian Allis-Chalmers, Ltd., 212 King St., W.—one No. 140 Bliss straight double crank press, geared type not less than 84 in. between housings or similar.

One No. 6 Bliss double crank press, geared type, not less than 84 in. between uprights.

One No. 21 Bliss inclinable press of flywheel or geared type or similar.

Two No. 3½ Bliss Stiles pattern, power punch presses, fly-wheel type or similar.

One No. 6 Bliss double crank press, geared type, 42 in. between uprights or similar.

One set smoothing rolls similar to Bliss No. 118a, length 36 in.

One No. 5 Springfield oscillating die grinder, which will have a grinding capacity of 24 in. to 30 in. wide, 24 in. high, and 5 ft. long, 48 in. to 52 in. between uprights or similar type.

One shear blade grinder to handle blade 60 in. long for squaring shears for cutting ⅜ in. material.

One power squaring shear of 130 in. length, capacity for cutting material up to ⅜ in. thick or similar.

One baling machine 1⅛ in sheet scrap.

Machinery Wanted

N. J., Trenton—The Sanitary Ice & Coal Co., Old Rose St.—machinery for cold storage plant.

Ill., Chicago—A. Batik, c/o A. Charvart, Archt., 262 Millard Ave. — artificial ice equipment.

Ill., Chicago—The Bunge Bros. Coal Co., 1648 West Lake St.—one little giant road crane, (used).

Ind., Gary—The Amer. Pure Paint Co.—grinding machine or pulverizer.

Mich., Detroit—The Schwartz Upholstering Co., 205 Moffat Bld., M. Schwartz, Purch. Agt.—general wood-working equipment, joining machines, etc.

Mich., Munising—The Munising Paper Co. —traveling crane.

O., Cleveland—P. Clinton, 3512 Central Ave.—shoe manufacturing machinery.

O., Columbus—The Buckeye Casket Co., 371 South High St., E. B. Rardin, Genl. Mgr. — wood-working machinery including saws, planers, etc.

Wis., Rice Lake — K. Knudson and S. Hegna—machinery for sash and door factory.

Wis., Ripon—The Ripon Handle & Specialty Co., L. Hall, Purch. Agt.—wood-working machinery.

Ont., Tilbury—The Ontario Flax Co. — machinery and equipment.

Metal Working

NEW ENGLAND

Conn., Hartford—N. Goldstein, 593 Windsor St., plans to build a 1 story garage, etc., on Morgan St. Estimated cost, $50,000. F. C. Walz, 407 Trumbull St., Archt.

Conn., New Haven — T. E. Guest, 71 Tower Rd., Waterbury, has awarded the contract for the construction of a 1 story, 30 x 45 ft. service station on Sperry St., here. Estimated cost, $17,000.

Conn., New Haven—The Tidewater Oil Corp., Wood St., will construct a 1½ story, 40 x 100 ft. oil warehouse and storage building and a 1 story, 40 x 50 ft. garage. Estimated cost, $25,000.

Conn., Windsor — The Windsor Garage has awarded the contract for the construction of a 1 story, 55 x 75 ft. addition on Windsor Ave.

Mass., Chicopee—G. P. Dion, 30 Center St., is preparing plans for the construction of a 1 story, 50 x 90 ft. garage on Center St. Estimated cost, $20,000.

Mass., Cohasset—The South Shore Garage, Inc., is having plans prepared for the construction of a 1 story, 30 x 80 ft. addition to its garage. Estimated cost, $10,000. G. F. Newton, 6 Beacon St., Boston, Archt.

Mass., Dorchester—I. Lesser, 3 Fayston St., Roxbury, will build a 1 story, 100 x 125 ft. garage on Mt. Vernon St. Estimated cost, $50,000.

Mass., Gardner — The Gardner Steam Laundry, Pine St., plans to build a 1 story garage and laundry. Estimated cost, $50,000. P. Varney, 25 Exchange St., Lynn, Archt.

Mass., Lynn — A. Attridge, Marblehead, will soon award the contract for the construction of a 1 story, 70 x 82 ft. garage on Chestnut St., here. Estimated cost, $35,000. E. F. Earp, 333 Union St., Archt. Noted Dec. 9.

Mass., New Bedford—The New Bedford Shuttle Co., 24 Elm St., will build a 2 story, 40 x 125 ft. addition to its factory on Rockdale Ave. Estimated cost, $40,000.

Mass., Pittsfield — J. North, Ontario St., has awarded the contract for the construction of a 2 story, 25 x 40 ft. garage and dairy building. Estimated cost, $10,000.

Mass., Worcester — The Aykroyd Iron Wks. Inc., 564 West Boylston St., has awarded the contract for the construction of a 1 story, 31 x 100 ft. machine shop, on Rochdale St. Estimated cost, $25,000.

Mass., Worcester—J. Johnson, 26 Spofford Rd., will build a 1 story, 48 x 136 ft. garage on Millbury St. Cost between $15,000 and $20,000.

Mass., Worcester—A. F. Mathieu, c/o J. Rice, Archt., 306 Main St., plans to build a 2 story, 60 x 180 ft. L-shaped garage on Pleasant and Fruit Sts. Estimated cost, $150,000.

Mass., Worcester — The Reed & Prince Mfg. Co., Duncan Ave., has awarded the contract for the construction of a 1 story, 40 x 290 ft. addition to its plant, for the manufacture of screws. Estimated cost, $10,000.

N. H., Exeter—A. E. McRell is having plans prepared for the construction of a 2 story, 40 x 150 ft. garage. Estimated cost, $40,000. J. E. Baker, 1008 Elm St., Manchester, Archt.

R. I., Pawtucket—The Farber Cornice Wks., 52 East Ave., has awarded the contract for the construction of a 2 story, 50 x 100 ft. plant on Pine St. Estimated cost, $30,000.

R. I., Providence—W. H. Farrell, Lockwood St., has awarded the contract for the construction of a 1 story, 60 x 66 x 83 ft. garage and showroom on Lockwood and Haskins Sts. Estimated cost, $20,000.

R. I., Providence — L. Michelovitch, c/o J. A. Hickey, Archt., 142 Atlantic Ave., will soon award the contract for the construction of a 1 story garage on South Main and Dollar Sts. Estimated cost, $15,000.

Vt., Springfield—Gilmore & Co. plans a 2 story, 50 x 150 ft. mill, for the manufacture of lathes to be used for turning out irregular wood articles.

Vt., Windsor — The Windsor Fdry. Co., plans to build a 1 story, 115 x 250 ft. foundry.

MIDDLE ATLANTIC STATES

D. C., Washington — The Chesapeake & Potomac Telephone Co., 725 13th St. N. W., is having plans prepared for the construction of a 2 story, 135 x 167 ft. garage near 1st St., N. E. Estimated cost, $100,000. C. T. Clagatt, Dir. Mgr. McKenzie Voorhees & Gmelin, 1123 Bway, New York City, Archts.

Md., Baltimore—W. E. Hooper & Sons Co., Parkdale Rd., manufacturers of cotton duck, has awarded the contract for the construction of a 1 and 2 story, 28 x 34 ft. and 12 x 49 ft. additions to its machine shop, on Parkdale Rd. and Druid Hill Park. Estimated cost, $60,000. Noted Dec. 9.

N. Y., Long Island City—Rolls Royce of America, Inc., 785 5th Ave., New York City, is having preliminary plans prepared for the construction of a 1 story service station and salesroom on Harris Ave. Estimated cost, $75,000. Ballinger & Perrott, 47 West 34th St., New York City, Archts. and Engrs.

N. Y., New York (Borough of Bronx)—The Edel Realty Co., 1901 Walton Ave., is having plans prepared for the construction of a 1 story, 50 x 246 ft. garage on Jerome Ave. Estimated cost, $75,000. J. E. Kirby, 4187 Park Ave., New York City, Archts.

N. Y., New York (Borough of Bronx)—T. Johnson, 30 East 42nd St., New York City, will build a 1 story, 25 x 112 ft. garage on Whitlock Ave. near Longwood Ave. Estimated cost, $30,000.

N. Y., New York (Borough of Bronx)—The Shaskin Realty Co., 220 Bway., New York City, will build a 2 story, 75 x 225 ft. garage on Inwood Ave. near 170th St. Estimated cost, $60,000. G. Shaskin, pres.

N. Y., New York (Borough of Brooklyn)—The Bay Ridge Land & Improvement Co., 189 Montague St., will build a 1 story, 110 x 120 ft. garage on 4th Ave. and 62nd St. Estimated cost, $30,000. R. Bennett, Pres.

N. Y., New York (Borough of Manhattan)—M. C. Haims, c/o H. Lippman, Archt. and Engr., 126 East 59th St., will build a 4 story, 34 x 98 ft. garage at 130-132 East 41st St. Estimate cost, $40,000.

N. Y., New York (Borough of Manhattan)—The Hester Realty Co., c/o G. H. Streeton, Archt., 115 East 34th St., will build a 1 story, 100 x 125 ft. garage at 555 West 34th St. Estimated cost, $30,000.

N. Y., New York (Borough of Manhattan)—The Rothbart Garage Corp., c/o J. M. Felson, Archt. and Engr., 1133 Bway, will build a 1 story, 120 x 125 ft. garage at 99 Jane St. Estimated cost, $35,000.

N. Y., New York (Borough of Manhattan)—The 16th St. Garage Corp., c/o C. Kreymbourg, Archt. and Engr., 309 East Kingsbridge Rd., will alter a 5 story garage at 235 West 16th St. Estimated cost, $50,000.

Pa., Charleroi—The Federal Fdry. Supply Co., 2633 East 79th St., Cleveland, O., plans to build a 2 story, 40 x 92 ft. factory here. Estimated cost, $30,000. Private plans.

Pa., Hollidaysburg—L. A. Brua, 304 Penn St., and E. H. Brua, 319 Alleghany St., will build a 2 story, 60 x 120 ft. garage and warehouse on Blair and Utica Sts.

Pa., Sharon—The Sharon Steel Hoop Co. is having preliminary plans prepared for the construction of a 2 story factory. Estimated cost, $150,000. J. H. Herron Co., 1360 West 3rd St., Cleveland, Archt. and Engr.

SOUTHERN STATES

Va., Richmond—S. G. Mercer and R. C. Trettan, 218 North 9th St., will build a 3 story, 40 x 50 x 140 ft. garage at 608 East Grace St. Estimated cost, $50,000.

Va., Roanoke—The F. N. Hayes Machine Co. plans to construct an addition to its plant.

MIDDLE WEST STATES

Ill., Chicago—The Narowetz Heating & Ventilating Co., 223 West Lake St., has awarded the contract for the construction of a 1 story, 81 x 132 ft. factory at 1711-17 West Park Ave. Estimated cost, $75,000.

Ill., Chicago—The United States Brewing Co., 2519 Elston Ave., will receive bids about Jan. 1, for the construction of a 1 story, 128 x 168 ft. garage on Grand Place near Clark St. Estimated cost, $40,000. W. Granger, 36 West Randolph St., Archt.

Ill., Peoria—The Peoria Auto Parts Co. has awarded the contract for the construction of a garage. Estimated cost, $20,000.

Ind., Lafayette—The Chicago, Indianapolis & Louisville Ry., (Monon Route), 608 South Dearborn St., Chicago, Ill., has awarded the contract for the construction of a 1 story, 85 x 440 ft. car repair shop, here. Estimated cost, $105,000. Noted Dec. 2.

Mich., Birch Run—W. R. Hadsell is having plans prepared for the construction of a 1 story, 110 x 147 ft. garage. Estimated cost, $20,000. Cowles & Mutscheller, Saginaw, Archts.

O., Cleveland—M. Goldstein, 2707 East 55th St., will receive bids until Dec. 28, for the construction of a 1 story, 50 x 56 ft. factory for auto repairs. Estimated cost, $15,000. Private plans.

O., Cleveland—The Mall Motor Co., 632 Superior Ave., has purchased a site on Superior Ave. and East 12th St. and plans to build a 2 story, 120 x 160 ft. garage. Estimated cost, $250,000. M. Rohrheimer, Pres. Christian, Schwarzenberg & Gaede, 1900 Euclid Ave., Archts.

O., Cleveland—J. Meyerhoffer, 8039 Superior Ave., is building a 1 story, 20 x 68 ft. garage at 8025 Superior Ave. Estimated cost, $10,000.

O., Cleveland—P. Priesz, 1850 West 24th St., will soon award the contract for the construction of a garage at 1925 West 24th St. Estimated cost, $15,000. F. Azzarello, 2500 East 20th St., Archt.

O., Cleveland—The Telling Belle Vernon Co., 3825 Cedar Ave., has awarded the contract for the construction of a 1 story, 30 x 160 ft. garage and stable at 704 Eagle Ave. Estimated cost, $30,000. Noted Dec. 9.

O., Cleveland — The Vcela Building & Loan Co., c/o A. Klipec, 5703 Bway., has awarded the contract for the construction of a 1 story, 20 x 63 ft. garage at 5703 Bway. Estimated cost, $10,000.

Wis., Sheboygan—H. H. Schmidt, c/o C. Reiss Coal Co., is having plans prepared for the construction of a 2 or 3 story, 60 x 185 ft. garage on Jefferson and 8th Sts. Cost, between $75,000 and $100,000. R. R. John, Betsy Ross Bldg., Archt.

WEST OF THE MISSISSIPPI

Kan., Wichita—The Clear Vision Pump Co., 1107-1109 East Douglas St., is building a 120 x 320 ft. plant for the manufacture of clear vision dispensing measures.

WESTERN STATES

Cal., Los Angeles—The Ambassador Hotel Co., c/o Alexander Hotel, 210 West 5th St., has awarded the contract for the construction of a hotel, theater and garage. Estimated cost, $350,000.

Cal., Los Angeles — P. L. Wilson, 631 South Sprague St., plans to construct a garage, machine shop, and store building, on the corner of Bonnie Brae and 7th Sts. Cost to exceed $70,000. Walker & Eisen, Hibernian Bldg., Archts.

CANADA

Ont., Goderich — The Huron Specialties Castings Co., Clinton, plans to build a plant here. Estimated cost, $75,000.

Ont., Woodstock—The Amer. Ironing Machine Co., 168 North Michigan Ave., Chicago, Ill., plans to remodel and equip a factory here for its own use. Estimated cost, $100,000.

General Manufacturing

NEW ENGLAND STATES

Me., Rockland—The Rockland & Rockport Lime Co. will build an addition to its lime plant, to include 6 lime kilns and gas producers, 1 story, 35 x 100 ft. main building and a 2 story, 60 x 108 ft. lime storage and packing house.

Mass., Cambridge — The E. & R. Co., Massachusetts Ave. and Windsor St., has awarded the contract for the construction of a 1 story dry cleaning plant and laundry. Estimated cost, $20,000. Noted Dec. 2.

Mass., Chicopee—The Dwight Mfg. Co., Exch. Bldg., Boston, has awarded the contract for the construction of a 6 story, 150 x 600 ft. addition to its cotton plant, here.

Mass., Newtonville—The Strangman Mfg. Co., Crofts St., manufacturers of builders finish, will build a 1 story, 85 x 105 ft. addition to its plant. Estimated cost, $20,000.

Mass., Oxford—A. G. Stanhope, 340 Main St., Worcester, plans to build a 2 story, 75 x 100 ft. cold storage plant. Estimated cost, $40,000.

Mass., Westfield — The Certified Foods, Inc., Gillett Bldg., plans to build a 2 story, 30 x 50 ft. plant. Estimated cost, $25,000. Jarvis Eng. Co., 261 Franklin St., Boston, Engrs.

Mass., Westerly — The Westerly Textile Co., 41 Main St., plans to build a 2 story addition to its textile plant on Main St. Estimated cost, $50,000. C. T. Main, 201 Devonshire St., Boston, Engr.

MIDDLE ATLANTIC STATES

N. J., Trenton—The Sanitary Ice & Coal Co., Old Rose St., plans to build a large ice-cream cold storage building. W. B. Maddock, 42 Division St., Pres.

Md., Baltimore — A. Thompson Co., 501 Water St., plans to build a 2 story, 100 x 200 ft. printing plant on 29th St. and Remington Ave. Estimated cost, $75,000.

SOUTHERN

Fla., St. Petersburg—The Williams-Beers Ice Co., is having plans prepared for the construction of an ice plant. H. Williams, Pres. H. Beers, St. Petersburg, Engr.

Ky., Franklin — The Western Kentucky Oil & Refining Co. is having preliminary plans prepared for the construction of an oil refining plant.

La., Bastrup—L. H. Fox has awarded the contract for the construction of a reduction plant, to include three 2 story, 50 x 200 ft. buildings and four 1 story, 30 x 60 ft. buildings. Estimated cost, $200,000.

N. C., Andrews—F. P. Cover & Sons, Inc., plan to build a tannery.

N. C., Hickory—The Catawba Creamery Co. plans to rebuild its creamery to include packing plant and refrigerating rooms, which was recently destroyed by fire. Estimated cost, $30,000.

N. C., Winston-Salem—The Blue Ridge Ice & Coal Co. plans to build an ice manufacturing plant. Estimated cost, $75,000. G. M. Hinshaw, Pres.

MIDDLE WEST STATES

Ill., Chicago—A. Batik, c/o A. Charvart, Archt., 2621 Millard Ave., has had plans prepared for the construction of a 3 story, 40 x 120 ft. artificial ice plant. Estimated cost, $60,000.

Ind., Gary—The Amer. Pure Paint Co. is building a 40 x 100 ft. plant for the manufacture of paint pigment and putty. Estimated cost, $30,000. W. J. Schroeder, Secy.

Ind., Logansport—The Sandusky Cement Co., c/o E. J. Maguire, Secy., Engineers Bldg., Cleveland, O., plans to construct a 1 story, 46 x 102 ft. factory and storage building here. Estimated cost, $50,000.

O., Cleveland—The Crossley Rubber Co., 2170 East 18th St., has awarded the contract for the construction of a 1 story, 30 x 40 ft. factory. Estimated cost, $10,000.

O., Cleveland—Glenville Hospital, c/o A. White, 701 Parkwood Dr., has awarded the contract for the construction of a 2 story, 40 x 40 ft. boiler house and addition to its laundry. Estimated cost, $40,000. Noted Oct. 14.

O., Cleveland—A. Jicha, 11006 Woodland Ave., baker, has awarded the contract for the construction of a 1 story, 35 x 91 ft. factory at 4215 East 131st St. Estimated cost, $15,000.

O., Cleveland—The Ohio Granite & Marble Co., 538 Schofield Bldg., plans to build a 1 story factory on Pearl Rd. Estimated cost, $100,000. G. W. Haskins, Secy. Private Plans.

O., Cleveland—C. Webber, c/o F. Dieffenback, 3217 West 92nd St., has awarded the contract for the construction of a 2 story, 40 x 56 ft. commercial building and bakery on West 25th St. Estimated cost, $75,000.

O., Greenville—The Consumers Supply Co. plans to build a 2 story, 60 x 120 ft. factory for the manufacture of fence posts. Estimated cost, $25,000.

O., Lima—The Crystal Ice & Coal Co. has awarded the contract for the construction of a 1 story ice plant. Estimated cost, $25,000.

Wis., Cedarburg—The Wetzel Art Furniture Co., 1367 Green Bay Ave., Milwaukee, has awarded the contract for the construction of a 2 story, 40 x 120 ft. factory on Main St., here, for the manufacture of furniture. Estimated cost, $75,000.

Wis., Chippewa Falls—The Bd. of School Trustees will receive bids about Feb. 1 for the construction of a 2 story, 125 x 160 ft. addition to the junior vocational school, to include a manual training department. Estimated cost, $150,000. Beers, Schlintz & Bailey, Chippewa Falls, Engrs.

Wis., Granville—The T. J. Moss Tie Co., Security Bldg., St. Louis, Mo., has awarded the contract for the construction of a 1 story, 40 x 200 ft. creosoting plant.

Wis., Rice Lake — K. Knudson and S. Hegna plan to build a sash and door factory.

Wis., Sheboygan — The Sheboygan Cold Storage Co., c/o E. C. Peacock, South 12th St. and Jefferson Ave., plans to build a 2 or 3 story, 100 x 250 ft. cold storage plant on West Water St., to replace the one which was recently destroyed by fire. Loss between $350,000 and $400,000.

Wis., South Milwaukee—The Line Material Co. has awarded the contract for the construction of a 1 story, 100 x 180 ft. factory for the manufacture of lighting equipment. Estimated cost, $30,000.

WEST OF THE MISSISSIPPI

Col., Ault—The Great Valley Sugar Co., Central Savings Bank Bldg., Denver, has awarded the contract for the construction of a sugar factory, here. Estimated cost, $1,000,000.

Ia., Cedar Rapids—The Hutchinson Ice Cream Co., 519 H St. W., will receive bids about Jan 10, for the construction of a 2 story, 60 x 100 ft. factory on 5th Ave. and 3rd St. E. Estimated cost, $50,000. Hatton, Holmes & Anthony, 323 Masonic Temple, Archts.

Ia., Sioux City—The Zonta Tire & Rubber Co. has awarded the contract for the construction of a 1 story, 100 x 120 ft. factory.

Mo., Maplewood (St. Louis P. O.)—The St. Louis Paper Can and Tube Co., 4400 North Union Ave., St. Louis, has awarded the contract for the construction of a 1 story, 200 x 540 ft. factory on Big Bend Rd. along the tracks of the Missouri, Pacific R.R. Estimated cost, $500,000.

Mo., St. Louis—The Brecht Packers Supply Co., 1201 Cass Ave., has awarded the contract for the construction of a 2 story, 73 x 74 ft. factory, at 1215 Cass Ave. Estimated cost, $20,000.

Mo., St. Louis—The Fleischmann Yeast Co., 1535 Market St., plans to build a 1 story, 75 x 170 ft. factory on Forest Park Blvd., east of Bogal Ave. Estimated cost, $50,000.

Tex., Fort Worth—The Mid West Petroleum Co. plans to build a refinery to have a daily capacity of 2,000 bbl.

CANADA

B. C., Prince George—F. Jones, Pres. of the Canada Cement Co., 273 Craig St. W., Montreal, and C. Gordon, Pres. of the Dominion Textile Co., 112 St. James St., Montreal, are interested in a syndicate which plans to build a pulp and paper plant here. Estimated cost, $6,000,000.

Ont., Tilbury — The Ontario Flax Co. plans to rebuild its flax mill which was recently destroyed by fire. Estimated loss, $75,000.

Ont., Guelph — The Provincial Government, Toronto, plans to build a dairy in connection with the agricultural college, here. Estimated cost, $100,000. Address, M. Doherty, Toronto.

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Pages 212 to 234

December 30, 1920 American Machinist Vol. 53, No. 27

Production and Salvage of Locomotive Piston Rings

By J. V. HUNTER
Western Editor, *American Machinist*

The systematic manner in which locomotive piston rings are cared for as described in this article is well worthy of record. Several devices that have been shop-built for doing this work should help to suggest ideas to other railroad shop-men for caring for their work of similar character.

PISTON rings are a constant source of expense in the upkeep of a locomotive. Not only must they be replaced when the engine comes in for its periodical overhauling, but they must often be replaced as a part of the running repairs in roundhouse work. In the Beech Grove shops of the Big Four railway system, at Indianapolis, piston ring work has led to the development of some remarkable machines both for making up new sets and for salvaging the old.

The recovery of old rings is by no means an unimportant portion of the work of this shop, since it has been found possible by adopting a series of standardized sizes, to use each ring several times by successively reducing its cylinder size. Wear on the rings has been found to be greater on one edge than the other so that the surface is worn off on a sort of bevel but by again truing the periphery in a manner that will be described later, it has been found possible to salvage each ring for re-use.

New rings are turned from cast bushings on vertical boring mills in a manner no different from regular machine-shop practice. In the second machine operation the device shown in Fig. 1 is used for cutting the rings into equal sections so that they may be bundled as shown in Fig. 2 and distributed to all points where new rings are needed.

The cutting saw, shown in Fig. 1, is driven by a belt through a worm gear reduction. The ring is carried on a sliding table *A* that can be fed against the saw by the hand lever *B*. The lever feed is simple since little travel is required and the necessity of a rack feed is therefore eliminated. The lever has a fulcrum in a slotted hole about the pin *C*. The second pin, *D*, provides attachment to the table and carries the latter forward when the lever is raised. The thrust from the saw on the ring is carried by a block *E* bolted to the table.

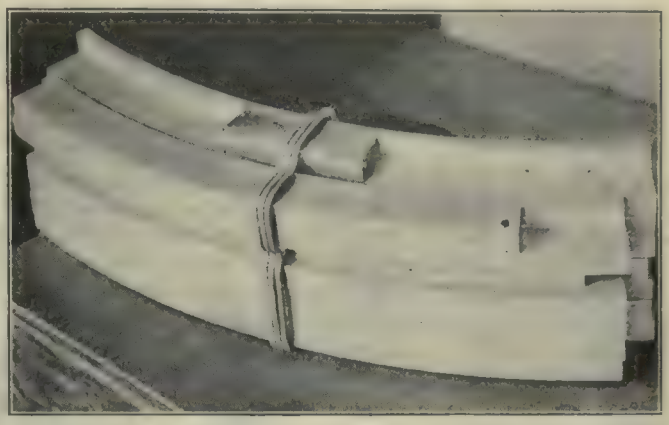


FIG. 2. BUNDLE OF WIRE-BOUND PISTON RING SEGMENTS

The details of the mechanism for dividing the ring into equal sections are shown in Fig. 3. The table is inscribed with circles of standard ring diameters which will indicate the size without necessarily measuring. The center *A* for the arm *B* is set in the center of the ring circle and the length of arm approximately regulated so that its bracket stops *C* will reach the inside of the

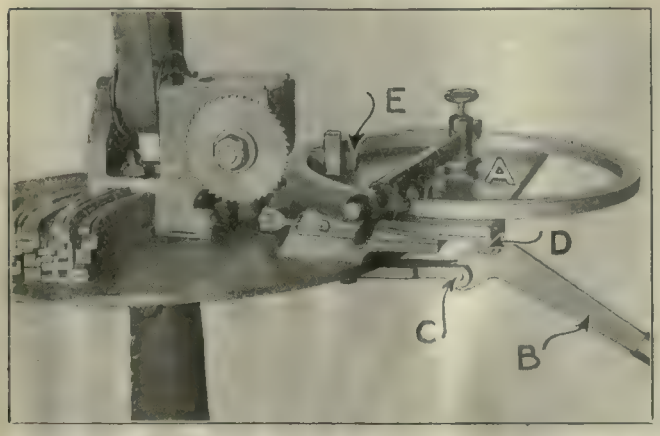


FIG. 1. DEVICE FOR SAWING LOCOMOTIVE PISTON RINGS INTO SEGMENTS

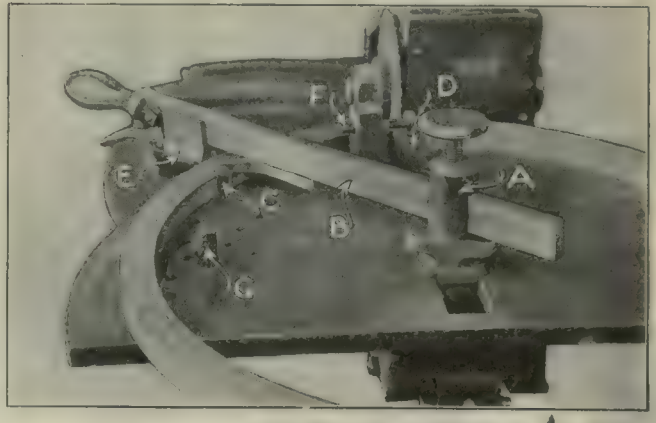


FIG. 3. SEGMENT SPACING DEVICE ON RING SAWING MACHINE

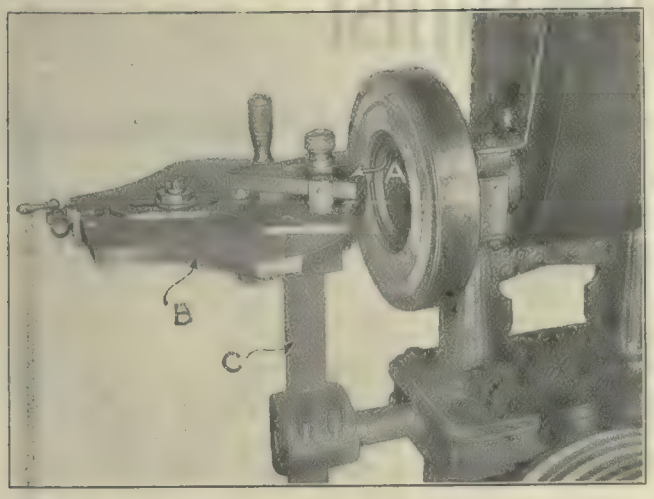


FIG. 4. GRINDING MACHINE FOR SALVAGING WORN PISTON RINGS

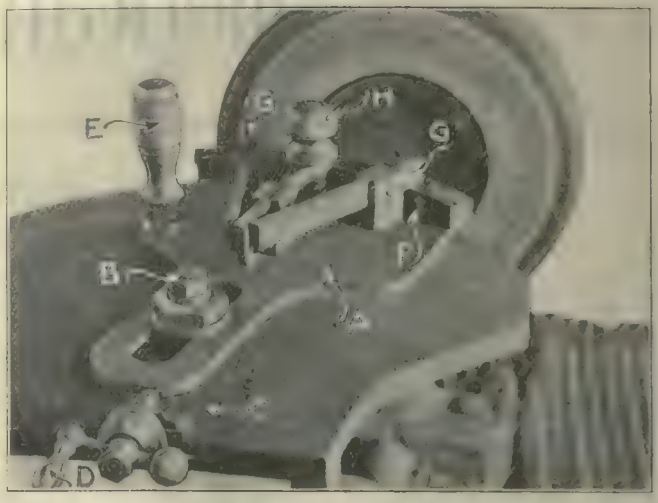


FIG. 5. CLAMPING AND FEEDING MECHANISM OF RING GRINDING FIXTURE

ring when the latter is pressed against the saw stop *D*. A spring grip *E* on the outer end of the handle holds the ring against the stop *C* so that the ring may be rotated about the center *A* of the arm without slipping.

The radius arm *B* is then in a position to swing in the segment of a circle from the screw stop *F* to the stop pin *G* for dividing the ring into segments. There are a number of holes provided for the insertion of the stop pin G and each hole is designated for a different size of ring. After setting the pin the screw stop *F* is regulated by trial until the swinging arm will divide the ring into the required number of equal segments. Since large lots of the same size rings are put through the shop at a time, the time required for setting the machine counts for little when divided among the aggregate amounts.

Worn piston rings are returned from the different repair shops in sets with suitable care exercised so that the component parts of each ring are not lost. Each section of every ring is numbered in sequence and the diameter of the ring is also stamped on its side. The returned sections are taken to the device shown in Fig. 4 for regrinding to the next smaller diameter and thus salvaged in the manner that has been mentioned previously. The section of ring *A* is held clamped in a special fixture on the table. The table *B* is rigidly supported in position by the vertical brace *C* but may be adjusted to or from the wheel as the requirements of supporting the work-fixture may indicate.

The plate *A*, Fig. 5, carrying the clamping fixture has a slotted and graduated arm so that it may be adjusted to swing at different radii about the center pivot *B*. The pivot center is carried on an adjustable slide *C* so that the work (while being rotated at the proper radius) may be set forward to bring it against the wheel until the proper amount of stock has been removed. The feed of the slide *C* is by the handwheel *D*. Graduations on the collar and table indicate when the slide has been fed forward to the zero point, where it swings at the radius required for the ring.

In swinging, the plate *A* slides on the surface of the table and has a sufficiently broad bearing to provide adequate support and prevent rocking. The operator grasps the handle *E* for imparting the swinging action. The work is inserted in the clamping fixture against the pin stops *F* and beneath the clamping arms *G*, and clamping pressure is obtained by screwing down the hand nut *H*. A free cutting grinding wheel is used for removing the material with fair rapidity.

Both new and salvaged sets of ring segments are bundled for handling, as shown in Fig. 2, in the wire wrapping device shown in Fig. 6. The wire wrapping must be so tightly done that there is no danger of segments slipping out to be mixed or lost. A set of segments are stacked in the holder *A* and tightly squeezed together by the clamping screw *B*. The wire is fed from the reel beneath the table through a friction guide *C* and in starting to bind the end is twisted about the screw *B*. The wire reel is a steel affair carried on a couple of shaft hangers, supported from the under side of the table. A friction brake is provided on the reel shaft so that considerable force must be exerted to draw off the wire, thus helping to insure tight binding.

The segment holder *A* can be rotated by the crank *D*. Usually three complete turns of wire are sufficient for the job, and the loose end is caught under the reel end of the wire and twisted to kink and hold before the tension is released by cutting the wire. After twisting the ends together the tension on the wire is further augmented by kinking in at the corners in the manner shown in Fig. 2.

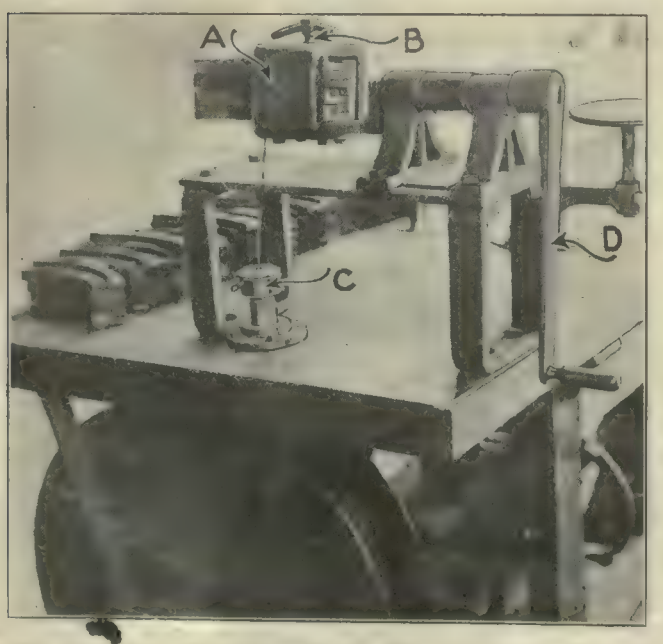
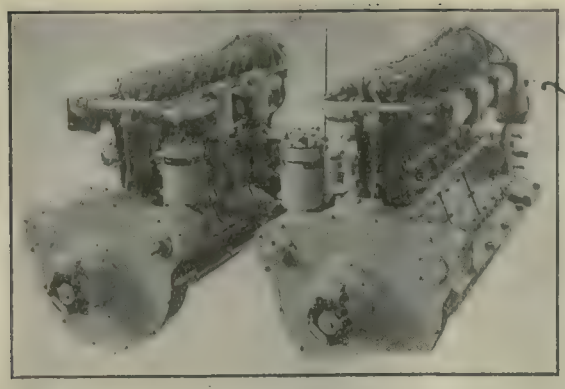


FIG. 6. WIRE BINDING DEVICE FOR BUNDLING PISTON RING SEGMENTS



BUILDING MOTORS ON THE PACIFIC COAST

By Fred H. Colvin
EDITOR-AMERICAN MACHINIST

This installment, the second of the series, takes up the machining of crankcases for both aircraft and marine types of motors, which are a departure from the usual marine motor when it comes to weight and finish. The methods can well be studied by anyone having moderate production problems.

MACHINING the crankcases for the Hall-Scott motor involves a number of interesting operations, as will be seen from the accompanying illustrations, which show the fixtures and machine set-ups for both aircraft and marine motor work. Machining operations begin with facing the ends of the bearings of an aircraft crankcase on the Lucas boring machine, as shown in Fig. 25, the cutter arbor carrying a gang of sixteen cutters. These cutters face not only the ends of the bearings inside the crankcase but also the outer ends.

Another milling operation on the same machine is shown in Fig. 26, where the pad for the water pump is being faced. Boring the holes through which the lower ends of the cylinders project and which locate the cylinders in their proper position, is shown in Fig. 27, both this and the succeeding operations being performed on the Cincinnati-Bickford radial drilling ma-

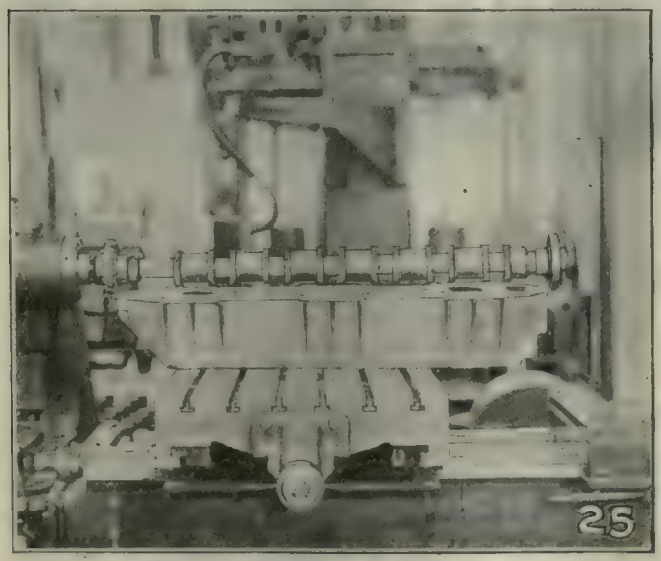


FIG. 25. FACING ENDS OF BEARINGS

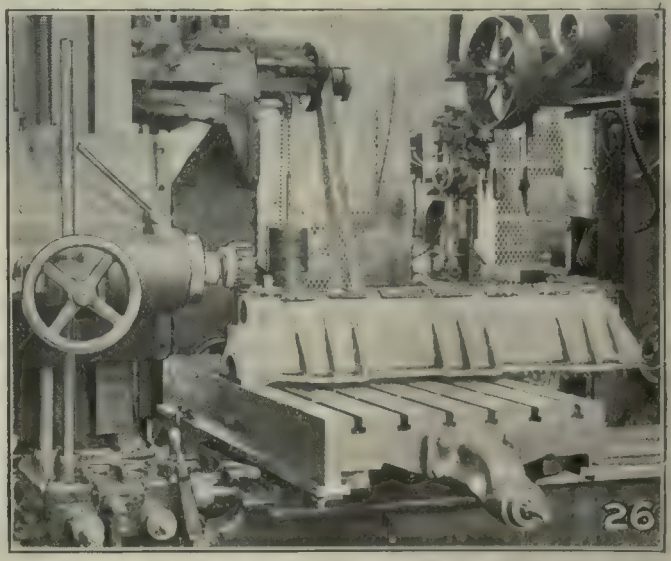


FIG. 26. MILLING WATER PUMP PADS



FIG. 27. BORING CYLINDER HOLES

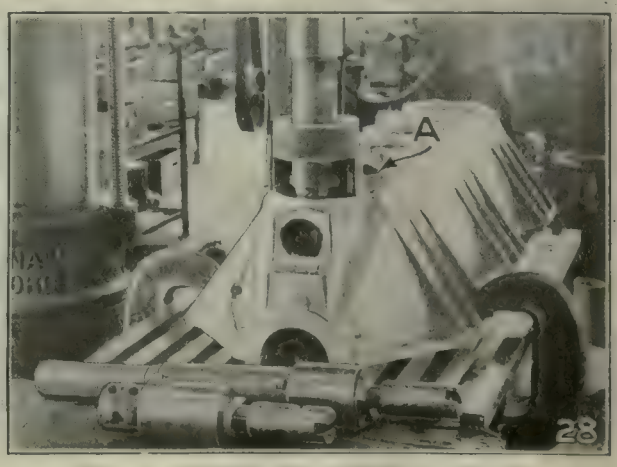


FIG. 28. BORING FOR VERTICAL SHAFT

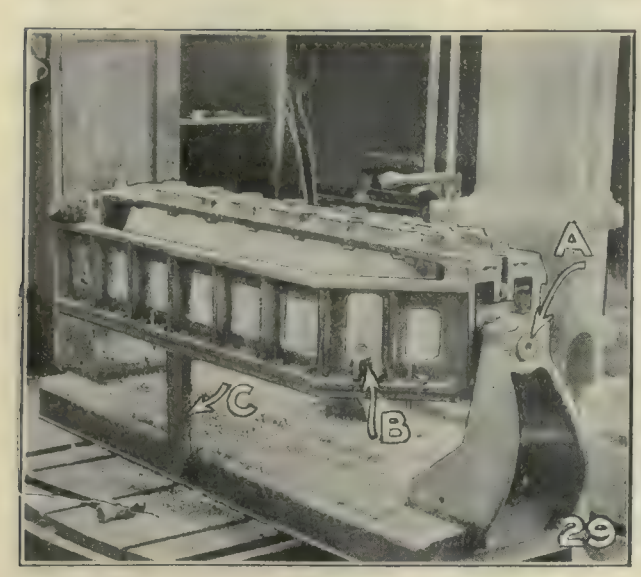


FIG. 29. DRILLING CYLINDER BOLT HOLES

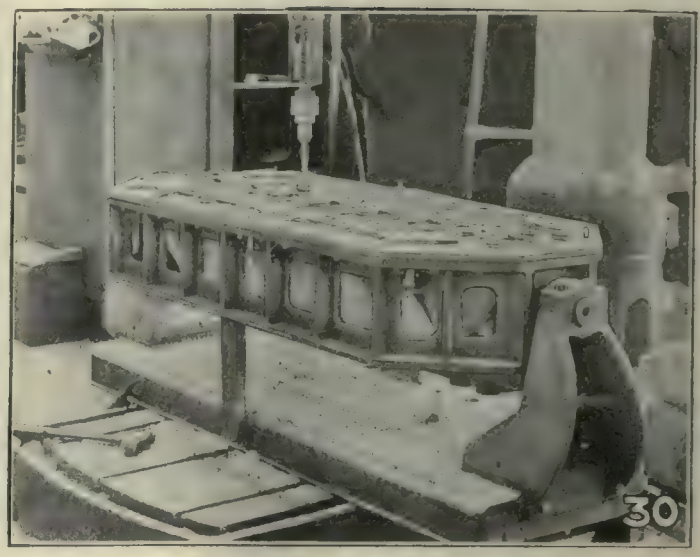


FIG. 30. DRILLING LOWER BOLT HOLES

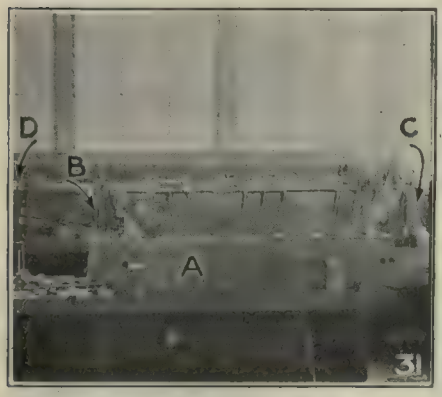


FIG. 31. LINE REAMING MAIN BEARINGS



FIG. 32. THE LINE REAMING MACHINE



FIG. 33. REAMING MACHINE AND LAPPING TABLES

chine shown. The form of fixture used for guiding the boring tool *A* is shown at *B*. The large bearing surface above the cutting tools, insures the boring head being properly guided. In Fig. 28 the hole for the vertical shaft which drives the overhead camshaft, is being bored on the same machine. The hole is located by a jig having a projection at *A*, which fits into the end cylinder-hole. The boring tools are shown in front of the work.

Drilling the holes, both for holding down the cylinders and for the main bearing bolts, is shown in Figs. 29 and 30. The same drilling fixture handles both operations, as can be seen. The fixture is of the cradle type, mounted on trunnions as at *A* and carrying the drill bushings in their proper positions. Both top and bottom of the crankcase are drilled in this same jig by revolving it on the trunnions.

The method of holding the crankcase in the cradle is shown at *B*, Fig. 29, where one of the four toe-clamps used is plainly shown. The strut *C*, holds the cradle in a horizontal position in which it is assisted by another arm on the opposite side.

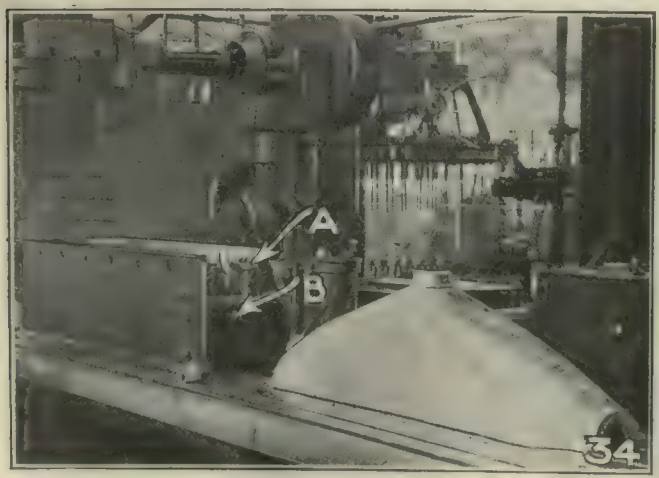


FIG. 34. MILLING LOWER HALF OF CRANKCASE

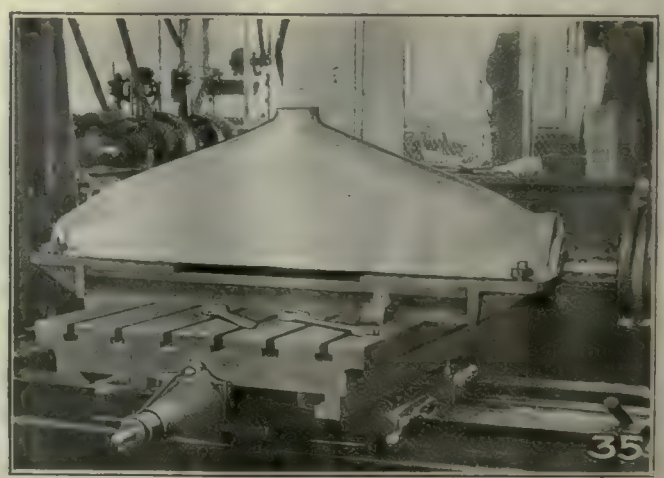


FIG. 35. BORING END OF LOWER HALF OF CRANKCASE

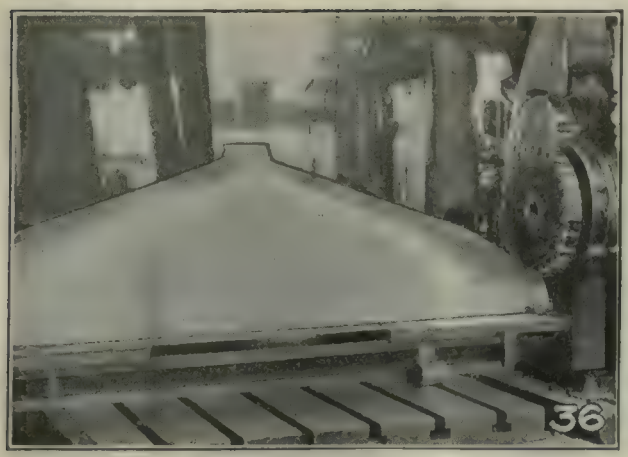


FIG. 36. FACING END OF LOWER HALF OF CRANKCASE

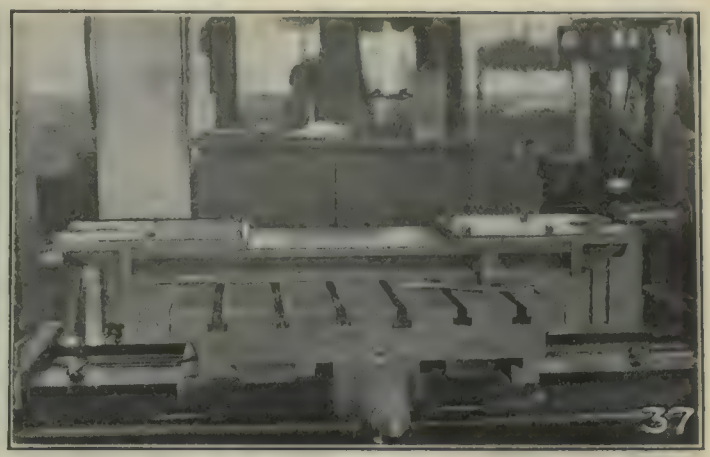


FIG. 37. THE BORING AND MILLING FIXTURE

The crankshaft bearings are next bored and reamed, the line reaming operation being shown in Fig. 31. Here the crankcase is supported on the substantial base *A*, while the uprights *B* and *C*, support the line reamer in correct relation to the cylinder face of the crankcase. The line reamer is driven by a Barnes horizontal drilling machine, through an Oldham coupling at *D*, the correct alignment not being dependent upon the machine itself. Fig. 32 shows a complete view of this machine and the fixture used. It also shows the crankshaft bearing caps bolted in position so as to be bored at the same time and to present a continuous surface to the boring tool.

The next illustration, Fig. 33, shows the sub-assembly department for the crankcases, with the lapping plates at *A* and *B*, and the line reaming machine in the foreground. This view also shows the power stand which has been erected for driving the reaming machine. The frame work is for the most part of angle iron, and carries the motor, jack shaft, and countershaft. This view also gives an excellent idea of the exceptional window area which makes this a particularly attractive shop.

The Lower Crankcase

Face milling the lower half of the aircraft crankcase, is shown in Fig. 34, an Ingersoll machine being used for this purpose. The type of milling fixture is a very simple box jig with suitable clamps as at *A*, and adjusting screws as at *B*, for holding the crankcase in its proper position.

More horizontal boring machine work is seen in Figs. 35, 36 and 37, the machine in this case being a universal. Fig. 35 shows the boring of the end of the crankcase, Fig. 36 the facing of the end with a large milling cutter, while Fig. 37 shows the fixture used and the boring cutter in position on the spindle.

The bolt holes are drilled under a Hammond radial drilling machine having a jointed arm, as shown in Fig. 38. This view also shows the light construction of the drilling jig. As the drill is brought to each hole and with only one hole drilled at a time, the jig is not subjected to any heavy strain.

The Marine Crankcase

The marine type of crankcase is shown in Fig. 39, on an Ingersoll milling machine where the joint surface is being faced with two vertical milling cutters. The mating half of this crankcase is also faced in a similar way and on the same machine, as in Fig. 40.

The recessed surfaces for the crankshaft-bearing caps are milled in the horizontal boring machine shown in Fig. 41, the outer end of the cutter arbor being supported by the special bracket shown.

Drilling the bolt holes for the crankcase is shown in



FIG. 38. DRILLING THE BOLT HOLES

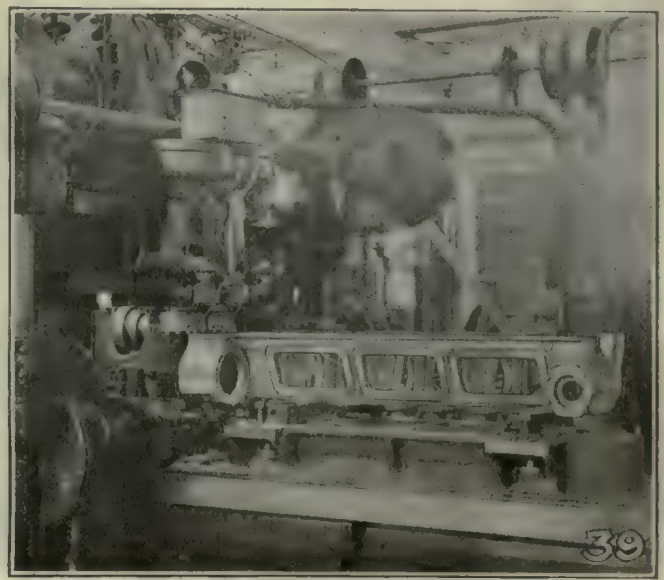


FIG. 39. FACING THE MARINE ENGINE BASE

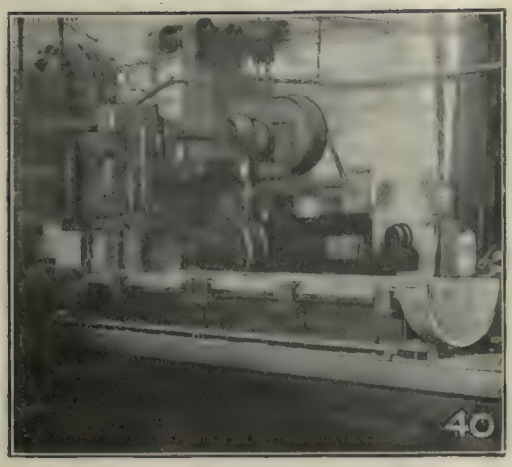


FIG. 40. FACING LOWER HALF

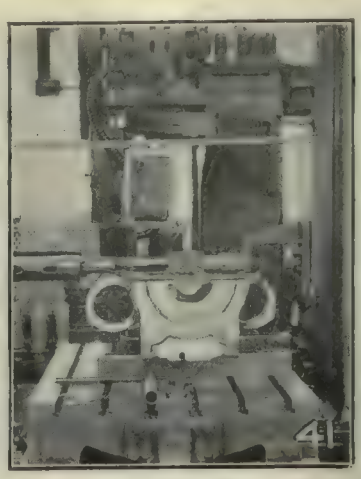


FIG. 41. MILLING FOR MAIN BEARING CAPS



FIG. 42. DRILLING FLANGE BOLT HOLES

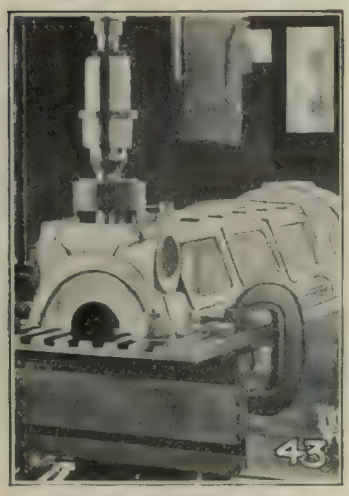


FIG. 43. BORING FOR VERTICAL SHAFT

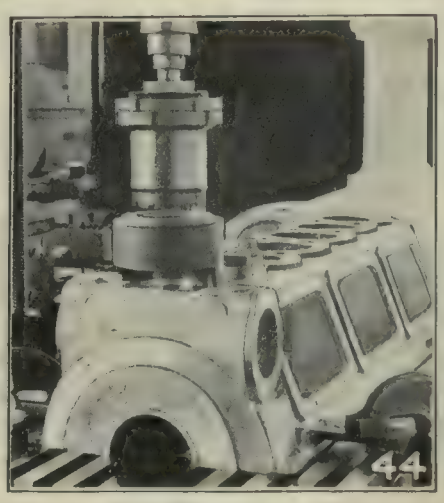


FIG. 44. COUNTER-BORING VERTICAL SHAFT HOLE

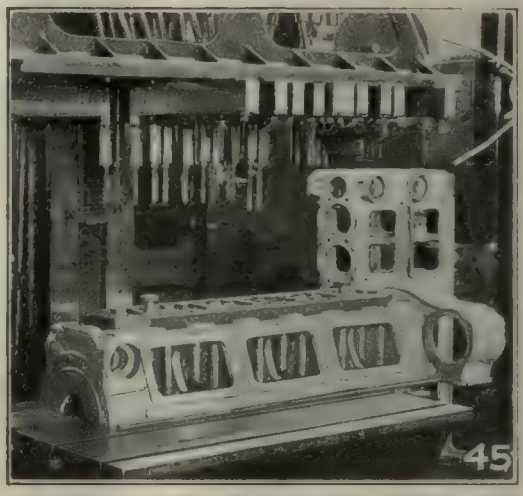


FIG. 45. DRILLING FOR CYLINDER FLANGES

Fig. 42. As these bolts are the same as in the aviation engine previously shown, the plate which carries the drill bushings is removed from the fixture shown in Fig. 30 and used by clamping in position as shown in Fig. 42. This obviates the necessity of duplicating an expensive drilling jig.

Boring and counter-boring the vertical-shaft bushing holes is shown in Figs. 43 and 44, the operation being practically the same as that for the aviation engine.

Another similarity with the aviation engine is the drilling of the cylinder flange bolt holes as shown in Fig. 45. As in the case of the lower bolt holes, the plate carrying the drill bushings is borrowed from one of the aviation drilling fixtures. The seats for the hand hole cover plates are milled on the universal machine shown in Fig. 46. This operation requires only a plate having a suitable angle for the base and simple means for clamping the work in place.

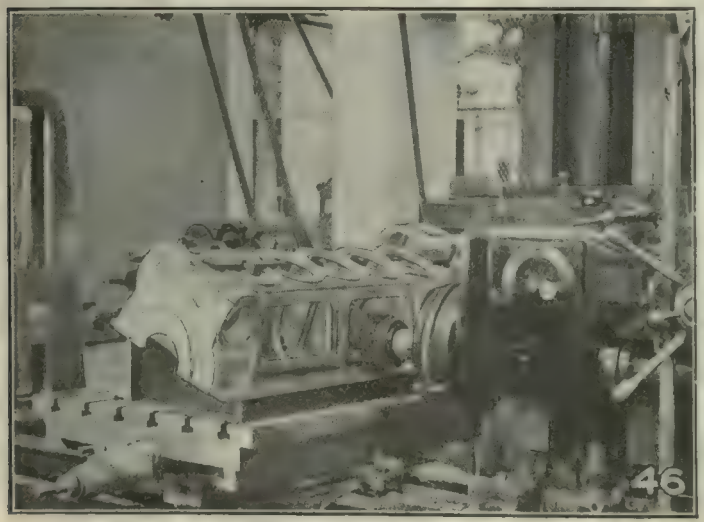


FIG. 46. FACING FOR HANDHOLE COVER PLATES

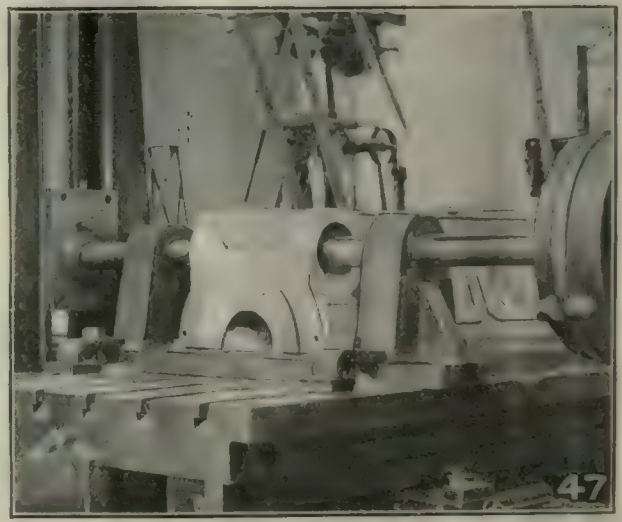


FIG. 47. BORING THE CROSSHOLE

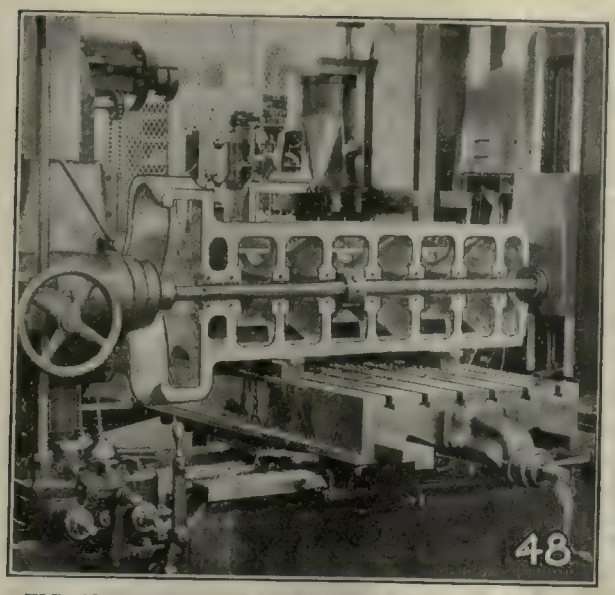


FIG. 48. FINISHING THE MAIN BEARING SEATS

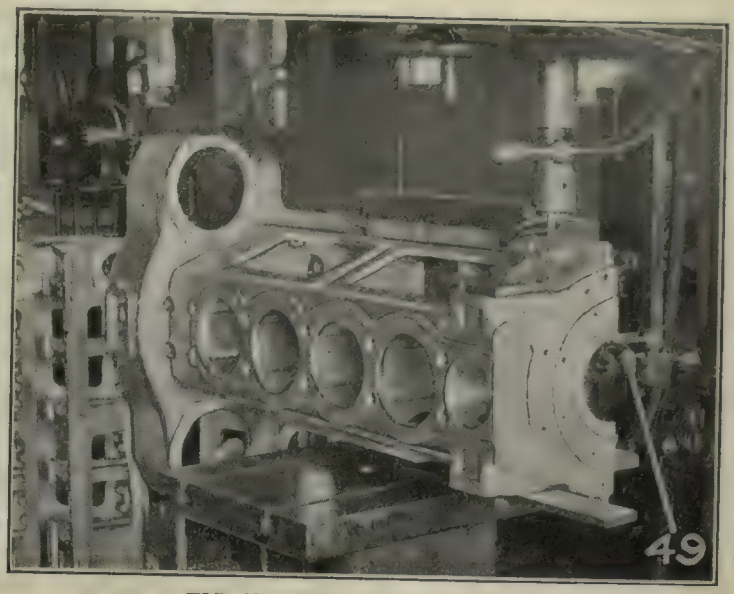


FIG. 49. DRILLING FOR PUMPS

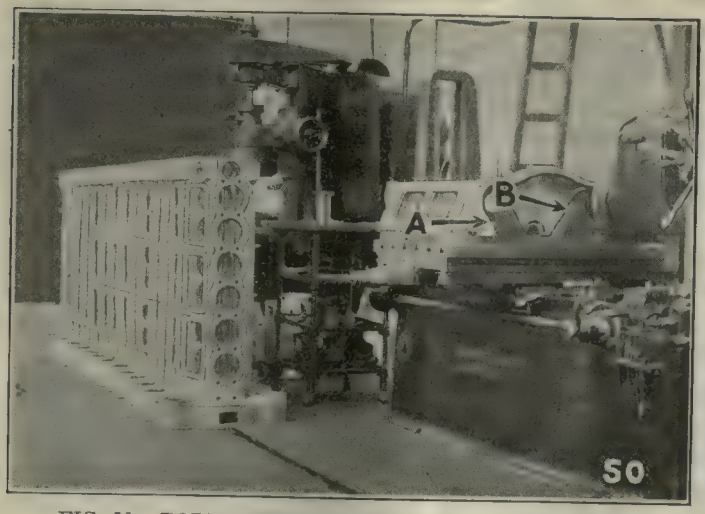


FIG. 50. BORING FOR STARTER AND GENERATOR

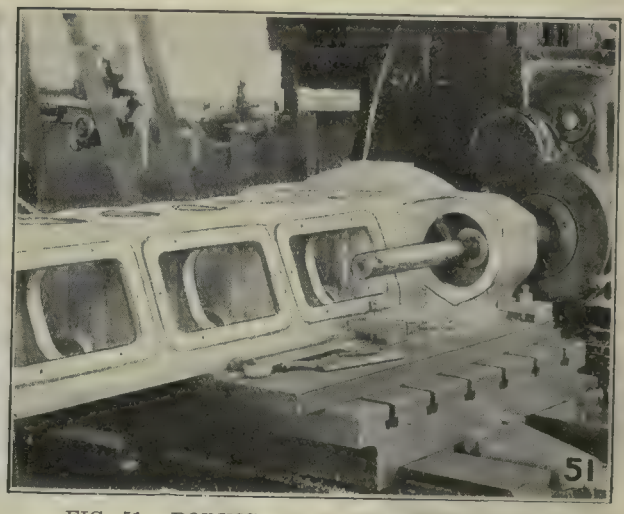


FIG. 51. BORING HOLE FOR GENERATOR

Boring the crosshole in the end of the crankcase for the water pump and oil pump bushings, is shown in Fig. 47. The fixture is simple but substantial and was designed for easy handling of the work and insuring the crosshole being at right angles to the main bearings.

The seats for the shells which form the main bearings are finished with single point cutters as shown in the boring bar at Fig. 48. It will be noted that this boring bar is supported both in the center and at each end in order to avoid spring, and insure the holes being in line and of correct diameter.

Drilling the stud holes for the water and oil pump

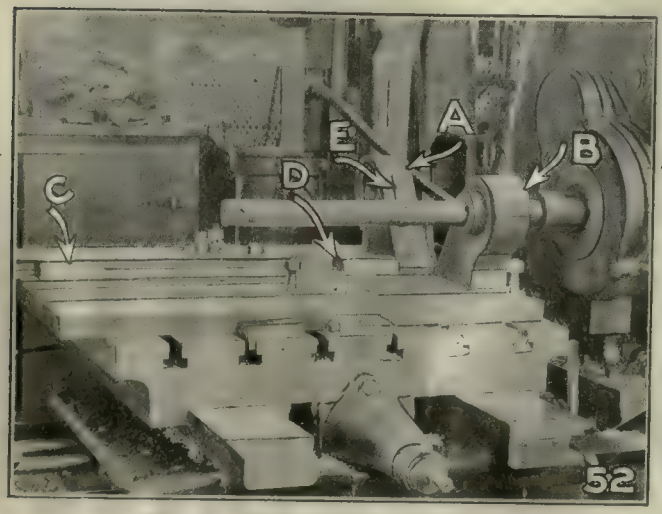


FIG. 52. THE BORING FIXTURE

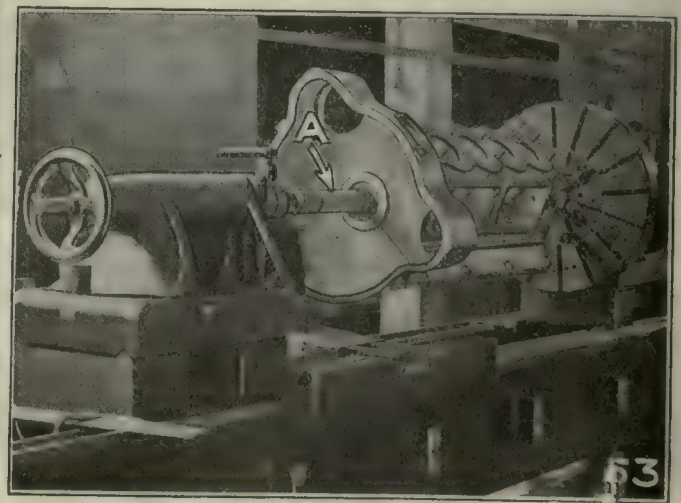


FIG. 53. FACING THE ENDS OF COMPLETE CRANKCASE

is accomplished with the simple drilling fixture shown in Fig. 49. The crankcase is clamped against a suitable angle plate and the drill jigs located with a bar to the crosshole which has already been bored.

The holes for the starter and generator at each side of the crankcase are bored on the universal machine shown in Fig. 50. These holes are located with reference to the main bearing seats, by the arms *A* and *B*, which form a substantial part of the fixture that supports the case while being bored.

Another view of this operation is shown in Fig. 51, and the type of tool used for finishing these holes may also be seen. Fig. 52 shows the fixture with the crankcase removed, showing the supports *A* and *B*, and also the blocks *C* and *D* which guide the case by means of the main bearings. The tool is shown at *E*.

The final facing of the ends of the crankcase so as to insure its being square with the crankshaft, is shown in Fig. 53. The upper and lower halves are bolted together around the mandrel *A* and swung between centers of an old Draper lathe which has had the headstock and tailstock raised for this purpose. Mounted in this way, it is an easy matter to have the surface of the flywheel housing faced square with the crankshaft bearings. This is very important where reverse or other gearing, housed in a separate case, is bolted to the end of the crankcase. Unless this precaution is taken it is very difficult to secure perfect alignment and without this, it is impossible to secure the best results from the attached units.

Beef-Bone Screws for Surgical Use

By George G. Little

As there is a growing demand for screws made of beef bone for surgical use in repairing fractured bones of the leg and arm, it may be of interest to the readers of the *American Machinist* to know something about what has been done in perfecting the methods of producing the screws ready for the operating room.

Some of the shops that do model work will undoubtedly be called upon to make screws of bone for surgeons in various parts of the country.

The joint ends of a front or rear shank beef-bone are sawed off, holding the bone in a bench vise and using a coarse-toothed hacksaw. The remaining sections are then boiled in clean water about one and one-half hours to remove the marrow and any tissue adhering to the outer surface. In removing the joint-ends only enough is cut off to leave the thick straight cylindrical portion of the bone. After the boiling and cleaning the bone is sawed into pieces suitable for the lengths of screws to be made. These pieces are then sawed lengthwise into segments large enough for the diameter of the screws. The segments are held in a lathe chuck and a high-speed tool, ground as for cutting brass, is used to rough them out. They are then rechucked in a draw-in collet and sized for threading.

Soaking the cylindrical blanks in pure vaseline brought to the melting point, for an hour or two, will replace some of the natural oil of the bone and make the finishing of the thread easier. It also lessens the danger of breaking the screws when the surgeon starts them into the holes in the fractured bones.

Before the blanks are threaded they should be pointed and the point-end supported in a female center to insure the threaded portion being of one diameter throughout.

A small bench lathe with a rear thread cutting attachment is the most suitable for this work as the bone is brittle and a single tool proves better than any other kind for forming the thread.

Three sizes of solid or split dies will produce good threads with a great deal of care, starting with the larger and stepping down, but one is very likely to break two or three out of a dozen of the screws using the dies. The hands should be washed clean and the work kept as clean as is possible and after the screws are finished they should be scrubbed in clean water with ivory, castile or lava soap and dried with a clean cloth.

If an ordinary screw-cutting lathe is used with a single tool for forming the thread, the tool should be shaped the same as for steel and fed to the work at an angle of 30 deg., but I find that with the back attachment of the bench lathe, if the tool is fed straight in to the work, it produces a smooth thread. There is no breakage with this method.

There are three standard diameters of bone screws produced for and used in the operating rooms of the Mayo Clinic, Rochester, Minn., and they have proved very satisfactory. The three diameters are as follows: $\frac{5}{16}$ x 3 in., 18 threads per inch; No. 10 machine screw, $1\frac{1}{8}$ and $1\frac{1}{2}$ in. long, 24 threads per inch; No. 6 machine screw 1 in. long, 32 threads per inch. The largest size is used for hip fractures only. Any small screw-cutting lathe can be used to size and thread the screws especially if threading dies are used but it takes quite a bit longer and the thread is likely to be crooked owing to the dies gouging in the soft spots that are in the bone.

In cutting the thread with dies the point support is not used. In forming the hex head an 8-in. No. 0 narrow pillar file is used. A filing block $\frac{3}{4}$ x 1 in. having one end squared and the other with a 60-deg. V in it is a big help. The head of the screw is placed in the V and a flat filed, this first flat is turned to fit against one side of the V and another flat is filed, the two flats are then turned to fit the two sides of the V and the third flat is filed, this forming every other side of the head.

The plain squared end of the filing block is now turned up. One of the three flat sides is placed on the block, this bringing one of the unfinished sides up ready to be filed flat. The remaining two unfinished sides are filed in the same manner. If care is taken to hold the screw level, have the block level and to file level with the vise and to remove only enough to make the flats the right width, the head will be a nicely finished hex. With a little practice and care the heads can be filed to size with less trouble and more speed than they can be formed by machining. We have tried milling with end mills, side cutters, plain cutters and slitting saws with sides relieved, but found that none of the machining was satisfactory, owing to the time it took and the breakage of the screws in spite of the care given.

The filing block, of course, is held in the vise, and it is well to have a section of the bone 1 in. square with the three sizes of holes taped out for inspection gages, as if there is any trouble with the diameters it balls up the work in the operating room and the fellow that made the screws gets cussed good and plenty.

A short piece of $\frac{1}{4}$-in. steel tube shaped over a $\frac{5}{16}$-in. hex cold-rolled bar makes a standard socket wrench for gaging the size of the head when forming and for the surgeon to use to place the screws.

Tests of Cast Iron for Locomotive-Cylinder Parts*

Frequent renewal of cylinder parts of locomotives results in greatly increased cost of maintenance to the railroads, and consequently the quality of the cast iron entering into their construction is a matter of paramount importance, particularly from the standpoint of wear. These parts include piston-valve bushings, packing rings and bull rings, cylinder bushings, piston packing rings, and piston-head or bull rings. It was found that ordinary high-silicon cast iron gave unsatisfactory wear, particularly in modern superheater locomotives, and the tendency has been toward a harder and stronger iron.

AT THE request of the former U. S. Railroad Administration the Bureau of Standards has investigated the mechanical, chemical, and microscopical properties of a number of packing rings furnished with service-mileage records, as well as arbitration-test bars, chill-test specimens, and miscellaneous samples from different manufacturers. All of this material was cast iron such as used for the various cylinder parts. It was desired at the same time to review the previous work and specifications on this subject, to ascertain as far as possible the practices of the different foundries and to suggest such revision of existing specifications as would be warranted by the results of the present and of earlier investigations.

The samples, 131 in number, were furnished to the Bureau of Standards by the U. S. Railroad Administration. The first samples were received April 2, 1919, and the last September 26, 1919, nine foundries supplying specimens.

Mechanical Tests

The mechanical tests made at the Bureau of Standards consisted of transverse, tension, hardness, and fracture tests of chill-test specimens.

Transverse Tests. Thirty-four arbitration bars, ordered made in accordance with the standards of the American Society for Testing Materials, from six different manufacturers, were tested.

When the packing rings furnished were sufficiently large in size, specimens for small transverse tests were machined from them also. It is not to be expected that these results will be similar to those on unmachined arbitration bars, because of the absence of skin or surface hardness.

Tension Tests. After breaking the arbitration bars in the tranverse tests, the broken pieces were used to determine the tensile strength of the material. Tension tests were made from packing rings furnished by four foundries. From the tension tests, at least, there appears to be some more or less definite relation between laboratory and service tests.

Brinell Hardness Tests. Brinell hardness tests, using a 10-mm. ball with a pressure of 3,000 kg., sustained for 30 seconds, were made on flat, longitudinal sections of the arbitration bars. Approximately ¼ in. of material was removed by the shaper to obtain a surface for the Brinell tests. As there is a variation of only 10 points from the maximum to minimum hardness, it is concluded that, in view of the widely varying quality of the irons as indicated by other tests, the Brinell test does not satisfactorily measure the quality of iron for cylinder parts.

The Brinell hardness tests of packing rings and bushings indicate that the castings themselves are considerably softer than the arbitration bars. This is undoubtedly due to the fact that the slower rate of cooling of the former results in a higher graphitic carbon content.

Chill Tests. Chill-test specimens were received from four foundries and broken at the Bureau of Standards, four to six samples of the product of each foundry having been submitted.

Chemical Analysis

Chemical analyses were made of one of each of the arbitration bars from each of six foundries. The various bars were quite uniform in total, graphitic, and combined carbon content. The silicon and sulphur contents, however, varied within rather wide limits, the former from 1 per cent to 1.47 per cent and the latter from 0.051 per cent to 0.167 per cent. The phosphorus content varied from 0.37 to 0.56 per cent; manganese from 0.36 to 0.90 per cent. It is generally recognized that there should be at least three times the percentage of manganese as sulphur present; otherwise, sulphur will combine with iron instead of manganese, and brittle material will result.

In general, the silicon, and naturally the graphitic carbon is higher in the packing rings, bushings, and similar castings than in the arbitration bars. A ring which gave 93,000 miles in service showed no unusual characteristics in chemical composition.

Metallographic Examination

The samples were polished and examined microscopically both before and after etching. Heat tinting was found to be very suitable for revealing the irregularly shaped masses of phosphide eutectic and at the same time allowing the black flakes of graphite to stand out clearly. Micrographs were taken only of typical samples selected for purposes of illustration.

Some attempt was made to correlate the microstructure with the endurance in service, but, due to the many variable factors, it was realized that any very close comparisons were apt to be misleading. The inhomogeneity of cast iron made it somewhat doubtful that the small sample used for metallographic examination was representative of the whole. In some instances, however, with the aid of the principles governing the constitution of gray cast iron, the samples could be approximately classified, and the service records bore out fairly well the predictions that could be made of mechanical qualities from a study of the microstructure.

The microscope is most useful in determining the size, amount, and distribution of graphite flakes, amount of combined carbon, and to some extent the physical soundness of the castings.

*From Technologic Paper No. 172 of the Bureau of Standards, Washington, D. C., entitled "Cast Iron for Locomotive-Cylinder Parts," by C. H. Strand, issued Sept. 11, 1920.

Conclusions are drawn and recommendations made as follows:

On the basis of test made by inspectors of the U. S. Railroad Administration and of the Bureau, which were substantially in agreement, it is concluded that air furnace or so-called "gun iron" is more uniform in character and on the average of somewhat better mechanical properties than cupola iron. The latter, however, often equals or even excels in mechanical properties the specimens of air-furnace iron tested in this investigation. The sulphur content of the air-furnace irons examined seldom exceeded 0.06 per cent, while the cupola iron varied in sulphur content from 0.10 to 0.17 per cent.

It was impossible, except in a very general way, to find any correlation between the quality of the iron as developed by laboratory tests and the mileage obtained in service. This is explained by the fact that many other factors besides the quality of the iron enter into consideration in the service results, namely, design, lubrication, method of handling the locomotive, topography of the country, character of water used in the locomotive, etc. It is for the reasons cited above that the conclusions and recommendations of this paper are based essentially upon the results of laboratory tests.

The present specifications of the American Railway Master Mechanics' Association are somewhat lax in the requirements for mechanical properties. It is recommended that the transverse-strength requirements of a 1¼-in. arbitration bar on supports 12 in. apart be increased from 3,200 to 3,500 lb. for castings ½ in. or less in thickness, and from 3,500 to 3,800 pounds for castings over ½ in. in thickness. It is further recommended that the minimum deflection requirements for both cases be increased from 0.09 to 0.11 in. The rate of application of the load shall be from 20 to 40 seconds for a deflection of 0.01 in. The division line of the casting thickness is changed from ⅝ in. of the American Railway Master Mechanics' Association, to ½ in. in order to conform to the recognized standards of the American Society for Testing Materials. Two arbitration-test bars, cast as specified, should be poured from each ladle used for one or more castings.

Composition Recommendations

It is preferable to leave the chemical composition and the melting process used to the manufacturer, depending for the most part on the mechanical tests, and of these primarily upon the transverse test. The existing specifications allow a maximum of 0.70 per cent phosphorus and 0.12 per cent sulphur; there are no developments in this investigation which would warrant a revision of the maximum permissible amounts of these elements.

For the chill test a sample of the iron shall be taken before pouring and chilled in a cast-iron mold. The sample shall be allowed to cool in the mold until it is dark red or almost black, when it may be knocked out and quenched in water. On being broken, it must show a close-grained gray iron, with a well-defined border of white iron at the bottom of the fracture. The depth of the white iron must not be less than ⅛ in. as measured at the center line, for castings ½ in. or less in thickness, nor less than ⅛ in. for castings over ½ in. in thickness. One chill test shall be poured from each ladle of metal used for one or more castings. The specimens may be cast in adjacent molds, but in such cases a space must be provided between the molds.

Castings shall, of course, be smooth, well cleaned, free from shrinkage cracks and from other defects sufficiently extensive to impair their value, and must finish to blueprint size.

The purchaser, or his inspector, shall be given a reasonable opportunity to witness the pouring of the castings and test specimens, as well as to be present when the mechanical tests are made. Inspection shall be made at the place of manufacture, and the manufacturer shall also furnish the facilities for making the mechanical tests, if desired.

Side-Cutting of Thread-Milling Hobs*

By Earle Buckingham

(*Continued from last week's issue*)

The hobbing of internally threaded parts, when the axis of the hob is parallel to the axis of the thread which is being cut, develops conditions which are similar in many respects to those which occur in the hobbing of screws which have previously been discussed. The same symbols will be used in this discussion as were used in regard to the hobbing of screws and formulas will be derived to show the interference between the path of any cutting point on the hob and the flanks of the thread.

Fig. 9 shows a diagram of a hob and the thread is a nut which it is cutting. It will be noted that the value of y is:

$$y = r - r' \qquad [9]$$

The equation for x is identical with equation [6] for hobbing screws; namely,

$$x = y \tan C - \frac{B}{360N}$$

In order to determine the value of y, the triangle shown in heavy lines in Fig. 9 must be solved. The known values will be taken as r, R and B. From the relation

$$(r - R) \sin B = R \sin (A - B)$$

$$\frac{(r - R) \sin B}{R} = \sin (A - B) \qquad [10]$$

And given the value of B and $(A - B)$, the value of A is readily determined. Solving the triangle for r', we have

$$r' = \frac{R \sin (180^\circ - A)}{\sin B} = R \frac{\sin A}{\sin B} \qquad (11)$$

The value of y is then determined by equation [9].

In order to determine the nature of the side-cutting the following example will be taken: A hob 0.800 in. in outside diameter will be used to hob an internal Acme thread, 2.000 in. in outside diameter, 4 threads per inch.

First determine the maximum side-cutting at the largest diameter of the work. The known values are then $r = 1.000$, $R = 0.400$, $N = 4$, and $C = 14\frac{1}{2}$ deg., from which the following coefficients are obtained:

*Presented at the annual meeting of the American Society of Mechanical Engineers, New York, Dec. 7 to 10, 1920.

For	B	=	5°	6°	7°
	x	=	—0.001995	—0.002039	—0.001928
	y	=	0.005710	0.008230	0.011240

The side-cutting at a point 0.100 in. farther down the flank of the thread will next be determined. In this

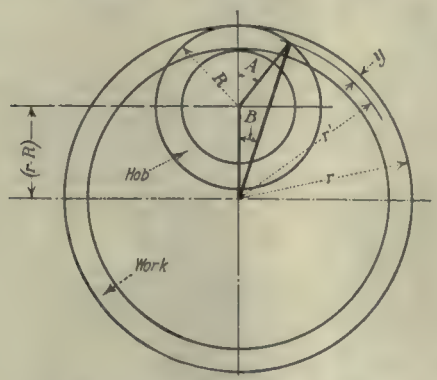


FIG. 9. DIAGRAM OF HOB AND INTERNAL SCREW

case $r = 0.900$ in., $R = 0.300$ in. and these give the following coefficients:

For	B	=	4°	5°	6°
	x	=	—0.001644	—0.001698	—0.001607
	y	=	0.004383	0.006858	0.009900

When the side-cutting is at a point 0.200 in. below the largest diameter of the work, $r = 0.800$ in. and $R = 0.200$ in., giving the following coefficients:

For	B	=	3° 30′	4°	4° 30′
	x	=	—0.001297	—0.001303	—0.001236
	y	=	0.004384	0.005704	0.007304

These values are plotted in Fig. 10. In general, the curve is very similar to the one shown in Fig. 4, except that the flank of the thread in the work is concave instead of convex as in the case of a hobbed screw. It will also be found that on hobbed nut threads the curvature of the flank of the thread is much less than on hobbed screw threads, while the amount of side-cutting at the point, both on the x-axis and y-axis, is much greater; in other words, the fillet at the bottom of the hobbed thread will be larger.

Fig. 11-A represents the form of the thread which would be cut with a hob whose form was that of a standard thread. The values employed are the same as those used in discussing the hobbing of screws. Fig. 11-B represents a corrected hob and the form of thread cut with it. The formula for the corrected angle of the hob will be very similar to that for external hobbing, and is given by the equation:

$$\tan C' = \tan C + \frac{x_1 - x_2}{r_1 - r_2} \qquad (12)$$

As with the external hobs, the true correction of the hob would be in a curved line. This is indicated by the dotted line in Fig. 10-B. In this case, however, the flank of the hob should be concave instead of convex as in the case of external hobs. If the fillet at the bottom of the thread should be objectionable, the point of the hob could be extended by an amount equal approximately to y_2 if undercutting was permissible.

In the example given previously, we have the following values:

$C_1 = 14° 41′ 52″$ $x_1 = 0.002039$ in.
$K = 0.000027$ in. $y_1 = 0.008230$ in.

In order to determine the effect of varying the diam-

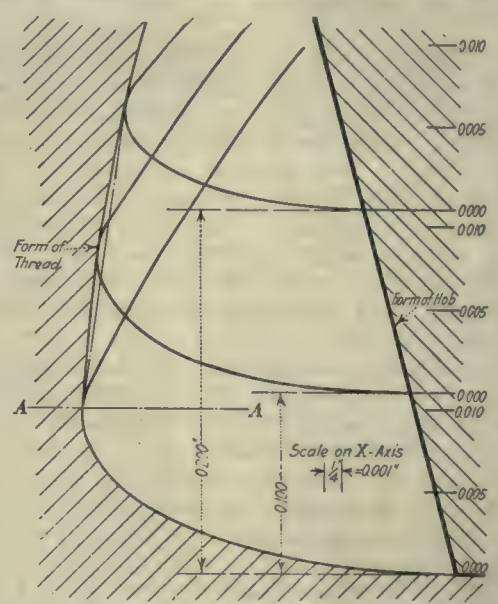


FIG. 10. CURVES SHOWING FORM OF INTERNAL THREAD

eter of the hob, two further examples will be taken: First, with the outside diameter of the hob equal to 1.200 in. and second, with it equal to 1.600 in.

The following tabulation is made to show the effects

TABLE III. VALUES OF y/r FOR r/R = 1.1 TO 4.0 (INTERNAL THREADS)

		Ratio r/R													
B	$B/360°$	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0	2.5	3.0	3.5	4.0
1°	0.002778	0.00001	0.00001	0.00001	0.00002	0.00002	0.00003	0.00004	0.00005	0.00006	0.00007	0.00019	0.00031	0.00039	0.00046
2°	0.005556	0.00005	0.00010	0.00015	0.00020	0.00025	0.00031	0.00037	0.00043	0.00049	0.00055	0.00089	0.00122	0.00147	0.00178
3°	0.008333	0.00010	0.00023	0.00036	0.00049	0.00063	0.00077	0.00091	0.00105	0.00119	0.00133	0.00204	0.00274	0.00336	0.00398
4°	0.011111	0.00021	0.00045	0.00069	0.00093	0.00117	0.00141	0.00166	0.00191	0.00216	0.00241	0.00364	0.00487	0.00600	0.00713
5°	0.013889	0.00035	0.00073	0.00111	0.00149	0.00187	0.00225	0.00263	0.00301	0.00340	0.00379	0.00571	0.00762	0.00945	0.01128
6°	0.016667	0.00052	0.00107	0.00162	0.00217	0.00272	0.00327	0.00382	0.00437	0.00492	0.00547	0.00823	0.01100	0.01369	0.01673
7°	0.019444	0.00072	0.00146	0.00220	0.00295	0.00370	0.00445	0.00520	0.00595	0.00670	0.00745	0.01124	0.01502	0.01879	0.02255
8°	0.022222	0.00095	0.00192	0.00289	0.00386	0.00483	0.00581	0.00679	0.00777	0.00875	0.00973	0.01470	0.01967	0.02477	0.02987
9°	0.025000	0.00121	0.00244	0.00367	0.00490	0.00613	0.00736	0.00859	0.00983	0.01107	0.01231	0.01864	0.02498	0.03167	0.03877
10°	0.027778	0.00150	0.00302	0.00454	0.00606	0.00758	0.00910	0.01062	0.01214	0.01366	0.01519	0.02306	0.03094	0.03952	0.04811
11°	0.030556	0.00182	0.00365	0.00549	0.00733	0.00917	0.01101	0.01285	0.01479	0.01663	0.01837	0.02797	0.03757	0.04835	0.05913
12°	0.033333	0.00217	0.00435	0.00653	0.00871	0.01090	0.01309	0.01528	0.01747	0.01966	0.02185	0.03331	0.04486	0.05817	0.07148
13°	0.036111	0.00255	0.00511	0.00767	0.01023	0.01279	0.01535	0.01792	0.02049	0.02306	0.02563	0.03923	0.05283	0.06902	0.08521
14°	0.038889	0.00296	0.00593	0.00890	0.01187	0.01484	0.01781	0.02078	0.02375	0.02673	0.02971	0.04560	0.06149	0.08092	0.10036
15°	0.041667	0.00340	0.00681	0.01022	0.01363	0.01704	0.02045	0.02386	0.02727	0.03068	0.03409	0.05246	0.07084	0.09392	0.11699
16°	0.044444	0.00387	0.00774	0.01161	0.01548	0.01935	0.02323	0.02711	0.03099	0.03487	0.03875	0.05983	0.08091	0.10807	.....
17°	0.047222	0.00437	0.00874	0.01311	0.01748	0.02185	0.02622	0.03059	0.03496	0.03933	0.04371	0.06777	0.09183	0.12341	.....
18°	0.050000	0.00489	0.00978	0.01467	0.01956	0.02446	0.02936	0.03426	0.03916	0.04406	0.04896	0.07630	0.10365	0.14000	.....
19°	0.052778	0.00544	0.01089	0.01634	0.02179	0.02724	0.03269	0.03269	0.04359	0.04904	0.05449	0.08548	0.11647	0.15789	.....
20°	0.055556	0.00602	0.01205	0.01808	0.02411	0.03014	0.03617	0.04220	0.04823	0.05427	0.06031	0.09535	0.13039	0.17713	.....
21°	0.058333	0.00663	0.01327	0.01991	0.02655	0.03319	0.03983	0.04647	0.05311	0.05976	0.06641	0.10593	0.14546	.....	.....
22°	0.061111	0.00726	0.01454	0.02182	0.02910	0.03638	0.04366	0.05094	0.05822	0.06551	0.07280	0.11725	0.16171	.....	.....
23°	0.063889	0.00792	0.01587	0.02382	0.03177	0.03972	0.04767	0.05562	0.06357	0.07152	0.07947	0.12932	0.17917	.....	.....
24°	0.066667	0.00861	0.01725	0.02589	0.03454	0.04319	0.05184	0.06049	0.06914	0.07779	0.08644	0.14213	0.19783	.....	.....
25°	0.069444	0.00933	0.01870	0.02807	0.03744	0.04681	0.05618	0.06555	0.07493	0.08431	0.09369	0.15567	0.21766	.....	.....

of varying the diameter of the hob. (Diameter of work = 2.000 in.; 4 Acme threads per inch, see Fig. 11-A):

Diameter of hob =	0.800 in.	1.200 in.	1.600 in.
x_1 =	0.002039	0.004615	0.012734
y_1 =	0.00823	0.017063	0.052800
$2C'$ =	29° 23′ 44″	29° 25′ 6″	29° 28′ 8″

It will be noted that the same general principles hold true, as regards the effect of increasing the diameter of the hob, for both external and internal hobbing. The amount of side-cutting (x_1) and the height of the fillet (y_1) increase considerably as the diameter of the hob increases, while the included angle of the corrected hob increases but very slightly. If a tangential correction at the pitch line is used, the formula for determining C' given for screws can also be used for nuts.

In order to determine the effect of varying the diameter of the work, the following tabulation is made:

Diameter of work =	2.00 in.	3.000 in.	4.000 in.
x_1 =	0.012734	0.002342	0.001028
y_1 =	0.052800	0.009739	0.004080
$2C'$ =	29° 28′ 8″	29° 10′ 24″	29° 5′ 52″

This tabulation shows the same general conditions as exist in external hobbing. As the diameter of the work increases, the side-cutting (x_1), the height of the fillet (y_1) and the angle of the corrected hob decrease quite rapidly. Thus a hob which is corrected for a certain diameter of work would introduce a noticeable error when used for cutting a different diameter. The amount of this change also decreases quite rapidly as the diameter of the work increases. Beyond a certain diameter of work, therefore, no correction would be practically required.

It will be noted, if comparison is made with external hobbing, that the amount of side cutting in internal hobbing is very much greater although the correction in angle is somewhat similar.

In order to simplify the calculations, Tables III and IV have been prepared. These are similar to Tables I and II, and are to be used in exactly the same manner.

It has been a common belief that for internal hobbing the hob should be made as small as possible. As a matter of fact, any 60-deg. thread which does not have a sharper helix than any of the U. S. standard threads can be hobbed satisfactorily, with as large a hob as will clear the tap-drill diameter, provided the hob is suitably corrected. The only effect, beyond a slight modification in the hob form, which is caused by the use of a smaller hob is the reduction of the height of fillet (y_1) at the bottom of the hob. To overcome this, when the height may be objectionable, the point of the hob may be extended, thus producing a slight undercut, which is nearly always permissible.

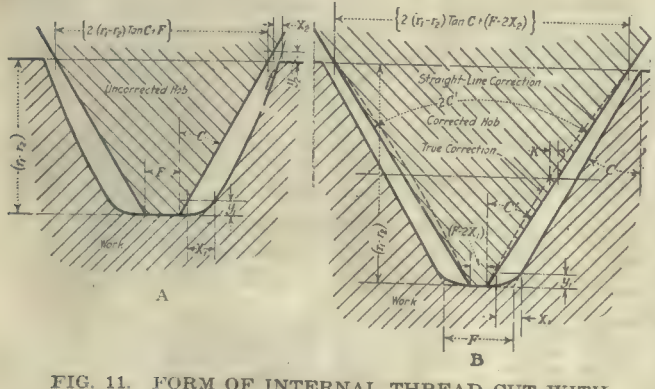


FIG. 11. FORM OF INTERNAL THREAD CUT WITH UNCORRECTED AND CORRECTED HOBS

TABLE IV. VALUES OF y/r FOR r/R = 1.1 TO 1.7 (INTERNAL THREADS)

		Ratio r/R						
B	$B/360°$	1.1	1.2	1.3	1.4	1.5	1.6	1.7
26°	0.072222	0.01008	0.02020	0.03032	0.04044	0.05056	0.06069	0.07082
27°	0.075000	0.01085	0.02175	0.03265	0.04355	0.05445	0.06536	0.07627
28°	0.077778	0.01165	0.02336	0.03507	0.04678	0.05849	0.07020	0.08191
29°	0.080556	0.01247	0.02501	0.03755	0.05009	0.06263	0.07518	0.08773
30°	0.083333	0.01331	0.02671	0.04011	0.05351	0.06692	0.08033	0.09374
31°	0.086111	0.01418	0.02847	0.04276	0.05705	0.07134	0.08584	0.09994
32°	0.088889	0.01507	0.03028	0.04549	0.06070	0.07591	0.09112	0.10633
33°	0.091667	0.01599	0.03213	0.04828	0.06443	0.08058	0.09673	0.11288
34°	0.094444	0.01694	0.03405	0.05116	0.06827	0.08538	0.10249	0.11960
35°	0.097222	0.01791	0.03601	0.05411	0.07221	0.09031	0.10841	0.12651
36°	0.100000	0.01891	0.03802	0.05713	0.07624	0.09535	0.11446	0.13358
37°	0.102778	0.01993	0.04008	0.06023	0.08038	0.10053	0.12068	0.14084
38°	0.105556	0.02097	0.04219	0.06341	0.08463	0.10585	0.12707	0.14829
39°	0.108333	0.02205	0.04435	0.06666	0.08897	0.11128	0.13359	0.15590
40°	0.111111	0.02315	0.04657	0.06999	0.09341	0.11683	0.14025	0.16367
41°	0.113889	0.02429	0.04882	0.07337	0.09792	0.12248	0.14704	0.17160
42°	0.116667	0.02540	0.05111	0.07682	0.10254	0.12826	0.15398	0.17970
43°	0.119444	0.02655	0.05345	0.08035	0.10725	0.13415	0.16105	0.18796
44°	0.122222	0.02772	0.05583	0.08394	0.11205	0.14016	0.16827	0.19638
45°	0.125000	0.02891	0.05825	0.08759	0.11694	0.14629	0.17564	0.20499

Due to the above-mentioned misapprehension in regard to internal hobbing, this method of manufacture has been seldom used except on threads of about two inches and over in diameter. It will be seen from the foregoing, however, that it is practical for threads three-quarters of an inch in diameter and upward, and under some circumstances it can be successfully used on even smaller diameters.

Inaccessibility of Auto Parts

By George Little

While discussing the inaccessibility of automobile mechanism with an auto-repair instructor, the question came up of how much time was lost unavoidably by mechanics in getting at parts which required adjustment or repair. He roughly estimated this time at about 75 per cent.

Recently, oil leaked from the crankcase of my car, so I took a half-day off with the thought that I would get it fixed in two or three hours. I am an experienced mechanic, but instead of the three it took me nearer eight hours to fix the leakage. I removed seventy-two separate parts plus twenty-six lock washers—all to get at something that required fifteen minutes to repair. Nine of the capscrews were so located that at least five minutes was required to remove each and ten minutes to get each back and tightened properly.

No doubt there has been much experimenting done by automobile makers and designers to get various parts perfected so that a car will be turned out as nearly perfect as is mechanically possible, but I cannot help thinking that higher efficiency and more satisfied customers would be the result if greater efforts were taken to make some of the parts, now hard to get at, more accessible.

As a whole the automobiles of today are well designed and usually well built. But when you get one on the road, sooner or later you will find a weakness in some of the little parts that are seemingly unimportant, due to the lack of proper foresight of the designer. A slight change in shape or a different material, a curled edge or a rib added in the proper place to stiffen a weak spot, two or three screws added to the number holding a part in place or a next size larger screw would perhaps be the means of saving many dollars and hours of time for the owners.

A few repair jobs given to designers would possibly help a great deal in remedying the inaccessibility of many parts.

SEVEN CENTURIES of BRASS MAKING



VI. Characteristics of Brass

Control of the quality of the product of a plant depends not alone upon the perfection of the mechanical apparatus used in its manufacture, but also upon an exact knowledge of the characteristics of the product, since they affect the operation of the apparatus. The characteristics of brass and the laboratory and research methods used to determine them are herein delineated.

(Part V was published in the Dec. 16 issue.)

THE first step in placing the processes of the Bridgeport Brass Co. on a scientific basis was the organization of a research laboratory. To begin with it was necessary to make a research man out of every foreman in the plant, many of whom were technically educated men, thoroughly trained in research methods. Having organized the force, the processes were carefully developed and scheduled, and then it was necessary to provide an inspection laboratory to insure the standards that had been set up. Therefore, the laboratory work of the department may be divided into two parts, the research work and the control routine work. The research work divides itself into two general classes, namely: research work on products of the company and research work on materials and equipment employed by the company in the manufacture of its products. The control laboratory systematically samples the product at the various stages of manufacture and performs chemical analyses and certain physical tests, depending upon the nature of the product and the particular step in the process from which the sample was taken. In this way, it is possible to control closely the properties of the products passing through the plant.

The control laboratory is specially valuable in protecting the various alloys from any impurities there may be in the scrap used in their composition, and in this way serves as an accurate guide in the determination of the proportions of various kinds of scrap to be used in any given mixture.

The research department develops new alloys and studies details of the manufacturing processes, with a view to eliminating wastes and improving the quality of the product. It examines the fuel, lubricating oils and greases, the steel used for the dies and tools, and in many other ways develops and guards the manufacturing process in all its details.

The activities of this end of the business are far too numerous to be described in detail, but some idea may be obtained of the extent and character of the equipment from the illustrations shown herewith. Fig. 69 shows the electrolytic cells for determining the copper and lead content of brasses and bronzes as applied in the control testing of the chemical laboratory. The glass beakers are closed at the top with semi-circular pieces of glass, as may be plainly seen at the left. The girl in the center is washing off these plates so as to prevent any possibility of error, due to part of the solution clinging to the cover plates. The girl in the background is setting up a cell. The cells are operated from a special low voltage motor-generator set. Fig. 70 is a view in the balance room, where an important part of the control work is carried on. In the control laboratory every possible precaution is taken to avoid errors. The measuring devices shown in Fig. 71 are so constructed that an accurate quantity of liquid is measured automatically. All the operator does is to pump until the measuring column is full to the top. An internal tube, extending exactly to the upper graduation of the measuring tube, draws off the liquid automatically, leaving in the measuring tube the exact quantity required. Fig. 72 shows special electric furnaces for burning out filter papers. This is another improvement calculated to eliminate possible errors. It supplants the old method of open flame burner with the ever present possibilities of loss, due to drafts or accidental upsetting. Fig. 73 shows one of three micro-photographic machines. These machines are used both in control testing and investigation work. By means of systematic crystal

*Booklet published by the Bridgeport Brass Co., Bridgeport, Conn.



FIG. 69. ELECTROLYTIC CELLS FOR DETERMINING THE COPPER AND LEAD CONTENT OF BRASSES AND BRONZES AS APPLIED IN THE CONTROL TESTING OF THE CHEMICAL LABORATORY



FIG. 70. A VIEW IN THE BALANCE ROOM



FIG. 71. AUTOMATIC LIQUID MEASURING DEVICES



FIG. 72. SPECIAL ELECTRIC FURNACES FOR BURNING OUT FILTER PAPERS

count, the standard of Bridgeport brass is maintained at every stage of the rolling and drawing processes.

Scleroscopes and Brinell hardness testing machines are used to test the hardness of the tubes and rod and sheet metal. A group of testing machines is shown in Fig. 74. In Fig. 75 is shown a conductivity bridge for routine testing of phono-electric wire and in Fig. 76 a machine for tensile and compression tests. Miniature melting and annealing furnaces for brasses and bronzes are shown by Fig. 77. A bar mold and various tools required for casting are shown in the center of the picture. The research laboratory also uses a miniature electric furnace for investigation purposes.

One of the most important elements in the successful manufacture of rolled and drawn brass is the lubrication of the working parts. This company has found it necessary to compound its own oils and greases for these purposes. The equipment shown by Fig. 78 is part of the oil laboratory in which formulas for compounding are evolved. Full testing equipment used for the inspection of fuels used in the power plant is illustrated by Fig. 79. The various furnaces are purchased to



FIG. 73. MICRO-PHOTOGRAPHIC MACHINES

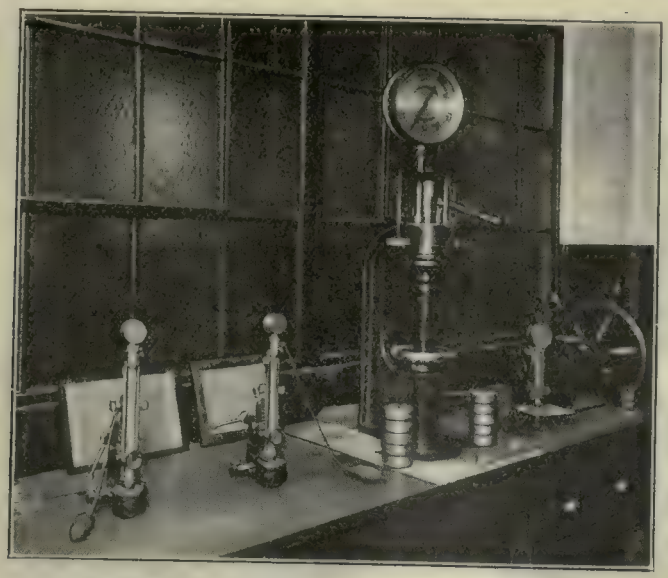


FIG. 74. A GROUP OF TESTING MACHINES

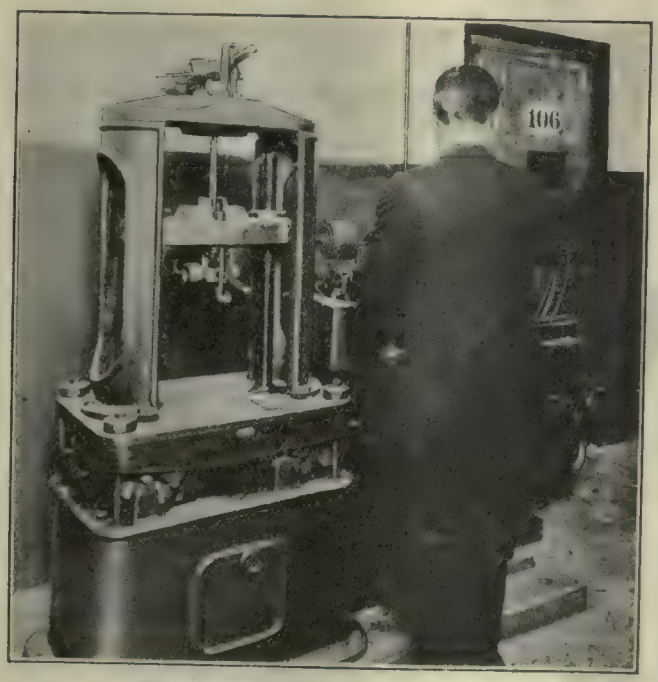


FIG. 76. MACHINE FOR TENSILE AND COMPRESSION TESTS



FIG. 77. MINIATURE MELTING AND ANNEALING FURNACE FOR BRASSES AND BRONZES



FIG. 75. CONDUCTIVITY BRIDGE FOR ROUTINE TESTING OF PHONO-ELECTRIC WIRE

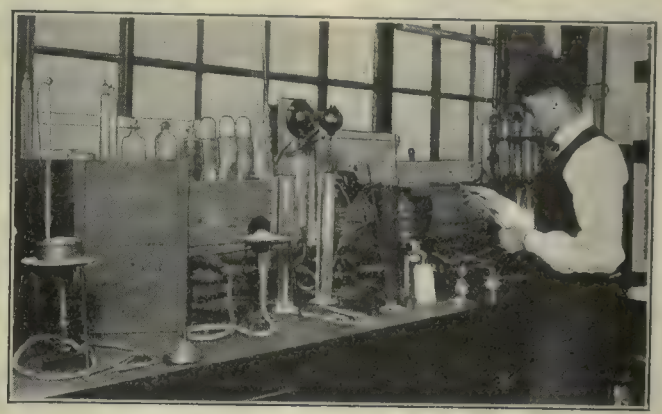


FIG. 78. PART OF THE OIL LABORATORY

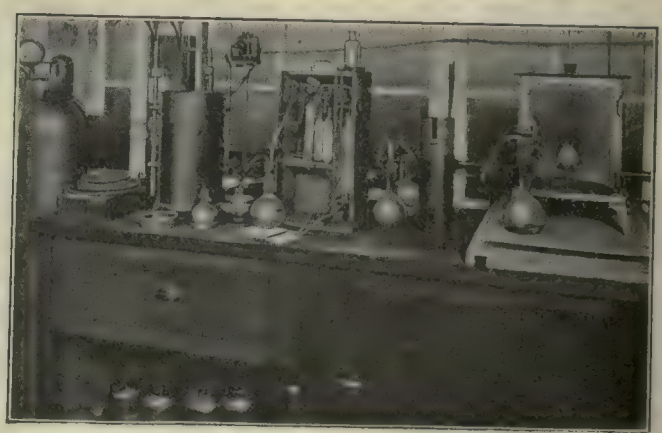


FIG. 79. FUEL TESTING EQUIPMENT USED FOR THE INSPECTION OF FUELS USED IN THE POWER PLANT

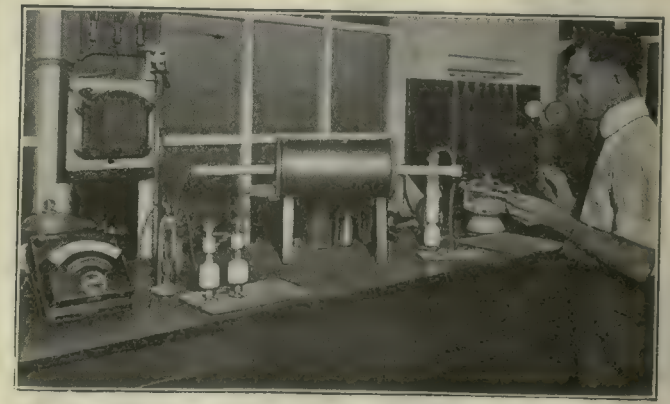


FIG. 80. ELECTRICAL APPARATUS FOR THE DETERMINATION OF CARBON CONTENT IN STEEL

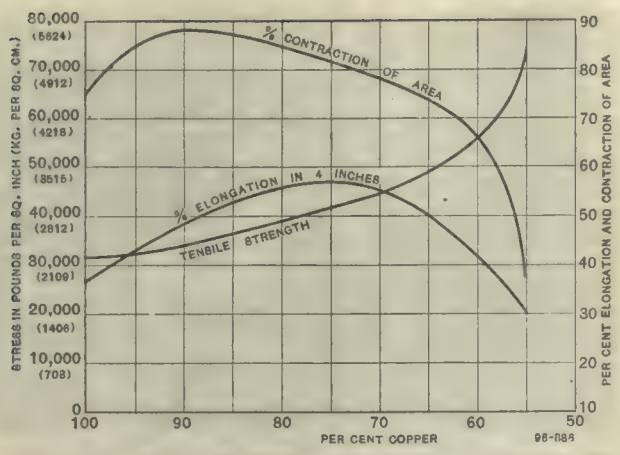


FIG. 81. RELATION BETWEEN PERCENTAGE OF COPPER AND ZINC AND THE PHYSICAL PROPERTIES OF BRASS

specification and carefully checked. Fig. 80 shows electrical apparatus for the determination of carbon content in steel. This apparatus is part of the equipment employed by the laboratory which controls the metals used for the various dies and tools in the mills.

Characteristics of Brass

The useful alloys of copper and zinc cover a series from about 55 per cent of copper and 45 per cent of zinc up to pure copper, and exhibit a wide range of normal properties and characteristics according to the proportions of the two constituents present. Their physical characteristics, when cold rolled and annealed, vary with the proportion of the two ingredients as shown in Fig. 81.

These curves were produced by plotting the results of tests on samples of sheet of various mixtures which had been rolled to 0.1 in. thick and carefully annealed at about 650 deg. C.

Brass Mixtures

Mixtures high in zinc are relatively unimportant because of their comparative lack of toughness which prevents their being readily worked cold. When containing less than 63 per cent of copper, however, they are readily rolled, forged or extruded, when hot. Within this range they are usually alloyed with other constituents for particular purposes. In the intermediate and lower ranges from 57 to 60 per cent copper, iron and tin are added, either singly or in combination, to the extent of about 1 per cent each, to increase strength, forming the manganese bronzes and naval brasses. The range from 60 to 63 per cent, combined with about 3 per cent of lead, covers the mixtures usually employed for making "leaded" or "free cutting" brass rod for screw machine use. From 63 to 70 per cent are the high brasses ordinarily employed in making sheet and strip; they constitute by far the greater part of all the sheet produced.

The mixtures containing the higher percentages of copper are necessarily more expensive and are required when color or certain qualities of toughness are important.

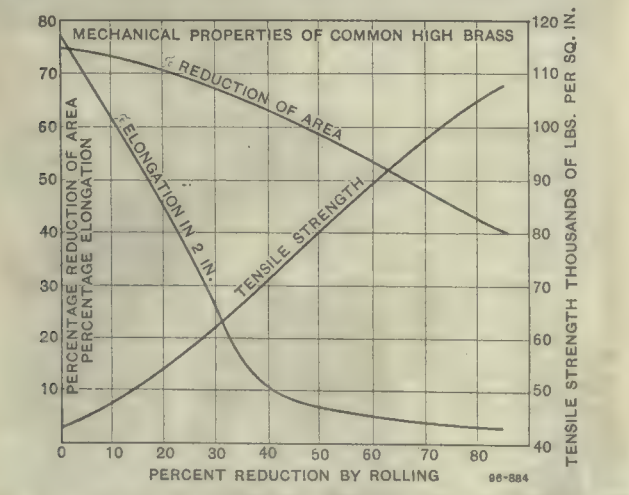


FIG. 82. DIAGRAM SHOWING EFFECT OF REDUCTION OF AREA UPON PHYSICAL PROPERTIES FOR BRASS OF A GIVEN COMPOSITION

Effects of Cold Working

The properties of any individual mixture may be varied over a wide range by varying the amount of cold working from the annealed state and by varying the annealing temperatures from the cold worked state. The relative effect which a given amount of cold working or degree of annealing produces varies with the proportion of copper and zinc present.

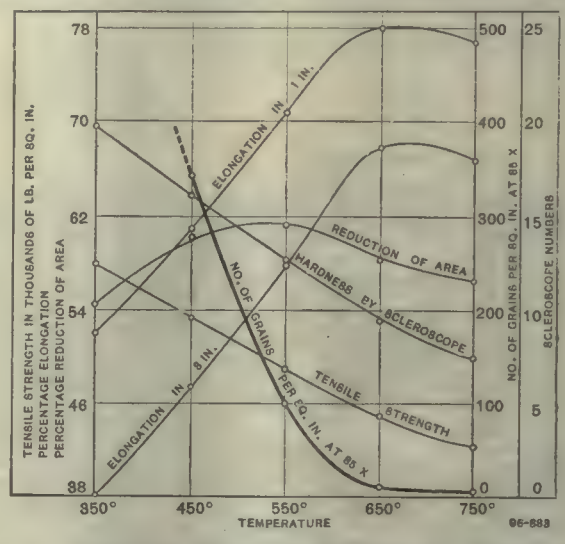


FIG. 83. DIAGRAM SHOWING EFFECT OF ANNEALING TEMPERATURE UPON PHYSICAL PROPERTIES FOR BRASS OF A GIVEN COMPOSITION

The effect produced by a given amount of cold working is dependent solely upon the extent thereof irrespective of whether it is effected by a series of reductions or by one of the same total magnitude.

Effects of Annealing

In Fig. 82 is shown the effect of cold rolling on brass containing 67 per cent of copper. The percentage of reduction is the expression of the initial thickness minus the final thickness, divided by the initial thickness and multiplied by 100. Fig. 83 shows the effects of annealing a brass containing 67 per cent of copper and 33 per cent of zinc at varying temperatures. These values may be influenced somewhat by the degree of cold rolling to which the material has been subjected prior to annealing.

It is a usage of the trade to express the temper of cold rolled brass in terms designating the amount of reduction given in the final rolling after the last anneal, "1 number hard" or "quarter hard" corresponding to 10 per cent, "2 numbers hard" or "half hard" to 20 per

cent and "4 numbers hard" or "hard" to 40 per cent. Similarly the degree of annealing is somewhat roughly designated as light annealing, soft and dead soft, corresponding to about 500 deg. C., 600 deg. C., and 700 deg. C. respectively.

Additions and Impurities

The quality of copper ordinarily employed in brass is exceedingly high, containing 99.9 per cent or more of copper, the balance being largely oxygen, the presence of which is required mainly to enable the metal to be cast in suitable form.

Zinc is, however, obtainable in various qualities, the chief variable impurity in which is lead, which is found in various percentages from a few one hundredths up to as high as 2 per cent.

Lead

The quality of brass is affected to a considerable degree by the amount of lead carried by the zinc of which it is produced. The effect of this ingredient is to lower its toughness, ductility and ability to withstand cold working processes, involving stretching and distortion. The presence of lead also has a very marked effect upon the ease with which brass can be cut with a tool, and where this property is of importance, lead is purposely added in amounts up to 3 per cent or slightly over.

Iron

Next to lead the most important impurity carried by brass is iron, which is introduced partly with the zinc, in which metal it exists in varying quantities according to the grade of the latter, and also from accidental contamination when in the molten state. The effect of iron is to reduce ductility and increase hardness and its influence in these respects is markedly detrimental when present in quantities over 0.1 per cent.

Antimony and Bismuth-Arsenic

Other metallic impurities are seldom present in amounts sufficient to be detrimental, although antimony and bismuth, which are particularly objectionable, are usually carried in minute amounts by copper. Arsenic is sometimes present when grades of copper carrying that element are employed, but its effect, however, is ordinarily not pronounced and is useful rather than objectionable.

Tin

Tin is sometimes present by accident and sometimes by design. It increases the elastic limit and hardness of the material somewhat and acts as a deterrent to certain corrosive influences. Other elements are seldom found in the presence of good practice.

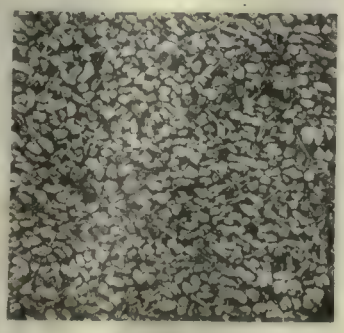


FIG. 84. SAMPLE FROM EXTRUDED ROD SHOWING MIXTURE OF ALPHA AND BETA CRYSTALS

Accurate knowledge of the physical properties of brass and the use of scientific methods in its manufacture have not heretofore been of sufficiently wide employment to have resulted in any generally accepted practice in specifying the qualities of brass required for specific uses or in testing it for the determination of its suitability. As a general rule, therefore, the largest measure of satisfaction can be secured when the brass maker is cognizant of the exact purpose for which material is to be employed and in close co-operation with the user can apply his knowledge and skill to the selection of mixture and treatment best adapted for the purpose.



FIG. 85. MICROSTRUCTURE OF BRASS WHICH HAS BEEN ANNEALED AT VARIOUS TEMPERATURES. MAGNIFIED 85 DIAMETERS

The chemical, physical and research laboratories of the Bridgeport Brass Co. are, in equipment and personnel, second to none in their ability to determine and select the most suitable material for any particular usage.

Temper

It is equally important, however, that the temperature to which the material has been finally annealed, or the temper to which it has been rolled in case a temper is desired, be determined. The former may be ascertained by the ordinary tensile test, although on thin material this is somewhat uncertain. It may also be determined by microscopic examination as the size of crystal varies, as shown by Fig. 85, with varying temperatures of anneal.

The scleroscope and Brinnell tests are also useful in this connection. The latter in particular is applicable to relatively thick sections. For thin sheet the Erichson machine is very useful. This instrument employs a dome shaped tool to draw sheet into the corresponding shape. This drawing action is continued until fracture occurs. The depth of the cup at fracture, which is measured by the machine, is a measure of the ductility of the material. At the same time the smoothness or roughness of the drawn cup indicates roughly the size of the crystal structure.

Comprehensive attempts to draw specifications for various forms of wrought brass have not been conspicuously successful except in isolated instances. This

is because of the absence of reliable data of a specific nature relating the various properties of brass to the requirements of individual users. As indicated by the data heretofore given an enormously wide range of physical characteristics can be imparted to brass by variations in composition, heat treatment and manipulation.

Structure

The crystallic structure of brass is revealed by the microscope. The crystals are of two kinds, known respectively as the alpha and beta crystals. The crystals shown in Fig. 85 are alpha crystals, while Fig. 84 shows a mixture of alpha and beta, the light ones being the former and the dark ones the latter. Fig. 85 shows the effect which varying annealing temperatures have on crystal size in the case of a sample of brass which has been rolled quite hard and then annealed at different temperatures. Fig. 86 shows the effect upon the crystal structure produced by cold rolling. In this instance a sample of very thoroughly annealed brass has been rolled to several degrees of hardness as stated.

Some of the useful mixtures are composed entirely of alpha crystals, some of beta crystals and others of a mixture of the two. These crystals separate out of the molten brass as solidification occurs and exist singly or together in any particular mixture according to its composition and temperature. The alpha crystals are relatively weak and ductile; the beta are stronger and less ductile.

The equilibrium diagram, Fig. 87, shows the relations existing between the proportions of copper and zinc, the temperature, and the crystallic structure. The line *ABC* indicates the temperature at which, for various proportions of copper and spelter, solidification begins as a molten mass cools. The line $A\ b_2\ b_1\ c_1\ C$ shows the respective temperatures at which solidification is complete. It will be seen from this diagram that the presence of alpha or beta crystals is a function not alone of the proportions of copper and spelter present but of the temperature also. A brass containing 70 per cent or over of copper will consist only of alpha crystals, whereas one containing 65 per cent of copper will, when at a temperature of 700 deg. C. or over, contain some beta. If it is slowly cooled the beta will grow less as the temperature falls and finally disappear completely. If, however, it be rapidly cooled as by quenching in water there will be insufficient time for the latter transformation to take place and the presence of beta will be found upon microscopic examination. Similarly a brass containing 60 per cent of copper will, after high heating, contain all beta or a mixture of alpha and beta according as it is rapidly or slowly cooled.

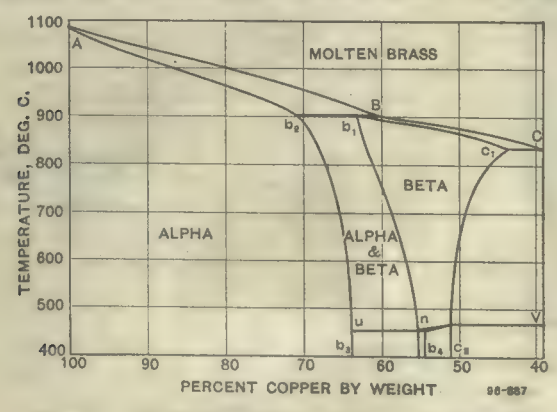


FIG. 87. EQUILIBRIUM DIAGRAM OF COPPER-ZINC ALLOYS



FIG. 86. MICROSTRUCTURE OF BRASS WHICH HAS RECEIVED VARYING AMOUNTS OF COLD ROLLING. MAGNIFIED 85 DIAMETERS

The Relation Between Brinell Hardness and the Grain Size of Annealed Carbon Steels

In Scientific Paper No. 397, issued by the Bureau of Standards, Washington, D. C., are given the results of a study of the relation between the Brinell hardness and the grain size of annealed carbon steels, made by Henry S. Rawdon, physicist, Bureau of Standards, and Emilio Jimeno-Gil, professor of Physical Chemistry, University of Oviedo, Spain. The general plan of study included the determination of the hardness of specimens which were of the same composition but widely different in grain size. Two methods were used to develop grains of different sizes, one being slow cooling after heating in a furnace, the other consisting of annealing bars which had been given a cold working by stretching in tension. Each specimen was examined microscopically and a grain-size determination attempted. The Brinell hardness was determined in two different ways.

The results of the experiments show that no simple and direct relation exists between the grain size and the Brinell hardness number for carbon steels, although a very pronounced increase in grain size is usually accompanied by a decrease in hardness. No appreciable difference in hardness number was observed between groups of small crystals and the large ones of the same specimen. The general effect of heating steel was to harden it appreciably. The rate at which steel is cooled affects the hardness much more than any other factor, because of the effect on the structural condition of the hardening constituents. The change in grain size is often very abrupt, the crystals growing rapidly with but small increases in temperature, which is above the Ac_3 transformation point.

Slotting-Machine and Planer Toolholders for Railroad Shop Use

By Frank A. Stanley

The halftone and the line drawing, Figs. 1 and 2, show the construction of a heavy-duty adjustable slotting-machine toolholder with backstroke release. The shank or body of this holder which is turned down at the end to 3½ in. in diameter is threaded to eight threads per inch to receive the internally threaded split sleeve *A*, Fig. 2. This sleeve also fits to the threaded shank of block *B*, and thus connects the latter with the bar or shank. The block *B* is made to carry the cast-steel head *C* which is planed out across the upper end to provide jaws to fit over the rectangular lower portion of *B*. Here head *C* is mounted in place by means of a taper pin upon which it rocks when in operation.

The method of attaching the carrier to the body by means of the sleeve *A* allows the toolhead to be adjusted around at any desired angle and securely clamped when once set. The sleeve is not only split vertically to permit of its being gripped tightly to the threaded members which it incloses, but it is further cut horizontally well into the bore at a point midway of its height and two independent clamp screws are provided so that the lower portion may be released upon the toolhead and the latter readjusted without loosening the upper half and its grip upon the threaded end of the holder; or the upper adjustment may be made without necessarily loosening the clamp on the toolhead.

The toolpost *D* slides into a 2-in. cylindrical bore at the bottom of the head *C* and the tool is clamped by the nut which draws the post up and binds the slotter tool against the upper side of the rectangular tool slot. The head is held forward in normal position by a compres-

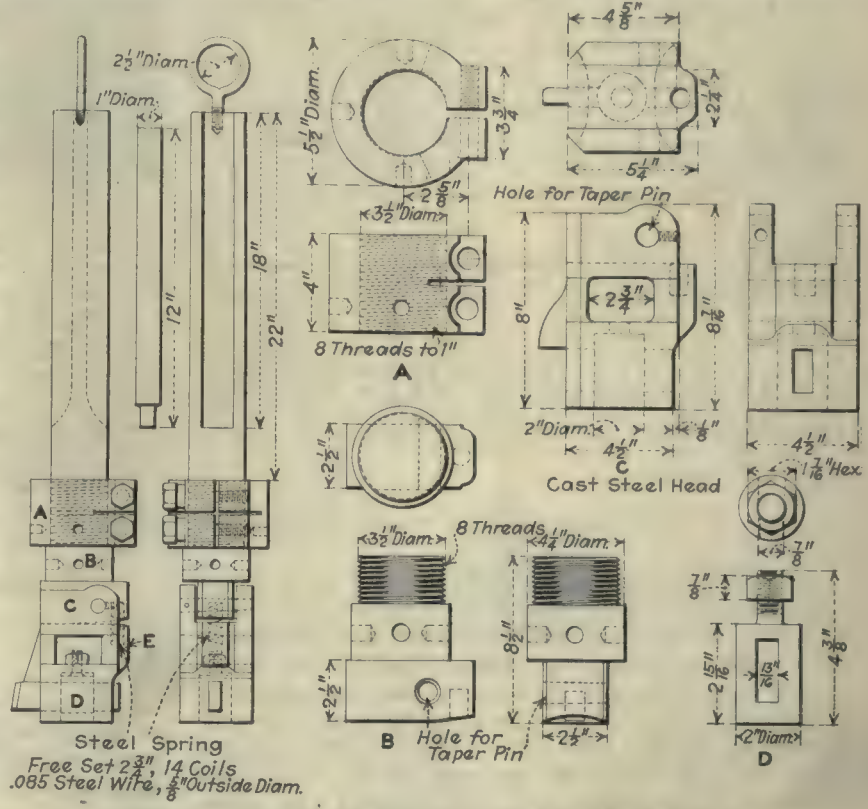
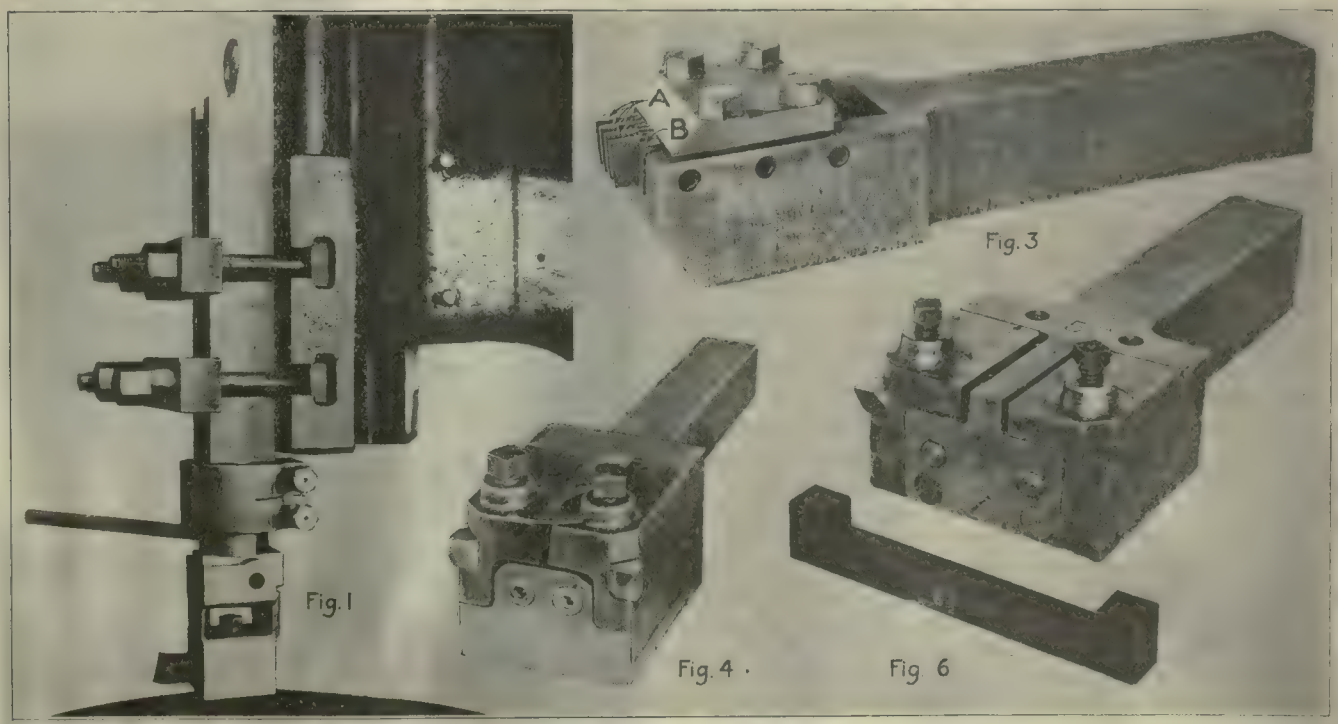


FIG. 2. DETAILS OF TOOLHOLDER SHOWN IN FIG. 1.



FIGS. 1 TO 6. THE SLOTTING-MACHINE AND PLANER TOOLHOLDERS

Fig. 1—Heavy-duty adjustable slotting-machine toolholder with back-stroke release. Fig. 3—Planer tool for cutting reverse lever slots in foot bar. Fig. 4—Adjustable shaper toolholder with back-stroke release. Fig. 6—Planer toolholder for finishing both sides of crosshead slot for gib in one operation.

sion spring *E*, $\frac{5}{8}$-in. outside diameter by $2\frac{3}{4}$ in. long free set. The spring is of 0.085-in. steel wire.

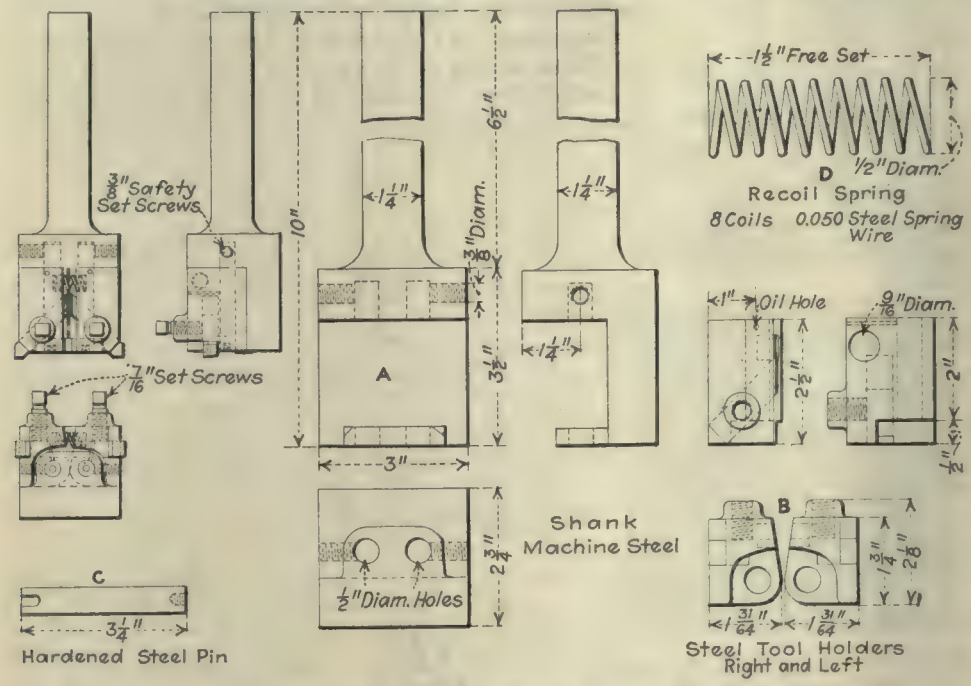


FIG. 5. DETAILS OF TOOLHOLDER SHOWN IN FIG. 4.

A gang planer toolholder is shown in Fig. 3 and is made for cutting reverse lever slots in foot bars. This toolholder carries four cutting-off tools *A* of high-speed steel which are beveled or cleared from the top thickness of $\frac{5}{16}$ in. to $\frac{5}{32}$ in. at the bottom. They are separated or spaced by tool-steel filler blocks of the same degree of bevel. The thicker filler block *B* at the outside of the group of tools takes the pressure of the three side clamping screws which have hollow heads and which are set in flush with the outside of the holder. The top of the holder is fitted with a half-inch tool-steel clamp plate which is drawn down by four $\frac{1}{2}$-in. capscrews to grip and seat the tools firmly.

An Adjustable Shaper Toolholder

The tool illustrated in Fig. 4 is a back-stroke release holder for shaper tools. It is adjustable and its two tools may be used for openings from $3\frac{1}{8}$ to $3\frac{13}{8}$ in. wide. Other sizes are made in similar designs. Details of this holder are covered in the line drawing, Fig. 5.

The body *A* is of machine steel with a shank $1\frac{1}{4}$ in. square, the body proper being shaped like a screw-machine box tool. The blocks which hold the tools are made right and left hand as shown at *B*. They are of steel with $\frac{1}{2}$-in. holes finished through to receive hardened and ground steel pins *C*, upon which they rock to give the relief upon the back stroke of the shaper ram. This recoil or release action is opposed by the coiled spring *D* which is seated in opposing holes in the inner faces of the two tool blocks so that the two are acted upon with uniform pressure. The pivot pins *C* are seated with both ends in the body of the holder and are secured in place by $\frac{3}{8}$-in. safety setscrews which are set up against their inner ends.

The cutting tools are $\frac{1}{2}$-in. square and are placed in square openings formed in the holders at an angle of 45 deg. When adjusted, the tools are secured by $\frac{7}{16}$-in. setscrews tapped in through the top of the holders. The small oil holes near the rear ends of the tool blocks enable the pins to be properly lubricated so that the holders can operate freely upon their pins.

A tool of somewhat similar design but made for use in the planer is illustrated in Fig. 6. This has a cutting width over the tool points of $5\frac{1}{2}$ in. and is used for finishing both sides of crosshead slots for the gib in one operation. The toolholders proper have the same relief action as in the case of the smaller size just described. The ends of the pins upon which the holder blocks rock are seen at the front of the device. The coil springs are barely noticeable in the photograph. The gage seen in the foreground is used for setting the two tools to proper width for the slot to be finished.

The tools illustrated in this article were designed and made at the Southern Pacific Railroad shops, Sacramento, California.

Frame Welding Apparatus in Railroad Shop

By Frank A. Stanley

The collapsing forge and the special power hacksaw shown in the illustrations herewith are used for welding operations on locomotive frames at the Southern Pacific shops at Sacramento, Cal. The forge is used in connection with fuel oil burners which are introduced through the openings in the front. The forge walls are built up of fire brick and held together while in use by the angles at the corners, through which are introduced tie rods with nuts at the ends.



FIG. 1. COLLAPSING FORGE FOR LOCOMOTIVE FRAME WELDING

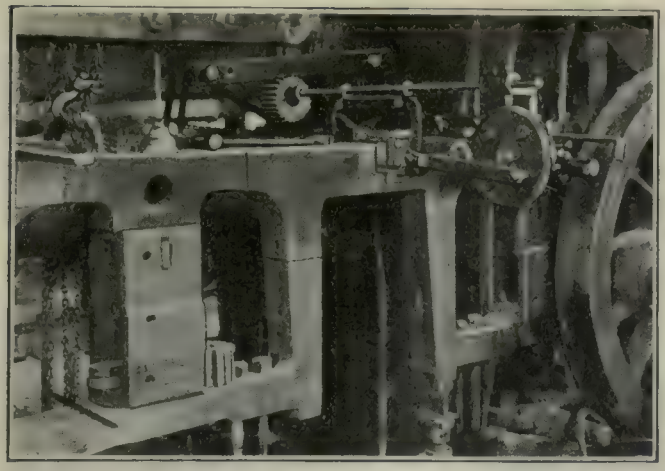


FIG. 2. SPECIAL POWER SAW USED ON A ROUNDHOUSE JOB, PREPARING FOR OIL WELD

The forge is built up around the portion of the frame requiring repairing by welding. It is used either in the roundhouse or at the shop pits. Before welding, however, the frame is operated on by the power sawing machine seen in Figs. 2 and 3. In the first of these views the sawing machine is shown on a roundhouse job cutting through the top of a locomotive frame, while in Fig. 3 a similar machine is seen in operation on the side of a jaw with the same blade cutting horizontally instead of in the customary vertical direction.

The Saw Arrangement

The sawing machine is made up of a special frame mounted upon a bracket which carries also the shaft for the main driving gear. This gear is connected with and driven by a small gear operated by the spindle of an air drill motor, which in Fig. 3 is shown supported upon a block directly under the saw frame. The gear reduction is about six to one, giving a speed rate sufficiently low for satisfactory operation of the saw.

The saw is used to cut through the frame at the point where a crack may have occurred and thus a clean square surface is secured for the welding of the joint. After the frame has been thus cut a piece of Norway iron, say 1 in. thick, is placed in the opening. The forge is then built up around the work, the fire brick openings being left at whatever points are required for clearing the frame members, for introducing the heating apparatus and for the heavy air hammers that are used in welding the job. Building up the collapsing forge and heating the joint is usually done in less than a couple of hours. With the welding iron in place and the work heated to welding point, the frame is drawn up taut to close up the inserted metal in the joint to, say, about $\frac{5}{16}$ in. thick by means of heavy through bolts and clamps applied to the frame sides, and as the clamps are tightened gradually the work is acted upon at each side by heavy air hammers applied through the openings at opposite sides of the forge. Usually an allowance of $\frac{5}{16}$ in. in the work is left for shrinkage as the frame cools off after welding.

The collapsing forge and saw outfit have been used with the greatest success on a large number of jobs of this character.

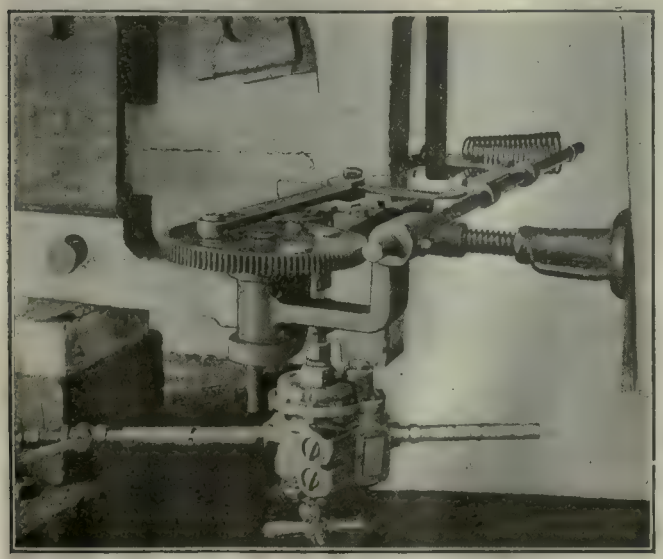
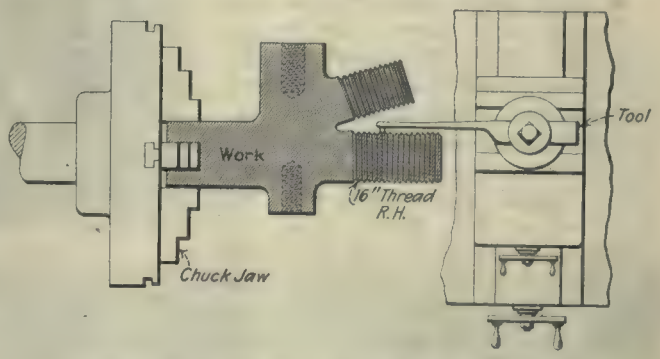


FIG. 3. POWER SAW CUTTING SIDEWISE THROUGH LOCOMOTIVE FRAME, PREPARING FOR OIL WELD

Emergency Method of Cutting Thread

By Richard H. Kiddle

We recently had occasion to cut a thread on a brass casting of such shape as to require a thread tool the reverse of the one commonly used to cut inside threads.



EMERGENCY METHOD OF CUTTING A THREAD

We had but one casting, so to save the time of forging a new tool we simply ran the lathe backwards and used the regular inside tool. The sketch shows the shape of casting.

A Veteran of Three Wars

By Thomas L. Stephen

Referring to the article entitled "Veteran of Three Wars," which appeared on page 1032 of the *American Machinist*; we have read the article with considerable interest and have been making some investigation among our old records covering Putnam tools.

From the illustration, there would appear to be some Putnam characteristics on this lathe, particularly with respect to the headstock, tailstock, bed, and compound slide. The carriage is, however, unlike anything that Putnam ever made. The T-slots in the wings of the carriage run parallel to the toolslide and this is a feature which Putnam never approved. If the carriage shown is the one originally sent with the machine (and, of course, no one knows whether this is so or not), then the machine is not a Putnam product. While the writer is not so intimately acquainted with the older builders of large lathes, he is rather of the opinion that the New Haven Machine Co. may have been the manufacturer of this sturdy veteran.

Machining Large Water Turbines

By FRED H. COLVIN
Editor, *American Machinist*

As nearly all of the water turbines turned out by the Pelton Water Wheel Co., San Francisco, Cal., are designed for specific duties, almost every wheel becomes a special job, often taxing both the capacity of the machine tools and the ingenuity of the executives and men to an unusual degree. The difficulties of this work, however, make it extremely interesting as can be seen from the accompanying illustrations.

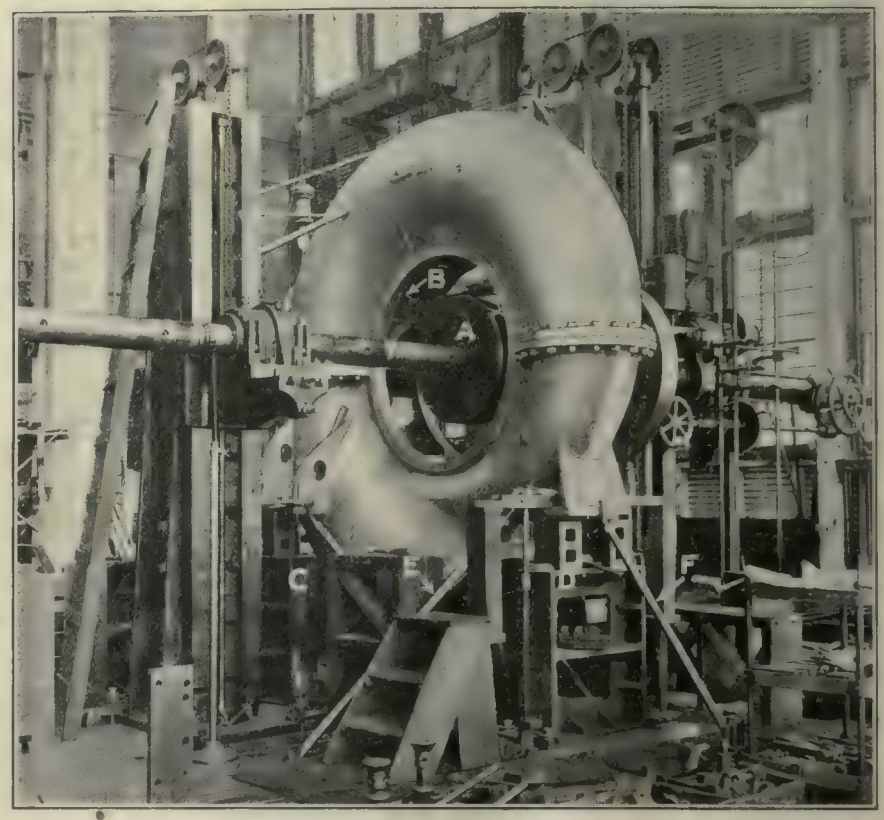


FIG. 1. A 14-FT. HORIZONTAL BORING MACHINE AT WORK

TO ONE who is accustomed to work of comparatively small size and to production in such quantities as to warrant the designing and building of elaborate special fixtures and machines, the problems presented in the manufacture of large Pelton water wheels or turbines must seem nearly insurmountable. Both the executives and workmen of the Pelton shop are, however, accustomed to work of this kind and to solving difficult machining problems. A few examples of turbine work are illustrated herewith and are particularly interesting on account of the way in which both the work and the machines have been handled to accomplish the desired results.

In Fig. 1 is shown the casing of a good-sized turbine being bored and faced on a 14-ft. floor-type boring mill. The hole being bored is about 36 in. in diameter, the boring head being shown at *A* and the boring tool at *B*. The method of blocking up a heavy casting of this kind can be seen at *C* and *D* while the type of adjustable angular brace is shown at *E* and *F*. Details of the bor-



FIG. 2. DETAIL OF THE CUTTER HEAD

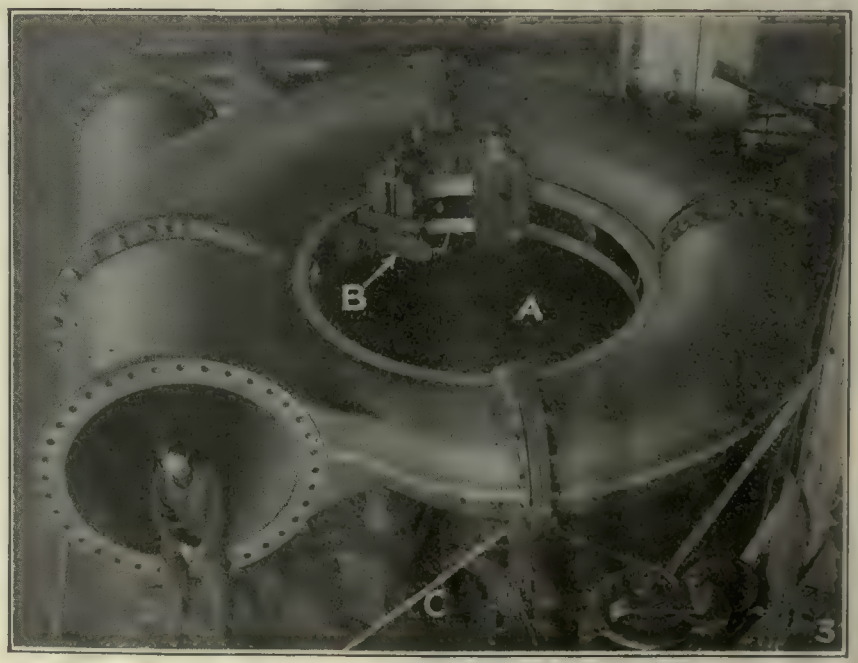


FIG. 3. BORING AND FACING A 9-FT. HOLE

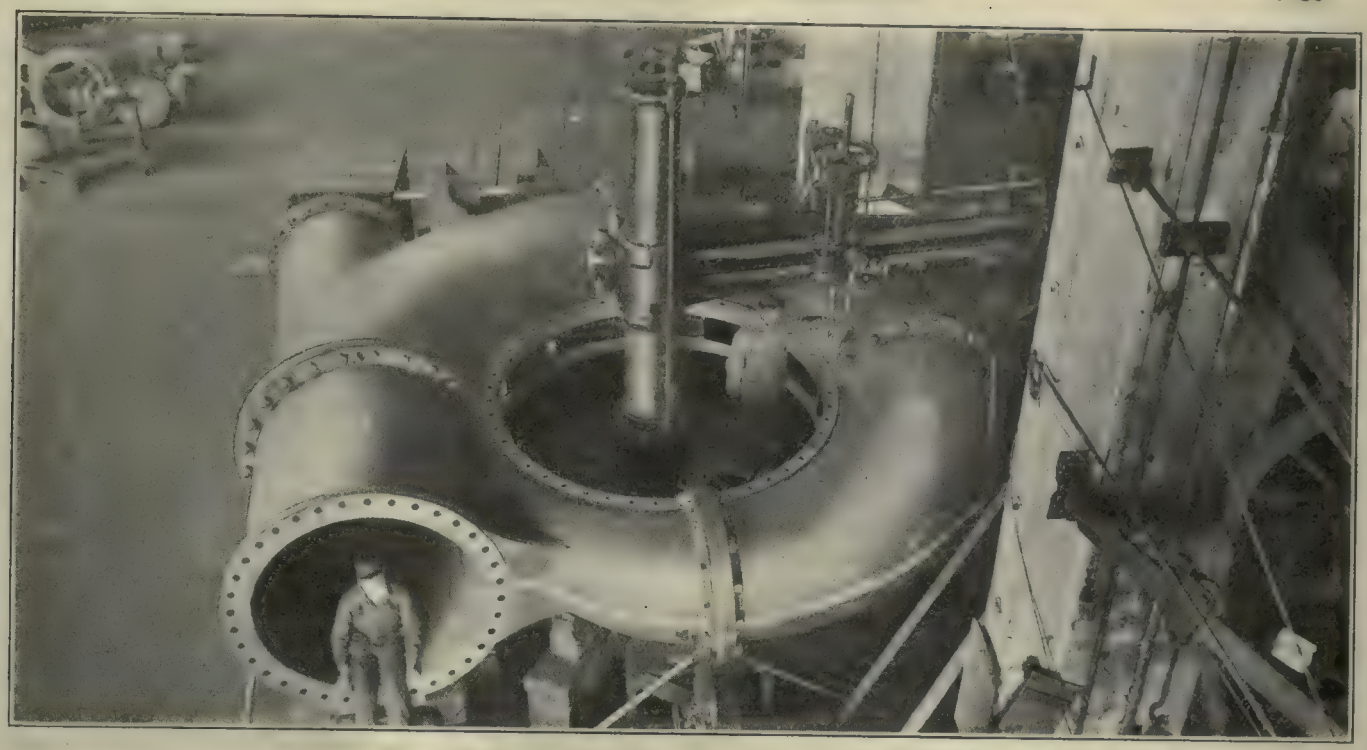


FIG. 4. RADIAL DRILLING ON A BORING MILL TABLE

ing head are shown in Fig. 2, which is taken from the other side.

An unusual and interesting job, shown in Fig. 3, is the boring of a 20,000-hp. cast-steel turbine casing having an internal diameter of approximately 9 feet. As it was impossible to swing this casting on the boring mill table, as well as not being feasible to handle it in the same way as shown in Figs. 1 and 2, an entirely different method was devised and put into practice. The housings and cross-rail of a large vertical boring mill were removed from the base, leaving only the table and its driving mechanism. Then the casing with the

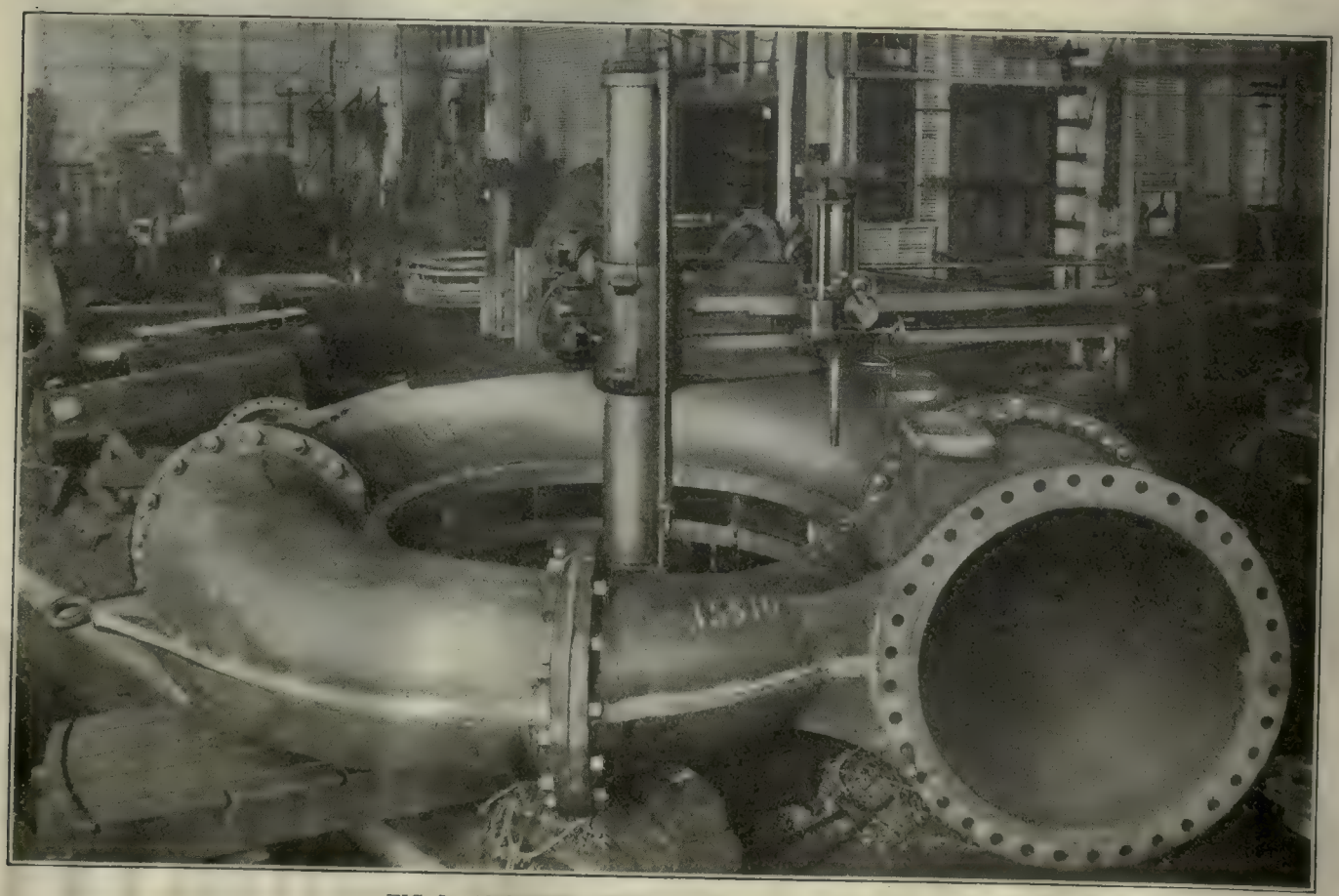


FIG. 5. ANOTHER METHOD OF RADIAL DRILLING

four sections bolted together as shown, was mounted on suitable blocking over the bed and table of the boring mill, and centered with the table. The boring mill table is shown at *A*, while *B* shows a substantial tool head mounted on the table and revolving with it, carrying the cutting tool as it revolves. This arrangement enabled the central opening to be bored and faced in good time. This view also shows the blocking and the use of the braces at *C*.

It will also be noted that the different sections of the casing are bolted together with studs screwed alternately into the flanges of the four pieces. This method makes it possible to get the studs close together and still have room for wrenches on the nuts. Close spacing of the studs is made necessary owing to the extremely high pressures at which these turbines work, the head being frequently as great as 1,500 ft. and occasionally somewhat more.

After the center opening has been bored and faced, the toolhead is removed from the boring mill table, and the column of the radial drilling machine, shown in Fig. 4, is bolted to the center of the table. The column is simply removed from its base, picked up by a crane and lowered into the opening as shown. The blocking remains the same as before.

A somewhat different method of drilling another turbine casing is shown in Fig. 5. Here a complete radial drilling machine is picked up by the crane and the base threaded through the center of the casing, or the column removed and replaced as the case may be. The illustrations show some of the different expedients which it is necessary for a shop of this kind to use and which relieve the work of any tendency toward the monotony usual in mass production.

At the time of my visit there were in process of construction six units of 15,000 hp. each, for Japan. The cases for these units, owing to the water to be used, had to be lead lined which was considerable of an undertaking. The turbines were to run at 300 r.p.m. which gives a peripheral speed of about 200 ft. per second.

Conversion Factors for Weights of Metals

By Chester E. Josselyn

The usual method of obtaining weights of similar castings necessitates the use of a calculation of the following sort: $\frac{0.26 \times 5.75}{0.31} = 4.8225$, when a brass casting weighs 5¾ lb. and it is desired to know its weight if it were iron. The 0.26 and 0.31 are weights per cubic inch of cast iron and of brass, respectively. By use of the constant multipliers given in the table the work can be simplified, the multipliers being obtained by dividing the unit weight of the desired material by that of the given material.

The use of the table may be illustrated by means of an example: If a brass casting weighs 5¾ lb., the same casting of iron weighs $5.75 \times 0.8387 = 4.8225$ lb., the multiplier 0.8387 being found opposite the name of the material of given weight, brass, on the left and in the column headed cast iron, the weight of which is desired.

TABLE SHOWING RELATIVE WEIGHTS OF METAL.

Material of given weight	Multipliers for weight of desired material				
	Cast Iron	Steel	Brass	Lead	Aluminum
Cast Iron	1.	1.0769	1.1923	1.5769	0.3461
Steel	0.9285	1.	1.1071	1.4643	0.3214
Brass	0.8387	0.9032	1.	1.3225	0.2903
Lead	0.6341	0.6829	0.7561	1.	0.2195
Aluminum	2.8888	3.1111	3.4444	4.5555	1.
Weights per cubic inch	0.26	0.28	0.31	0.41	0.09

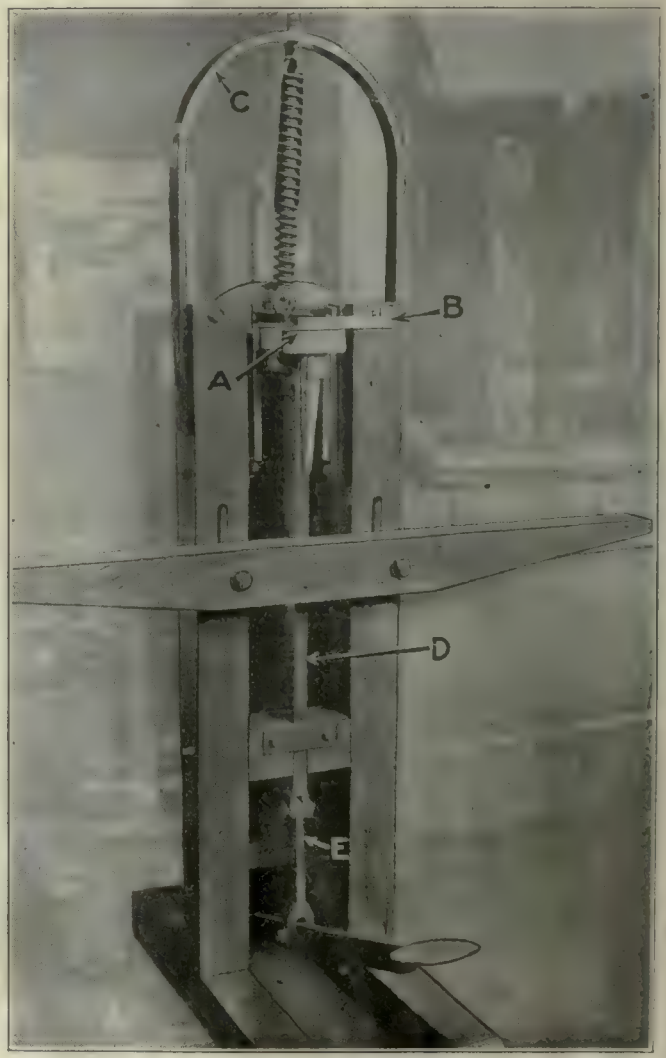
A Mortising Machine for Locomotive Cab Work

By J. H. Vincent

The mortising machine shown herewith has been completed recently in the Decatur shops of the Wabash Railway Co. It is used by the carpenters of the locomotive cab department to handle mortising work that was formerly done by hand.

The frame and workrest are made of oak. Slotted openings are provided for the bolts that hold the workrest to the uprights so that the former may be adjusted for varying heights of work. The mortising toolhead slides on guides made from steel forgings.

The toolhead *A* carries a special mortising tool provided with a handle *B* that drops into slots in the toolhead; these slots, together with a setscrew, hold the tool in position when turned to face in either direction. The arched steel bar *C* above the frame carries a coil spring that sustains the weight of the toolhead and connecting rods *D* and *E* and lifts them after each stroke of the foot-lever.



MORTISING MACHINE WITH WOODEN FRAME

Machining Railroad Cross-Ties*

By D. W. EDWARDS
Greenlee Bros. & Co.

The author tells of the recognition of the economic importance of prolonging the life of railroad cross-ties by increasing their resistance to mechanical wear and decay. The necessity of certain machining operations is explained and the operations, together with the machines required for them, are described. Both portable and stationary systems are considered.

THE cost of railway-track maintenance has vastly increased in recent years and one of the largest single items of expense involved in this work is the cost of cross-ties. Not only is their cost increasing with the diminishing supply of the most suitable timber and the growing scarcity of labor, but their life when unprotected grows shorter because of the greater destructive effects of heavier wheel loads and more frequent trains. Also the labor cost of renewing ties, exclusive of the value of ties themselves, has advanced.

A consideration of these facts leads to the conviction that there is no department of railway administration in which there is such an opportunity for large saving as in the field of tie conservation. It is encouraging to observe that the number of plants for the chemical treatment of ties is constantly increasing, heavy tie plates are coming into more general use, and a growing appreciation of the importance of improved rail fastenings is apparent.

Two Causes of Tie Deterioration

There are two causes of tie deterioration, decay and mechanical wear, and there is no economy in increasing the resistance to one without also increasing the resistance to the other. In some localities decay proceeds more rapidly than mechanical wear, and in arid sections ties wear out before they decay, but as an average the two destructive agents may be considered of practically equal importance.

It is evident that efficacy of treatment can be realized by doing all cutting before the treatment takes place so that the chemical may present an unbroken barrier to the attacks of decay spores. The majority of all ties are so winding or crooked that they should be adzed to secure proper bearings for the rails, but to do this after treatment is folly as it nullifies the effect of the treatment at the points where it is most needed, around the rail fastenings.

Smooth, safe and durable track demands the equal distribution of the load over all ties. This result can be obtained only by providing a perfect and equal bearing for each rail on every tie. By so doing it is possible to eliminate half-moon breaks in rail bases, to greatly reduce rail cutting and to lower the labor cost for upkeep, because surface is more easily maintained. This can be done accurately only by a machine designed for the purpose. It cannot be satisfactorily done by hand adzing.

Tests made by the United States Bureau of Forestry, and independently by many railway companies, show that the holding power of common square spikes is increased by driving them into previously bored holes of suitable size. The resistance to transverse flange pressure is also increased because the spikes have a backing in the solid wood and not against the torn and distorted fibers. When the spikes are driven into bored holes the gage is better maintained, respiking is less often necessary and the ties are not so soon spike-killed.

Where ties are to be treated it is essential that they be bored for the spikes before treatment as the holes permit the chemical to enter the interior portion of the tie. When the spikes are driven there is no possibility of the grain of the wood being opened to moisture beyond the penetration depth. The elimination of decay around the spikes removes the most fruitful cause of the necessity for tie renewals. A lighter total treatment will give the same or better results because the effect is concentrated where most needed.

That ties are frequently terribly mutilated through driving cut spikes directly into them without boring is clearly illustrated in Fig. 1. Although the saving of putting machined ties in track is slight in proportion to the total return thus gained, this alone is sufficient to pay the cost of the adzing, boring and trimming operations.

Importance of Trimming

Trimming off the ends of ties by means of cut-off saws exposes internal decay which is not otherwise apparent because of the weather-hardening of the ends. A considerable percentage of ties is so decayed internally as to be of little value and these may be thrown out before the cost of treatment has been expended upon them. This raises the average grade of the ties put in track and gives more uniform service. Trimming also increases the absorption of the chemical by the removal of the refractory case-hardened end surfaces.

Recently a quantity of short ties was required in a tunnel project. More than twice the number were taken

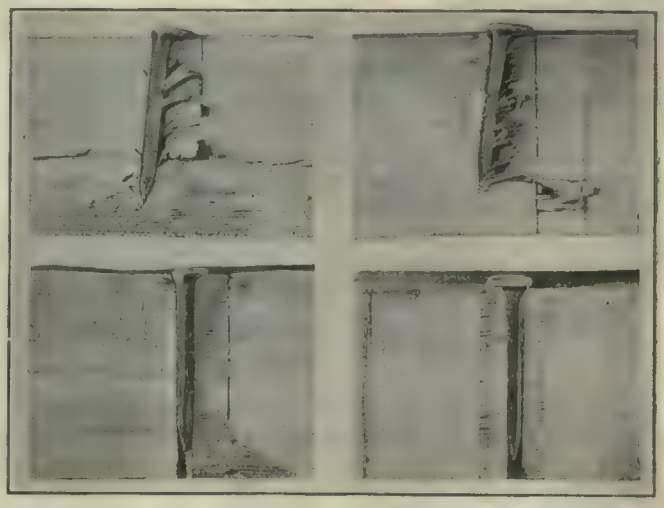


FIG. 1. CROSS-SECTIONS OF TIE SHOWING EFFECT OF SPIKES DRIVEN WITH AND WITHOUT BORING

*Presented at the Annual Meeting, New York, December, 1920, of the American Society of Mechanical Engineers.

from apparently sound ties before a sufficient quantity that actually were sound were obtained. In another instance 640 ties were rejected after trimming from a lot of 3,000 ties of perfectly good outward appearance, which goes to prove that it not only pays to trim the tie ends for inspection of their internal state of preservation but that in that manner only can their true state be discovered. That an unsound tie should not be treated or put in main line track is beyond argument.

Why Ties Are Adzed

Briefly, ties are adzed to assure perfect rail-plate bearing; bored to permit chemical penetration, provide correct gage and perfect spike support; and trimmed for appearance and inspection. That the trimming operation is of the utmost importance and worthy of serious consideration cannot be too greatly emphasized.

It has been almost universal practice on the English and many other European railways to machine their ties before attaching the rails or rail chairs to them. The consensus of opinion there is to the effect that such preparation by machining is of marked economy. Years of observation, and tests on both treated and untreated ties, have proved that longer life is obtained by the machining operation.

American railroads that have assisted in the development of machines for adzing, boring and trimming ties believe that great economy in track maintenance is derived through their use. Every road that has made an installation of equipment of this character, after a period of practical tests through use of machined ties, has added to its original plants, and is endeavoring as rapidly as possible to provide for machining all ties used in main-line track.

The operations performed on machined ties are trimming, adzing, boring and branding. Standard machines, developed through ten years of more or less experimental work, are now on the market and a great many installations are in successful operation in various tie yards throughout the United States. The trimming, adzing, boring and branding machines are in the main built in individual units and so installed that the ties pass automatically from one to the next. Any one or more may be either installed or operated without consideration of the rest.

There are two distinct systems followed in installing these machines, each of which has advantages peculiar to itself, the choice being governed by the conditions under which it must operate. These are installations in fixed locations, and portable installations in which the machine is mounted in a car which may be moved from place to place. Each system has strong advocates but apparently there is little difference in the ultimate economy. The stationary type has somewhat greater output, but this is offset in a great degree by the cheaper handling of ties to the portable type. Since there are more stationary than portable plants in operation at the present time, doubtless this type is deserving of the closer study.

Stationary Installations

For the complete four-unit type of trim saw, adzer, borer and brander, and with in and out tramcar tracks, skidways and conveyors, a building is required 66 ft. 6 in. long by 36 ft. 6 in. wide. The mill building is one story high, 14 ft. to the plate with gable roof. A shed-roofed lean-to 12 ft. x 16 ft. at one side provides accommodations for the toolroom equipment which includes the knife grinder, saw grinder, two work benches, emery-wheel stand, tool cabinet, countershafting and motor for driving the grinders and the usual set of mechanic's hand tools and vises.

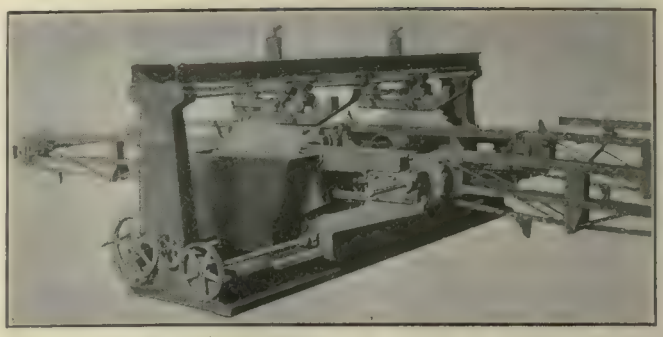


FIG. 2. TIE-SAWING OR TRIMMING MACHINE

The incoming tram track is 2 ft. higher than the outgoing one. This provides the desired elevation for unloading and reloading the trams in the mill and gives a down-grade pitch to the track for moving the empty tram cars around the mill by hand. The machine foundation is a raised platform of 4-in. thick wood plank carried on heavy timber stringers supported by concrete posts from the concrete floor of a pit 5 ft. deep. The shavings-exhaust pipes and waste-ends conveyor are placed within this pit. The tie machines, their countershafting and motive power are placed on the raised platform. On this platform at one side of the machine an operator's station is built up about 2 ft. high. Control levers governing the machine operation are extended to this point from which he can watch and command the entire action.

Trains of loaded tram cars en route to the treating cylinders are switched up the 1½ per cent up-grade ingoing mill track. At the mill the track starts on a 1½ per cent downward slope, passes through the mill on a return bend at the rear side and back to connect with the main line. Loaded trams are cut off the train and pushed on the down grade into the mill. When empty they are moved around the return bend to the delivery side. Here they are reloaded, shoved out of the mill, the bales applied and they are moved on down the track and again made up into trains and switched to the retorts.

Unloading the Ties

Ties enter the mill in tram cars that stop in front of the skidways. A tram-car dumping rig removes the load of ties from the car and deposits it on the skidways. This consists of an overhead winch, driven by power. The double capstans wind up chains securely anchored at their lower ends to heavy cast-iron abutments over which the ties are rolled by the tightening action of the chains. As the winch unwinds the chains lower and rest in slots in the floor, permitting the tram car to pass on.

The bales are removed from the tram cars just before the loads enter the front side of the mill. As the trams are unloaded they are moved around the circular track to the delivery end of the mill. Here they are reloaded and moved out to the front side of the mill where the bales are again applied. Wherever possible the mill should be located between the stacking yard and the treating cylinders so that all ties must pass it in their movement between these two points.

The ties are halted in their fall down the skidways by railroad rails suspended from overhead. Two men, one either side of the skids, place the ties face downward in the correct endwise position on the machine's in-feed conveyors. The passage of the ties from this point through the machines is automatic and the trimming, adzing, boring and branding and delivery to the out-feed conveyors are accomplished mechanically. From the out-feed conveyors the ties drop into the outgoing tram car and are properly laid in place by two laborers. A loading form that outlines the bale circle assists the men in finishing off the load so the bales will fit in place when the loaded tram car leaves the mill. Since ties bind against the form, this device is arranged to swing as the load moves out and thus not interfere with the movement of the car.

Ties pass through the machines face downward and all operations are performed from below. Provision is made so the regular run of ties, large and small, straight and crooked, pass through as they may come and are automatically machined regardless of their irregularity of size and form.

Description of Machines

The double trim saw (Fig. 2) cuts about ½ in. off each end of the ties. This removes the old hardened end wood, thus permitting better penetration of the chemical used for preservation, makes all ties of equal length, which makes for better and neater roadway, presents true surfaces for the brand and principally discloses the condition of the internal state of preservation.

The design comprises a heavy cast-iron base upon which are mounted housings that carry the saw arbors and feeding mechanism. The housings are gibbed to the base and are movable longitudinally upon it by means of large screws and a back-geared handwheel. Each carries an independently driven saw arbor. The feed consists of two endless chains driven through speed-reducing gearing from the main countershaft. Refuse removal is accomplished by a shavings-exhaust fan piped to the dust chutes beneath the saws, and by a block conveyor which removes the waste ends and delivers them where required. This conveyor is of the chain type and is placed below the base, receiving the waste from the hoppers outside the saws.

The tie-boring machine (Fig. 3) is usually employed in combination with the trim saw and adzer, but there are some cases, such as work on sawed ties, where boring alone may be deemed sufficient. The feed is by means of a set of hinged and counterweighted dogs which are reciprocated by a cam and lever movement through worm and spur gearing. On the backward stroke the dogs pass under the ties, rise behind them and carry them ahead on the forward stroke. This intermittent feed gives time for the boring operation to take place upon the tie which is between the clamps. Feeding and discharge conveyors of any reasonable length may be applied.

A centering and clamping device holds the ties while the bits are boring, and automatically locates the holes so that the plate will rest correctly in the center of the available timber. This device consists of a pair of cam-operated spring-hinged centering and clamping jaws carried by the overhead supports and operated in unison with the bit-spindle feed. The centering jaws are assisted in their clamping work by four sets of graduated hold-downs that prevent the tie from raising. Since the centering device operates on the exact center line of the rail, the boring is located in the center of the available timber.

The bit spindles are arranged in two groups of two, three or four spindles each with adjustment between the groups for gage, and between the spindles of each group for different widths of rail bases and tie-plate punching. A tie-boring templet having hardened bushings for guiding the tie-boring bits assures correct boring. Templets are made for each type of boring and are properly marked for identification.

The Automatic Adzing Machine

The automatic adzing machine (Fig. 4) produces perfect plane surfaces at the points where the rails or tie plates will rest. Its productive capacity is so great and its operation so simple that perfectly surfaced ties can be turned out at very small fraction of the cost of hand adzing. The heavy cast-iron bedplate carries two housings, one fixed and one adjustable thereon. Each of the housings carries an independent arbor with a shear-cutting, expansion adzing head, 11 in. in diameter and cutting up to 14 in. wide. The adzing heads are surrounded by refuse chutes arranged for connection to a shavings-exhaust system. Above each head is carried a weighted hold-down shoe having its fall regulated by an air cushion. The feed is by endless chains fitted with carrying dogs and driven by gears from the main shaft. A self-adjusting equalizing device which automatically raises or lowers one or both of the ways upon which the ties travel over the cutting heads so functions that the depth of cut is divided equally between the two ends regardless of bends in the tie, instead of the low end being cut much deeper than the other.

The operation of the brander is both automatic and hand-controlled. After the boring operation is completed the tie is released from the clamps and moves forward where it strikes a trip which operates supply valves and allows compressed air to enter the valve chests. The cylinder valves are operated by a cam connected with the feeding mechanism of the boring

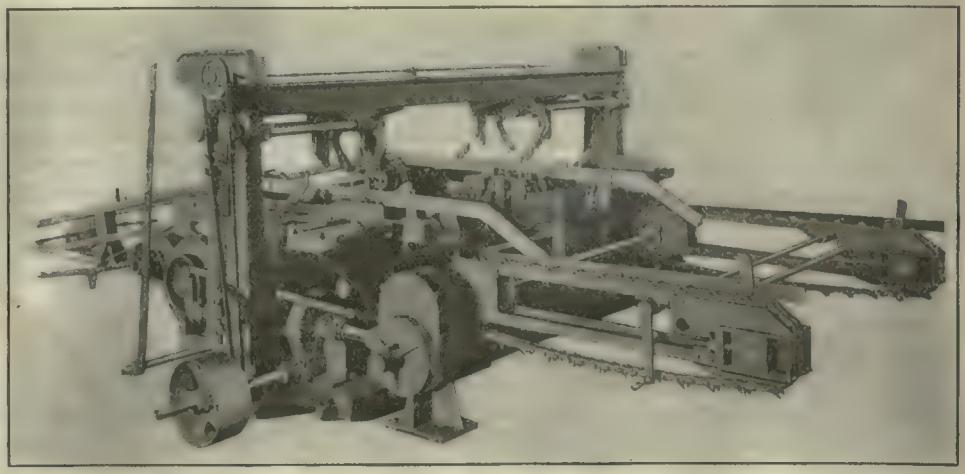


FIG. 3. AUTOMATIC TIE BORING MACHINE

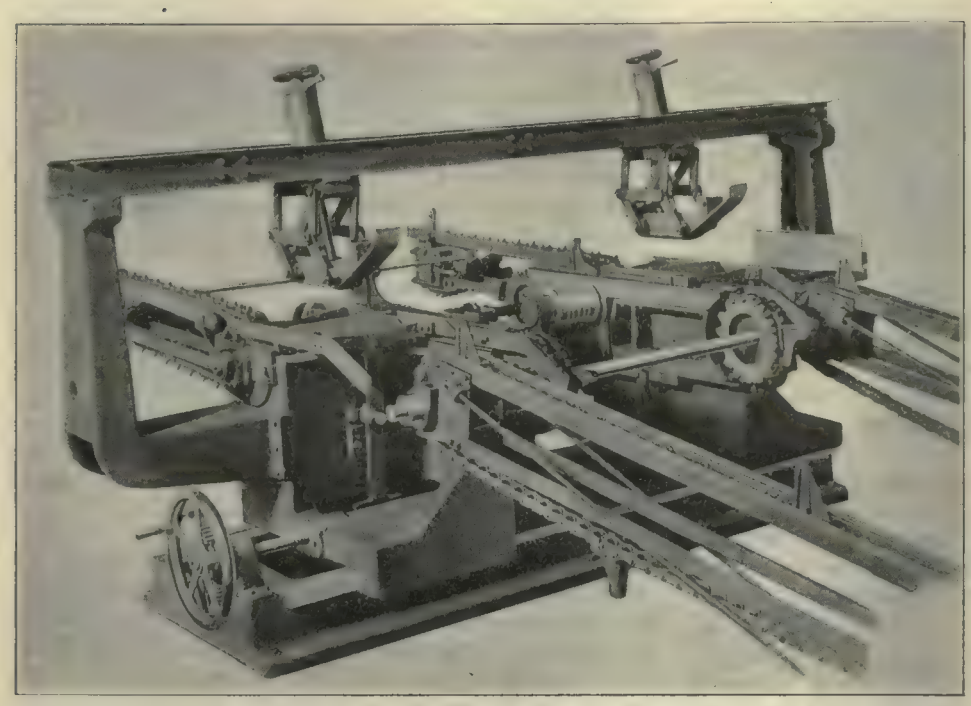


FIG. 4. AUTOMATIC TIE-ADZING MACHINE

machine and are timed to open when the tie arrives between the dies. The blows are struck on both ends simultaneously and the dies withdrawn. The feed then discharges the tie from the machine. As ties which have S-irons driven in their ends to keep them from splitting should not be subjected to the branding blow, a lever is provided by means of which the machine operator can cut off the air and cause the cylinders to miss the stroke when the ironed tie comes between them.

The Sawing Operation

In-feed conveyors deliver ties from the skidways to the machine proper. The trim saw is placed first in the train. Saws 30 to 36 in. in diameter are used. The adzing machine receives the ties from the trim saw. The boring-machine feed moves them at an accelerated speed to the bits. There they pause, are centered, clamped and bored, and passed on to the brander which is placed to the rear of the borer. Out-feed conveyors pick up the ties at this point and deliver them to trams. These conveyors are fitted with an accumulator which when thrown in causes ties to be retained by the conveyor while the outgoing trams are exchanged. This provides time for the operators to dispose of a loaded and place an empty tram in position without stopping the machine feed; thus constant production is maintained. A shavings-removal system is provided. The machines are built with shaving chutes at each adzing head and group of bits, with flanges for connecting the piping leading to a shaving-exhaust fan. A cyclone dust collector is used where shavings are delivered in the open.

Portable Installations

Portable installation is advantageous when plant conditions make it more economical to take the machine to the ties than to bring the ties to the machine. Also where the machine may be required only a part of the year in one plant and can be conveniently moved to another and thus be kept in practically continuous operation throughout the year. This is important as it materially reduces the machining cost per tie, because the fixed charges are spread over a greater volume of output.

Its daily output is less than that of a machine in a fixed location, but as one handling of the ties is eliminated its unit production cost varies little from that shown by the stationary engine. A compromise arrangement is often adopted which involves placing the portable machine in a fixed location in the yard and bringing the ties to it in trams. This gives practically the same output as a machine on a stationary foundation but with a smaller original investment.

The car which forms the basis of the portable outfit must be of steel underframe construction, 50 ft. long and of the greatest possible width, within standard clearance limits. While it may be a little less it works out best when at least 9½ ft. wide. Its load capacity should be not less than 80,000 lb. It is better to build the necessary superstructure on a flat car, arranging the openings as dictated by the machine layout, than to remodel a box car.

The power plant is usually a heavy tractor-type internal-combustion engine. When the trim saws are included in the equipment a six-cylinder engine developing 90 hp. is employed. When the saws are not included a four-cylinder engine of 62 hp. is sufficient. The main motor is usually furnished with a small auxiliary gasoline engine for starting. Gasoline is used for starting after which distillate or kerosene is used for running. Through a suitable transmission with lever control the engine drives directly to the tie machines or to the car axles giving a self-moving speed of about 100 ft. per minute for traveling about the tie yard.

Portable Plant Equipments

Portable plant equipments include the trimming, adzing, boring and branding sections, power plant, car-propelling device, tram-moving winch, shavings-exhaust system, knife grinder, work benches and an electric-lighting plant consisting of an independent direct-connected engine and generator with switchboard. While this is a good deal of equipment in a small space, it is a fact that there is room sufficient for the economical operation and maintenance of the entire outfit. To operate a tie-machining plant a crew of eight men is required, consisting of one foreman mechanic, his assistant, the machine operator and five laborers. Six to seven ties per minute are run and 2,500 to 3,000 ties per day are machined, or approximately 500,000 per year.

The total cost, including interest on the investment, maintenance, operation and all other items of expense incidental to the production of the finished cross-tie perfectly machined and properly prepared for chemical treatment and service, is so small in proportion to its real value as shown by the results obtained that railroads generally are now fast adopting this method.



Chart for Determining Safe Loads

By J. B. Conway

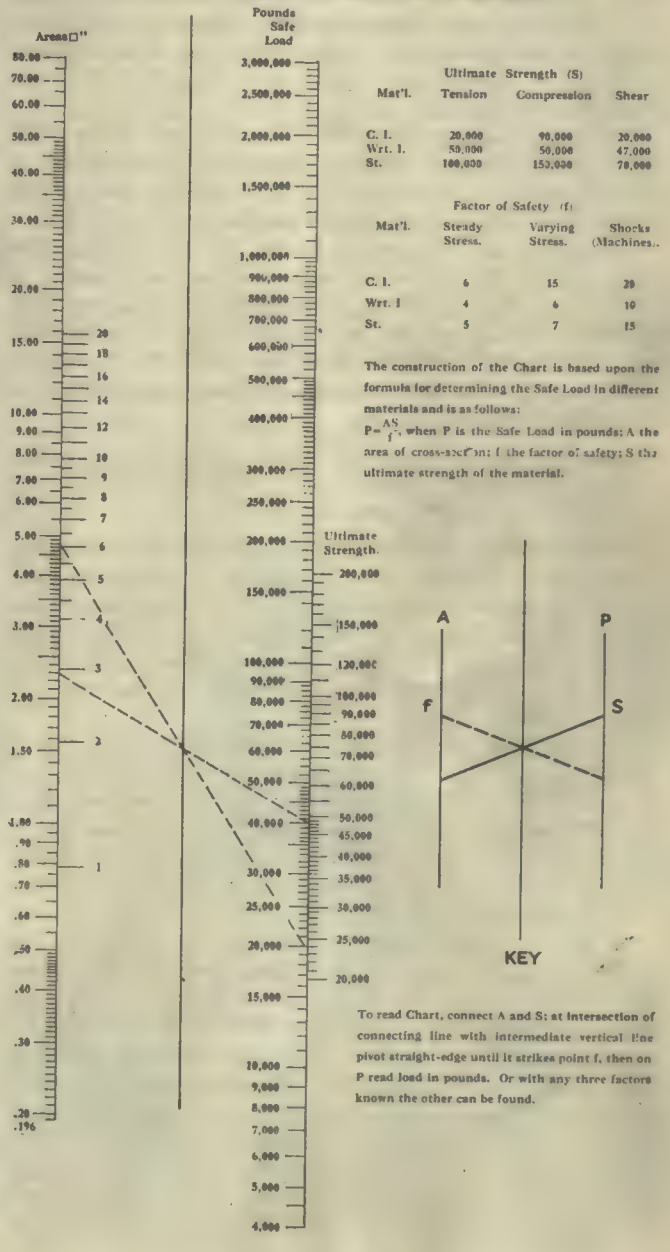
In general mechanical design it is necessary to predetermine just what will be the safe load that a piece of given dimensions will sustain or the size of a piece when the load is known. Those whose work necessitates frequent calculations of this nature usually have the necessary formulas and other information at hand; but in tool design and shop practice the proportioning of parts is customarily arrived at by the use of good judgment or factors governing the design that cannot be altered. In the latter instance the metal is proportioned for strength and rigidity with but very few, if any, preliminary calculations. On the other hand, if such information as is required was available in condensed form for ready reference, greater reference would be made to it. The accompanying chart is designed to facilitate the work of proportioning parts such as shafting of short lengths, after general machine and tool practice. A study of it will no doubt prove helpful to those having occasion to use data of this nature.

The formula, which is the basis of the chart, is $P = AS / f$, where A = area of the part in square inches; S the unit stress in pounds per square inch or ultimate strength; f = the factor of safety; and P = safe load in pounds. The formula is for calculating the dimensions of small parts when the stress is known, or vice versa, and pertains to parts whose length does not exceed ten times the smallest diameter or shortest side, if a square. For parts exceeding such dimensions, the usual formula for columns should be used.

As an example, let us assume that it is required to find the diameter of an axle with bearings on either end, supporting a load of 40,000 lb., to safely resist shearing. Since there are two bearings the stress on each will be 20,000 lb. Assuming that the path traveled by the wheels is irregular and that consequently the load varies it will be safe to use a factor of safety, for wrought-iron, of 6; the unit stress, or ultimate strength of the material will be taken as being 50,000 lb. Then $A = Pf/S$, or $A = 20{,}000 \times 6 \div 50{,}000 = 2.4$ square inches. The diameter will be the square-root of 2.4/0.7854 or 1.75 in., the diameter necessary to withstand a shear-load of 20,000 lb.

Referring to the chart we find two double scales upon which are plotted the values of A, S, P and f. To solve the above problem with the chart, first locate the load, 20,000 lb., and from this point lay a straight-edge or triangle across the chart connecting the factor of safety, 6, with the former value. The intermediate vertical line on the chart acts as a support for the result of this operation. At the intersection of this line with the edge of the triangle, pivot the triangle and swing it until one end rests on the value of S, or 50,000 lb., then

CHART TO DETERMINE THE SAFE LOAD FOR PARTS IN TENSION, COMPRESSION AND SHEAR
where the part does not exceed in length, ten times its least diameter.



Mat'l.	Ultimate Strength (S) Tension	Compression	Shear
C. I.	20,000	90,000	20,000
Wrt. I.	50,000	50,000	47,000
St.	100,000	150,000	70,000

Mat'l.	Factor of Safety (f) Steady Stress.	Varying Stress.	Shocks (Machines..
C. I.	6	15	20
Wrt. I	4	6	10
St.	5	7	15

The construction of the Chart is based upon the formula for determining the Safe Load in different materials and is as follows:

$P = \frac{AS}{f}$, when P is the Safe Load in pounds; A the area of cross-section; f the factor of safety; S the ultimate strength of the material.

To read Chart, connect A and S; at intersection of connecting line with intermediate vertical line pivot straight-edge until it strikes point f, then on P read load in pounds. Or with any three factors known the other can be found.

on the opposite scale read the area in square inches, in this problem 2.4. The diameter is then calculated. Similarily, if the diameter were known and it was desired to ascertain the load that the axle would sustain, the operation would be to first determine the area, then connect the area, on the chart, with the unit stress, swing triangle to factor of safety and read 20,000 lb. as the load per bearing.

The table represents fair average ultimate strengths, although these values are of course subject to change when warranted. The factors of safety given are representative of good practice and afford a considerable range to choose from, as any values between those given can be used; this change rests largely with the good judgment and experience of the designer and his knowledge of the material he is working with.

It will be found interesting to give some study to the chart with the idea of acquainting one's self with the various stresses that parts of given dimensions will sustain, other factors varying. For instance, take the above example and vary *f*, the factor of safety. If 4 were used, the safe load supported would be 30,000 lb. Varying *S*, say to 30,000 the result is 3.1 square inches, or a diameter of 2 inches. Similar problems dealing with tension and compression are solved in the same manner, the values of *S* changing for the different methods of loading and those of *f* changing with the character of the load.

Problems similar to the following can be readily and quickly solved: What force will be required to punch a hole 1 in. diameter in a wrought-iron plate 0.375 in. thick? The area in square inches = 1 in. × 3.1416 = 1.1781 sq.in. Assuming 50,000 for *S*, locating this value on the chart, connect with area, swing triangle to 1 = *f*, and read 59,000 lb. (by calculation this result is 58,905). What load will a 1-in rod support, in tension, assuming 5 for *f*; and 90,000 as the value of *S* for steel? Area = 0.7854 sq. in.; connect area with load, swing to f = 5 and read 15,000 lb.

Plain vs. Grooved Winding Drums

By John S. Watts

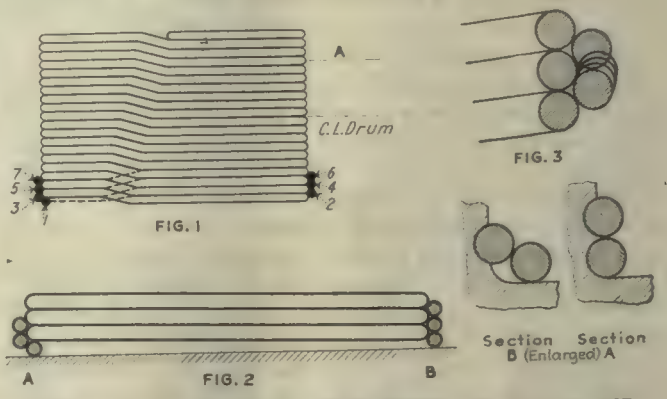
A clear understanding of the action of the rope being wound up on a drum when a number of layers of coils are to be carried, is very essential for the proper lay-out of the relative positions of the hoist and the head sheave. It may also tend to settle the much vexed question as to the relative superiority of the plain or grooved drum.

Studying the plain drum first, and referring to Fig. 1, it will be seen that the ropes are not laid spirally, but in parallel coils. It is necessary that the first coils that are left permanently on the drum, that is those which do not uncoil when in use, be laid as shown for better coiling of the second and succeeding layers as will appear further on in this article.

If it is not otherwise a detriment, the better way is to leave coils on the drum permanently up to the center line of the drum, the head sheave being in line with this center line. The remaining coils will, of necessity, be close coiled and parallel to the first coils as shown in Fig. 1. If the drum has not sufficient capacity to allow this arrangement it will be necessary to place the head sheave in line with the line marked *A* which will be a line through the center of the last coil which is left on the drum permanently because if the head sheave is set on the center line, and the rope commences to coil on the drum at the line *A*, that part of the coils between line *A* and the center line of the drum will not coil closely.

The second layer of coils will follow the path indicated by the dotted lines, and can be traced by following the lines from circle 1 to 2, to 3, etc. It will be clear that the second layer is guided into close coils by the grooves formed by the ropes in the first layer of coils which prevent the second layer from traveling along the drum to the center line of the head sheaves, except as forced to by the preceeding coils pushing each succeeding coil over into the next groove.

This action compelling the rope to coil closely will continue indefinitely so long as the rope is under strain and kept taut. If the rope is allowed to become slack, the tendency will be for it to slide over to get in line with the head sheave and cannot be prevented by any method of coiling.



FIGS. 1 TO 3. WINDING CONDITIONS ON PLAIN AND GROOVED DRUMS

Fig. 1—Rope wound on plain drum. Fig. 2—Rope wound on grooved drum. Fig. 3—Second layer of rope on grooved drum being crowded over into position.

Considering now a grooved drum, the groove must of necessity be a helical one, and it is permissible to commence coiling at the side of the drum with the head sheave in line with the center line of the drum, as the grooves will counteract the tendency of the rope to coil loosely until it gets in line with the head sheave.

Coming now to the second layer of coils, the last coil of the first layer, see Fig. 2, leaves a space whose width narrows from the diameter of the rope to zero in the circumference of the drum, forming a long wedge-shaped space. Into this space the first coil of the second layer is wedged, gradually climbing out of it as the space narrows, as indicated in the sectional views in Fig. 2 until it gets on top of the first layer.

This jamming of the rope into the tapering space throws a severe bending strain on the rope when the load is being lowered, due to the pull necessary to get it out so as to be free to uncoil. The trouble can be averted on the first coil by fitting a filling-in piece on which the first coil of the second layer will ride without getting wedged in between the last coil of the first layer and side flange of the drum. It is clearly impossible, however, to do this for any of the succeeding layers.

In this respect the method of coiling on a plain drum, as shown in Fig. 1, is much superior, as the wedging atcion is practically eliminated.

With the grooved drum, if the first layer is laid in a right-hand helix the second layer will be a left-hand helix, or vice versa. The rope in the second layer will travel in the grooves made by the first layer until pushed over into the next groove by the preceeding coil, as

indicated in Fig. 3, which shows the rope rising out of one groove until it is on the very top of the rope in the first layer. From this position the rope drops suddenly into the next groove with a shock that cannot but be a severe strain on the rope.

This crossing of the coils takes place in the plain drum also, but a little consideration will show that if the rope is laid as shown in Fig. 1 the drop is much less serious.

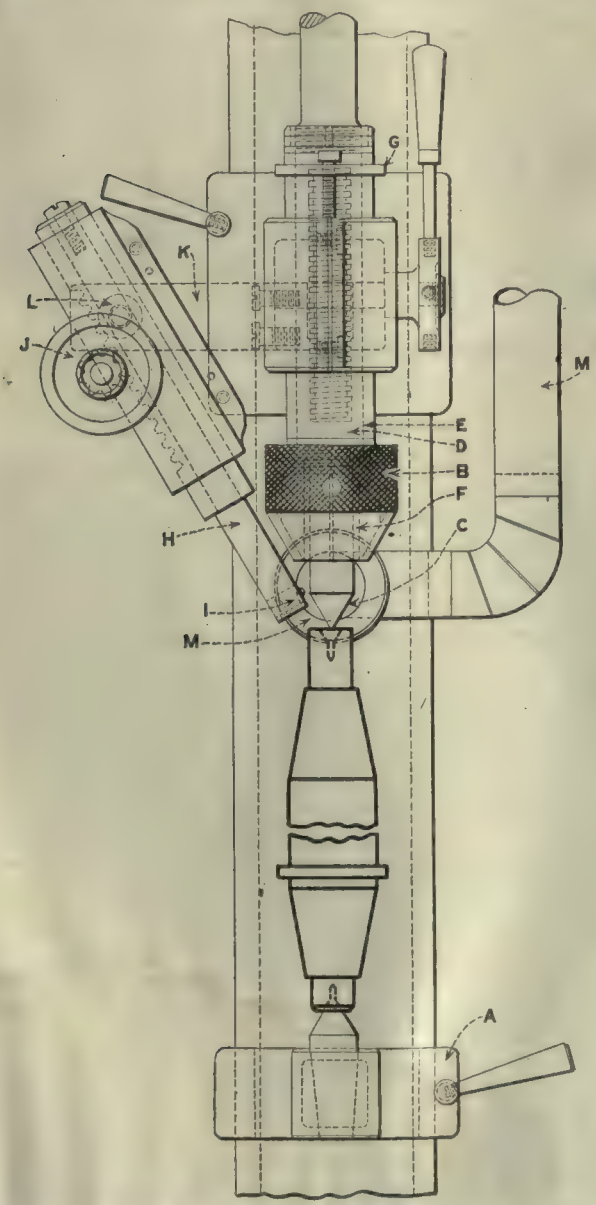
In my opinion, then, the plain drum is much to be preferred if the coiling is properly started.

Lapping Center Holes in Hardened Work

BY A. L. EDDY

I recently designed equipment for a small sensitive drilling machine for lapping center holes in hardened work and from which we are obtaining excellent results.

The type of machine chosen for this operation was constructed with ways running the entire length of the standard to which bracket *A*, holding a center that could be adjusted for various lengths of work, was attached.



ATTACHMENTS TO DRILLING MACHINE FOR LAPPING CENTER HOLES

Notice that chuck *B*, for holding lap *C*, is a part of spindle *D*. My object in this manner of construction was to obtain the best results, bringing the lap closer to the spindle bearing *E*, causing less vibration, and also to economize on space and weight.

The chuck *B* is equipped with the brass split bushing *F*, which will prevent the lap wearing the chuck jaws, also acting as a support to the lap.

For the purpose of holding the lap *C* steady when truing it off, the stop *G* was constructed by making a clamp that was fastened to spindle bearing *E*, holding a knurled head screw which rests on the spindle bracket when truing off the lap.

The truing device was constructed by making the spindle *H* to hold the diamond nib *I* and inserting the spindle into a quill which is operated with the pinion and handwheel *J*, the housing for the rack being made adjustable to take up any wear.

This fixture was fastened to the spindle bracket with the bracket *K* and swivels on the bearing *L* which gives a close adjustment for truing the angle of lap *C*.

To prevent the abrasive dust from penetrating the bearings and for sanitary reasons, the machine was equipped with the suction pipe *M*, leading to an exhaust fan.

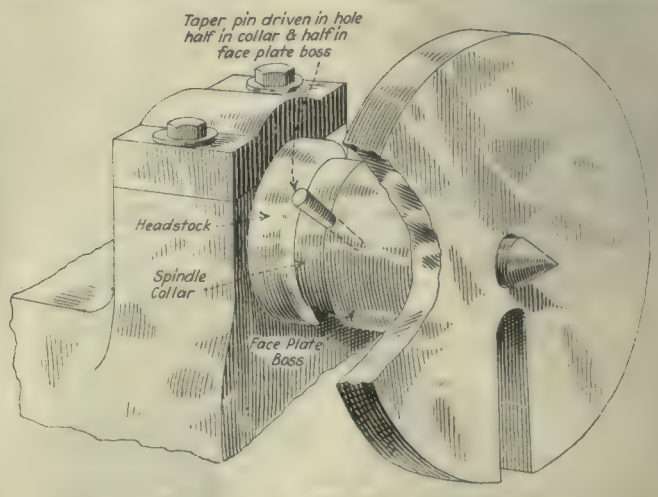
Making several tests of various grades of laps, the best results were obtained from using a lap made from alundum, grain 80, grade 0, which gave a hard smooth surface.

Rotating the lap at a speed of 1,800 r.p.m. gave us the desired results.

Securing the Faceplate When Running the Lathe Backward

BY H. H. PARKER

When winding coils and doing similar work it is desirable to run the lathe backward. If heavy wire is being wound there is much trouble caused by the face-



HOLDING FACEPLATE WITH A TAPER PIN

plate or driver becoming loosened and unscrewing. A good way to overcome this trouble is to drill a small hole through edge of the lathe spindle collar and the boss of the faceplate, the latter being first tightly screwed up. The hole is half in the collar and half in faceplate boss. It is taper reamed and a taper pin is then driven in lightly, leaving enough projecting to

allow of its removal with a pair of pliers. With the pin in place it will be impossible for the faceplate to unscrew. This plan is also of assistance in screw cutting where the lathe is run backward.

A Gear Problem

By H. Liddiatt
Wolverhampton, England

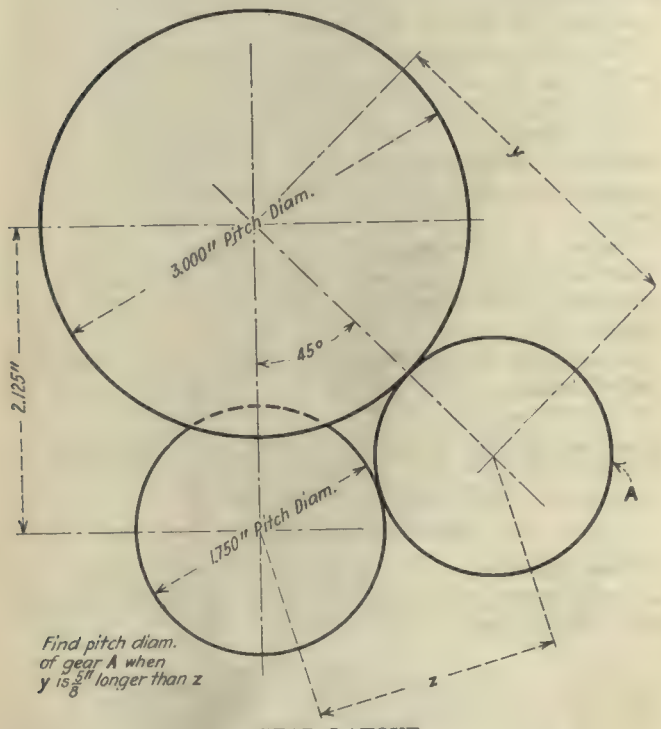
The problem shown by the sketch occurred in the design of a drilling head and was solved by using the well known cosine formula:

$$Z^2 = (2\tfrac{1}{8}^2 + Y^2) - 2 \times 2\tfrac{1}{8} \times Y \times \cos 45°$$

Y is given $\frac{5}{8}$ in. longer than Z.

Call $Y = Z + \frac{5}{8}$, and use this in the equation

$$Z^2 = (4.515625 + Z^2 + 1\tfrac{1}{4}Z + \tfrac{25}{64}) - (4\tfrac{1}{4} \times (Z + \tfrac{5}{8}) \times \cos 45°)$$



GEAR LAYOUT

$$Z^2 = (4.90625 + Z^2 + 1\tfrac{1}{4}Z) - (4\tfrac{1}{4}Z + 2\tfrac{21}{32} \times \cos 45°)$$

Transposing terms

$$Z^2 + (4\tfrac{1}{4}Z + 2\tfrac{21}{32} \times \cos 45°) = Z^2 + 4.90625 + 1\tfrac{1}{4}Z$$

Then

$$4\tfrac{1}{4}Z + 2\tfrac{21}{32} \times \cos 45° = 1\tfrac{1}{4}Z + 4.90625$$

$$4\tfrac{1}{4}Z + 2\tfrac{21}{32} = \frac{1\tfrac{1}{4}Z + 4.90625}{\cos 45°}$$

$$4\tfrac{1}{4}Z + 2\tfrac{21}{32} = 1.7677Z + 6.9385$$

$$2.4823Z = 4.28225$$

$$Z = 4.28225 \div 2.4823$$

$$= 1.725 \text{ in.}$$

$$Y = 1.725 \text{ in.} + 0.625 \text{ in.}$$

$$= 2.350 \text{ in.}$$

$$= 1.700 \text{ in.}$$

Pitch diameter required $= (1.725 - 0.875) \times 2$

$= 1.700$ in.

Proof:

$$Z = \sqrt{(2.125^2 + 2.350^2) - (2 \times 2.125 \times 2.350 \times \cos 45°)}$$

$$= \sqrt{2.975625}$$

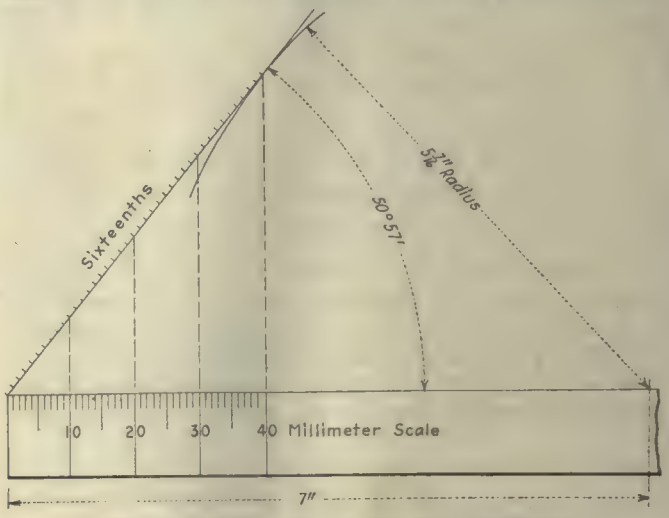
$= 1.725$ in.

Graduating a Scale to Millimeters

By Chester E. Josselyn

A demand for a scale graduated in millimeters was met by the construction of the one here illustrated.

It was found that a scale of sixteenths placed on an angle of practically 51 deg. serves for the purpose, each



GRADUATING A SCALE TO MILLIMETERS

division when projected to the base line representing one millimeter.

To obtain the angle with greater accuracy than by using a protractor, lay off 7 in. on the base line and from one end describe an arc of $5\frac{7}{8}$-in. radius. From the opposite end of the 7-in. line draw a line tangent to the arc.

Piston Clearances for Internal Combustion

By George M. Richards

In reference to C. Strom's article on "Piston Clearance for Internal Combustion Engines," on page 615 of *American Machinist*, it would be of interest to know if Mr. Strom has ever tried Charles T. Porter's method of first turning the piston the exact diameter of the cylinder and then turning the upper half of the circumference about $\frac{1}{32}$ in. smaller by throwing it out of center.

Years ago I had the same trouble as Mr. Strom and tried to overcome it the same way, at the same time knowing that I was thereby inviting other troubles and spending a lot of time in doing so. Mentioning the matter to Mr. Porter one day he suggested the above treatment and since then I have never found it necessary to remove a piston on account of sticking, and also found that it prolonged the life of the cylinder. As the lower half of the piston is then of the same radius as the cylinder and makes a tight joint against the wall, it is quite evident that if the ends of the piston rings are at the bottom, slightly staggered and dowel pinned, the piston will be tight and remain so.

I have used this method on vertical as well as horizontal gas and oil engines with equal success, using the concentric side of piston on the thrust side. I have also bored the flywheel hub to the exact diameter of the shaft and then bored the keyway-half out of center, which facilitated moving the wheel on the shaft and at the same time brought the lower half in complete contact with the shaft.

Executive Board of American Engineering Council Organized

HERBERT HOOVER, president of the Federated American Engineering Societies, presided at the executive board meeting of the American Engineering Council of that organization, held in New York City on Friday, Dec. 17. Every member of the council was present, with the exception of A. M. Greene, and two new members of the board were elected: W. B. Powell of the Buffalo Engineering Society, representing district 1 (New York and the New England states), and Gardner S. Williams, of Grand Rapids Engineering Society, representing district 2 (Michigan, Wisconsin and Minnesota).

Standing Committees Appointed

The president appointed the following standing committees: Procedure, Calvert Townley, chairman; Herbert Hoover, ex officio; W. E. Rolfe, D. S. Kimball, J. Parke Channing, L. W. Wallace and L. P. Alford. Constitution and By-laws, W. B. Powell, chairman; C. F. Scott and D. S. Kimball. Publicity and Publications, L. P. Alford, chairman; H. W. Buck and H. E. Howe. Membership and Representation, J. F. Oberlin, chairman; L. W. Wallace and A. S. Dwight. Finance, William McClellan, chairman; E. Ludlow, C. Townley and L. W. Wallace, ex officio. Public Affairs, J. Parke Channing, chairman; Fred J. Miller and L. B. Stillwell.

In discussing the program of the council immediately under consideration Mr. Hoover stated that he had called engineers together in various cities he had visited lately and that he found that the general desire of engineers everywhere was to join in the F. A. E. S. movement, but that the general trend was for territorial organization as distinguished from national organization. One of the stumbling blocks in the way of these territorial organizations joining the national organizations was the question of dues. Another complexity was that individuals hold memberships in more than one society. For example, the Western Society of Engineers has about four thousand members, of which three thousand are already members of national societies which have affiliated with the F. A. E. S. Mr. Hoover also stated that there had been some opposition to the Federation based on the constitution, but that the question of territorial organization was the most important, and he suggested that a committee should be appointed to canvass and help the situation. This question was discussed and referred to a special committee, which will include the six district delegates.

As a step forward in co-ordinating various inter-society activities already established the necessary action was taken to make it possible for certain of the activities of the Engineering Council to be taken over by the new organization. As soon as the United Engineering Societies have passed officially upon the proposed action of the Engineering Council to transfer and continue the work of the Engineering Council's committees which have not yet completed their work the president will appoint the necessary committees of American Engineering Council to take over this work. At the meeting of the Engineering Council held in Washington there was harmony among all the member societies in the Engineering Council to this end. In this connection action was taken to amend section 9, paragraph 6 of the by-laws so that members of committees can be selected from societies of the American Engineering Council other than those at present members of the Federation. Civil engineers and engineers in other bodies not at present affiliated with the Federated American Engineering Societies can, because of this action, co-operate in the committee work.

The four so-called founder societies in addition have been associated in a common employment service, and the American Engineering Council has offered to take over this service as a part of its function.

The American Engineering Council voted to act independently as a unit and not to affiliate with the Chamber of Commerce. It was the thought of the meeting that the council could make its best contribution to the public by acting independently.

The council authorized the appropriation of $1,000 as an initial fund to carry on publicity work and the committee on publicity and publications was given authority to set up a board of engineering editors.

It was voted that full expenses of members of the executive board for attendance at meetings would be paid.

A special committee reported on candidates for permanent executive secretary of the organization, but no final action was taken at the meeting.

A general feeling was expressed that the meetings of the board should be held at different centers and the place of the next meeting, which will be held on Feb. 11, was left to the discretion of the president.

Members and Officers of Executive Board

The following members of the executive board and officers were present:

Officers: President, Herbert Hoover, American Institute Mining and Metallurgical Engineers. Vice-presidents, Calvert Townley, American Institute Electrical Engineers; William E. Rolfe, Associate Engineering Societies of St. Louis; Dexter S. Kimball, American Society of Mechanical Engineers; J. Parke Channing, American Institute Mining and Metallurgical Engineers. Treasurer, L. W. Wallace, Society of Industrial Engineers.

Members of executive board (national societies): E. Ludlow, A. S. Dwight, P. N. Moore, all of the A. I. of M. and M. E.; L. P. Alford, F. J. Miller, E. S. Carman, all of the A. S. M. E.; H. W. Buck, William McClellan, C. F. Scott, L. B. Stillwell, all of the A. I. E. E.; H. E. Howe, A. I. C. E.; M. L. Cooke, Taylor Society.

Members of executive board (local societies): W. B. Powell, District No. 1 (New York and New England States); Gardner S. Williams, Engineering Society and Detroit Engineering Societies, District No. 2 (Michigan, Wisconsin, Minnesota); J. F. Oberlin, Cleveland Engineering Society, District No. 3 (Ohio, Indiana, Illinois); W. W. Varney, Baltimore Engineers Club, District No. 4 (New Jersey, Pennsylvania, Delaware, Maryland and District of Columbia); O. H. Koch, Technical Club of Dallas, District No. 5 (Virginia, West Virginia, North and South Carolina, Alabama, Tennessee, Kentucky, Mississippi, Louisiana, Texas); L. B. Smith, District No. 6 (North and South Dakota, Nebraska, Kansas City, Oklahoma, Arkansas, Missouri, Iowa).

WHAT to READ —for the man in a hurry



Suggested by the Managing Editor

A RAILROAD article opens this issue, the last of 1920. As we write "railroad" and "1920" we are reminded at once of the important events of the past year concerning our greatest means of transportation. From the experiment of government control, which must have convinced even its strongest adherents of its impracticability, the railroads have been returned to private enterprise and permission has been granted them to charge rates commensurate with their investments. The owners have entered well into the processes of repairing rolling stock and roadbed and of returning cars to their rightful roads; of introducing labor efficiency into their shops; of reducing standing time and under-loading of cars; and of educating the users of cars concerning the waste due to idle cars and cars not loaded to capacity. The chief duty of railroad shops is the repair of their equipment and if the roads wish to make conclusive the evidence of the advantages of present control they must not overlook the necessity of installing thoroughly modern equipment and instituting time, labor and material saving devices. With this introduction to a subject that we feel to be of real importance, we call attention to a number of railroad articles in this issue: "Production and Salvage of Locomotive Piston Rings," the opening article, by Western Editor Hunter; "Tests of Cast Iron for Locomotive Cylinder Parts," page 1221, from a technologic paper of the Bureau of Standards; "Slotting Machine and Planer Toolholders for Railroad Shop Use," page 1231, by Frank A. Stanley; "Frame Welding Apparatus in Railroad Shops," page 1232, by the same author; and "Machining Railroad Cross-Ties," page 1237, by D. W. Edwards. The titles indicate the contents and further comment seems unnecessary.

What to read was not a difficult matter to decide two hundred years ago when books were few and magazines unheard of. It is far different now when so much reading matter is offered to pass the time pleasantly or profitably as the reader chooses. We are doing our utmost to make the "American Machinist" not only profitable but indispensable as a clearing house of ideas and news of the machinery world. This page is the editors' advertisement of their section of the paper. It gives the high spots

The second installment of Colvin's "Building Motors on the Pacific Coast" begins on page 1215. It takes up the machining of crankcases for aircraft and marine types of motors.

Earle Buckingham's paper "Side Cutting of Thread Milling Hobs" is concluded, page 1222, by the section devoted to the hobbing of internally threaded parts. The first part, dealing with the hobbing of screws, was published last week.

On page 1225 begins the sixth and last of O. A. Kenyon's articles on brass making. It tells of the characteristics of brass and the laboratory and research methods used to determine them.

The difficulties in machining large water turbines so impressed our chief field editor on his coast-to-coast trip that he brought back photographs of some of the set-ups he saw in a San Francisco shop. He has combined reproductions of the photographs with a short description to make-up his story "Machining Large Water Turbines," which begins on page 1234.

Pages 1241 to 1244 inclusive are devoted to letters from practical men. A chart for determining safe loads is offered by J. B. Conway. John S. Watts compares plain with grooved winding drums. A. L. Eddy passes along his design of equipment for lapping center holes in hardened work. And an English correspondent, H. Liddiatt, solves a gear problem that he was up against while designing a drilling head.

A recent event that concerns machinery builders was the introduction in the Senate of Bill No. S 4675, "a bill to fix the metric system of weights and measures as the single standard for weights and measures." The *American Machinist* has, during the past year, given an abundance of reasons why the use of the metric system should not be compulsory and in this number, page 1248, we print the bill itself in full, knowing that its own provisions constitute a very strong argument against its passage. There seems to be no likelihood that the bill will be passed by the present Congress.

On page 1245 is our account of the meeting, on the 17th of this month, of the Executive Board of the Federated American Engineering Societies. Following as it does so quickly after the first meeting of American Engineering Council and including in its action the naming of committees and the formation of several definite lines for procedure, this meeting indicates that the Federation, in existence less than a year, is already on the way to hoped for results.

EDITORIALS

Ring Out the Old!

THE sound of the bells that ring out the old year will be sweet to many of us. 1920 will probably be a much pleasanter year to look back upon than it has been to live through, particularly the latter part of it. No matter how necessary the pangs of deflation, they have not been enjoyable. Those of us who have escaped them are few indeed.

On the first day of January, 1921, most of us can start in with a clean slate and go after new business with a will. If we may be pardoned for touching on a sore point, the loss of some of the business that has been wiped out by the depression of the last few months is not without its compensations. As one machine-tool builder put it recently: "It is better to have the goods and no money than to have neither one." The fellow with stock on his shelves or in his warehouse is going to profit when orders begin to come in. And that time is at hand. We know of more than one manufacturer who is booking real, honest-to-goodness orders for expensive machines and a good friend of ours has just told us that he is two weeks behind on one model.

Compared to the boom time we have been through these facts seem insignificant but when considered as harbingers of the revival of business they loom large. They should stimulate salesmen and managers to redouble their efforts in the buyers' market that now exists. Of course it is hard work to get orders in such a market, but hard work is good for everybody and the sales department has had little to do for a long time.

And now a word to the man who needs equipment. The buyers' market is his opportunity, but like other opportunities it will not sit around indefinitely and wait for him to grasp it. Just now he can get immediate deliveries on almost anything, but if he lets other buyers get their orders in ahead of his, he will have to wait his turn for delivery and may lose precious time in the manufacture of his own product. Most of us are thoroughly sold on preparedness for war, but are we fully awake to the need for equal preparedness for business competition?

The trend of affairs has its message for the production department as well. Capable managers have taken advantage of the lull to clean house and to take care of deferred or hastily made repairs. They worked wonders in getting out war material but they will have just as hard a task to face in 1921, in putting their production on a cost basis that will enable their salesmen to get the business. Money is most distinctly an object and will be for some time to come.

We of the *American Machinist* realize our responsibilities in the economic struggle that is just beginning and shall endeavor to do our part in helping American industry to hold its own and reach out for new markets. During 1921 we shall have frequent letters from our representatives in London and Berlin, and occasional ones from other parts of the world. They will tell of the technical and commercial developments in our field and will be valuable to the American manufacturers who face foreign competition at home and abroad.

We shall continue to devote considerable attention to the automotive industry and the railroad shops will receive their share of space. The material in preparation for the designers and engineers has unusual merit and will appeal both to the expert and to the beginner. Management articles will be strong and will appear frequently. Practical shop methods and "kinks" will be given the same prominence as before.

Our unique new equipment service will be continued for the benefit of the buyer, the seller and the user. We shall maintain its high standard and seek to amplify its scope.

In other words, the *American Machinist* for 1921 will be as well balanced as we can make it. The man in the office or drafting room and the responsible man on the job will find its columns filled with technical information, industrial and commercial news and forward-looking editorial comment of particular interest to himself. All in all volumes 54 and 55 will be efficient and indispensable tools for men in all ranks of industry and we commend them to your use.

Preventing Contract Cancellations in the State of New York

THE recent New York Supreme Court decision upholding the validity of the arbitration clause of the Walton Law will be a welcome one to contract cancellation victims. The clause in question says: "A provision in a written contract to settle by arbitration a controversy thereafter arising between the parties to the contract————shall be valid, enforcible and irrevocable, save upon such grounds as exist at law or in equity for the revocation of any contract."

The case which resulted in the decision mentioned was one brought by a far Eastern company against a New York company. The Eastern company had a contract for the sale of goods in which appeared this clause: "Any differences arising between the parties to this contract do not invalidate same, but shall be settled by arbitration at New York, unless otherwise specified herein, and decision by such arbitration shall be final and binding on both parties, each shipment to be considered separately." A shipment was made as agreed but the goods were refused by the New York company on the ground that they were of inferior quality. The purchaser declined to arbitrate. The seller then asked the Supreme Court to direct the purchaser to arbitrate under the provisions of the Walton Law. After hearing the evidence the court so directed.

The Walton Law was sponsored by the arbitration committee of the Chamber of Commerce of the State of New York in an attempt to mitigate the cancellation evil. There are certain features of the law that have not yet been passed upon by the courts but the clause concerning

the validity of arbitration agreements has at least been taken care of.

Chairman Bernheimer of the arbitration committee recommends that an arbitration clause to fit the particular case be included in every contract and that the clause be carefully drawn, with legal advice. Such a clause may not be an impregnable safeguard but it will certainly protect the seller or manufacturer in many instances. The provisions of the law are worth investigating.

Compulsory Metrics?

THERE seems to be, at this writing, little danger that Congress will pass the bill providing for compulsory use of the metric system of weights and measures, introduced in the Senate during the present session by Senator Frelinghuysen, of New Jersey.

The bill, as read, would compel the use of the metric system, and no other, from and after ten years from the date of its passage and approval with certain exceptions, of which the chief is apparently intended to be goods for export.

Furthermore, from and after *four* years from the date of passage and approval it would prohibit the manufacture, construction for personal use, purchase for use and conversion to use, of any weight or measure, or weighing or measuring device designed, constructed, marked or graduated to determine, indicate, or deliver weights or measures in any system other than the metric, in the transactions of selling goods, wares, or merchandise except for export, charging or collecting for the carriage or transportation of them, or collecting from or paying to another person for work or labors expended except those expended upon export goods.

Furthermore, from and after *two* years from the date of passage and approval it would prohibit the manufacture or packing, offering for sale or selling, of any goods, wares or merchandise in package form which are required by law to be marked in terms of weight or measure, unless they were marked in or according to weights or measures of the metric system, except in the case of goods for export.

The Frelinghuysen bill, if passed, would almost immediately involve us in a serious situation as regards our standards. Such legislation is not needed, is not wanted and must not come about.

The Metric System Bill Introduced in the Senate

A BILL providing for the compulsory use of the metric system of weights and measures after ten years from passage, has been introduced in the Senate by Senator Frelinghuysen, of New Jersey. Senator Frelinghuysen stated that he has no intention of pushing the bill and that he introduced it simply as a personal accommodation to one of his constituents. It is understood that the constituent is the representative in Washington of the "World Trade Club," of San Francisco. While Senator Frelinghuysen authorized no statement as to his position on the bill, a person in his confidence expressed the opinion that he is opposed to it.

It may be stated most positively that there is no chance to secure this legislation at this session of Congress. The bill will die with the Congress on March 4.

Representative Vestal, of Indiana, the chairman of the House Committee on Coinage, Weights and Measures, states very positively that there is no time at this short session to embark upon this type of legislation. Repeated efforts have been made to secure a promise from him to take some interest in this question. He does not intend to introduce a metric bill himself and is of the opinion that his committee would be very much averse to the giving of any consideration to such a measure at this time.

The bill has been read twice and referred to the Committee on Standards, Weights and Measures. The full text is as follows:

Bill No. S.4675

A BILL

To fix the metric system of weights and measures as the single standard for weights and measures.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That from and after ten years from the date of passage and approval of this act the weights and measures of the metric system shall be the single standard of weights and measures in the United States of America for the uses set out herein.

Sec. 2. That the fundamental standards of the metric system are the meter and the kilogram. The meter is the length at the temperature of 0 degree centigrade of the international prototype meter bar of platinum-iridum defined and adopted by the General Conference of Weights and Measures held at Paris in 1889, which bar is now deposited in the International Bureau of Weights and Measures at Sevres, France. The kilogram is the mass of the international prototype kilogram weight of platinum-iridium, which was similarly adopted and deposited.

Sec. 3. That the national prototypes of the fundamental standards of the metric system shall be the copies of these standards known as meter numbered twenty-seven and kilogram numbered twenty, allotted to the United States by the General Conference of Weights and Measures held at Paris in 1889. These are now deposited in the vault of the Bureau of Standards of the Department of Commerce, and are those which are now used and employed in deriving the values of all weights and measures used in the United States. These national representations are hereby adopted as the primary standards of weights and measures for the United States of America, and from these all other weights and measures shall be derived and ascertained.

Sec. 4. That from and after ten years from the date of passage and approval of this act no person shall do or offer or attempt to do any of the following acts, by weights and measures, in or according to any other system than the metric system of weights and measures; namely:

(1) Sell any goods, wares, or merchandise except for export as provided in section 12;

(2) Charge or collect for the carriage or transportation of any goods, wares, or merchandise; or

(3) Charge or collect from or pay or reimburse any other person for work or labor which has been or is to be performed or done, except that when in accordance with the provisions of section 12, weights or measures other than those of the metric system are used or employed in the arts, manufacture, or industry the wages of employees engaged in producing commodities in such weights or measures and paid by weight or measure of commodity produced may be computed and paid in terms of such weights or measures.

Sec. 5. That from and after four years from the date of passage and approval of this act no person shall manufacture or make for himself for use, or purchase for use, or convert to use, in any of the transactions detailed in section 4, any weight or measure or weighing or measuring device designed, constructed, marked, or graduated to determine, indicate, or deliver weights or measures in any other system than the metric system of weights and measures.

Sec. 6. That from and after ten years from the date of passage and approval of this act no person shall use or attempt to use in any of the transactions detailed in section 4 any weight or measure or weighing or measuring device, designed, constructed, marked, or graduated in any other system than the metric system of weights and measures.

Sec. 7. That from and after two years from the date of passage and approval of this act no person shall manufacture or pack, offer for sale, or sell any goods, wares, or merchandise in package form which are required by law to be marked in terms of weight or measure unless they be marked in or according to weights or measures of the metric system except the goods, wares, or merchandise on hand, and except for export as provided in section 12. Prior to ten years from the date of passage and approval of this act there may also be marked upon such packages the equivalent of the metric weight or measure in terms of weights or measures now in customary use. From and after ten years from the date of passage and approval of this act the marking in terms of weights and measures now in customary use is hereby prohibited, except for export as provided in section 12.

Sec. 8. That not later than ten years from the date of passage and approval of this act, all postage, excises, duties, and customs charged or collected by weights or measures by the government of the United States shall be charged or collected in or according to the metric system of weights and measures.

Sec. 9. That rules and regulations for the enforcement of this act, not inconsistent with the provisions hereof, shall be made and promulgated by the Secretary of Commerce.

Sec. 10. That all equivalents between the units of the metric system and the system now in customary use shall be calculated from the fundamental relations, one meter equals thirty-nine and thirty-seven one-hundredths inches, and one kilogram equals two and two hundred and four thousand six hundred and twenty-two one-millionths pound avoirdupois. Tables based upon these relations, showing the equivalents between the weights and measures of the metric system and those now in customary use, shall be prepared and promulgated by the Secretary of Commerce. The Secretary of Commerce shall also take such steps as he may deem expedient for giving publicity to the dates of transition specified herein and for facilitating the transition to the metric system.

Sec. 11. That all acts or parts of acts inconsistent herewith are hereby repealed, but only in so far as they are inconsistent herewith; otherwise they shall remain and continue in full force and effect. Whenever in any act, or rules and regulations, or tariff or schedule made, ratified, approved, or revised by the government of the United States of America, weights or measures of the system now in customary use are employed or referred to and to comply with the provisions of this act weights and measures of the metric system should be employed, then such references in such act, rules and regulations, tariff or schedule shall be understood and construed as references to equivalent weights or measures of the metric system ascertained in accordance with the fundamental relations set out in section 8 thereof.

Sec. 12. That nothing in this act shall be understood or construed as applying to—

(1) Any contract made before the date at which the provisions of this act take effect;

(2) The construction or use in the arts, manufacture, or industry, of any specification or drawing, tool, machine, or other appliance or implement designed, constructed, or graduated in any desired system;

(3) Goods, wares, or merchandise intended for sale in any foreign country, but if such goods, wares, or merchandise are eventually sold for domestic use or consumption then this clause shall not exempt them from the application of any of the provisions of this act.

Sec. 13. That nothing herein shall be understood or construed as prohibiting the enactment or enforcement of weights and measures laws or ordinances by the various states or cities, and the various states or cities shall have the same powers as though this act were not in force and effect: *Provided, however,* That no standard weights or measures shall be established for the uses set out herein which conflict in any way with the standards established herein, and such standards which may already have been established shall be null and void for the uses set out herein.

Sec. 14. That the word "person" as used in this act shall be construed to import both the plural and singular, as the case demands, and shall include corporations, companies, societies and associations. When construing and enforcing the provisions of this act the act, omission, or failure of any officer, agent, or other person acting for or employed by any corporation, company, society or association, within the scope of his employment or office shall in every case be also deemed to be the act, omission, or failure of such corporation, company, society, or association as well as that of the person.

Metal Cutting Tools of Cast High-Speed Steel

By S. H. Bunnell

The granular structure of high-speed steel when cast into tool shapes gives to the metal unusual strength and endurance under heavy cuts. The high-speed alloys are, however, extremely hard to cast without defects, so that the practical use of cast tool blanks has been impossible. The problem has been at last solved by the use of the electric furnace and a special heat treatment, devised within the last two years. By this process, which is the property of the U. S. High-Speed Steel and Tool Corporation, of Green Island, New York, high-speed steel alloys are made from simple metals or alloys by a single melting in the electric furnace and cast directly into cutter blanks of any desired shape.

The alloy in use for this purpose is a vanadium-tungsten-chrome mixture. The several components are charged into the furnace with a flux which assists the combination of the metals The molds are formed of a core mixture, baked in ovens as usual. These molds are placed on edge and clamped together in series, the flat back of one forming the cover for another. The alloy steel is poured by tilting the furnace into hand ladles and thence to the molds.

After cooling the runners are cut off the castings which are then annealed and made ready for the machining operation.

The first operation is to grind the flat faces close to the desired finishing size, leaving a suitable allowance for the finish-grinding later. If a casting is defective the flaws are invariably disclosed by this grinding, for experience has shown that high-speed alloy castings showing a clean surface after grinding are always sound throughout. The following operations of boring, turning, cutting teeth, keyseating and rough grinding are as usual.

The tools are heated in small gas furnaces provided with electric pyrometers. Quenching is done without the slightest care as to the manner in which the heated cutters are placed in the bath, and yet the tools do not crack in hardening or cooling.

SHOP EQUIPMENT NEWS

-Edited By-
S. A. HAND

SHOP EQUIPMENT • NEWS •
A weekly review of modern designs and equipment

Descriptions of shop equipment in this section constitute editorial service for which there is no charge. To be eligible for presentation, the article must not have been on the market more than six months and must not have been advertised in this or any previous issue. Owing to the news character of these descriptions it will be impossible to submit them to the manufacturer for approval.

• CONDENSED • CLIPPING INDEX
A continuous record of modern designs and equipment

Brown & Sharpe High-Speed Milling Attachment

A high-speed milling attachment recently brought out by the Brown & Sharpe Manufacturing Co., of Providence, R. I., for use on milling machines of their manufacture, is shown in the illustrations; Fig. 1 showing it in position, and Fig. 2 a rear view of the attachment separately. No auxiliary fixtures are required. The bracket and spindle support is a one-piece casting for attaching to the machine, designed to protect the mechanism from dirt and injury.

The attachment is built in two sizes: No. 1 for the smaller, and No. 2 for the larger machines. The No. 2 size is adaptable by means of adjustable gib stops to the larger machines having columns with different widths of face.

To assist in locating it vertically, the attachment is provided with a locating segment, seen in Fig. 2, which rests upon the spindle box of the machine. This spindle box projects beyond the face of the column and acts as a centering guide. The horizontal position is determined by first tightening the gib on the right-hand side, thereby locating the attachment. The gib on the left-hand side clamps the attachment to the face of the column.

The only gearing is the large ring gear that fits on the tapered spindle nose of the machine and the pinion

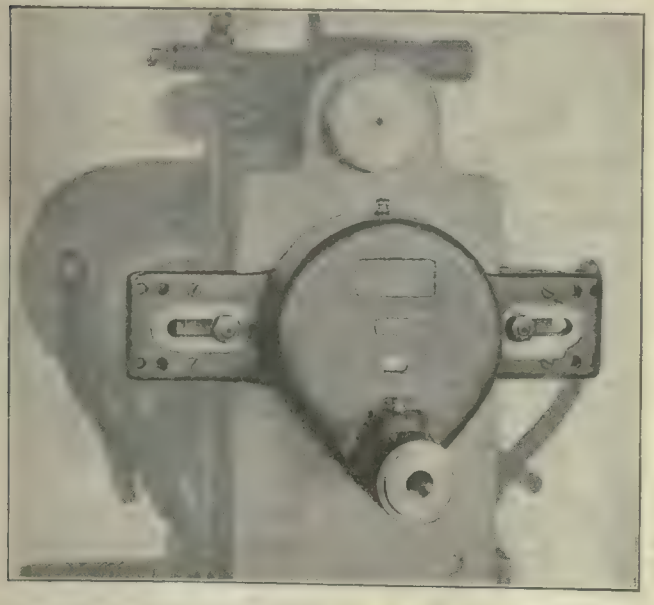


FIG. 1. BROWN & SHARPE HIGH-SPEED MILLING ATTACHMENT

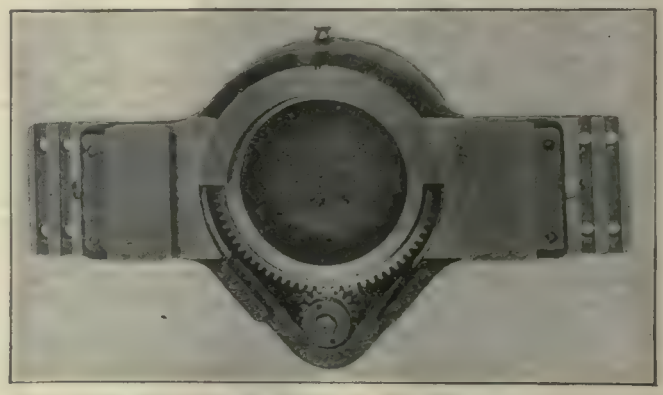


FIG. 2. REAR VIEW OF ATTACHMENT

on the attachment spindle. The large gear is made with an internal taper, ground to fit the nose of the machine spindle and is held in position by the regular cutter driver. This gear is made of machinery steel and left soft to insure a smooth drive and eliminate chatter and the objectionable "ring" often produced by hardened gears at high speed. On the No. 2 attachment the pinion is heat treated and keyed to the attachment spindle while on the No. 1 attachment the teeth of the pinion are cut directly on the spindle.

The spindle is hardened and ground and runs in a long phosphor-bronze bearing, the bearing being tapered so that wear is taken up by tightening an adjusting nut, thereby forcing the spindle into the taper. Once having adjusted the spindle a small setscrew clamps the adjusting nut in position. End thrust is taken by hardened steel and babbitt washers located directly behind the shoulder on the front end of the spindle. The front end of the spindle has a taper hole to receive cutters, the smaller attachment having a No. 7, and the larger one a No. 9 taper hole. Oiling of the spindle bearing is taken care of by means of a wool-filled oil pocket on the front of the attachment.

The cutter is held in position by the taper in the spindle and is driven by the tenon. Cutters are removed by a releasing bolt that is a part of the attachment and remains in the spindle.

Heald Style No. 80 Internal Grinding Machine

The Heald Machine Co., Worcester, Mass., has added to its line of grinding machines the No. 80, a front view of which is shown in Fig. 1. This machine is designed to grind comparatively long holes of small diameter.

The work-head is belt driven from an intermediate

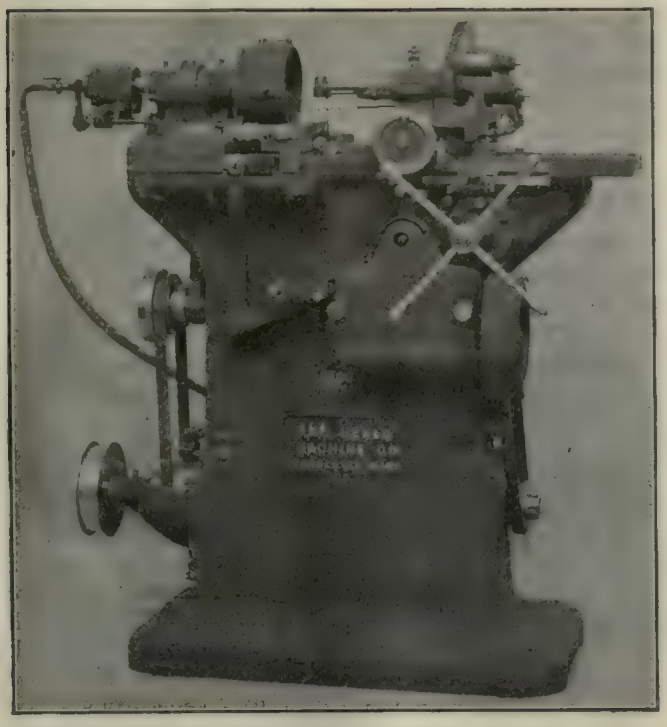


FIG. 1. HEALD STYLE NO. 80 INTERNAL GRINDING MACHINE

Specifications: Swing, 6 in. inside of water guard; 10 in. with water guard removed. Length that can be ground, 3¾ in. Diameter that can be ground, from 1¼ in. to 2 in. Wheel table has two traverse speeds, 34 and 78 in. per min. respectively. Work-head has three rotative speeds, 180, 325 and 590 r.p.m. respectively. The work spindle has a ⅛-in. hole clear through. The center line of the spindle is 46 in. from the floor. Front bearing of work spindle is 1⅝ in. and the rear bearing 1⅜ in. in diameter. The countershaft which, together with one grinding head, assortment of grinding wheels, and the necessary wrenches, is included in the machine equipment, runs at 600 r.p.m. and has a pair of tight and loose pulleys 10 in. in diameter by 2¾ in. face. The pump and water tank are extra. Floor space occupied is 28 by 56 in. The net weight of the machine is 1,300 lb.; crated for domestic shipment, 1,600 lb.; and boxed for ocean shipment, 1,800 lb.

pulley mounted on a stud at the end of the base, the crossed driving belt coming up through a cored space in the overhang. The intermediate pulley is integral with a three-step cone by means of which three work speeds are provided for the spindle. The spindle runs in dust-proof bearings that are adjustable to compensate for wear.

The work-head is mounted upon a swivelling base that is graduated up to 45 deg., and to 4 in. per foot. The main drive pulley is connected to its shaft through a friction clutch and provided with a brake, both of which are so connected with the wheel-slide that when the latter is drawn back both the work and the pump are automatically stopped. At the same time, and without attention from the operator, a small guard swings over the grinding wheel to protect the operator from injury due to accidental contact. No time need be lost in gaging the work, or in substituting another piece for the finished one.

The wheel-slide, or table, is reciprocated by a pinion at the upper end of a vertical shaft, driven through a double friction clutch under control of the operator. By shifting a single lever the traverse is changed from power to hand movement, without the possibility of both being engaged at the same time. This enables the operator, as soon as the grinding wheel is clear, to run the slide back quickly for the purpose of gaging or removing the work. This table slides upon flat and V ways. The power traverse may be set to any desired point of reversal. The table drive is through a two-step cone, thereby providing two rates of wheel traverse.

At the wheel end the spindle runs in a bronze tapered bearing that allows for adjustment to compensate for wear. At the pulley end a ball bearing is provided. The wheel-heads are made up as complete units, each having its own pulley, thereby insuring correct spindle speeds. A section through one of these wheel-heads is shown in Fig. 2.

The cross-slide may be operated by power feed or by hand, and the power feed is so calibrated as to work to half thousandths of an inch on diameters. The overhead countershaft, supplied with the machine, has an idler to keep an even tension on the belts.

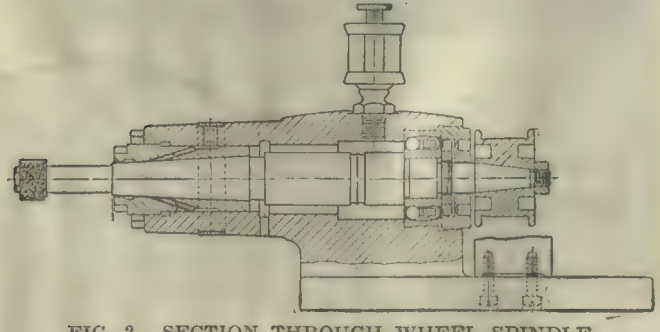
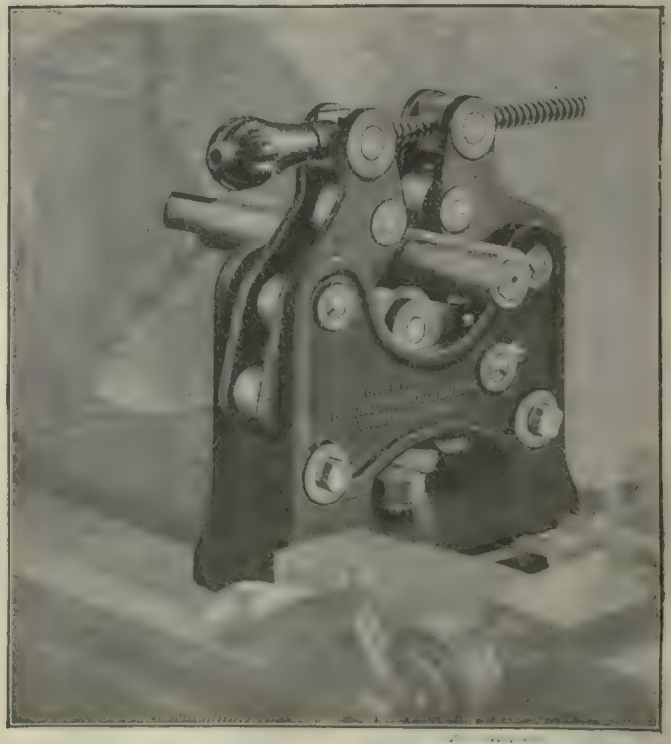


FIG. 2. SECTION THROUGH WHEEL SPINDLE

McCrosky Steadyrest

The steadyrest shown in the illustration has been placed on the market by the McCrosky Tool Corporation, Meadville, Pa. It is especially recommended for use in all operations performed on the end of a piece, such as facing, boring and turning. The work is held between three hardened rollers running on Hyatt roller bearings. For soft work, however, stationary cast-iron jaws can be furnished.

The rollers move toward the center simultaneously upon closing the jaws, the work having been inserted from the top with the jaws open. The handle end of



McCROSKY STEADYREST

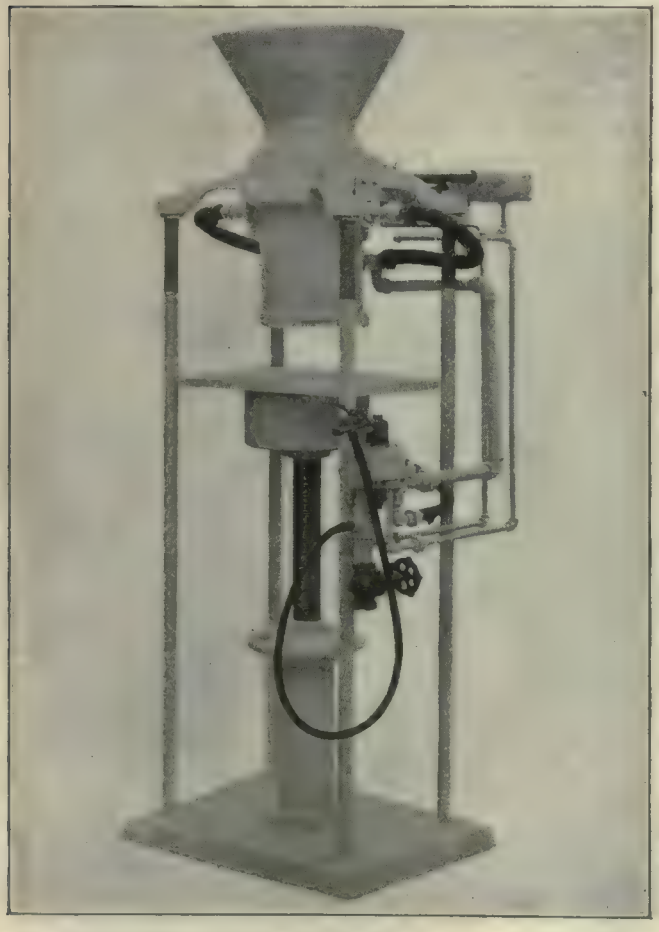
the screw is then dropped into the slot in the front jaw and the device tightened by turning the screw. The device can be easily attached or removed from the lathe, but when once adjusted for the position of the centers on the lathe on which it is used, no readjustment is required. Size 1 is intended for use on lathes having about 12 to 18 in. swing, and it handles work from $\frac{3}{8}$ to $3\frac{3}{4}$ in. in diameter. It weighs about 60 lb.

Woodison "Cappell" Core Machine

The E. J. Woodison Co., Detroit, Mich., has placed on the market the Cappell core-making machine shown in the illustration. The machine is operated by compressed air, a pressure of 80 lb. per square inch being recommended. It is intended for use in making sand cores, particularly those of complicated shape. The core boxes are placed on the table, which has a manual adjustment vertically of 18 in. The sand pot is 8 in. in diameter and holds about $\frac{1}{2}$ cu.ft. of sand.

With the sand hopper filled and the corebox in place, when the operating handle is turned, the sand is allowed to fall into the sand pot, which is then automatically closed at the top by means of a plate. The corebox is forced tightly against the sand pot by means of the air cylinder under the table. When the lever is returned to its original position, the sand is forced out of the pot and into the corebox by air pressure, the top and the sand pot being then opened again.

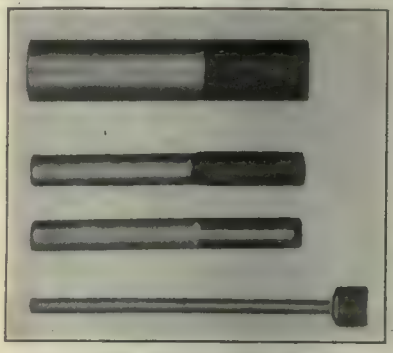
Aluminum coreboxes are especially recommended by the makers because of the ease in handling them. It is stated that the action of the sand does not wear the boxes perceptibly, since it is merely forced in without the action of a blast. The parts of the corebox must be securely clamped together to prevent spreading. It is claimed that the machine consumes but little air, operates very rapidly, and produces cores of uniform density and good finish.



CAPPELL CORE MACHINE MADE BY E. J. WOODISON CO.

Dawsearl Abrasive "Finger" Wheels

The Dawsearl Tool and Machine Co., 390 Forest St., Arlington, N. J., has placed on the market a line of small abrasive "finger" wheels. They are intended especially for regrinding button dies, and are applicable to such work as grinding small bushings. The abrasive used in the wheels is held by a hard bond, so that it is said to be possible to sharpen a large number of dies with one wheel. The shank is made of steel and extends through the center of the abrasive so as to support it. The illustration shows several types of finger wheels. The one at the top is $1\frac{5}{8}$ in. overall the cutting surface being $\frac{3}{8}$ in. in diameter and $\frac{5}{8}$ in. long. The one below it is similar except that it is $\frac{1}{16}$ in. in diameter. It can be seen in section in the next view, the rod in the center extending up to within $\frac{1}{16}$ in. of the end of the abrasive. The rod insures rigidity, but is small enough to allow of considerable elasticity. The wheel shown at the bottom is 2 in. long overall, $\frac{1}{4}$ in. in diameter and $\frac{7}{16}$ in. long on the cutting face, and $\frac{3}{32}$ in. in diameter, on the shanks. The wheels are intended for use on small high-speed portable grinding machines, since they must revolve at a speed of 30,000 r.p.m. or more.

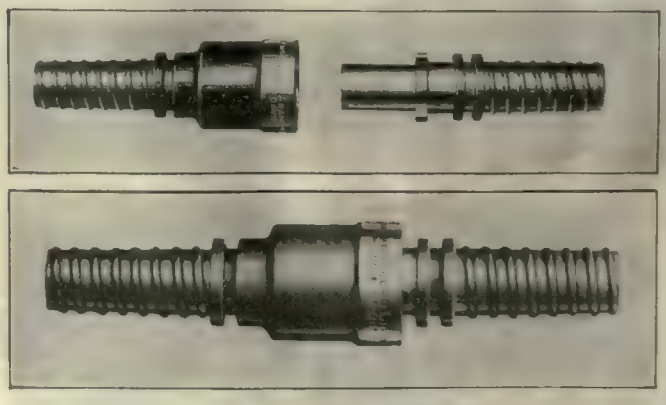


DAWSEARL ABRASIVE "FINGER" WHEELS

"Little David" Hose Coupling

The Ingersoll-Rand Co., 11 Broadway, New York, has recently placed on the market a hose coupling, called the "Little David," which will be distributed as an accessory to the line of "Little David" pneumatic tools manufactured by the same company.

The "Little David" coupling is designed with the view to overcome the trouble due to leakage and the jamming or sticking because of slight injury. Its main features



"LITTLE DAVID" HOSE COUPLING

are said to be sturdiness and simplicity, an all around ability to stand abuse without affecting its service, the absence of an outer sleeve exposed to injury, and a replaceable locking spring. It is claimed that the parts are made of a metal not subject to ordinary rusting or corrosion.

The female end is fitted with a V-shaped rubber gasket to provide an air-tight joint. The gasket is prevented from blowing out, should the coupling accidentally be disconnected under pressure, by a protective shoulder inside the coupling. The female end has no exposed parts which might be liable to injury that would cause jamming or sticking.

The air ports are straight and of uniform diameter to offer least restriction to the passage of air. The coupling may be connected or disconnected by a quarter turn. A groove in the hose end of each part allows the use of a clamp to attach it to the hose.

"Little David" hose couplings are manufactured in ½-in. and ¾-in. sizes, which are interchangeable; that is, a ½-in. male piece may be used with a ¾-in. female end or *vice versa*. Gaskets are also interchangeable between the different sizes.

"Precise" Parallel-Ruling Attachment

The New York Blue Print Paper Co., 102 Reade St., New York City, has recently placed upon the market a parallel-ruling straight-edge, shown in the illustration. It is applicable to drawing boards of any size, and need not extend the full width of the board. One end of the straight-edge carries a single pulley and the other a double pulley, a silk cord extending across the board at each end of the straight-edge. There are no cords under the board, and the ones running parallel with the straight-edge are enclosed in it.

When a straight-edge shorter than the board is used, ink and drafting tools can be placed on the bare space without interfering with the action of the attachment.



"PRECISE" PARALLEL-RULING ATTACHMENT

The straight-edge may be quickly adjusted to any angle desired. The metal parts are made of aluminum, the whole attachment weighing only about 2 oz. Straight-edges can be furnished with either transparent crytalloid, mahogany, ebony, or hardwood edges, and in lengths of 24, 30, 36, 42, 54 or 60 inches.

Universal Crane

The Universal Crane Co., successors to the International Crane Co., Swetland Building, Cleveland, Ohio, has recently placed on the market a small crane, operated by a gasoline engine, that can be mounted on railroad



THE UNIVERSAL CRANE ON AUTOMOBILE TRUCK

trucks, motor trucks, trailers, etc.; or upon a pedestal if desired for stationary service. In the accompanying picture it is shown upon an automobile truck and in use for the purpose of setting telegraph poles.

The crane swings through the full circle. It has high speeds for hoisting and rotating, and, when suitably mounted, for traversing. The control levers are conveniently mounted so that the operator has all movements under command without moving from his position and has an unobstructed view in all direction. A 40-hp. gasoline engine furnishes the power.

The crane has a lifting capacity up to 4 tons, dependent somewhat upon the mounting and the working radius. The dimensions of the crane unit exclusive of boom and mounting are: Length at level of operator's platform, 8 ft. 6 in.; width, 7 ft.; height, from mounting line to top of cab, 8 ft.

It can be equipped with grab bucket, electromagnet, hoist-block, nigger-head, capstan, steam-shovel or post-hole digging attachments as desired.

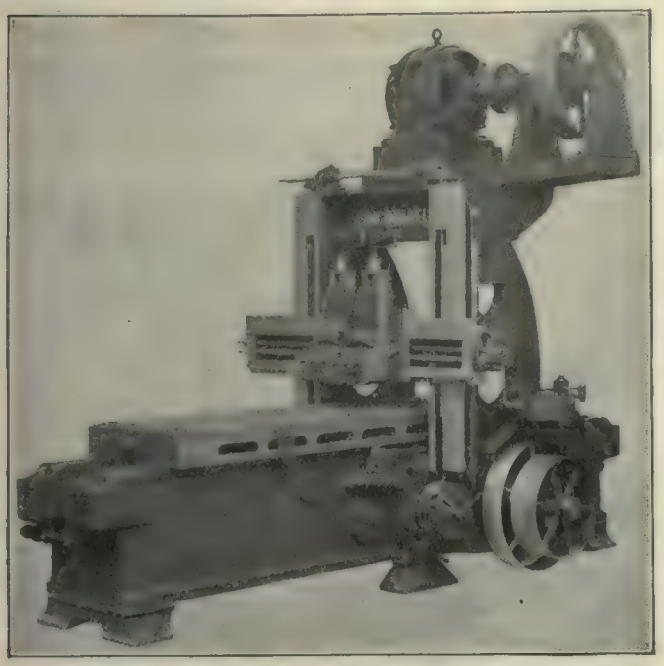
Cincinnati 30-in. Shoe and Wedge Planer

The illustration shows a shoe and wedge planer recently placed on the market by the Cincinnati Planer Co., Cincinnati, Ohio. The machine is intended for heavy-duty work, and is made with large bearing surfaces, steel herringbone gears and forced lubrication.

The bed is of box construction, and cast closed on the top for its entire length, except where the bull-wheel meshes with the rack. The table is of deep box construction, and the upper half of it has the holes for the stops drilled entirely through it, so that

chips drop through and do not have to be dug out. The lower half of the table is cast solid, so that the dust and chips cannot reach the V-ways, but can be cleaned out from the sides.

The housings extend to the bottom of the bed and are fastened to it both by bolts and dowel pins and by



CINCINNATI 30-IN. SHOE AND WEDGE PLANER

tongues and grooves. The bushings are tied together at the top in the usual way. The cross-rail carries but one saddle holding two heads. The heads must travel cross-wise in unison, but provision is made for moving them vertically independent of each other, by either hand or power.

The machine can be arranged for motor drive, either plain or variable speed, or equipped with a two-speed countershaft.

Hercules 24-In. Gear-Hobbing Machine

The Hercules Machine and Tool Co., Inc., Broome and Lafayette Sts., New York City, has added to its line of gear-hobbing machines the 24-in. automatic machine shown in the accompanying illustration. The machine is intended for the quantity manufacture of medium-sized gears, either worm, helical or straight-toothed, such as used for automobile transmissions and machine-tool drives.

The base and column are of box construction and cast in one piece. The table carrying the work slides horizontally on the base, and is equipped with a power feed. The work can be clamped to the circular table or mounted on a vertical arbor set up in the center of it. The table is provided with a rim for the collection of the chips and the coolant.

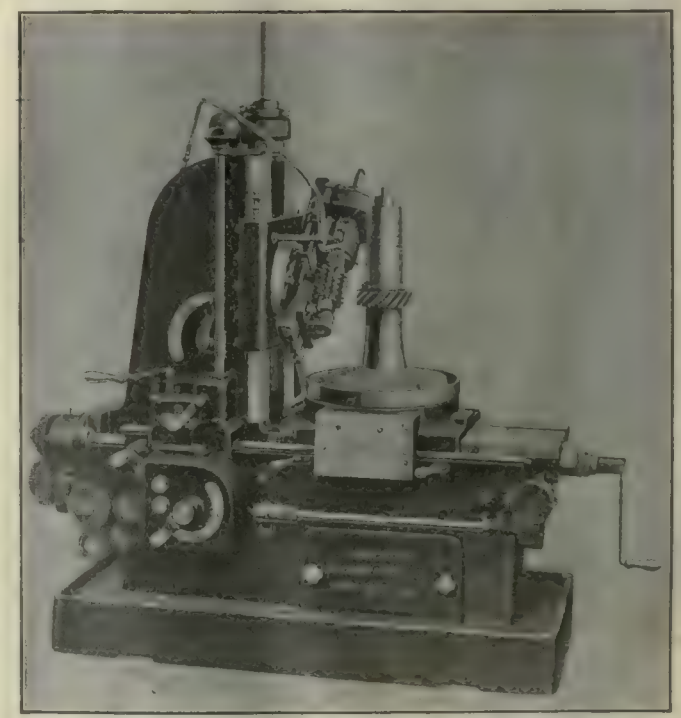
The spindle carrying the cutting hob is hardened and runs in bronze bushings, one of the bearings being conical. The position of the hob can be adjusted along the slide on which it is mounted, so as to permit of the centering of any tooth when setting up. In addition, the hob spindle can be swiveled 90 deg. to either side on its carriage mounted on the ways of the column.

The drive is from a single, inclosed, constant-speed pulley on the side of the machine not shown in the illustration. Speed changes are obtained by means of a quick-change gear box, the gears running in oil. The drive is transmitted through the column by means of a vertical shaft, and then to the spindle head by means of helical gears, thus bringing the hob spindle close to the column.

By means of the quick-change gears, feed changes can be made, the gears being inclosed and running in oil. The feed can be applied either to the vertical travel of the hob carriage, as for most work, or to the horizontal travel of the work table, as when cutting worm gears. In both cases, stops are provided for automatically controlling the extent of the travel. The hob carriage is fed by means of a revolving nut on a screw rigidly attached to the carriage. A rapid traverse is provided for the movement of the hob carriage.

The work spindle is indexed by means of a worm-wheel and hardened worm provided with a suitable adjustment for wear. Its movement is controlled by a separate feed mechanism, being varied by means of change gears at the rear of the machine.

It is claimed that the machine can be very easily set up for the cutting of helical gears, because of the fact that the feed and the indexing are handled by different mechanisms, but connected by a differential mechanism, situated at the rear of the machine. The change gears to obtain the proper rate of indexing are calculated in the same manner as for straight-toothed spur gears, while the gear for use in the differential mechanism can be ascertained by means of a formula. It is possible to change the feed while the work is being cut, because the helical angle is automatically kept constant by a corre-



HERCULES 24-IN. GEAR-HOBBING MACHINE

Specifications: Capacity in steel, to 4 D.P. Maximum size of work; diameter, 28 in.; width, 12 in. Distance from center of work arbor to center of hob mandrel, minimum, 1⅛ in. Speed of drive pulley, 360 r.p.m. Hob speeds: number, 9; range, from 37 to 150 r.p.m. Feeds, headstock (vertical) and work table (horizontal): number, 8; range from 0.005 to 0.100 in. per revolution of work. Power required, 3 hp. Floor space, 36 x 60 in. Weight: net, 4,000 lb.; domestic shipping, 4,250 lb.; export shipping, 4,350 lb. Export box, 96 cu.ft.

sponding change in the indexing rate. After the work is completed, the entire machine is automatically stopped, so that it is possible for one attendant to operate several machines.

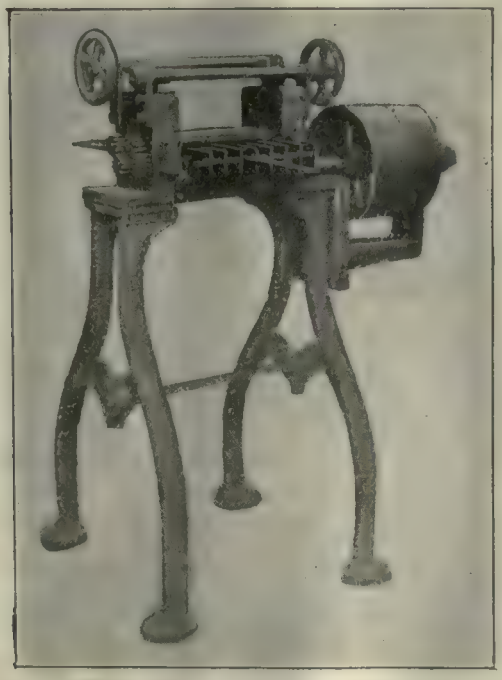
A coolant system, with a pump having a capacity of 10 gal. per minute, is provided. A bracket is furnished for bracing the work arbor. The necessary wrenches and change gears are also provided.

Kane & Roach No. "A" Straightening Machine

The straightening machine shown in the illustration, and known as the No. A machine, has recently been added to the line of Kane & Roach, Niagara and Shonnard Sts., Syracuse, N. Y. It is intended especially for straightening hacksaw blades, file blanks, knife blanks, or strip material stamped out of flat sheets and requiring straightening cold both before and after tempering. Pieces as short as 3 or 3½ in. can be handled.

It is a 4-roll machine, the upper rolls being adjustable and the upper rolls as well as the lower rolls being driven by gears. The first pair of rolls takes out the bends and irregularities and the last ones do the final straightening. In order to care for work of different thicknesses, the rolls are made with seven steps, increasing in size from one end.

When setting up, the rolls are usually set so that stock of standard thickness will be straightened on the center step. There are then three steps on one side for use when the stock is thicker than the standard, and three on the other side for thinner stock. The operator is usually enabled to judge by the feel or the weight of the piece as to which step it should be fed into in order to straighten it.

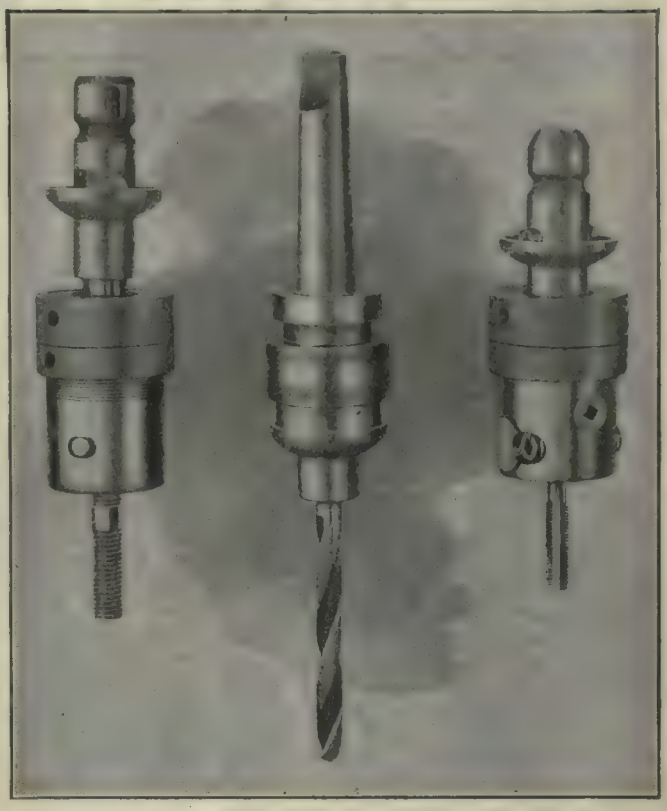


KANE & ROACH NO. "A" STRAIGHTENING MACHINE

Guides are provided so that the work is held in the proper position for passing through the rolls and so that it cannot move from one step to another. The machine requires only ½ hp. to operate it, and occupies a floor space of 24 x 36 in.

Jarvis Quick-Change Chuck and Collets

The illustration shows a type of quick-change chuck and collet recently put on the market by the Charles L. Jarvis Co., Gildersleeve, Conn. The device is intended for use where different operations, such as drilling, reaming, counterboring, tapping and stud-setting, are done with one spindle, especially when working on heavy castings with a radial drilling machine. They are adapted to lathe use also.



JARVIS QUICK-CHANGE CHUCK AND COLLETS

The chuck can be furnished with the type and size of taper required to fit the spindle of the drilling machine. The collets are short, are made from hardened drop forgings, have two radial bearing surfaces, and are driven by means of a pin placed close to the work, as can be seen by the two collets fastened to key-operated jaw chucks, shown at each side of the illustration. It is claimed that the collets can be easily inserted.

The tool is made in three sizes. The standard sizes of the chuck shank are from No. 2 to 5 Morse taper, the holes in the collets from No. 1 to 4 Morse taper, the diameters of the collets from 1 to 2 in., and the largest diameters of the chuck from 2 to 4 in.

Obtaining the Radius of Three Equal Inscribed Circles

A typographical error in an article by Leo A. Brennan, under the above title, appearing on page 593 of the *American Machinist*, has been called to our attention by Eric H. Tyler. The two lines appearing as

$$R + C = R + 0.57735$$
$$R = 1.57735 = B$$

should read $R + C = R + 0.57735\ R$
$= 1.57735 = B,$

the R being misplaced.

SPARKS FROM THE WOR

Valentine Francis

Wage Reductions in the Iron and Steel Industry

The most important development in the iron and steel industry recently was the acknowledgment by steel companies that wages would be reduced from 15 to 25 per cent beginning the first of the year. This was foreseen some time ago when these companies commenced lowering their prices of finished steel products and finally came down to the same level as was established by the Industrial Board in March of last year. At this level many of the independent mills were losing money and an adjustment in production costs became a necessity. As the labor at these plants is for the most part paid according to an established sliding scale, the drop in prices operated to automatically reduce wages, but as the mills continued to pay at the higher rate the trade was in a quandry as to how long the higher rate was to be maintained. During the past week officials of the Midvale Steel & Ordnance Co., the Lackawanna Steel Co. and other independents announced a reduction in wages of from 15 to 25 per cent beginning the first of the year.

Announcement was made of a reduction from 46 to 38 cents an hour at four Ohio Valley plants of the Wheeling Steel Corporation, with elimination of extra pay for time over eight hours. Judge E. H. Gary of the United States Steel Corporation declined to make any comment on wage reductions, nor would he give any indication as to the policy of the corporation. The open shop policy is maintained at most of the plants of the leading interest and wages are not paid on the sliding scale, and even if they were this interest still adheres to the former schedule of prices and is not confronted by the same adverse change in ratios of selling prices and production costs. It is anticipated in many quarters, however, that the corporation will soon announce a cut.

Revised Government Wage Rates

In the revised reclassification bill, which is now under preparation, it is understood that the following basic rates have been agreed upon for machinists in the Government service: Machinist, general, 80 cents per hour; automobile machinist, 90 cents per hour; printing-office machinist, $1 per hour; mechanic, office appliances, $1,500 to $1,860 per annum; automobile repair man, 55 cents to 65 cents per hour; blacksmith, 75 cents per hour; tinsmith and sheet-metal worker, $1 per hour; foundryman, 75 cents per hour; motor-truck driver, from $1,140 to $1,260 per annum.

Banker Sees Bright Outlook

"With a population of more than 100,000,000 people whose daily needs must be satisfied, there can be no prolonged period of depression," declares A. Burton Hepburn, chairman of the advisory board of the Chase National Bank. "It is true that there are considerable stocks of goods in the country, but they soon will be liquidated. The outlook for 1921 certainly is most hopeful and I anticipate normal business activity on a sound basis of cost and credit."

In discussing the outlook for next year, Mr. Hepburn said: "So far the improvement consists mainly in the psychological change in the public's attitude toward business. Changed conditions have made business men realize that there is a community of interest among them which must be respected and the prosperity of all safeguarded in order to insure the prosperity of each. Any business man is in a sorry plight unless obligations owed him by other business men are good.

"There is evidence of future easing of the money market. It comes from an undesirable cause, curtailment, the liquidation of business; but this must eventually ease the money market. The public is on strike against paying the high prices asked by retailers of goods —manufacturers, wholesalers and retailers have on hand quantities of goods made from raw materials at high prices which they naturally wish to dispose of without loss. There must be liquidation, but in the present temper of the public it can easily be brought about without disaster.

"We have over a hundred million people whose current wants must be supplied. Manufacturers should continue to make goods from raw materials and reduce prices—merchants should supply themselves with these goods in sufficient quantities to supply public needs. I have confidence in the good sense and good judgment of the American public and believe we will reach a lower and more stable level of prices without serious disaster."

Mr. Hepburn pointed out that with living costs becoming less, labor can afford to accept a reduction in wages.

Exchange Dealings With Russia Sanctioned

Restrictions over transactions involving Russian rubles and the exportation of coin to Soviet Russia were removed on Dec. 20, thus lifting one of the chief bars to trading with Russia.

Action to this effect was announced by the Treasury Department.

Will Tabulate Farm Equipment Manufacture

A census which will show the number and value of different items of farm operating equipment manufactured in the United States during 1920, the number sold in the United States, and the number sold for export, is being undertaken by the United States Department of Agriculture. Information will be collected from the manufacturers of farm implements, vehicles, and other equipment.

Since 1916 the department has compiled yearly reports showing the production and sale of tractors on information supplied by manufacturers to the Office of Farm Equipment Control, and later to the Division of Agricultural Engineering. In order to meet the continued demand for similar figures regarding other machinery and equipment, it has been decided to collect information concerning the manufacture and sale of all important items.

The co-operation of the manufacturers, who generally realize the value of such statistics to their industry, has been assured. The Division of Agricultural Engineering of the Bureau of Public Roads, which is to have direct charge of the collection of this information, has been assured through the National Implement and Vehicle Association of the co-operation of its members. The present plan is to send to each manufacturer of farm equipment a form on which to report by mail the manufacture and sale of different items by his firm during 1920. The department wishes it to be clearly understood that it will follow its usual custom of keeping the reports of the individual manufacturers confidential, and that they will be used for no other purpose than that outlined.

New Bodies Represented on A. E. S. C.

The following is a corrected list of the four new member-bodies, and their representatives, of the American Engineering Standards Committee:

U. S. Department of Agriculture: C. L. Alsberg, Chief, Bureau of Chemistry; Earle H. Clapp, Forest Service; T. H. MacDonald, Chief, Bureau of Public Roads.

U. S. Department of the Interior: E. A. Holbrook, Assistant Director, Bureau of Mines; O. P. Hood, Chief Mechanical Engineer, Bureau of Mines; P. S. Smith, Administrative Geologist, Geological Survey.

Gas Group (American Gas Association, Compressed Gas Manufacturers' Association, International Acetylene Association): A. H. Hall, superintendent of distribution, Central Union Gas Co.; A. C. Morrison, vice-president, Compressed Gas Manufacturers' Association; H. S. Smith, president, International Acetylene Association.

American Electric Railway Railway Association: (Official representatives not yet designated).

LD'S INDUSTRIAL FORGE
News Editor

German Statistics on Exports and Imports Cause Much Comment

Much comment has been given to the export and import statistics submitted at the conference in Brussels by the German delegates. These figures, it is said, would make it appear that the German foreign trade is on the way to show a balance on the right side. In 1919 the import was by 22 billions of marks larger than the export. In April, 1920, however, the export appeared to be 500 millions and in May 1,100 millions higher than the imports. It is said that these figures are misleading, and that the increase is mainly due to the fact that exporters speeded their shipments during those two months in anticipation of the export tax which came into force on the first of July. It was further mentioned, that, while the statistical office is able to compile exact figures as regards export values this is not the fact with regard to imports. Importers are not compelled—as are the exporters—to make declarations in all cases as to the value of their dealings and import figures are therefore mainly obtained by estimate, which, as has been found, has been much too low.

It has further been asserted that the figures for foreign trade submitted at Brussels have evidently been compiled with a view to give a favorable impression of the German trade situation not corresponding with actual facts.

Although the arguments brought forward are right to a certain extent it is believed that they emanate from quarters which are continually at work to demonstrate the impossibility of fulfilling the economical conditions of the Peace Treaty. From a comparison of the figures of exports in 1919 and 1920 it appears that from January, 1920, the import has slowly decreased, while the export has risen from January, 1919, in a steady curve up to May, 1920. The figures since May, 1920, have not been made public yet, but it is believed that they will show a considerable decline, not so much because of the alleged advance shipments made in April and May but on account the business depression.

A new labor act which provides for an 8-hour day in all factories and workshops has gone into effect in Holland. Sunday work is forbidden for youths and women, and can only be allowed for men by special arrangement with the Minister of Labor. Saturday work after 1 p.m. is governed by the same conditions, a rule which establishes 45 hours as the working week.

Conventions To Get Lower Fares

Reduced fares on account of conventions will be granted by some railroads in 1921. The discrimination against business and trade organizations which was observed during the period of Governmental operation of the railways has been abolished.

In a letter to the Merchants' Association of New York, under date of Dec. 16, C. M. Burt, chairman of the passenger department of the Trunk Line Association, writes as follows:

For your information it has been decided by the Trunk Lines to grant reduced fares for conventions to be held next year on the basis of fare and one-half with minimum of $1 for the round-trip, on the certificate plan, conditioned upon an attendance of 350 or more members, including dependent members of their families traveling to the meeting by rail, and the reduction will be applicable to all societies or other organizations qualifying under the rules.

Within the territory of the Trunk Line Association are all stations in Delaware, the District of Columbia, and New Jersey, and it also includes most of the stations in the States of New York, Pennsylvania, Maryland, Virginia and West Virginia.

Indications point to similar action on the part of the other territorial rail passenger associations.

Express Combine Approved

The Interstate Commerce Commission recently approved the consolidation of the Adams, American, Wells Fargo & Co. and the Southern Express Co. into the American Railway Express Co. The application of the American Railway Express Co. for the approval of the consolidation had been under consideration by the commission since last August. Commissioners McChord and Meyer dissented.

The principal objection to the consolidation, which was effected during federal control of the railroads, being approved by the commission was the attitude of the Adams and Southern Express companies toward the settlement of loss and damage claims. The protestants, which included representatives of many shippers and the state commissions, urged that if the commission approved the consolidation it should fix as a condition precedent thereto provisions which would protect the rights of claimants.

Give thought to your spending. Resolve to save part of your income by regular investment in Government Savings Securities.

Make a resolution to invest in Liberty Bonds and Victory Notes. Buy all you can afford. The current market prices make them an advantageous buy.

More Funds Needed for Bureau of Standards

Pointing out that the Bureau of Standards is giving valuable assistance to many industries which would warrant its maintenance if for no other reason S. W. Stratton, director of the bureau, in his annual report made public on Dec. 19 urges more adequate support through Congressional appropriations.

Mr. Stratton summarizes the needs of the bureau as follows:

Attention is again called to the necessity for adjusting the salaries of the scientific and technical experts of the bureau to compare more favorably with those paid by scientific and industrial laboratories, as well as educational institutions. It is to be regretted that this adjustment could not have been made during the year, since all scientific work of the Government has suffered to a greater or less extent. The demand for men capable of undertaking scientific and technical investigations is far greater than the supply; this, coupled with the present rate of compensation in Government work, has lowered the standard of workers available and greatly impaired the quality as well as the quantity of work. The number of changes in personnel during the year has been many times that under normal conditions. Here, again, the result has been decreased efficiency and a reduction of output.

The power of Bureau of Standards is entirely inadequate. It consists of the original plant, designed to supply two buildings, and two temporary boiler plants, added later. These installations should be combined in one plant capable of heating the various buildings. It should also provide the various electrical currents for power and experimental purposes, as well as the refrigeration, compressed air, vacuum, and other utilities required in scientific work.

The Government method of purchasing materials and supplies of all kinds by means of competitive bids often leads to injustice to the manufacturer and loss of money to the Government unless based upon correct specifications, methods of testing, and the testing of deliveries.

The direct assistance given by the Bureau to the industries along these lines would alone warrant its maintenance many times over. During the war the Bureau co-operated with the military departments in researches of many kinds. During the past year a special fund was provided for such co-operation with the industries and an analysis of the results will leave no question as to the usefulness of or necessity for such work by the Bureau. The funds available for this purpose during the coming year are entirely inadequate and it is earnestly recommended that in submitting the estimates for the next year a suitable fund be requested for co-operation with the industries in scientific research.

S. A. E. Winter-Meeting Programs

The annual meeting of the Society of Automotive Engineers, as already announced in our "Forthcoming Meetings" section, will be held in the Engineering Societies Building, New York City, on Jan. 11 to 13, inclusive. The program follows:

TUESDAY, JAN. 11

Standards Meeting—Discussion of the revisions of additions to prevailing S. A. E. Standards and Recommended Practices which will be reported by the Divisions of the Standards Committee.

Aeronautic Session—Technical meeting to consider the recent engineering develop-

wings, metal construction, internally trussed ments in aircraft, such as variable camber wings, retractable chassis, and propellers. Authoritative papers to be presented on these topics.

WEDNESDAY, JAN. 12

Annual Business Meeting — Election of officers for coming year. Finance, Membership, Meetings, and other Committee reports.

The Engineer's Place in the Industry—A definition of the increasing influence of the engineer in industry, the greater responsibility which he must assume, and the necessity for his building confidence around his undertaking. Presented by three prominent executives of the automotive industry.

Body Engineering Session—The genesis of a closer co-operation between engineers engaged in this automotive work. Consideration to be given to tendency in design, construction and methods of production. Encouragement of standardization in this field and reduction of body weight.

Aeronautic Session—The development of commercial aviation using both lighter and heavier-than-air types. Presentation of the progress of air transport in Europe, and study of its future possibilities in America.

Chassis Session—Increasing the efficiency of the automotive chassis to conserve fuel. Study of mechanical losses, advisability of smaller engines and higher axle ratios, reduction of sprung and unsprung weight. Possibility of European types of small cars in America.

"The Carnival"—The social event of the S. A. E. year! Colorful, mirthful, sensational. The annual reunion of the S. A. E. family, where members, wives and sweethearts revel in an environment of music and dance.

THURSDAY, JAN. 13

Fuel Session—Discussion of efficient utilization of present high endpoint gasoline in internal combustion engines. Analysis of valuable research in the phenomena of combustion and detonation. Employment of increased compression pressure with knock eliminated. Consideration of combustion and flame propagation. Distribution problems. The petroleum refiner's viewpoint. Extent and effect of crankcase dilution. Symposium of the leading authorities' present views.

Highway Session — Effect of the heavy automotive vehicle on highway surface. The study of subsoil and its relation to surface durability. A meeting to further develop co-operative contact with the civil engineer who builds and maintains the roadbed on which our products operate.

The Annual S. A. E. Dinner—(*Hotel Astor at 7 o'clock*)—The formal climax of the Meeting, when engineer, producer and salesman dine in fraternal spirit, exchange stories of the early days of our dynamic industry and hear words of wisdom spoken by eminent leaders in American business. The largest single gathering of representative men in the automotive industry.

CHICAGO MEETING

The Chicago meeting will be held on Feb. 2, 1921 at the Hotel Morrison. There will be a morning and an afternoon session. One will be devoted principally to the consideration of truck-design trend, introducing a paper on an interesting steam-truck development. The other session will deal with the operation of automotive vehicles from the viewpoint of the service man and the owner, offering an opportunity for the operator to criticize the engineering errors in design. A dinner will be held in the evening.

COLUMBUS MEETING

On Feb. 10, 1921, there will be a Columbus meeting at the Hotel Deshler. Two technical sessions devoted to the consideration of farm power engineering will be held. Trend of tractor design, plowing and belt speeds, and faults developed in Nebraska State trials will be discussed. Stationary farm engines for lighting, pumping and utility uses will also be considered. This meeting will end with an evening dinner.

Artificial Seasoning of Gage Steels

The investigation on the effects of various artificial seasoning treatments on the permanence of gage steels by the Bureau of Standards, Washington, D. C., has progressed sufficiently far to permit the drawing of certain conclusions. In this work hardened gages were heated in oil at various temperatures and under varying time conditions, and also subjected to seasoning by alternate dipping in hot oil and iced brine. The results of the work are as follows:

(1) Short gages ($\frac{1}{8}$ in.) showed no appreciable changes in length, with or without various artificial seasoning treatments, over a period of approximately seven months beginning about one to two weeks after hardening. In general the long gages (2 in.) showed no appreciable changes in planeness.

(2) For studying length changes with time, gage blocks of greater length than those used (2 in.) would be desirable. About 6 to 8 in. is recommended.

(3) Duplicate gages show wide variations in length changes; for example, one block showed no dimensional change in 217 days between first and last measurements, while a duplicate decreased 0.00018 in. in length in the same period.

(4) Except in the case of plain-carbon steel containing 1.18 per cent carbon, the changes in planeness are not appreciable. In this steel relatively large variations in planeness for duplicate gages are noted.

(5) Gages produced from stainless steel and ordinary drill rod are softer than reference blocks ordinarily produced and which are kept between about 90 to 100 Shore hardness. From this standpoint the stainless steel is unsatisfactory as it is not possible with ordinary treatment to maintain the hardness within the limits described. A higher-carbon alloy of this type would be more desirable, with possibly a decrease in chromium such as would not impair its stainless qualities and at the same time reduce production costs.

(6) The plain-carbon steel (containing 1.8 per cent carbon) appears to be the least desirable from the standpoint of permanence, showing in the main the greatest changes in length and planeness during a period approximately seven months from first to last measurements. Probably the most desirable are steels HC and K subjected to definite seasoning treatments, the former being the steel now generally used in production of reference gages at the Bureau of Standards.

(7) Measurements at intervals of approximately one week, one, two, four, and seven months after initial readings of length and planeness do not give very much information regarding the progress of the changes taking place. Where the greatest changes occur in either length or planness they appear to progressively increase with time. In many cases where these changes have been smallest over the entire time interval they seem to occur in the intervals immediately following the first measurement, the gages thereafter remaining constant.

Iowa's New Machine-Tool Company

The Bertschy Engineering Co. of Cedar Rapids, Ia., organized in May, 1920, has just completed the installation of a large machine-tool equipment. This company, which started business in July, 1920, purchased the buildings, property, equipment and supplies of the Peerless V-Belt Co. of Cedar Rapids, Ia.; from the Mattison Machine Works of Rockford, Ill., it purchased the metal working shaper business which had been conducted by the Rockford Co. for several years. In addition to these it also purchased the Bermo welding-apparatus business from the Bertschy Manufacturing and Engineering Co. of Omaha, Neb.

The new Iowa company began its production activities in October, 1920, and has now on hand castings, parts and materials which are in process of manufacture for 16-, 20- and 24-in. heavy-duty back-geared shapers. The entire output of the machine-tool department is covered by orders, and preparations are being made to extend this department to take care of the increased business. In the welding apparatus department it is claimed that upward of five thousand complete welding equipments and a large number of additional Bermo welding torches are in process of manufacture. In the belt department, where the silent-chain V-belt is manufactured, the demand far exceeds the company's ability to supply.

The company at the present time employs a large force of men; it is working full time, and all the overtime that is possible. The directors of the company are: A. J. P. Bertschy; George S. Wright, Council Bluffs, Ia.; Glenn M. and Arthur T. Averill, Cedar Rapids, Ia., and E. B. Poff.

C. W. Couch Organizes Sales Agency

C. W. Couch, recently sales manager of the Ford-Clark Co., has recently perfected a selling organization under the name of C. W. Couch & Co., with headquarters at 614 National City Bldg., Cleveland, Ohio.

Among the firms for whom the new organization will act as direct selling agents will be found such names as the Perry-Fay Co., Elyria, Ohio, manufacturers of screw machine products; the City Brass Foundry Co., Cleveland, Ohio, manufacturer of aluminum, brass and bronze castings; the Superior Metal Products Co., Elyria, Ohio, manufacturer of pressed and drawn steel parts; the Marquette Metal Products Co., Cleveland, manufacturers of hardened and ground steel bushings.

If you are on the right tack the winds and tides are with you and will get you there in the end—if you don't give up—*Forbes Magazine* (N. Y.).

Bullard's Third Christmas Party a Success

The third Christmas party for the children of the employees of the Bullard Machine Tool Co. of Bridgeport was given in the Bridgeport Casino on the evening of Dec. 22. The children of every man who had been on the Bullard payroll during 1920 were invited and the wards of the Bridgeport Protestant Orphan Asylum were also included.

The Casino, which has a seating capacity of 3,500, was jammed, 2,200 of those present being children. Each child was given a box with presents suited to his age and sex. There were four classifications—boys from one to six years of age, girls from one to six, boys from seven to ten and girls from seven to ten—and judging from the noise that followed the opening of the boxes the selections had been well made.

The program began with the singing of Christmas carols. Stanley H. Bullard then made a short address of welcome and presented the members of the factory bowling team with watch fobs for winning the city championship. Mr. Bullard was answered by Master Charlie Gvory, aged twelve years, who, aided by a megaphone, delivered the following speech of his own composition:

Ladies and Gentlemen:

I am a pupil of the Holland Hill School, Fairfield, and my father works for the Bullard Machine Tool Co. in that town.

This is the third time that the Bullard's have given us an entertainment and I have been waiting for someone to thank them for it, but as no one else does I can't wait any longer without telling my own feelings.

We did not expect anything this year because the work has been so slow, but we are glad to know that Bullard's did not forget the children whose fathers are working for their organization.

We all owe to Santa Claus and Bullard our greatest thanks for what he has done for us in giving us presents.

I am not ashamed to say I am a Hungarian boy and I hope to work for Mr. Bullard myself when I am old enough, because he has a good heart toward the working people. I, myself, do not think you could find an organization as good as the Bullard Tool Co. in any part of the United States.

Again I wish to thank them, and I wish every one here a Merry Christmas and a Happy New Year.

A few tableaux followed and led up to the arrival of Santa Claus, who brought joy to the hearts of the smaller children for the rest of the evening by dancing with them singly and in groups.

Manufacturers' Associations Meet

Formation of a National Board of Adjustment said to be demanded by the railway brotherhoods to handle all labor problems instead of the individual company settling its own troubles, as formerly, will be protested at a convention of manufacturers, merchants, railway executives and shippers at Chicago, Jan. 12, which will be held at the Congress Hotel.

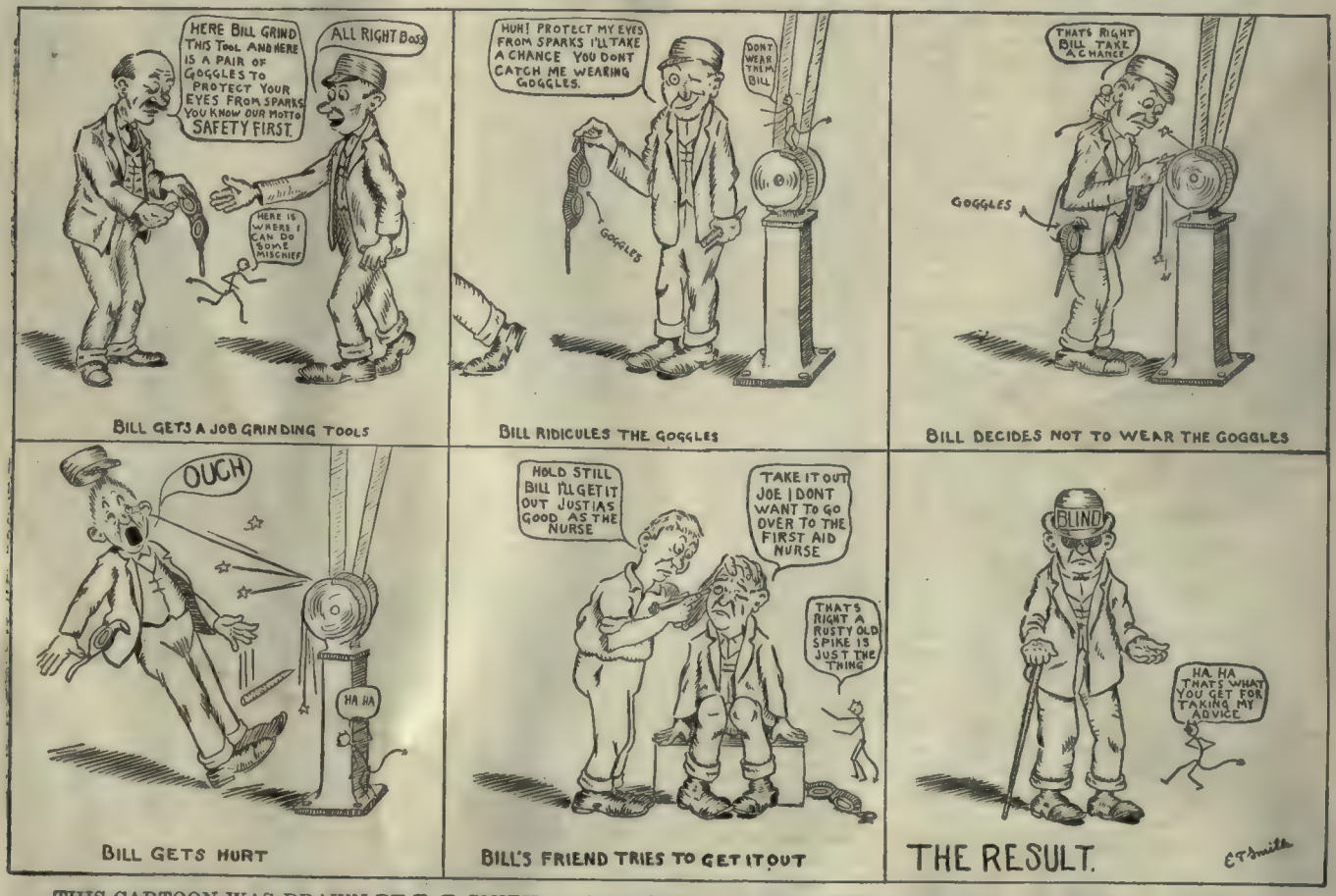
Acquiescence in the railway brotherhoods' plan would mean the opening wedge for collective bargaining and the closed shop in all branches of American industry, according to the convention call issued yesterday by the National Conference of State Manufacturers' Associations, through its president, William Butterworth, who is also a director of the Illinois Manufacturers' Association, vice-president of the Chamber of Commerce of the U. S. A., and the president of Deere & Co., Moline, Ill.; and the secretary, John M. Glenn, who holds the same position with the Illinois Manufacturers' Association.

Orders 200,000 Tons of Steel Rails

The Pennsylvania Railroad announced on Dec. 23 the placing of an order for 200,000 tons of steel rails, divided among the United States Steel Corporation and independents. The Illinois Steel Co. and the Carnegie Steel Co., Steel Corporation subsidiaries, were awarded 50,000 tons each, while 45,000 tons went to the Bethlehem Steel Corporation, 45,000 tons to the Midvale Steel and Ordnance Co. and 10,000 tons to the Lackawanna Steel Co.

Awarding of the order followed almost immediately upon the reduction in the price of open-hearth rails to the level of the Steel Corporation—namely, $47 a ton. Previously the independents had been quoting $57 a ton and $59 a ton for bessemer rails.

Deliveries, it is understood, will begin some time in the spring. This is one of the largest orders ever placed by the Pennsylvania, and will be used principally for renewals. Last year there was used for renewals 106,000 tons. The new rails will make up part of the deficiency that accumulated during the period of Federal control.



THIS CARTOON WAS DRAWN BY E. T. SMITH, A MACHINIST AT THE BUFFALO WORKS OF THE KING SEWING MACHINE CO., FOR ONE OF ITS SAFETY BULLETINS

Big Gains in U. S. Trade With Africa

While certain European nations have been readjusting boundary lines and territorial control in Africa, the manufacturers of the United States have been successfully invading the markets of that continent. Our exports to Africa, says a statement by the National City Bank of New York, in the year which ends with this month will aggregate six times as much as in 1914, and our imports from that continent seven times as much as in 1914. Our total trade with Africa in the calendar year 1920 will aggregate 325 million dollars, against 47 millions in the fiscal year 1914, all of which preceded the war.

Manufactures of all sorts, but especialy automobiles, mining machinery, cotton goods, iron and steel manufactures, electrical machinery, boots and shoes, clothing, and household requirements of all sorts are the principal articles exported to Africa, automobiles alone amounting to about $7,000,000 in the calendar year 1919 against 2½ millions in the preceding years.

Cancelled Contracts in England

In the London *Times* appears the following regarding England's feeling toward cancellations:

"No good purpose would be served by ignoring the fact that the cancellation of contracts is causing a good deal of feeling. We have passed through a time of very great difficulty, and we fear it must be admitted that those difficulties are by no means ended. During the past few years not only have prices been rising rapidly but supplies have been extremely hard to obtain, and in their anxiety to get goods for their customers merchants and importers abroad have sometimes been inclined to order more than they really required in the hope that they would get sufficient for their purpose.

"A year ago order books were bursting and manufacturers in many cases were unable to guarantee date of delivery or price—hence the much-discussed variation clause. Today conditions have entirely changed, and merchants and importers are threatened with delivery of goods bought at a high price for which they can only secure the lower market prices now ruling. In these circumstances some contracts have been cancelled. We cannot for a moment justify such a practice. The sanctity of contract is the basis of business, and in the past many a merchant has incurred immense loss rather than go back on his word, even if there were nothing whatever in writing to seal it and the only evidence of a contract was the recollection of an offer and acceptance by word of mouth. Unhappily, that is not a universal standard of honor.

"In the United States of America—if we are to accept the views of the American Chamber of Commerce in London—the speculator thinks he is doing a natural thing in "getting out from under" when markets are falling. It is not suggested that reputable American houses take this view, but it seems that during the scramble of the last few years a speculative element has been introduced, and we must remember that these gentlemen have usually very slender resources. Indeed, it may be that in some cases it is better for the manufacturer in the long run that his contract should be cancelled than that he should deliver the goods and figure as a creditor in a subsequent bankruptcy. Yet, though all these points are deserving of attention, the business world cannot view with equanimity the continuance or extension of so dangerous a practice as cancellation of contracts.

"A manufacturer can obviously make no plans for the future unless he is reasonably sure that ordered goods will be duly accepted and paid for. We see that it has been suggested that manufacturers should be more strict in reducing contracts to legal written form. That seems to us to be a retrograde step. Surely it should be a source of pride to any nation that its business men are so honorable that such precautions become unnecessary. The elimination of formal contracts is far more common than most people suppose, and tends greatly to facilitate the transaction of business. That firms should in these difficult times be more than ordinarily careful as to the standing of those with whom the deal is obvious."

Get the most out of tomorrow by resolving today to invest regularly in Government Savings Securities.

DOMESTIC EXPORTS FROM THE UNITED STATES BY COUNTRIES, DURING OCTOBER, 1920
METAL-WORKING MACHINERY

Countries	Lathes	Other Machine Tools	Sharpening and Grinding Machines	All Other
Azores and Madeira Island	$130	.....	.....	.....
Belgium	23,569	$21,965	$15,644	$63,498
Bulgaria	9,950	.....	.....	.....
Denmark	.....	7,557	2,143	725
France	22,620	268,260	10,091	187,359
Germany	.....	250	.....	3,120
Greece	4,305	285	102	10,122
Italy	10,303	35,312	13,680	46,405
Netherlands	15,100	20,520	996	1,614
Norway	.....	14,718	7,039	1,980
Poland and Danzig	.....	.....	.....	649
Portugal	2,579	2,703	.....	900
Roumania	1,142	5,843	1,592	580
Spain	15,278	50,834	7,006	38,963
Sweden	3,263	17,600	9,415	4,632
Switzerland	.....	9,338	1,727	13,421
Turkey in Europe	.....	.....	.....	1,759
England	46,080	269,994	46,686	275,243
Scotland	.....	12,038	673	6,374
Ireland	.....	.....	78	2,235
Bermuda	400	575	.....	.....
Canada	47,694	126,216	47,513	224,931
Costa Rica	.....	524	.....	.....
Guatemala	644	1,334	132	160
Honduras	.....	332	14	431
Nicaragua	.....	4	293	.....
Panama	.....	1,975	.....	.....
Salvador	.....	13	107	.....
Mexico	15,861	20,315	3,095	40,908
Newfoundland and Labrador	.....	574	.....	.....
Barbados	5	.....	.....	.....
Jamaica	.....	1,449	94	1,397
Trinidad and Tobago	.....	367	.....	10,009
Other British West Indies	1,605	9	.....	.....
Cuba	17,896	41,065	4,420	27,153
Virgin Islands of U. S.	115	.....	.....	816
French West Indies	.....	22	.....	.....
Haiti	.....	715	62	.....
Dominican Republic	2,210	201	482	3,297
Argentina	6,209	4,381	4,211	20,334
Bolivia	.....	370	115	.....
Brazil	6,992	8,570	3,668	17,862
Chile	1,471	6,480	.....	118,875
Colombia	2,809	4,310	435	4,873
Ecuador	1,568	127	62	.....
British Guiana	.....	.....	48	.....
Dutch Guiana	63	.....	.....	.....
French Guiana	.....	1,278	.....	.....
Peru	191	2,469	378	29,642
Uruguay	1,402	.....	227	420
Venezuela	2,619	1,774	138	173
China	25,882	37,175	7,131	32,323
Kwantung	.....	.....	.....	4,110
British India	15,063	42,320	5,406	17,121
Straits Settlements	.....	500	90	.....
Dutch East Indies	768	2,180	769	5,028
Hongkong	566	.....	.....	.....
Japan	25,066	55,298	40,291	283,364
Turkey in Asia	.....	179	.....	.....
Australia	16,658	36,175	5,224	17,807
New Zealand	2,165	12,783	897	4,764
French Oceania	.....	.....	44	.....
Other Oceania	.....	.....	.....	1,283
Philippine Islands	6,125	4,355	2,997	10,194
British West Africa	.....	721	45	.....
British South Africa	1,453	11,979	2,526	16,652
British East Africa	.....	702	.....	.....
French Africa	.....	37	.....	.....
Madagascar	.....	.....	.....	1,401
Morocco	.....	194	.....	.....
Portuguese Africa	.....	1,875	.....	.....
Egypt	269	936	.....	.....
Total	$358,088	$1,170,075	$247,788	$1,556,908

Condensed-Clipping Index of Equipment

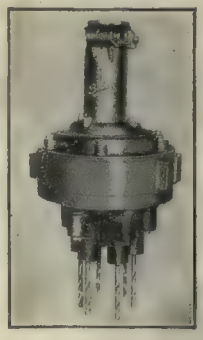
Patented Aug. 20, 1918

Center, "Frictionless," Ball-Bearing
Snellex Manufacturing Co., Rochester, N. Y.
"American Machinist," Dec. 2, 1920.



The device is intended to decrease friction between the work and the center, to make it unnecessary to regrind center points, and to eliminate the wearing and burning of center holes in the work. The general construction of the center can be seen in the illustration. The ball race at the rear end is held in place by a lock-washer and check-nut, and it is protected by an oil cap. The device is regularly made in four sizes, from Nos. 1 to 4 Morse taper, other sizes being made to order.

Drill Heads, Multiple-Spindle, "Buhr"
Nelson-Blanck Manufacturing Co., Dubois and Clay Sts., Detroit, Mich.
"American Machinist," Dec. 2, 1920.



The illustration shows head No. 16-F, which has six spindles, although heads having any number of spindles from three to twelve are made. The head is manufactured with four capacities. The smallest, or high-speed machine, running at 5,000 r.p.m., is equipped with No. 1-A Jacobs chucks taking drills up to ¼ in. in diameter. The next size is equipped with No. 1 Morse taper holes in the spindles, and can handle drills up to ⅝ in. in diameter. The heads having No. 2 Morse tapers will accommodate ⅞-in. drills; while the largest size, having No. 3 Morse tapers, will carry drills up to 1¼ in. in diameter.

Measuring Machine, Gear Pitch and Concentricity, "Wickman"
Alfred Herbert, Ltd., 54 Dey St., New York
"American Machinist," Dec. 2, 1920.



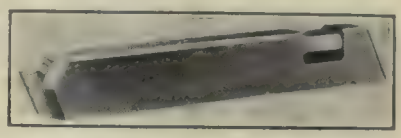
This machine measures the tooth spacing on the pitch line and the concentricity of the pitch line with the central bore on which the gear rotates. The gear to be tested is mounted on a taper arbor held down by a draw-bolt. The arbor is rotated through a worm and wheel, the worm having a graduated dial on its shaft from which readings can be taken. Both the worm and the wheel are hardened, and are finish-lapped to pitch and form, their accuracy being within 0.0001 in.

Tapping Attachment, Multiple-Spindle
Fox Machine Co., Jackson, Mich.
"American Machinist," Dec. 9, 1920.



The machine shown is of the D-22 type equipped for drilling and tapping, the tapping mechanism being applicable also to the D-12 and D-32 types of drilling machines. It is necessary that some changes be made in the machines when they are equipped for tapping, the drive-shafts being mounted on ball bearings. It is stated that the machine illustrated has tapped twelve ⅝-in. holes in cast-iron plates 1½ in. thick in five seconds, a maximum of 6 hp. being consumed. The positions of the spindles carrying the taps can be changed to suit different layouts for different jobs.

Toolholder, "Wilkes"
Dawson Tool Corporation, 51st and Lancaster Ave., Philadelphia, Pa.
"American Machinist," Dec. 2, 1920.



The holder is intended for heavy-duty, high-speed work, the point of the cutting tool being supported by a projection of the holder underneath it. No setscrew is used to hold the tool, the clamping action being obtained by means of the nut at the rear end of the holder. Because of the absence of a setscrew, the front of the holder can be passed through the toolpost. It is claimed that the holder will stand very severe use, and that it holds the tool so securely as to decrease chatter. The body is heat-treated. The holder is made in a range of sizes to take tools from ⅜ to 1 in. in size.

Truck, Self-Loading, Electric, "I.T.C."
Industrial Truck Co., Holyoke, Mass.
"American Machinist," Dec. 2, 1920.



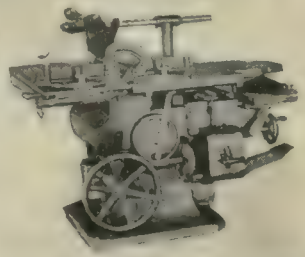
The truck has a turning radius on the extreme outside point of 7 ft. 10 in. and is said to be capable of being operated in intersecting aisles 60 in. wide. Specifications: Capacity, 5,000 lb. Loading platform: length, 55 in.; width, 26 in.; height lowered, 11 in.; height raised, 15½ in. Driving motor: 24 volt; 50 amp.; 1,500 r.p.m. Elevating motor: 24 volt; 35 amp.; 1,800 r.p.m. Gear reduction, 17½ to 1. Speeds: 3 forward, 3 reverse. Wheel diameter: driving end, 20 in.; trailing end, 10 in. Turning diameter: outside wheel, 14 ft. 3 in.; outside point, 15 ft. 8 in. Wheelbase, 59⅜ in. Height, 51 in. Width, 36 in. Length: overall, 102 in.; step raised, 91½ in. Weight: without battery, 2,150 lb.; with Edison battery, 2,600 lb.; with lead battery, 2,700 lb.

Pump, Centrifugal, "Two-Way," Coolant
Ross Manufacturing Co., 3160 West 106th St., Cleveland, Ohio
"American Machinist," Nov. 25, 1920.



The pump can be run in either direction. The liquid is delivered from the same orifice no matter in which direction the impeller is rotated. The pump is belt-driven, the pulley having an internal gear on its rim. This gear drives a gear on the impeller shaft, the speed ratio being 1 to 4. The four-bladed impeller is made of spring steel. It is claimed that, because the inlet is at the top, the impeller is always submerged and consequently primed. The pump delivers a large volume of coolant and can be used to serve a battery of small machines. It can also operate with a slight suction lift.

Saw, Bench, "No. 80, Variety"
Oliver Machinery Co., Grand Rapids, Mich.
"American Machinist," Dec. 9, 1920.



This machine will do ripping, cross-cutting, dadoing and gaining, and can be furnished with a special table equipment that permits it to be used for boring and mortising. Specifications: Table; universal or plain, 36 x 44 in. Universal table; tilts to 45 deg.; movable section, 15-in. wide; vertical adjustment, 4 in. Capacity; ripping, 23 or 27 in. wide; cross-cutting, 32 x 3 in.; dados, 4 in. wide; mortising, ¾ x 4 in.; boring, 2 in. diameter by 6 in. Saw arbor, 1 in. diameter. Driving pulley; 600 r.p.m.; 18 x 5 in. Motor drive; 5 hp.; 1,800 r.p.m. Weight; crated, 1,650 to 1,700 lb.; boxed, 1,850 to 1,900 lb. Export box, 60 cu.ft.

Star Brass Works Changes Name

The Star Brass Works, 3114-26 Carroll Ave., Chicago, manufacturers of spray cooling systems and painting and spraying machinery, announces that on and after Jan. 1, 1921, the company name will be changed to Binks Spray Equipment Co. This change of name has been made to conform more nearly with the nature of the products manufactured. Simultaneously announcement is also made of the completion of a new plant and office extension on the old plant in which provisions are made for new salesrooms, testing laboratories, and greatly increased manufacturing facilities on the first floor, with new offices and drafting rooms on the second floor. The new addition was necessary by reason of the rapid expansion of the business in all lines.

Personals

HARRY H. BADGER, for several years superintendent of the tool division of the Stanley Insulating Co. at Great Barrington, Mass., has recently resigned.

JOHN T. CHIDSEY, president of the American Piano Supply Co. of New York, and president of the Root Co. of Bristol, Conn., has recently been honored by being elected president of the Chamber of Commerce of Bristol, and a member of the Board of Directors of Connecticut Chamber of Commerce.

LEON E. THOMAS, president of the Reading Iron Co., has been elected president of the Eastern Pig Iron Association. Mr. Thomas was at one time connected with the United Engineering and Foundry Co. of Pittsburgh.

F. K. COPELAND, president of the Sullivan Machinery Co., Chicago, Ill., has been named new national councillor of the Compressed Air Society of New York, to represent it in the Chamber of Commerce of the United States.

GEOFFREY C. BROWN, formerly with the Northern Electric Co., Montreal, is now superintendent of manufacturing, Habirshaw Electric Cable Co., Yonkers, N. Y.

SAMUEL W. DUDLEY, at present chief engineer of the Westinghouse Airbrake Co., has been chosen professor of mechanical engineering on the Strathcona Foundation by the Yale Corporation, it was announced recently.

W. C. RICE has become general manager of the Frontier Machine Tool Co. of Buffalo, N. Y., manufacturer of drilling machines, power hack saws and grinding machines.

According to *The Journal of Commerce*, New York, German state railroads are to be removed from official management and their finances entirely separated from state finances. A private corporation has been formed for their operation. Financial collapse of state management is reported the cause.

Business Items

The Engineering Business Exchange, 30 Church St., New York, announces the opening of a Pacific Coast branch with James T. Whittlesey as director and with offices in the Claus Spreckels Building, San Francisco. This will make available to the engineers and engineering industries of the Coast states the same service in bringing together the buyers and sellers of engineering and technical business properties that is being rendered by the New York office of the Exchange.

The Detroit Belt Lacer Co., Detroit, Mich., announces the completion of its new building. Its new machine department is now in full operation and producing 500 closing machines a month. The addition of eight automatic hook machines will increase the company's production capacity to 50,000 boxes per month.

The Heavy Oil Engine Division of the Dodge Sales and Engineering Co., of Mishawaka, Ind., announces the publication of a small catalog describing Dodge heavy oil stationary engines, Dodge heavy oil marine engines, and Dodge heavy oil engine electric generating units. The catalog is printed on paper of excellent quality and contains fifteen illustrations of the various types of engines described and is now ready for general distribution.

Siemens & Halske, a German concern, received a large order for electric machinery for Chinese mines, railroads and industrial establishments. This order has been secured in competition with American, English and French manufacturers.

The Inland Steel Co., Chicago, announced that on Jan. 1 its plants would return to the ten- and twelve-hour basis a day. Wages will not be changed per hour.

Unconfirmed reports from Queluz, State of Minas, say a manganese mine, the largest in South America was purchased by North American interests from the Morro da Mina Co. for approximately $4,000,000.

Obituary

GEORGE E. TROWBRIDGE, an owner and the general manager of the Whitinsville Spinning Ring Co., of Whitinsville, Mass., and very well known in New England industrial circles, died at his home in Linwood, Mass., Dec. 13, after an illness of six days, from pneumonia. Mr. Trowbridge was nearly 63 years old.

Your will power determines your destiny. Make your New Year resolution to save regularly. Invest your savings in Government Savings Securities.

New Publications

Advanced Shop Drawing. By Vincent C. George, B.S., Instructor in Mechanical Engineering, The University of Wisconsin. 144 pages 6 x 9. 147 illustrations. Published by the McGraw-Hill Book Co., Inc., 239 West 39th St., New York, U. S. A.

A well-written and comprehensive treatise on practical drawing that should be of value to ambitious students who desire to master the art. The author makes no attempt to teach the underlying principles, but assumes that the reader is already familiar with the use of instruments, knows plane geometry, and is ready to apply his knowledge to the practical everyday problems of the shop. The first subject discussed is the matter of titles, lettering, etc., and the practice of various shops is cited. There follow two chapters on gearing in which the technical terms, the mathematical calculations, and the method of laying down the construction on the drawing board are very clearly explained. These chapters include problems in bevel and worm as well as in spur gearing. Isometric, cabinet and shaded drawing are considered in other chapters as are also structural, electrical and patent office drawings, plans for piping systems, sheet-metal work, etc.

Motorcycles and Side Cars, Construction, Management, Repair. By Victor W. Page, M.E. 665 pages, 5 x 7¾, 372 illustrations. The Norman W. Henley Publishing Co., 2 West 45th St., New York.

In this volume the author has covered the subject quite completely, showing pictures and giving details of many early experimental models; and following the development down to date. Construction of all standard machines is shown in detail, accompanied by valuable hints on the care and operation of same. Chapters on Lubrication, Carburetion, Ignition, Power Transmission, etc., are given, each including illustrations and careful description of the functions of each part. Final chapters on Maintenance, and Instructions for Complete Over-Hauling, round out a work that every owner of a motorcycle will appreciate.

Modern Welding Methods. By Victor W. Page. Two hundred ninety-two 6 x 9-in. pages, 113 illustrations. Bound in dark red cloth boards. Published by the Norman W. Henley Publishing Co., 2 West 45th St., New York.

The author of this book makes no attempt to cover other than the ordinary practice. The range of the text is so large that only limited details are given of any one subject. The first 34 pages are devoted to a general discussion of the art of joining metals, including soldering, brazing and various forms of welding. Then follow 17 pages on the properties of metals. The next 76 pages and 50 illustrations deal with welding gases, gas producing apparatus, welding appliances, and examples of welding work. The subjects of arc welding, butt welding, spot welding, seam welding, and all the various phases of resistance welding mentioned are put into 49 pages. Seventeen more pages are devoted to Thermit welding, and the balance of the book is made up of text and cuts dealing with soldering and brazing processes and fluxes, forge welding and the heat treatment of steel.

MacRae's Blue Book. Vol. XI, 1920. Eighteen hundred fifty-four 8 x 11-in. pages, including advertisements. Published by MacRae's Blue Book Co., 18 East Huron St., Chicago.

The book is divided into the following sections: Catalog; Address; Classified material; Trade name; Miscellaneous Data; Standard List Price. There are also a discount computer and service post cards.

The Theory of Machines. By Robert F. McKay. Four hundred forty 5½ x 8½-in. pages, 407 illustrations. Bound in green cloth boards. Published by Longmans, Green & Co., New York.

This book covers the theory of machines in a very comprehensive manner. Students, designers and mechanical engineers will find much of value and interest arranged in a logical and easily accessible manner.

After a definitive introduction the author takes up plane motion of a particle; force and torque; work and energy; plane motion of a particle under variable acceleration; displacement; velocity and acceleration diagrams; statics, analysis of motion; synthesis of a machine; examples of mechanisms obtained by inversion; relative linear

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